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004

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PRO

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OF THE

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1886.

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ERRATA.

Page 164, 5th line from top, *for* "Subilium" *read* "Suprabilium," and *for* "Subscapula" *read* "Suprascapula."

,, 164, 14th line from top, *for* "Preomosterna" *read* "Preomosternum."

,, 164, 15th line from top, *for* "Hemi-pelvisterna" *read* "Hemi-prepelvisterna."

,, 164, 16th line from top, *for* "Substernal" *read* "Suprasternal."

,, 257. For *Balænopterus* read *Balænophilus.*

,, 262. After *Calanus finmarchicus*, add "length 2 millim."

,, 265. Last line *for* "enlarged" *read* "diminished."

,, 328. 19th line from the bottom *for* "N.-American" *read* "N.-Indian."

ZOOLOGICAL GARDEN
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ALIPORE

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at. 26/12/86

PROCEEDINGS

OF THE

SCIENTIFIC MEETINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.

January 19, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of December 1885 :—

The total number of registered additions to the Society's Menagerie during the month of December was 157. Of these 2 were by birth, 137 by presentation, 2 by purchase, 2 by exchange, and 14 on deposit. The total number of departures during the same period, by death and removals, was 116.

The most noticeable additions during the month were :—

1. A male Cheetah (*Cynælurus jubatus*), received December 8th, presented to the Society by Nawab Mirza Hassim Ali Khan, of the Afghan Frontier Survey. A pair of feline animals captured, in November 1884, near the Istoi Pass on the Perso-Afghan frontier, when quite young, after the mother had been shot, by some of the members of the Afghan Boundary Commission, were believed at the time to be Snow-Leopards (*Felis uncia*)[1], and were forwarded to Pisheen, where they were kindly kept through last summer by Mr. H. J. Barnes, Political Agent at Quetta. The survivor of them, having arrived in this country, proves to be not a Snow-Leopard, but a fine young male Cheetah (*Cynælurus jubatus*).

The Cheetah was well known to occur in Persia (see Blanford's 'Eastern Persia,' vol. ii. p. 35), but I am not aware that its occurrence so near the frontiers of Afghanistan has been actually recorded.

2. A young female Tiger, deposited by J. E. T. Aitchison, Esq.,

[1] See Sir Peter Lumsden's letter, P. Z. S. 1885, p. 610.

M.D., Naturalist to the Afghan Boundary Commission. This specimen seems to belong to the small and densely furred form of *Felis tigris* prevalent in northern latitudes. This animal is stated to have been captured on the Hari-rud, between Sarakhs and Pul-i-Kátúm.

3. Four young Gazelles obtained during the survey of the boundary of Northern Afghanistan, and deposited by the same gentleman. These Gazelles are probably referable to *Gazella subgutturosa*, but seem to differ somewhat from our previously received specimens of the same species.

4. Two curious hybrid Ducks bred in 1884, at Cannes, between the Ruddy Sheldrake (*Tadorna rutila*) and the Egyptian Goose (*Chenalopex ægyptiaca*). This pair of hybrids was presented to Dr. T. E. Charles, of Cannes, by Madame de la Blanchetain, of the same place. Dr. Charles presented them to Sir Joseph Fayrer, who has kindly transferred them to the Society's Collection.

The Secretary laid upon the table a series of specimens of Lepidopterous insects which had been bred in the Insect-House during the past season, and read the following report upon the subject drawn up by Mr. A. Thomson :—

The following species of insects have been exhibited in the Insect-House during the past season :—

Silk-producing Bombyces.

Indian.

Attacus atlas.
—— *cynthia.*
—— *ricini.*
Attacus pernyi.
Actias selene.
Antheræa mylitta.

American.

Samia cecropia.
*—— *ceanothi.*
Telea polyphemus.
Actias luna.
Hypochera io.

African.

**Gynanisa maia.*
**Antheræa cytherea.*
*—— *tyrrhea.*
**Bunea caffraria.*
**Cirina forda.*

Diurnal Lepidoptera.

Papilio podalirius.
—— *alexanor.*
—— *machaon.*
*—— *asterias.*
Thais polyxena.
Parnassius apollo.
Aporia hippia.
—— *cratægi.*
Euchloe cardamines.
Lycæna corydon.
**Limenitis disippus.*
Vanessa antiopa.
—— *atalanta.*
—— *levana.*
—— ——, var. *prorsa.*
Melitæa cinxia.

* Exhibited for the first time.

Nocturni.

Smerinthus ocellatus.
—— *populi.*
—— *tiliæ.*
Sphinx ligustri.
Deilephila euphorbiæ.
**Hemaris marginalis.*
Euchelia jacobææ.
Callimorpha hera.
Arctia caja.
Chelonia villica.
Liparis chrysorrhœa.
Bombyx quercus.
**Hemileuca maia.*
Lasiocampa quercifolia.
**Dipthera ludifica.*
Endromis versicolor.
Saturnia carpini.
Dicranura vinula.
**Clostera anachoreta.*
Notodonta ziczac.
Catocala fraxini.

It will be noticed from the preceding list, that the three species of European *Papilio*, viz.:—*P. podalirius*, *P. alexanor*, and *P. machaon*, have been exhibited, and that specimens of *Papilio asterias*, from N. America, were exhibited for the first time. Together with the pupæ of this last-named species, I obtained some very small larvæ (hybernating) of *Limenitis disippus*. They had spun up in small leaves, but after being in the warm Insect-House for a few days, they came out and commenced to feed very freely upon weeping willow; they grew rapidly and ultimately produced some very fine imagos, some of which I have the honour to exhibit this evening.

I again obtained by exchange some larvæ of *Aporia hippia*, and I took the opportunity to get a coloured drawing made of the larvæ, pupa, and imago of this little-known insect, which I now exhibit[1].

Of the American silk-producing Bombyces, *Samia ceanothi* was exhibited for the first time, and I succeeded in obtaining fertile ova from one pairing, and in due course the larvæ; but I regret to say that they all died. Of the 2nd, 3rd, 4th, and 5th stages, I exhibit coloured drawings which Mr. F. W. Frohawk was good enough to make from the living larvæ. The larvæ in the first stage were black, similar to those of *Samia cecropia*.

Although the pure-bred larvæ died, some hybrids which I obtained from a pairing of a male *Samia cecropia* with a female *S. ceanothi*, throve remarkably well, and there are over 60 cocoons now in the Insect-House, from which the insects may be expected to emerge early in the coming spring.

Early in the past season, I purchased about four dozen large pupæ from South Africa, which had been stripped of whatever cocoon or other covering they had possessed, so that it was not possible to determine to what species they belonged; it could only be seen that they were Bombyces of some kind. As will be seen by the list, examples of five species were obtained from them. They were very irregular in their appearance, the first emerging on May 7th, and the last on September 29th. I obtained a pairing of *Gynanisa maia*, but the larvæ, I am sorry to say, died, although one fed, till it reached its third stage, on Laburnum. Good specimens of *Antheræa tyrrhea*, Fabr., are, I believe, rather scarce in collections.

[1] See Mr. Butler's paper, *infrâ*, p. 80.

Young larvæ were obtained of the following species:—*Attacus atlas*, *A. mylitta*, *A. pernyi*, and some hybrids said to be hybrids between *Attacus pernyi* and *A. mylitta*, and between *A. pernyi* and *A. roylei*, *Actias selene*, *Samia ceanothi*, and hybrid *Samia cecropia* and *S. ceanothi*. Of these, *Attacus pernyi* and the hybrids only were reared, the other specimens all died. Every attention was given to them, and I regret to have to express my opinion that the present Insect-House is not a suitable building for rearing young larvæ. At the same time, it must be borne in mind that the past season was, in consequence of the long drought, bad for rearing larvæ, as the leaves of the food-plants became hard and dry early in the summer. Apart from this, the leaves of all trees growing in or near the Gardens get very dirty with smoke, and although the precaution is always taken to wash the food before using it, the leaves are not so fresh and good for feeding as those obtained from the open country.

The larvæ of *Attacus pernyi* were reared upon the English Oak when the leaves were young and succulent, and they grew very rapidly and did well.

The so-called hybrids of *Attacus pernyi* and *Attacus roylei* were reared, and a good number of cocoons obtained. The hybrids (?) of *Attacus pernyi* and *Attacus mylitta* did not do so well, and only three cocoons were obtained. One insect from each of these cocoons has emerged up to the present, and these are, in my opinion, *Attacus pernyi* pure. I tried to obtain pairings of *A. pernyi* with females of *A. mylitta*, but did not succeed, although the insects were in the finest condition, and the males of *A. pernyi* were most energetic in their endeavours to pair with the females of *A. mylitta*. I had no opportunity of trying this experiment with *Attacus roylei*, as I had not any of that species.

I am sorry to have to record the death, in November, of the very fine *Mygale fasciata*, which was presented to the Society by Mr. H. R. P. Carter, in January 1885, and of which a life-sized figure was published in the 'Field' of April 25, 1885, together with some notes by Mr. W. B. Tegetmeier, F.Z.S.

The colours of this Spider during life were very beautiful.

A communication was read from the Rev. T. R. R. Stebbing, containing descriptions of some new Amphipodous Crustaceans from Singapore and New Zealand. The species were shortly described as follows :—

1. Byblis kallarthrus, sp. nov.

This new Amphipod was brought from Singapore by Brigade-Surgeon S. Archer.

The most striking peculiarities are the doubly sinuate lower margins of the fourth pair of side-plates, the branchiæ carrying on their surfaces rows of overlapping secondary vesicles, and the third uropods, in which the inner margin of the outer branch and the outer margin of the inner branch are much ornamented. The head

in this species is long, very much narrowed distally; the telson is divided beyond the centre.

The following accounts of *Talorchestia tumida* and *Amphithopsis cærulea*, from New Zealand, were sent along with the specimens by Mr. G. M. Thomson, their discoverer. His remark that in *Amphithopsis* (*Pherusa*?) *cærulea* the 4th coxa is broader than the preceding three together, applies to the appearance in the undissected specimen, not to the coxæ or side-plates when drawn apart.

"2. Talorchestia tumida, n. sp.

General form of body, when seen from above, much inflated. Eyes large (in living specimen of a turquoise-blue colour).

Anterior antennæ very short, reaching a little past the extremity of the penultimate joint of the peduncle of the posterior pair; flagellum 7-8-jointed, subequal with peduncle. *Posterior antennæ* as long as cephalon and first two segments of pereion, last joint of peduncle much the longest; flagellum 12-14-jointed, slightly shorter than peduncle.

Males apparently of two forms:—

First Form.—First gnathopod with the propodos somewhat curved, its inferior margin distally produced and rounded; dactylos curved and much longer than the palm; carpus and propodos with numerous spines. Second gnathopod with the carpus small and triangular; propodos ovoid and smooth, palm very oblique and furnished with two rows of minute teeth; dactylos two thirds as long as propodos, with its point lying over the edge of the palm. Third pereiopod short, fourth and fifth very long, former with the bases not dilated.

Second Form.—Second gnathopod with the propodos broadening towards the distal margin, palm nearly transverse with a blunt tooth between the middle and hinge of the dactylos; latter furnished with a large tooth impinging outside of the tooth of the palm. Third and fifth pereiopoda normal: fourth with the the carpus nearly quadrate and broadly dilated.

Telson nearly as broad as long, quite round at the apex and fringed above with a submarginal row of minute spines. Colour, when alive, ivory-white.

Hab. In sandbanks, Purakanui near Dunedin, among roots of littoral plants, many yards from high-water mark. Each specimen inhabiting a hole of its own. When taken out they leap with great vigour.

"3. Pherusa (?) cærulea, n. sp.

Colour of body a deep indigo-blue, appearing black when alive. Length about 5 mm. *Superior antennæ* about 4 mm. long, and considerably longer than the inferior; last joint of the peduncle with a secondary appendage consisting of a single joint and a terminal seta; flagellum about three times as long as peduncle and very-many-jointed. *Inferior antennæ* about two thirds as long as superior, and with the peduncle reaching slightly beyond the extremity of peduncle

of the first pair. The mandibles have an appendage. The gnathopoda are small and subchelate; the dactylos of the second pair is quite peculiar; it does not end in a claw, but in a finger-like setiform process. Pereiopoda very similar in form, the basa being progressively dilated; fourth pair the longest. Telson entire. Coxæ of the first four segments very deep, the 4th broader than the preceding three together.

Hab. Several specimens of this species were taken in a runnel of water on the Obelisk (or Old Man) Range in the interior of Otago, at a height of about 3000 feet. The stream was a little thing that one could have dammed with the hand, and running at such a slope that I can hardly imagine how the crustacea are not washed away by every shower of rain. The Old Man range is about 80 miles from the sea. The only other fresh-water amphipod found in New Zealand (excluding the subterranean forms found by Chilton) is *Colliope fluviatilis*, mihi, which is very common."

This paper will be published entire, with illustrations, in the Society's Transactions.

A letter was read from Dr. C. S. Minot, of 25 Mount Vernon Street, Boston, Mass., U.S.A., calling attention to the Elizabeth Thompson Science Fund, for the advancement and prosecution of Scientific Research, and inviting applications for assistance from it.

Mr. Howard Saunders exhibited an adult specimen of the Sooty Tern (*Sterna fuliginosa*) sent to him by Mr. A. C. Foot, of Bath, with the statement that the bird was caught alive about three miles from that city, on the 4th or 5th October, 1885, the weather being windy and the floods extending over the meadows. It was brought to Bath on the 6th October, and seen in the flesh by the Rev. Leonard Blomefield and the Librarian of the Bath Museum.

Only two examples of this species had as yet occurred in Great Britain. Its habitat was principally intertropical, but it bred as far north as the Florida Cays, and straggled northwards, generally in autumn, to the coasts of New England. Under the name of "Wide-awake Fair" its breeding-colony at Ascension was well known.

The following papers were read:—

1. On Butterflies of the Genus *Parnassius*.

By H. J. Elwes, F.Z.S.

[Received January 19, 1886.]

(Plates I.–IV.)

Notwithstanding that the Butterflies of this genus have for years been especial favourites among entomologists, and that their countless variations have caused many pages of unprofitable descriptions to be written on them, yet our actual knowledge of their life-history is, with

the exception of two or three species, so slight that it would be quite premature to write a monograph of the genus. But, partly through the numerous scientific explorations which have been carried on in Russian Asia of late years, and partly owing to the high value placed on these Butterflies having encouraged the efforts of professional collectors in remote parts of Turkestan, so large a number of specimens have reached Europe during the last five or six years that a review of the genus is both possible and useful. The principal object, however, in my work has been to investigate the functions and structure of the horny pouch-like appendage which is found in the female sex of the genus, and which seems to have been almost entirely overlooked by most of those who have classified and described the species.

I had not appreciated the immense importance of this structure, as a specific and generic character, until I received two years ago, through the kindness of my friend M. Charles Oberthür, of Rennes, a specimen of the magnificent *Parnassius imperator* from East Tibet; but when I saw how strongly it resembled *P. charltonius* of West Tibet in everything but the form of the pouch, whilst this organ was remarkably different, I saw what appeared to me a structural character of the highest value, and was led to an examination of the whole genus, which, on account of the extreme tendency to variation in size, and in the number and colour of the ocelli and markings—which had previously been considered as the principal characters by which to distinguish the species—was in a most unsatisfactory state of confusion.

The result of my examination is here given; and I may say that, however faulty and incomplete it may be, I have taken every pains to bring it up to date, and have personally examined the principal collections, both public and private, in Germany, France, Russia, and England. I have thus been able to see, and to a certain extent compare, large numbers of almost all the known species, and though my conclusions may not be accepted by those whose interest and pleasure it is to multiply synonyms, and thus to increase the difficulty of the study of Lepidoptera, yet I believe that as far as it goes it is based upon facts alone.

My own collection, a part of which is now shown, contains about 400 specimens of the 23 species which I recognize in the genus, and includes both sexes of every described species except two. Though this number may seem large, yet I believe that it is not more than half of what would be required to illustrate perfectly such variable species as are most of the *Parnassii*, and though I have a long series of many, I have kept no specimens which are not necessary to illustrate some fact either of geographical distribution, of variation, or of range of altitude and season. And such I imagine should be the object of every scientific collector in any branch of natural history. We too often see, in British collections at least, a fixed number of specimens exhibited in order to complete a row; but it is evident that whereas in some species of restricted habitat and little or no tendency to variation, two or three pairs may be

ample, in another 100 pairs may be insufficient to illustrate all the points in the history of a species.

With respect to the development and function of the pouch in this genus, which appears to me interesting not only to lepidopterists but to all students of Biology, I must here acknowledge the assistance I have received from Mr. A. Thomson, of the Society's Gardens—who undertook and carried out in a most painstaking manner the observations on living insects, of which an account is given below—and especially to Mr. Salvin and to Prof. Howes, of the Biological Laboratory, South Kensington, who undertook the difficult and delicate task of dissecting and examining the specimens preserved by Mr. Thomson at the Gardens.

And though much remains to be done before we can say that we fully understand this intricate question, yet a distinct advance has been made on our previous knowledge, and certain facts which were previously doubtful or obscure have been proved. The first writer who seems to have paid much attention to this organ was Von Siebold, who published in the 'Zeitung für wissenschaftliche Zoologie,' 1850, iii. pp. 54–61, and reprinted in the 'Stettiner entomologische Zeitung' 1851, pp. 176–185, a long and most valuable paper on the subject, a *précis* of which, from an English translation kindly lent me by Mr. Gosse, I am here able to give:—

The first part is historical, and shows that though Linnæus, Latreille, and Schäffer had mentioned the existence of the pouch and described its form more or less incompletely in *P. apollo* and *P. mnemosyne*, no one had carried these observations any further. Ochsenheimen accepts its existence in the female as a generic character of *Doritis*, and Boisduval separates *Doritis apollinus* from *Parnassius* because it has no pouch.

Siebold doubted whether the organ really formed part of the body, as he found that he could easily separate it in *P. mnemosyne*, and, with more difficulty, in *P. apollo*, as in this species it is glued more strongly by its base to the underside of the abdomen.

He then suggests that it originates during copulation, in these words:—"Probably from the male or female individual, at the anal region there is secreted a clammy coagulable fluid, poured forth during the close association of the genital organ of the male with that of the female, which, by coagulating and hardening, produces a firm and long-enduring union of both sexes. After the end of the copulative act, and after the complete severance of the sexes, there remains this coagulated substance as a sort of cast or impress of the hinder parts of the male in the vicinity of the sexual orifice of the female, a witness of the accomplished coitus." He then states that virgin females fresh from the pupa have no pouch, and says that Höger was mistaken when he suggested that the pouch was afterwards protruded from the body for the purpose of oviposition. He then goes on to state that a chemical examination of the substance of the pouch by Dr. Baumert showed that it had no affinity with the chitinous substance of the body of the insect, which was insoluble when treated with caustic alkali; whereas the pouch of both *P. apollo*

and *P. mnemosyne* dissolved when boiled in the same chemical, leaving only brown oily drops. The alkali was then saturated with mineral acid, but nothing organic was separated from it, whence we must conclude that the originally dissolved substance was destroyed.

Siebold compares the pouch of *P. hardwickei*, which he saw in the Vienna collection, with that of *P. mnemosyne*, from which, however, as I have afterwards shown, it is very different. He also compares the pouch of *P. delius* with that of *P. apollo*, and says that it agrees in colour, texture, and shape, wanting only the sharp keel. In this, however, he was mistaken, as I have never seen a specimen of *P. delius*, or of any species of this group, in which the keel was absent, though in *P. jacquemonti*, which Siebold could hardly have seen, it is so.

He then describes the observations of Herr Reutti, of Freiburg, who undertook the rearing of *P. apollo* from the larva in order to prove the correctness of Siebold's views. On May 29 he collected fifty larvæ, which had mostly undergone their last moult, on *Sedum album*. He describes them as being very troublesome to rear, because the larvæ, though feeding greedily when placed on the plants, would not return to the food of their own will, owing to the want of sunshine in a room of north aspect.

He succeeded, however, in rearing 11 larvæ, which went into pupæ under plants or stones, and in one case in an angle of the cover of the cage in a slight web of spun threads; "within this the larva hung by the hind feet in the manner of a *Vanessa*; the pupa, however, lay free in the web." Reutti succeeded in rearing four pairs of the butterfly, one of which, on July 17 at 1 P.M., united, and remained *in coitu* until late at night; next morning they were separate, and the female had a perfect pouch; but no observation was made of its formation.

Siebold thinks that the keel in the pouch of *P. apollo* is produced as follows: "By observing the male genital organs of *P. apollo*, it seems to me that the coagulating secretion is poured out under the two lateral valves, which, on the end of the abdomen of the male beneath, keep the proper genitals embraced, so that these latter, after coagulation of the pouch-forming secretion, are found in the interior of the pouch, whilst the valves are pressed against the outside of the vault of the pouch, and part of the coagulated matter stands out between them as the above-mentioned keel."

Lastly, Siebold quotes Kollar for an extraordinary story about the larvæ of *P. mnemosyne*, which are preserved in the Imperial Collection at Vienna, resembling those of *P. apollo* in habit, colours, markings, and which are "not seldom found on recently dead horses in the lower mountain valleys of Austria and Hungary"!!!

On the same evening that this paper was read, I had hoped that Prof. Howes would have been able to give us the result of his examination of the specimens preserved at the Society's Gardens as hereafter mentioned; but Prof. Howes having been delayed by illness and press of other work, his observations will form the subject of a later

communication from him, and he is only able at present to supply the following note:—

"The assumption that the pouch of the female *Parnassius* performs a definite function after copulation, appears in all cases to have been, without doubt, suggested mainly by its scoop-like shape, no less than by its constant characters and relations and its persistence after coition. This assumption originated with Höger, who believed the pouch to have been concerned in oviposition, describing it, in fact, as a veritable ovipositor, 'zuerst im Hinterleibe dieser Schmetterlinge fertig verborgen.' V. Siebold[1] first successfully disposed of this view, and showed that the structure in question was a secretion, believed by him to be derived from the male, and to be functional in prolonging the coitus[2]. I cannot agree with him that this is the case, the adhesion of the copulating individuals being assured by the hook-like claspers of the male. The pouch is densest in the vicinity of the female genital orifice, and its detailed structure conforms internally to the ventro-lateral parts of the male genital funnel. In view of this, the fact that it is impossible, in dissection of specimens procured during copulation, to remove the pouch without bringing away the internal generative apparatus of the female, points, to my mind, to a direct connection between that apparatus and the pouch itself. It suggests the probability of an origin of the same from the body of the female, and not of the male as is generally supposed. I cannot accept the view 'that the pouch is composed of hardened cases of adherent spermatophores,'[3] and the only supposition which seems to me thus far possible is that it represents a viscid secretion, poured out most probably by the female during copulation, which—instead of slowly disintegrating or otherwise disappearing, as do similar coagulable and non-coagulable secretions functional among other animals as accessories to the conjugative act—is hardened on exposure to the atmosphere. It persists as a cast of the male genital apparatus, which may be carried by the female until the day of her death, a token of the consummation of her existence[4].

"The above remarks apply to *P. apollo*, one pair of which species, preserved during a copulation of 75 minutes' duration, I have alone examined. My best thanks are due to Mr. Elwes for these specimens and others, upon which I hope shortly to be engaged."

But though to Von Siebold the credit is principally due of calling attention to this organ, yet no one seems to have carried his observations any further, though Mr. W. H. Edwards, with Dr. Hagen's assistance, gave a summary of Von Siebold's paper in the 'Butterflies of North America' several years ago, and Dr. Burmeister has

[1] Zeitschr. f. Wissensch. Zoologie, vol. iii. 1851; also 'Entomolog. Zeitung,' same year.

[2] *Loc. cit.* p. 55.

[3] Macalister, 'Introduction to Animal Morphology,' vol. i. p. 412. 1876. Prof. Macalister informs me by letter that his material was in a "very dilapidated state."

[4] Conf. v. Siebold, *l. c.* p. 56.

in the allied genus *Euryades* proved Von Siebold's ideas to be in the main correct.

Burmeister, in his 'Atlas de la République Argentine,' Livr. I, p. 10, pl. 3, figures and describes the structure of the abdomen in *Euryades duponcheli* and *E. corethrus*, which is analogous to that in *Parnassius*.

He says that the copulation in *Euryades* is very protracted, and though he gives no details of the manner in which the appendages of the female are formed, yet he states that the secretion forming them proceeds from the male, in the same manner as in *Parnassius*. He does not, however, suggest any use for the appendages nor state whether there is any variation in them. From the figures it is clear that they are almost identical in the two species comprising the genus.

Dr. Hagen, in the 'Comptes Rendus Ent. Soc. Belgique,' vol. 18, p. lvi, says that he is convinced that the appendage of *Euryades* is an analogous structure with the pouch of *Parnassius*, and that the only difference is one of form, which may be easily understood if one allows that the fluid which composes it is emitted on the two sides during copulation.

Burmeister, in Stett. ent. Zeit. 1874, p. 427, says of *Euryades*, that he is convinced that the female appendages of this genus are not developed before copulation, and that the substance of which the apparatus is composed is completely homogeneous with that of *Parnassius*. He suggests that the secretion flows from the male during the act of copulation, and hardens afterwards in the form which it took during its exudation from the male's body.

Though there was every reason to believe that Reutti's observations, as far as they went, were accurate, yet wishing not only to understand more fully the manner in which the pouch was formed, but also its function in the life of the insect, I went in 1884 and 1885 to the Alps to study the question, where the insects are abundant; but owing to various difficulties, which are detailed in my account of the life-history of *P. apollo*, *delius*, and *mnemosyne*, I failed in observing for myself the necessary details. I was, however, fortunate in procuring through Herr Heine, of Leipzig, a number of pupæ of *P. apollo*, which were sent to the Insectarium of the Zoological Gardens, and have afforded ample details as to this species. Mr. Thomson's notes are here printed verbatim, but I was able to gather some further details which are worthy of note.

He found that *Parnassius apollo* requires about an hour after emerging from the pupa, in order to perfect and harden the wings, and that the colour of these is at first of a yellowish tinge, but soon fades to white when exposed to the sun. This yellowish tinge I may add is found in some very fresh examples of almost all the species, and may be taken as an indication that the insect is only just out of the pupa.

He found that the copulation of the sexes takes place immediately after the complete development of the insects, provided that the sun is bright and warm, but that on dull days the insects remain

torpid without flying; that the duration of the act is from 3½ to 6½ hours, but the pouch is developed in a much shorter time, thirty minutes in one case sufficing to make it visible to the naked eye. But my observations of *P. mnemosyne* make it evident that either that species differs from *P. apollo* in this respect, or that instances of imperfect copulation, not followed by the appearance of a pouch, may occur.

Mr. Thomson also proves:—That eggs may be and are sometimes laid before the completion of the act, and that they may be laid by pouchless females of *P. apollo*, as I found was also the case with *P. mnemosyne*. That laying continues for several days at intervals, the life of the female extending to at least a week, whilst the males appear completely exhausted by the act of copulation, and die in one or two days after it without flying much, though they remain lively and strong for several days before the act takes place. No attempt was made by virgin males observed by Mr. Thomson to mate with an already mated female, but my own observations in nature show that this is not the case in a natural state. The date of emergence from the pupa is usually two or three days earlier in the male than the female, and the proportion of males not much greater than of females. But in a wild state the proportion of males of both *P. apollo* and *P. delius* always seems to be much greater; and from the comparative rarity of the females in almost all the species of the *P. apollo* group this seems to be the case in other countries. But in the *P. mnemosyne* and *P. delphius* groups females, though occurring somewhat later, seem usually to be nearly as abundant as males.

Notes on the Copulation of Parnassius apollo.
By Arthur Thomson.

"On the 18th of June, 1885, I received forty pupæ of *Parnassius apollo*, which had been sent to the Gardens by order of Mr. H. J. Elwes, F.Z.S., for the purpose of watching the perfect insects when copulating, and to endeavour, as far as possible, to throw some light upon the development of the 'horny pouch' with which the female is provided after copulation.

"How far I have been successful I must leave others to judge, but I wish to say that the fact of the female *Parnassius* developing such a 'pouch' after emerging from the chrysalis was quite new to me, so that I had no preconceived ideas upon the subject, and I have noted the facts just as they occurred.

"I first had a large gauze cage made, and placed in it six plants of *Sedum telephium*, the food of this species, and put in the insects as soon as they were ready, after emerging from the pupæ.

"The first and second copulations took place on June 27; the first pairing lasted from 11.10 A.M. to 2.25 P.M.=3 hours 15 minutes, and the second pairing lasted from 11.30 A.M. to 3.0 P.M.=3 hours 30 minutes. The 'pouches' in each case were perfectly developed, and the females began to deposit their eggs upon the gauze within five minutes of their separation from the males.

"Whilst the first pair were in copulation I made a sketch (as well as I was able) of the 'pouch' as it then appeared (fig. 1), a side view of the 'pouch' immediately after separation (fig. 2), a side view of the position of the female whilst laying her eggs (fig. 3), and a back view of the same (fig. 4)[1]. The 'pouch,' as then seen through a magnifying glass, appeared to be about $\frac{1}{16}$ of an inch long and not quite an eighth of an inch broad, with a *very slight* central depression the whole length, of a dark green colour, and with very minute transverse corrugations. This I found, during the time I was watching them, to be a membranous covering attached to the abdomen of the *male*, containing a dark green fluid. This membrane entirely covered the true pouch of the *female*, as I observed that the male appeared to be able to contract it, and did several times, so as to expose the 'pouch' of the female, which was then quite white; and it has since occurred to me, that this exposure of the 'pouch' might be for the purpose of hardening it a little, as the 'pouches' of the females are *quite soft during copulation*, but soon harden after separation and exposure to the atmosphere, and this leads me to think that this membranous covering of the male is the mould in which the 'pouch' is formed during copulation. One thing, however, is certain, that the 'pouch' is developed entirely *during copulation*.

"The third copulation took place on the 28th of June, and lasted from 10.23 A.M. till 12.48 P.M.=2 hours 25 minutes. The pouch was developed. These specimens were dropped into spirits of wine 'in cop.'; the membrane of the male then began to contract by the action of the spirit, but the insects did not separate.

"The fourth copulation took place on the 28th of June, and lasted from 1.15 A.M. till 2.30 P.M.=1 hour 15 minutes; these specimens were then dropped into spirits. The 'pouch' was developed; and I may here mention as a proof that the 'pouch' has nothing whatever to do with oviposition, that the female of this pair laid an egg whilst 'in cop.'

"The fifth copulation took place on the 4th of July, and after the insects had been in copulation 30 minutes they were put in spirit. The 'pouch' was apparently developed.

"The sixth copulation took place on the same day; after being in copulation *ten* minutes the pair were put in a cyanide bottle and killed. They separated after death, but no sign of a 'pouch' was visible. These specimens were afterwards put in spirits.

"The seventh copulation took place on July 6, and after the insects had been in copulation about three hours, I separated them forcibly. The 'pouch' of the female was quite soft, and I pressed the keel gently with a pin to see if the impression would remain when the 'pouch' had hardened, and it has done so. I then examined the membrane of the male, and found that by squeezing the abdomen of the male, and holding up the membrane with a pin, a white opaque gelatinous substance issued from that part of the abdomen of the male where the *point* of the pouch of the female would be during copu-

[1] These drawings are not now published.

lation. Some of this substance I was able to pull out with a pin, but it began to harden immediately on exposure to the atmosphere, and became quite brittle, and of a yellowish colour. From this I am led to think that the male supplies the material of which the 'pouch' is made, and that the female has really very little to do with making the 'pouch' at all.

"Besides the copulations before mentioned, three others took place, two being remarkable for the time they lasted, viz. 6 hours 30 minutes, and 6 hours 25 minutes.

"So far as I have been able to see, the 'pouch' of the female is of no use whatever after copulation.

"Although the food-plant of this species was in the gauze cage, not one egg was laid upon it but all were laid upon the gauze."

Partly owing to the fact that nearly all the species were happily unknown to the older authors, and partly because no one has yet attempted to divide the genus, its synonymy and literature is much more simple than in some genera. Herrich-Schäffer, Oberthür, Felder, and Staudinger have all published more or less complete catalogues of *Parnassius*, of which the last is the most accurate and valuable for the European species known to him. The principal authors who have described the various species are Ménétries, Eversmann, and Gray; but I need not refer here to their various writings, which are cited under the various species they described. The characters upon which most, if not all, previous writers have principally relied for the definition of the various species, namely, the pattern of the markings and the number and position of the black or red spots and ocelli, are, however, far too variable in most cases to be trustworthy. A very uniform style of coloration and pattern prevails throughout the genus, and though the affinities of most of the species to each other are more or less traceable by these characters, yet I have preferred myself to trust to the much more permanent, invariable, and important characters of the antennæ, fringes, and pouches of the females. Though these characters are not absolutely invariable, yet, as far as I can see from the examination of large series, they are much more so than colours or markings; and the pouch alone is so good a structural character, as to be invaluable for the purpose of classification.

But I have not described the form of these pouches in words, because the illustrations make it unnecessary; and though I have not, as I should have wished, been able to figure the pouch in every individual species, with the corresponding organs of the male, on account of the excessive number of plates that would have been required, yet all the most characteristic and remarkable have been accurately drawn by Mr. E. Wilson, of Cambridge, on a uniform scale of $\frac{2}{3}$.

As far as I have observed, the difference between the clasping organs of the male in different species is trifling compared with the difference between the pouches of the female; and it will be a most

[1] *Cf.* note by Prof. Howes, above, p. 10.

interesting problem for the future to discover how the organs of such curious species as *P. acco*, *P. charltonius*, *P. imperator*, or *P. tenedius* are produced, and why insects so very similar in appearance as *P. jacquemonti* and *actius*, or *P. charltonius* and *imperator*, have such very differently shaped pouches.

The distribution of this genus is entirely confined to the Palæarctic region, and in this respect it is peculiar, among large and important genera, with *Melitæa* and *Erebia*, which have an almost exactly similar distribution, though *Erebia* is more arctic than either of them. In the Nearctic region, which, as I have before mentioned, can hardly be separated from the Palæarctic region on the ground of any peculiarity among the Lepidoptera, it is confined, as is *Erebia*, and, with trifling exceptions, *Melitæa*, to the Rocky Mountains and country west of them. It is most numerously represented in the mountain-ranges of Turkestan, Southern Siberia, and the Himalaya, having only three species out of 23 in Europe; none in North Africa; none within the Arctic Circle, though *P. mnemosyne* and *P. eversmanni* come within a few degrees of it.

Of all the sections into which I have divided the genus, only two, namely the *apollo* and *mnemosyne* groups, have a wide range, and only these two have developed any marked specific differences; all the rest of the groups, most of which are monotypic, being confined to limited areas in Central Asia. It is almost certain that several species remain to be discovered in the mountainous regions of Mongolia, Tibet, and North-western China; but many years must elapse before we can have any complete knowledge of the natural productions of these extremely distant, inhospitable, and elevated regions.

Parnassius in one respect is unique among Rhopalocera, namely, that though in a great part of its range a genus most characteristic of mountain-ranges, and most abundantly represented where, as in Ladak and the mountains of Khokand, the climate is of an almost Arctic character, yet it does not occur anywhere in the Arctic Regions. *Colias*, *Argynnis*, *Erebia*, and *Chionobas*, with which *Parnassius* is generally associated in Europe, Asia, and America, are all typically Arctic genera. Why, then, is *Parnassius*, which finds a home at as great an elevation as any other known butterfly, absent?

Though in Europe generally looked on as mountain butterflies, several of the species, as *P. apollo*, *mnemosyne*, *bremeri*, *eversmanni*, and *nomion*, are also found in low and wooded districts. *Eversmanni* is said to be an inhabitant of deep bogs. *Mnemosyne*, though ascending the Alps to 5000 feet or more in Western Central Europe, in Eastern Europe is found commonly in the steppes. *Apollonius* also occurs both in saline steppes and high mountains.

The following Table shows the general distribution of the species, but it must be understood that almost everywhere the species are found in somewhat restricted localities, and not generally through the country.

Name of Species.	Europe.	Caucasus.	Turkestan.	West Siberia.	East Siberia.	Himalaya and Tibet.	Japan and China.	U. S. America.
1. *P. apollo*	*	*	...	*				
Var. hesebolus	...	*	*	*				
2. *P. delius*	*	*?						
Var. intermedius	...	...	...	*	*			
Var. ? corybas	...	...	...	...	*			
Var. sminthcus	...	...	...	...	...	...	...	*
Var. hermodur	...	...	...	...	...	...	...	*
3. *P. nomion*	...	...	...	...	*	...	...	*
4. *P. actius*	...	...	*	...	...	*		
Var. discobolus	...	...	*					
Var. ? rhodius	...	...	*	...	...	*?		
Var. himalayensis	...	...	...	...	...	*		
5. *P. honrathi*	...	...	*					
6. *P. davidis*	...	...	...	...	...	...	*	
7. *P. bremeri*	...	...	...	...	*			
8. *P. apollonius*	...	...	*					
9. *P. acco*	...	...	...	...	..	*		
10. *P. simo*	...	...	...	...	...	*		
11. *P. jacquemonti*	...	...	...	...	...	*		
Var. sikkimensis	...	...	..	...	...	*		
12. *P. delphius*	...	...	*					
Var. staudingeri	...	...	*					
13. *P. stoliczkanus*	..	...	...	...	...	*		
14. *P. hardwickei*	...	.	...	...	...	*		
15. *P. charltonius*	...	...	...	...	...	*		
16. *P. imperator*	...	...	...	...	...	*		
17. *P. tenedius*	...	...	...	*?	*			
18. *P. mnemosyne*	*	*	*					
Var. stubbendorfi	...	...	...	...	*			
19. *P. glacialis*	...	...	...	...	...	...	*	
20. *P. eversmanni*	...	...	...	...	*	...	...	*
? Var. felderi	...	...	...	...	*			
? Var. thor	...	...	...	...	...	...	...	*
21. *P. clodius*	...	...	...	...	...	...	...	*
22. *P. clarius*	...	...	*?	*				
23. *P. nordmanni*	...	*						

Europe has three species belonging to two groups.
Caucasus has three or four species belonging to two groups.
Turkestan has seven species belonging to three groups.
West Siberia has three or four species belonging to three groups.
East Siberia has six species belonging to three groups.
The Himalayas and Tibet have eight species belonging to seven groups.
Japan and China have two species belonging to two groups.
U.S. America have four species belonging to two groups.

Though the genus *Parnassius* has hitherto been included in the family of Papilionidæ, yet it seems to me worthy to constitute a separate family, comprising the genera *Eurycus*, which is confined to North Australia and New Guinea, *Euryades*, which is found in the Argentine States, and *Lähdorfia*, which is an inhabitant of the southern coasts of Amurland and probably North Japan. In making this proposal, I do so on the ground that the extraordinary appendages of the female abdomen, which are found in these four genera alone among the Rhopalocera, and which, though very different in structure, are apparently analogous, afford a character of at least as much, if not of greater, value in classification than the characters drawn from legs, venation, antennæ, or larval structure.

And though my ignorance of larval characters among Lepidoptera generally, makes me unable to form an opinion as to their value for purposes of classification, yet they apparently lead to the grouping of very dissimilar forms. Mr. W. H. Edwards remarks on the subject in 'Papilio,' vol. iii. p. 159:—"I do not think, judging from the egg and young larva as I know them, and by the mature larva and pupa as figured in books, that *Parnassius* has any right among the Papilionidæ. Under a system in which the preparatory stages were considered—and in the future we shall have to come to that—it would stand a long way from the Papilionidæ. The egg of *smintheus* is like *Lycæna*; of *baldur* like *Chrysophanus*; the young larva is like some Nymphalidæ (and perhaps Erycinidæ), the mature larva more like a Heterocerous moth (in all but the tentacles), and the chrysalis like a Hesperian, or also perhaps some moths."

In 1870 the late Edward Newman published in the 'Entomologist' a system of classification for Butterflies, in which he places *Parnassius* in the second division of the Rhopalocera, which he called *Celantes*, forming with *Doritis* the Group A, Bombyciformes. The division is defined as follows:—"*Celantes*, or those in which the larvæ, prior to changing to pupæ, envelope themselves in a silken follicle or cocoon more or less compact; the pupæ are generally without angles, like those of the genus *Chelonia* among the Sessiliventres." The Bombyciformes are those in which the head of the larva is smaller than the second segment, and the body is altogether that of the *Bombyces*. The *Capitati*, which form the second section of this division, are the Hesperidæ, in which the head of the larva is larger than the second segment.

Now, without expressing any opinion on the propriety of such a classification, it is clear that any arrangement which depends on larval characters must in the case of very many genera be conjectural. Newman criticizes the classification of Kirby's catalogue very unfavourably, saying that his subfamily Papilioninæ is entirely opposed to his own idea of natural arrangement. The genera Kirby included are *Mesapia*, *Calinaga*, *Hypermnestra*, *Ismene*, *Doritis*, *Parnassius*, *Eurycus*, *Euryades*, *Sericinus*, *Thais*, *Teinopalpus*, *Papilio*, and *Leptocircus*.

Staudinger includes *Parnassius* with *Papilio*, *Thais*, *Ismene*, and *Doritis*, in his family Papilionidæ, which comes at the head of the

class, instead of last but one as in Kirby's catalogue, whilst Herrich-Schäffer places *Parnassius* as the second section of the genus *Doritis*.

Synopsis of the Genus.

Fam. PARNASSIIDÆ.

Imago imaginì Papilionidarum similis quoad alarum structuram, sed fœmina nupta sacculo corneo ad ventrem extremum instructa. Pupa haud suspensa. Larva distincta, larvis Heteroceror um affinis.

Gen. 1. PARNASSIUS, Latr.

SECT. I.	
1. APOLLO, Linn.	Europe (excl. reg. pol. et Anglia); Armenia; Caucasus.
a. Var. *hesebolus*, Nordm.	Siberia, Altai, Alatau, Ural, Caucasus.
v. major, ♂ albidior, ♀ obscurior. transitus ad *hesebolus*	Tarbagatai (*fide* Stgr.), Cauc. Arm. (*fide* Rom.).
2. DELIUS, Esp.	Alps Eur. cent., Caucasus?
a. Var. *intermedius*, Mén. sedakovii, Mén.	Altai, Sib. cent. et or. (Irkutsk).
b. ? Var. corybas, Fisch. de Wald.	Kamschatka; ? Sib. s. or.
c. Var. *sminthens*, Doubl.	Rocky Mts. U.S. Am.; Colorado, &c.
d. ? Var. Behrii, Edw.	
e. Var. ♀ *hermodur*, H. Edw. major obscurior. ? transitus ad *discobolus*.	Rocky Mts., Brit. Columbia, Montana, &c.
3. NOMION, Fisch.	Prov. Amur, Alaska.
a. var. ? minor (transitus ad *sminthens*?)	Brit. Columbia.
4. ACTIUS, Ev.	Alps of Turkestan.
a. Var. *discobolus*, Stgr. major obscurior (an *delius* referendus?)	Alatau, &c., Alps of Khokand.
b. Var. *rhodius*, Honrath. ?=epaphus, Oberthür. (minor, al. post. punct. bas. coccineis.)	Prov. Ladak, Alai, Khokand.
c. Var. *himalayensis*, Elwes. jacquemonti, Blanch. et Moore in part. (? an *delius* referendus.)	Prov. Lahoul, &c.; N.W. Himalaya, Alps, 11000–16,000 ped. alt.
5. HONRATHI, Stgr. corybas, Ersch.	Alps of Samarkand, Bokhara, &c.
6. DAVIDIS, Oberthür (♀ mihi naturâ ignota incertæ sedis.)	Mountains of N. China.
7. BREMERI, Brem.	Prov. Amur.
8. APOLLONIUS, Ev.	Prov. Kuldja, Khokand, steppes and mountains.
SECT. II.	
9. ACCO, Gray	Prov. Ladak, Tibet.
†10. SIMO, Gray. (♀ ignota incertæ sedis.)	Prov. Ladak.
SECT. III.	
11. JACQUEMONTI, Boisd. ?=epaphus, Oberthür.	Prov. Ladak, N. W. Himalaya, supra 14,000 ped. alt.
Var. ? *a. sikkimensis*, Elwes. (minor, orientalis).	Alps of Sikkim, Tibet.

SECT. IV.	
12. DELPHIUS, Ev.	Mont. Tarbagatai, Altai, &c.
Var. ? *a.* staudingeri, Bang-Haas.	Mont. Bokhara, Khokand, &c.
13. STOLICZKANUS, Feld.	Prov. Lahoul, N.W. Himalaya, Ladak.
SECT. V.	
14. HARDWICKEI, Gray	Himalaya 6000–14,000 ped. alt.
Ab et var. ♀ vix nom. conserv. *charino*, Gray (obscurior).	Prov. Ladak.
SECT. VI.	
15. CHARLTONIUS, Gray	Prov. Lahoul, N.W. Himalaya. Prov. Ladak, supra 11,000 ped. alt.
SECT. VII.	
16. IMPERATOR, Oberthür	Ta-tsien-lo, Tibet or.
SECT. VIII.	
17. TENEDIUS, Ev.	Sib. cent. mer., prov. Amur sup.
SECT. IX.	
18. MNEMOSYNE, Linn.	Europe (excl. reg. pol. et Anglia), Asia occ. et cent.
Var. *a.* ? nubilosus, Chr.	Armenia, Persia bor.
Var. vel transitus ad *stubbendorfii*.	Prov. Amur sup.
Var. *b.* ? an bona sp. *stubbendorfii*, Mén.	Prov. Amer. sup. et inf.
Var. *c.* vel trans. ad *glacialis*	Corea.
19. GLACIALIS, Butl. citrinarius, Motsch.	Japan.
20. EVERSMANNI, Mén.	Prov. Transbaikal, Amur sup., Prov. Alaska.
a. Var. ? felderi, Brem.	Prov. Amur cent.
b. Var. ? thor, H. Edw.	Yukon River, N.W. America.
21. CLODIUS, Mén.	Mont. et litt., N.W. America.
a. Var. ? menetriesi, H. Edw.	Mont. Sierra Nevada, California.
22. CLARIUS, Ev.	Mont. Altai ?, Tarbagatai.
23. NORDMANNI	Mont. S.W. Caucasus, Daghestan.

The two species marked † are only provisionally placed in the sections of the genus, as the female pouches are unknown. The varieties marked with a ? are those which do not seem from my present knowledge to be sufficiently well marked to be always recognizable.

PARNASSIUS APOLLO, Linn.

This is the best known and one of the most widely distributed species of the genus, and is found in almost all the mountain districts of Central and Southern Europe, from about 1000 up to nearly 6000 feet in the Alps, and in many parts of Northern and Eastern Europe at quite low elevations; in the Caucasus according to Wagner up to 8000–9000 feet, in Southern Sweden and Norway, in Finland close to the sea-coast, in the hilly sandy pine-forests of the Lower Ural and Central Russia, in the higher mountains of Spain, Greece, and Asia Minor, and in some of the mountain-ranges of Northern Turkestan and the Altai, though its distribution in Asia is not yet perfectly known.

In some parts of Germany it has become extinct of late years,

probably owing to the number of collectors, but in most of its habitats it is a common, and in many of them a very abundant insect.

It commences to fly in some of the warmer valleys of the Alps in May; I have taken it myself on May 25th on the Canton Wallis at about 2500 feet, but this is a local occurrence, as Meyer-Dür gives June 17 as the earliest date of its appearance, and on the same day I found half-grown larvæ at the same elevation. It continues to fly for six weeks or two months, and fresh specimens may sometimes be met with up to the first week in August. I think that elevation has not so much to do with the time of its appearance as other circumstances. I found fresh specimens in the Lower Bregalia Valley near Chiavenna at 1200 feet in the end of June; and six days later I found it close to Pontresina, in the Engadine, at nearly 6000 feet. It prefers warm rocky slopes facing south and west, and is rarely found in Switzerland on a north exposure, or in woods. Meyer-Dür says that it seems to be wanting on the "Urgebirge," and is only local on the "Molasse" formation.

The flight of the insect is strong and sailing, but not rapid, and is continued from eight or nine in the morning till four or five in the afternoon. The females always appear in much smaller numbers than the male, fly less, and settle more often; with practice they may be distinguished on the wing. I am not aware that the insect has been bred in confinement from the egg, nor can I say with certainty whether the eggs are hatched in autumn or spring; but I believe that some part of the larval stage is passed in autumn[1]. The larvæ feed up in spring on the young leaves of *Sedum telephium* and *Sedum album*, and go into the pupa stage about fourteen days previous to the appearance of the perfect insect. According to Reutti they feed only during sunshine, and I found them generally two or three together on hot rocks where the food-plant was abundant. When touched they curl up and unroll with strong convulsions, and if well grown and healthy will live two or three days in a closed box, as the larva and pupa were drawn by Miss F. Woolward from specimens which I sent alive by post from Brieg in Switzerland to England. I believe that the females in this species, as in others, are almost invariably mated very soon after their emergence from the pupa, as specimens in which the pouch is not developed are but seldom found. I am not able to say whether in a state of nature the eggs are laid on the food-plant or not, but, according to Mr. Thomson, this is not the case in confinement.

The Rev. A. E. Eaton, in Ent. Mon. Mag. xix. p. 89, gives the following note on stridulation in the female of *P. apollo*:—"In the evening of July 23rd, whilst reclining on the grass near Bannio, Val Anzasca, a rustling as of a lizard or snake close to the back of

[1] W. H. Edwards in 'Papilio,' vol. iii. p. 159, says:—"But G. M. Mollinger writes me that the eggs of *P. apollo*, in Switzerland, hatch late in the fall, and the young larvæ hybernate; awaking in early spring, and eating the leaves of *Sedum*, not the flowers."

my head made it desirable to look round to see what was going on there; an apparently drowsy *P. apollo*, hanging by her fore feet to a composite flower, was slowly flapping her wings, and scraping the hinder pair with her four posterior legs, which were thrust backwards simultaneously each time that the wings opened. Obstruction to the movement of the fore wings caused no hindrance to the production of the sound, but when the hind wings also were held firmly between the finger and thumb, the noise ceased. The insect became so wide awake at this stage of the proceedings, that no further observations could be made, but it seemed probable that friction of the spines of the tibiæ and tarsus over the wing-veins largely contributed to the vibration of the wing-membrane."

The usual manner of pupation of *P. apollo* is described as being in a slight silken web among leaves, and this is confirmed by Miss F. Woolward, to whom I sent living larvæ to be figured. She says: "The larva did not hang itself up in any way, and the pupa is too fat and heavy for this to be likely. The way in which the larval skin was slipped off would seem to make it impossible. The larva had a very scanty supply of silk, which it spread about at the bottom of the box, making no attempt to enclose itself closely." Tachler, however, in 'Bericht der St. Gallischen Gesellschaft,' 1869–70, p. 87, says that "two larvæ of this species, instead of pupating in a light web among leaves, as is generally said to be the case, went into pupa hanging to the gauze of the cage in which they were confined." He thinks that this is a most abnormal occurrence, and perhaps the observation requires confirmation. These two larvæ remained seventeen days in pupa, and took two hours after emerging before the wings were fully formed.

The variation which exists in this species is very great, both in size and in the number and colour of the ocelli.

The largest female that I have is of the variety *hesebolus*, Nordmann, from the Transili mountains, which measures 3·5 in. across the wings. Another, from the Thian Shan, resembles it in size and colour. These females and those from the Ural are much more overlaid with black scales on both fore and hind wings than ordinary European specimens, but I have a female from the Jura almost as dark. A male from the Ural of the same variety measures 3·6, whilst eight males from the Altai measure from 3·1 to 3·3 across. These males are all more creamy in the ground-colour of their wings and less overlaid with black scales than Swiss specimens, showing that the causes which have induced the change of colour have acted on the sexes in opposite directions. Seven specimens from Eperies in North Hungary vary from 2·8 to 3·2; seven specimens from Norway and Sweden are from 3·2 to 3·3. The largest Swiss specimens I have are from Brieg and measure 3 to 3·1, whilst those from other parts of the Alps and Jura do not exceed 2·8, and I have one from Dourbes only 2·1 across the wings.

Specimens from the Sierra Nevada of Andalusia have the ocelli yellowish instead of red, and this occurs rarely elsewhere. One or two red spots beyond the cell of the fore wing as in *P. delius* occur

as a rare aberration in *P. apollo*, and the large ocelli on the hind wing are sometimes all red without white in the centre.

The variety named *P. hesebolus* by Nordmann, according to Alpheraky's notes on the Butterflies of Kuldja and the Thian Shan, is found from the end of May to about the 7th of August, between 3500 and 9000 feet. The difference between this form and *P. apollo* of the Alps consists in the greater size of both sexes, and the whiter colour of the wings in the male, whilst in the female the reverse is the case, so that the difference in colour between the sexes is greater in this variety than in the typical *P. apollo*. *P. hesebolus* appears to be the prevailing form from the Ural Mountains eastwards, though in the Tarbagatai Haberhauer found a form more like the Swiss one. In the Caucasian province the Grand Duke Nicholas says that "the var. *hesebolus* is found in the same places as *P. apollo* and many specimens show the transition from the type to the variety." In the Carpathians, near Eperies, the form found is more like *P. hesebolus*; whilst in the Jura, according to Meyer-Dür, the *P. apollo* can always be distinguished from those of the Alps by their duller, more yellowish ground colour of the wings.

Though *P. apollo* is sometimes found flying at the same place and time as *P. delius*, I have never seen a specimen which could be certainly looked upon as a hybrid. Dr. Christ of Basle has one which may be such; but the antennæ seemed to me to resemble those of *P. apollo*. Meyer-Dür quotes Meissner to the effect that a hermaphrodite of this species was taken on Oct. 10, 1816, on the hill of Tourbillon, near Sion in Wallis. He describes it as follows:—

"The right-hand side is female, the left male; the two wings of the female side are longer and broader, the red ocellus larger than on the male side, the right antenna is also longer and stronger. The abdomen has only in the middle somewhat longer hairs. But what proves the hermaphroditism most remarkably is the apex of the body, which not only has the horny pouch peculiar to the female in this family, but also the male organ clearly projecting."

I have seen in the collection of Herr Röder, at Wiesbaden, a hermaphrodite of *P. delius*, obtained from the late Dr. Settari of Meran, which has the left-hand wings perfectly female, and the right male; the left side of the body is also less hairy than the right, and though there is no clearly developed pouch, there are indications of hermaphroditism.

The distinguishing characters between *P. apollo* and *P. delius* are in typical specimens clear enough and are enumerated by Meyer-Dür on page 18 of his 'Butterflies of Switzerland;' but the only points which seem to be in all cases absolutely reliable are the hairs of the body and the antennæ, which on comparison show well-marked and constant difference.

P. DELIUS.

Parnassius delius, Esp. pl. 115, fig. 5 (1790?).

P. phœbus, Prun. Lep. Ped. p. 69 (1798).

Var. *intermedius*, Mén. Enum. i. p. 72 (1855); Stgr. Stett. Ent. Zeit. 1881, p. 256.

P. sedakovii, Mén. l. c. p. 71, pl. i. fig. 1.

Var. *corybas*, Fisch. Ent. Russ. p. 11, pl. vi. figs. 1, 2 (1822).

Var. *smintheus*, Doubl. Gen. Lep. pl. iv. (1847).

P. sayi, W. H. Edw. Proc. Ent. Soc. Phil. ii. p. 78 (1863); Edw. Butt. N. Am. i. pl. vi. (1872).

Var. *behrii*, W. H. Edw. Trans. Am. Ent. Soc; Butt. N. Am. vi. fig. 3 (1870).

Var. ♀. *hermodur*, H. Edw. *Papilio*, i. p. 4 (1881).

If this species is considered in a narrow sense as a purely European insect, its range of distribution is somewhat limited; but if the innumerable forms and varieties which occur in Asia and in the Rocky Mountains of North America—and which, as far as I am at present able to judge, have no constant structural characters differing from each other or from *P. delius*—are treated, as I think they should be, as forms of *P. delius*, then it is the most widely distributed species of the whole genus.

For the present, however, I will only give what I have been able to discover with regard to its life-history in Europe, where it is confined to the higher Alps of Switzerland, Tyrol, and Styria. According to Nordmann, it is also found in the mountains of Adshara in the Caucasus; but as neither Lederer nor the Grand Duke Nicholas Romanoff include it in their lists, I can say nothing as to this habitat. The species seems to be found more locally in the Alps than *P. apollo*, but is in many places abundant. I have always found it commonest in localities between 4500 and 7500 feet elevation, where a mountain stream had spread out into wide channels and formed rapid shallow brooks, bordered by a luxuriant growth of *Saxifraga aizoides*, which, according to Zeller's, Anderegg's, and my own observations, is the food-plant of its larva. Zeller, in Stett. ent. Zeit. 1877, p. 279, describes the larva as being in every way extremely like that of *P. apollo*, but as having yellowish, not orange antennæ; the pupa also resembles that of *P. apollo*.

It has been supposed that the larva and pupa of this species are able to exist under water, for a short time at least, and this, according to Zeller, must certainly be the case; the plant on which the larva feeds is always close to the water, and the sudden rise of a mountain stream, which must often occur, would drown them if they were unable to endure the bath. I have seen, near Bergun, a freshly emerged male, the wings of which were not yet dry, sitting on a plant of *Saxifraga aizoides* within a few inches of the water, and I have never seen the female settle on any other plant, though the male will on dull days rest on grasses and flower-heads.

Zeller says that he found the larva creeping over slimy wet ground without being in the least smeared or wetted; and Herr Anderegg, who takes the insects abundantly in Wallis, has assured me that he never saw it on any other plant but *Sax. aizoides*.

I visited a favourite haunt of this species with his son on July 1st,

1884, in hopes of being able to find larvæ or pupæ, but was disappointed in this, as on other occasions, though I took many males and several freshly emerged females. One pair were taken in copula at about 11.30 A.M., but separated in the net, and the female pouch was developed and hard, leading me to suppose that it was not the copulation of a virgin female, or that the act was already complete when I found them. The males flew backwards and forwards over a space of about 200 yards by 40, where their food-plant was most abundant; but unless chased flew at a slow pace, and frequently settled; the females flew but seldom, and settled for several minutes at a time on the plants of *Saxifraga*. I did not observe them in the act of laying, though eggs were visible externally in one or more specimen. The egg appears identical with that of *P. smintheus*, figured by Edwards in the 'Butterflies of North America.'

I returned to Brieg in May 1885, hoping to find the larva in the same place; but in this season the snow was still unmelted on May 26th, and lay two feet deep over the place where the butterfly had been common on July 1st in the previous season. This leads me to think that *P. delius*, like *P. apollo* and probably *P. mnemosyne*, passes some parts of its larval existence in the autumn, and remains dormant under the snow during 6 to 8 months, according to the elevation. I have found the butterfly as early as the end of June, both near Bergun and at Pontresina, and it may be found at higher altitudes up to 7000 or 8000 feet throughout July and August.

The variation to which this species is subject consists principally in the number and size of the red ocelli. The male has sometimes one, but usually two, red spots on the fore wing beyond the cell: the one on the costa is almost always present, and there is sometimes a black, and very rarely a red spot as well, near the middle of the hind margin of the fore wing. The fringe of the wings is sometimes plain white, and sometimes more or less distinctly marked with black at the end of the veins.

In the variety *intermedius*, from the Altai Mountains, these black markings on the fringe are much more regular and constant. In female specimens, as in the American form *smintheus*, there are generally two, sometimes one, and rarely three, red spots beyond the cell. In one specimen in my collection, and in one figured by Meyer-Dür, these three spots are almost confluent, forming a short bar edged with black.

The size of Swiss specimens varies from 2·50 to 1·80 inches; the Altai specimens average about 2·25; in American specimens the largest I have are of the so-called var. *hermodur*, from the Rocky Mountains of British Columbia, which are 2·40 to 2·50 inches across the wings, and the smallest, from Colorado, measure 2·10 to 1·80 inches.

With regard to the American form *smintheus*, such a full and excellent account of its habits has been given by Mr. W. H. Edwards in Butt. N. A. vol. i. pp. 21–26, that I need say but little; a further account of its habits as observed in the Judith Mountains,

Montana, by Mr. Courtis, is so interesting that I copy it from 'Papilio,' vol. iii. p. 158.

Mr. W. H. Edwards is here speaking of *P. smintheus*, var. *hermodur*, H. Edw., and says:—"These Montana examples of both sexes are very large, considerably beyond the average of *smintheus* from Colorado, some males and females reaching 2·70 inches. Several of the females are very black, there being little of the yellow-white ground left, and that principally in cells of primaries and on disks of secondaries. The red spots are of extraordinary size. I should have taken the female for a distinct species had not the male been so like and often indistinguishable from the Colorado males of *smintheus*, though larger. Some of them have the spots orange as in var. *behrii*.

"*Several of both sexes I cannot distinguish from a pair of* P. intermedius *sent me by Dr. Staudinger as Ménétries' species from Siberia.* These are the examples which are not melanic, and in which the marginal borders of both wings are transparent. I have a female of the same form taken on Mt. Bradley, California, by Mr. James Behrens[1].

"Mr. Courtis at my suggestion shut up some females with *Sedum*, on which *smintheus* has been known to lay, and obtained 140 eggs. Mr. Courtis says, 'Most of these eggs came from females that mated after I caught them. The others would not lay, although I kept them shut up with several males until they nearly starved.'"

This is a most curious fact, as I found that *P. mnemosyne*, and Mr. Thompson found that *P. apollo*, mated freely in captivity; but Mr. Edwards says this is the first instance he has heard of in which butterflies have mated in captivity.

"Mr. Courtis goes on to say:—'The virgin females seemed to have the end of abdomen a light green horn instead of black, but after mating I noticed they turned black.' This seems to throw doubt on either Mr. Courtis's accuracy of observation, or to prove that the development of the pouch is not as in *P. apollo*. He goes on to say:—'I think they lay on the roots of plants, as the females always drop to the ground, climb up a stalk, and fly away. Those in confinement climbed sticks and window frames, laying eggs as they went. They curved their bodies round and put an egg on whatever they touched, except the *Sedum*; I made one lay on it by keeping her moving from one piece to another, but she seemed much excited, and as soon as I put her on grass and sticks she laid every few minutes.' In a later letter, 5th of August, Mr. Courtis writes, 'I noticed a female *Parnassius* alight on a piece of *Sedum*, drop to the ground, climb up and lay an egg either on the leaves or roots or on the ground. I could not find the egg, though I saw her go through the motion of laying.'"

Mr. W. H. Edwards has tried without success to breed *P.*

[1] I have received a pair from this locality, through the kindness of Mr. H. Edwards, and can only say of the female that I can hardly distinguish it from small examples of *discobolus* from Turkestan. The difference between the two sexes is most marked, the male being very like those from the Altai Mountains.

sminthens from the egg in Virginia. He states that the eggs hatched in the last days of winter, but will not eat *Sedum* leaves. He is certain that the eggs of this species do not hatch naturally till spring. He says that the newly hatched larvæ are most singular creatures, bearing no resemblance to any members of the Papilionidæ which he has seen. They are thickly studded with small tubercles in rows, and each of these gives out several short curved black hairs. They look something like caterpillars of *Argynnis*, but are different from these also.

Reakirt, in Proc. Phil. Ent. Soc. vi. p. 129, describes "eight very closely allied, but perfectly distinct and seemingly constant forms" of *P. smintheus*. He says:—"I think it highly probable that both *P. smintheus* and *P. nomion* are derivatives from the same parent stem, the former being yet in process of segregation, while the latter, most probably the older form, has passed through its transitional stages, and now presents only constant specific diagnostics. The chain of closely linked varieties of *P. smintheus*, of which the highest (*sayi*) approximates to *nomion*, would seem to corroborate this supposition." He goes on to describe a remarkable female form, and says that the only apparently constant diagnostic which he has detected in the species is the seemingly regular situation and form of the four basal spots on the under surface of the hind wings, in which it differs strongly from *nomion*, the only species he knows which closely approximates certain forms of the male and female.

"Mr. Ridings captured this fine species in July, solely within the mountain districts, usually when settled on the flowers of some tree, and always near the edge of a watercourse. It is abundant, but of difficult capture, not only from the natural obstacles interposed, but also from its very high and quick flight, this commonly ranging from four to eight yards above the head."

The form figured and described by Ménétries as *sedakovi* (Men. Enum. p. 71, t. 1. fig. 1), from Irkutsk, of which I have seen the type, is very like some of the Altai specimens, as are some of those from Kamschatka; whilst what was described as *corybas* by Fischer, from the same country, which I have also seen in the St. Petersburg Museum, are more like European specimens. I also possess a specimen which I can only refer to this species, from Kodiak in the North Pacific. There is evidently much to learn as to its distribution and variation in Eastern Asia, *cf.* Stett. ent. Zeit. 1881, p. 275.

Zeller, reviewing Edwards's 'Butterflies of North America' in Stett. ent. Zeit. 1874, pp. 433, 434, says that *smintheus* certainly belongs as well as *intermedius* to *P. delius*, and quotes Zincken to the effect that a beautiful drawing of female *P. delius* taken near St. Peter and Paul in Kamschatka by Dr. Langsdorf in 1804, does not show the least difference from Swiss specimens.

Zeller, in the same journal for 1872, p. 119, quotes Dietze to the effect that the eggs of fresh specimens of *P. delius* found on the Splugen pass on August 14, hatched in 14 days under the heat of an Italian sun. This seems to prove what I have before suggested, that *P. delius* must pass a considerable part of its larval existence in autumn.

P. NOMION.

Parnassius nomion, Fisch. de Waldh. Ent. Russ. ii. p. 242, pl. 6 (1823–4).

This species, though at first sight very like *P. apollo*, may be certainly and constantly distinguished by the fringes of the wings, which are conspicuously chequered black and white; whilst in *P. apollo* this is never the case to the same extent, though some specimens have a tendency to it. The pouch also (though of the same general form) is black, more lengthened behind, and set on at the end, and not underneath the abdomen; the antennæ, the clothing of the body, and the general pattern of the markings are very similar.

I am not aware that the geographical range of the two species anywhere meets, *P. nomion* first appearing in the mountains of Dahuria, whilst *P. apollo* seems to go no farther east than the Altai Mountains; but these ranges on the Siberian frontier are but little known.

P. nomion appears to be common in the valley of the Amur, at Raddefskaia and Khabarofka, and Christoph found the larva feeding on a yellow-flowered *Sedum* near Vladivostock. According to Ménétries *P. nomion* is found near Irkutsk and at Kiachta, and I have seen a specimen from this locality in Dr. Fixen's collection.

Bremer says that it is found on the north side of Lake Baikal on the Onon river, and on the Ussuri between Noor and the Ema; the largest and finest specimens are from the Bureija Mountains, and farther west they become smaller.

M. Charles Oberthür says in a letter that he has received *P. nomion* from the Abbé David, who found it in the mountains of North China; he has also very curious specimens from Sidemi in Mantchuria taken by Jankowsky, which resemble the *P. nomion* of California, of which he has also an authentic specimen from the collection of Boisduval. This is probably the one mentioned by Boisduval in his list of the Butterflies of California. With regard to the occurrence of the species in N.W. America, there is, however, some doubt, for though Mr. H. Edwards says it has been taken in Alaska, and that he has seen a specimen in a collection from the Cariboo mining district in British Columbia, whilst Mr. W. H. Edwards includes it in his catalogue as from Alaska and Sitka (coll. Behr), yet I have never seen or heard of any true *P. nomion* in the numerous collections made in the Rocky Mountains of late years.

I have, however, a female specimen of *P. smintheus*, var. *sayi*, which might very well be considered as a small form of *nomion*, and I am not able to find any good character by which to separate it.

Indeed, it is quite possible that *P. nomion* represents *P. smintheus* on the North-western coasts of America, and that Mr. Reakirt's idea, *cf. supra*, that they have sprung from the same stock, is a correct view, though it would be a very curious fact in distribution if it was found that the two species come together in N.W. America, whilst in North-east Asia, as far as one can judge, from the very scanty materials which exist, *P. nomion* and *P. delius* remain distinct.

P. nomion varies considerably, but not so much as some species of

the genus: a fine female specimen from Dahuria in the St. Petersburg Museum has the fore wings almost free from white scales and the cell yellowish. I possess two females from the Amur which have a faint yellow tinge all over the white parts of the wings, as is sometimes seen in very fresh Alpine and Himalayan specimens. I think this fades very soon after the insect emerges from the chrysalis. Some specimens have two or three of the black spots on fore wing pupilled with red, as in typical *P. delius*. The ocelli of the hind wing are sometimes with and sometimes without white pupils, but I have seen no specimen which cannot be at once recognized as *P. nomion*.

Of the habits and life-history of this species we know nothing at present; but it does not seem to be a high-mountain insect, but rather an inhabitant of wooded hilly regions, where it flies in July.

Schaufuss, in a publication called 'Numquam Otiosus,' published at Dresden in 1877, on pp. 417–424, after describing two varieties of *P. nomion* under the names of *venusi* and *virgo*, attempts to make an analytical table of the genus *Parnassius*; but this, depending alone on such variable characters as the colours and pattern of the wings, results in an unnatural and unreliable arrangement of the genus, in which no attention whatever is given to structural characters.

The publication of such papers is in my opinion of no advantage to science. As the number of recognized entomological journals is already too great, and the difficulty of reference to such a one as this almost insuperable to foreigners, one has at least a right to expect that after so much trouble as these references give, something worth notice should be found. Short papers of no value are becoming too numerous.

P. ACTIUS.

Parnassius actius, Eversmann, Bull. Mosc. 1843, iii. p. 540, t. ix. figs. 2 *a*, *b*; Staudinger, Stett. ent. Zeit. 1881, p. 278; Alpheraky, Lep. Kuldja, p. 23 (1881).

Var. *rhodius*, Honrath, Berl. ent. Zeit. 1882, p. 178, t. ii. fig. 6, 1885, p. 274.

This is a very puzzling species to assign to its proper position in the classification of the genus; for though it undoubtedly appears to have minor characters which entitle it to be recognized as a species in the high mountains of Northern and Eastern Turkestan, yet I cannot specify any by which it can be constantly distinguished from *P. discobolus*; and the form which has been described as *rhodius* is so like the corresponding sex of *P. jacquemonti*, that I am unable to distinguish between them in the male sex, and do not know for certain whether *P. actius* exists at all in Ladak or the Himalayas, whence no female corresponding to it with a keeled pouch has yet come under my notice. It is, however, distinct from the form I have called *himalayensis*, of which a large series constantly differs in the greater blackness of the antennæ, which, though ringed, are in many cases almost entirely black, whilst in *P. actius* from Turkestan, in *P. jacquemonti*, and *P. discobolus* they are, as far as my specimens go, always distinctly ringed with white. On the underside it perfectly agrees

with *P. discobolus*, *jacquemonti*, and *rhodius*, and differs from *himalayensis* in having the red markings much more strongly ringed with black. The pouch of the one fresh female I possess is quite like that of *P. delius*, small and much more covered with hair than in *P. apollo*, and the abdomen of this female is as hairy as that of the male, a character which seems very unusual in the genus.

The type, as figured by Eversmann, like those from the mountains of Khokand, is an insect with much fewer black scales on the wings than those from the Alatau, which are also less marked with red ocelli. The spot at the base of the hind wing above, a character which is principally relied on by Honrath to separate *P. rhodius*, is variable, as in other species of the genus, but does not appear in *P. discobolus*. In *P. himalayensis* it is often found, but more often is not visible on the upper side.

P. actius was discovered with *delphius* and *clarius* probably in the Tarbagatai (or, as Dr. Staudinger thinks, in the Alatau) by Schrenck, and remained almost unknown until a few years ago, when it was collected in some quantity by Haberhauer in the Alatau, near Lepsa. Later he also found it in the Sultan Hazret Mountains south-east of Samarkand, and in greater abundance on the northern slopes of the Alai Pamir, south of Osch, in Khokand.

Alpheraky also found it uncommon in the Thian Shan, at from 9000 to 13,000 feet elevation; and Grumm-Grshimailo found it near Katta-Karamuk, and at Karasu on the north side of the Tersagar Pass, which crossess the Trans-alai Mountains of Karategin at an elevation of 10,000 feet. In the former place, which seems a wonderfully rich collecting-ground, *P. discobolus*, *mnemosyne*, and *romanovi* also occurred; in the latter *P. staudingeri*, *romanovi*, and another. This region seems to be more rich in species of *Parnassius* and *Colias* than any other in the world; for at Kizil-art, on the western Pamir, which the same energetic collector also visited, he obtained, along with *P. actius*, a new one, which he calls *P. cæsar*, a form of *P. delius*?, and another, thus obtaining no less than nine species of this genus in a single journey, besides six or seven of *Colias*, and many new and interesting *Lycænidæ*, *Erebiæ*, and others.

P. ACTIUS, var. DISCOBOLUS.

Parnassius discobolus, Stgr. Berl. ent. Zeit. 1882, p. 182, t. i. figs. 1–3.

P. corybas, var. *discobolus*, Alph. Lep. Kuldja, p. 16 (1881).

P. (*corybas*, Fisch.?, var.?) *discobolus minor*, Stgr. Stett. ent. Zeit. 1881, p. 275.

This form was first found in great numbers by Haberhauer in the Alatau, and later also very abundantly by Alpheraky in the Thian Shan range. Both Staudinger and Alpheraky in their descriptions go into many details of the markings, number of ocelli, and other peculiarities of this insect (which is extremely variable both in size and colour) in their endeavours to show that it is distinct from the somewhat mythical species *P. corybas*, Fischer; but neither of them gives any constant characters by which it may be separated from *P. actius* and

the Siberian form of *P. apollo* known as *hesebolus*. In fact Staudinger says he received some specimens which are intermediate between *discobolus* and *actius*, and may be hybrids of them in his opinion; while Alpheraky describes a form which he thinks is a hybrid between *hesebolus* and *discobolus*, and states in confirmation of this theory that he found a male of the former *in copula* with a female of the latter.

I confess that after careful examination of Dr. Staudinger's series, as well as of those I have received from him and M. Alpheraky, I can find no constant characters; for the absence of the red spot at base of hind wings is not constant, as Schilde, in Ent. Nachrichten, 1884, p. 334, observes; and even if it was in some species, it is certainly not in *discobolus* or *actius*. I see nothing in the pouch, fringe, or antennæ to make this form worthy of separation, though it is almost impossible, on the other hand, to say to what it should be joined, unless it is *P. actius*; and some of the American specimens of *P. smintheus* are also exceedingly close.

Alpheraky found it in all parts of the Thian Shan which he visited, at elevations of 3500 to 11,000 feet, from the 15th of May throughout the summer, the specimens found at high elevations being smaller, less richly coloured, and more like those of the Alatau Mountains, which Staudinger has separated as var. *minor*. What Staudinger describes as ab. ♀ *nigricans* seems, according to Alpheraky, to be a not uncommon form of the female at low elevations. It is simply a form in which the wings are very diaphanous and covered with black scales to such an extent that when on the wing they seem black.

The yellowish tint which very fresh specimens of *Parnassius* (especially females) often show is found in *discobolus*; and I noted in one specimen in Dr. Staudinger's collection that the fringes of the fore wings are blackish, whilst others had a very strong resemblance to *nomion*, but could apparently be certainly distinguished by the fringes of the hind wings, which are never so distinctly chequered as in that species.

P. ACTIUS, var. HIMALAYENSIS.

Parnassius jacquemonti, Blanch. Jacquemont's Voy. p. 16, t. i. figs. 3, 4; Moore, P. Z. S. 1882, p. 257; Oberthür, Et. Ent. liv. iv. 1879, p. 23, t. ii. fig. 5; Honrath, Berl. ent. Zeit. 1885, p. 274.

Though it is very difficult to say what this species may be, I think it certain that it is not the *P. jacquemonti* of Boisduval, on account of the remarkable difference in the pouch, which I have pointed out in alluding to that species. Neither Moore, Gray, Blanchard, Honrath, nor Oberthür seems, however, to have paid any attention to Boisduval's description of the pouch, or, if they did, failed to understand the importance of this character. The extreme rarity of female specimens of the true *P. jacquemonti* in museums has doubtless prevented other writers from distinguishing the form now under notice from the much rarer and more inaccessible species

which Jacquemont seems to have found on some part of the Kashmir territory.

The species now under notice might very fairly be said to be the Himalayan representative of *P. delius*; but though I cannot specify any structural character by which it differs from that species, yet it has far more general resemblance to *P. actius*. It differs from that species (which perhaps also occurs in Ladak) in the fringes of the wings, which in *P. actius* are almost always distinctly marked with black at the end of the nerves, and in the darker antennæ less ringed with white, and the ocelli of the underside, which are much less ringed with black.

I have received such a large number of specimens of this species from Lahoul, that I am able to say with some certainty that the pouch of the female is always keeled; and though there is, as I show below, very great variation in specimens from one locality, yet I think I could say that none of those from this one locality could be mistaken by one who really knew the species for any other *Parnassius*.

After examination of a large series from Lahoul, taken between July 15 and Aug. 28, 1884, at various elevations between 11,500 and 15,000 feet, I find the following principal variations:—

As regards the ground-colour of the wings, from a pure creamy white to a yellowish white, only seen in very fresh specimens and most pronounced in females; the black scales in some cases almost covering the interspaces of the wings and giving the insect a very dark appearance, whilst in some others, mostly males, they are almost confined to the costal and basal areas and to the line of the nerves. As a rule the females have a greater abundance of these black scales than the males.

As regards the fringes, I find in some specimens, usually those least marked with red, an almost unbroken white fringe, whilst in others it is more or less broken by black at the ends of the veins, but never so distinctly alternated with black and white as in *jacquemonti* or *actius*; and this is one of the best means of distinguishing the males from these species.

As regards the red ocelli, they vary in number from none to three on the fore wing above, of which two are near together between the cell and apex, and one about the middle of the space, between the third median nervule and the submedian nervure, and in size from a mere dot of a few red scales surrounded by black to an ocellus about 2 lines in diameter.

On the hind wing above they vary in number from two to six, of which one is at the base of the costa (usually, but not always, conspicuous, and sometimes quite absent), one halfway along the costa, and one extending from the second subcostal nervule to and beyond the discoidal nervule: these two are always present, and sometimes large and pupilled with white; one, and in females often two, at the anal angle, and rarely one showing through the black scales at the base of the cell.

On the undersjde the full number of red ocelli (namely three on

the fore wing and four on the hind wing), together with the four basal ones, are almost always present, corresponding to those on the upper surface, in which the red is often absent. The pattern of the underside is very characteristic, and would, I think, alone be enough to distinguish all the specimens from Lahoul from any other species.

The antennæ are decidedly blacker than in any of the allied forms, and though ringed faintly with whitish in some specimens, are never so much so as in all the forms of *P. delius*, or in *P. actius*, *discobolus*, and *jacquemonti*. They vary so little in 100 specimens that I have examined, that should series from other localities besides Lahoul be found to present the same constant differences in antennæ and markings from *P. actius* that these do, I think it might be allowed specific rank with as much or more justice as other so-called species of *Parnassius*. Of the habits we know but little. It begins to fly about the middle of July or earlier, according to the season and elevation, and continues to be found in a fresh condition till the end of August.

I think that the figures of Blanchard and that given by Oberthür, which is taken from a male specimen from Boisduval's collection, supposed by him to be the type of Boisduval's description, represent this species and not the true *P. jacquemonti*.

Whether this species ever occurs in the same region with that insect I am not at present able to say; but I think it does not occur at so high an elevation, and I doubt whether it extends to Ladak. I have never seen specimens from any locality east of the Ganges valley in Upper Gurwhal, where Mr. Duthie found it at elevations of about 11,000–13,000 feet near Phuladaru.

P. HONRATHI.

Parnassius honrathi, Stgr. Berl. ent. Zeit. xxvi. 1882, p. 161, t. i. figs. 4, 5, 5 *a*.

P. corybas, Ersch. Fedtschenko's Reise, p. 2, t. i. figs. 1, 2 (1874) (nec Fischer).

This little-known species seems to have been first discovered by Fedtschenko at Kulbasin, near Sangi Djuman, on May 25, and Kuli Kalan on June 25, in Zarafshan, about 7000 feet high, but being mistaken by Erschoff, who described the Lepidoptera of the collection, for *P. corybas* of Fischer, remained unknown until Haberhauer sent from the Hazret Sultan Mountains south of Samarkand a number of specimens (about 20 males and 5 females), which he took at about 6000–7000 feet in July 1881. These were described by Dr. Staudinger, who considers the species quite distinct from *P. corybas* of Fischer, which comes from Kamschatka, and is probably only a form of *P. delius*.

It differs from all other *Parnassius* of this group in having black antennæ, black fringes, and black legs and feet; the clothing of the body beneath is also black.

The pouch of the female is of the *apollo* type, though this is not shown either in Erschoff's or Staudinger's plates; and Staudinger says that in one specimen it has a rather produced point.

I have seen Erschoff's type in the museum at St. Petersburg, and have little doubt that it is identical with Haberhauer's, of which I possess one example; but the fringes of the former are not so black and do not seem to be correctly represented in the figure.

In general appearance the species is extremely similar to *P. discobolus*, and, no doubt, varies in the usual manner.

Though I cannot find Fedtschenko's locality in a large-scale map of Turkestan, yet it cannot be very far from the mountains where Haberhauer found the species; and neither he nor other explorers seem to have met with it further north or east, whilst to the south and west are no mountains at all connected with this range[1].

P. DAVIDIS.

Parnassius davidis, Oberthür, Et. Ent. liv. iv. p. 23, t. ii. fig. 2 (1880).

Beyond the single specimen which M. Oberthür has described, nothing is known of the species, which seems to differ in nothing from *P. nomion*, excepting that the fringes of the wing are entirely black. It has also, as M. Oberthür informs me, grey antennæ ringed with black, and the club black, the legs grey, with the last articulation only black. It was discovered by the distinguished naturalist, Abbé David, in the Jehol Mountains north of Pekin, and must be either very local or rare, as no other specimen was ever procured by him in his numerous journeys in the north of China.

P. BREMERI.

Parnassius bremeri, Feld. MSS.; Brem. Lep. Ost Sib. p. 6, t. i. figs. 3, 4 (1864); Feld. Reise Novara, i. p. 133, t. 21. *e–g* (1865).

Var. *graeseri*, Honrath, Berl. ent. Zeit. 1885, p. 272, t. viii. figs. 1, 1 *a*, *b*, *c*.

This species, sent by Bremer to Felder as *P. delius*, is undoubtedly a good and distinct species, very variable in colour, but always to be recognized by its black antennæ, plain black-and-white-edged fringe, and black pouch of the *apollo* type; but like those of its countryman, *P. nomion*, the pouch is more prominent and less covered by hairs. The veins are always covered with black scales, as in the *mnemosyne* group. In the number and colour of the ocelli it is extremely variable, some specimens having no red markings on either wing; but the majority have three or four on the hind wing, and some have two, or even three, on the fore wing as well. Two fresh females from Khabarofka, one of which is without a pouch, have the fore wings (which are without any red) strongly tinged with yellow; but out of nine males and nine females in my collection, not one presents the slightest deviation from the characters of the species, excepting that the antennæ of some pale-coloured males from the Amur are faintly ringed with whitish.

[1] Since this was in print, I have received a specimen of *P. honrathi* from the Grand Duke Nicholas, collected by M. Grumm Grshimailo at Agwas Potasuk, which I believe to be in the mountains of Karategin.

This species was discovered by Radde in Amurland, where it seems common in many places from the middle of May till the beginning of July. Christoph discovered the larva on a slope above a swampy valley near Raddefskaia, but gives no details as to its food plant, or the habits of the insect. Its range extends from the Upper Amur to the Ussuri, but not apparently to the coast; and as far as I can learn, it is an inhabitant of mountains as well as of low-lying wooded districts.

The form described by Honrath as var. *graeseri* has red spots on the fore wing beyond the cell, which are rarely found in the typical *bremeri*; this form appears to be common, and is perhaps the prevalent one near Pochrofka in the Jablotschnoi Gora (Apfelgebirge) in Transbaikalia, near the watershed of the Amur region, at about 4500 feet elevation. Unless, however, it is proved to be constant and peculiar to this locality, I do not see any reason for separating it.

P. APOLLONIUS.

Parnassius apollonius, Eversm. Bull. Mosc. 1847, iii. p. 71, t. iii. figs. 1, 2; Alph. Lep. Kuldja, 1881, p. 20.

This distinct species was only known from Eversmann's description and figure in the Bulletin of the Moscow Academy for 1847, until quite recently, when it has been taken in large numbers by Alpheraky at Sibo, near Kuldja, and by Haberhauer in Ferghana. According to Alpheraky's account, it is an inhabitant of saline steppes about 2000 feet above sea-level, and flies at the end of March and beginning of April, laying its eggs on a species of *Salsola* which is abundant here, and which is probably the food-plant of the larva. Eversmann, however, says that it flies in the mountains of Soongaria in June; and Erschoff says that it was taken by Fedtschenko's expedition between 8000 and 12,000 feet in July. These statements appear almost irreconcilable (*cf.* Alpheraky, *l. c.* p. 21); and if the latter is correct, the vertical range of this species is greater than that of any other *Parnassius*. Grumm-Grshimailo found it near Woadjili, south of Osch, at the beginning of June, but gives no particulars of its habits, save that the locality is bare, rocky, and very hot; it is about 3000 feet above the sea, according to the Russian Staff-map of Turkestan. The same explorer found it afterwards near Karamuk, in the north-east corner of Karategin, at about 7500 feet. Alpheraky further states that whereas the fringe of the wings in Kuldja specimens is alternately white and black, it is, in those from Ferghana, almost entirely white; but in nine specimens in my collection, of which four are from Kuldja, four from Margilan, and one from Samarcand, I do not find this remark confirmed, as the fringes are more or less marked with black in all the examples. The antennæ of this species are deep black, the hairs of the neck, thorax, and abdomen white. The number and size of the red spots vary as in other species. The pouch is of the same form, but perhaps rather larger than in *P. apollo*, black in colour, and somewhat prominent as in *P. nomion*.

P. ACCO, Gray.

Parnassius acco, Gray, Cat. Lep. Brit. Mus. i. p. 76, t. 12. figs. 5, 6 (1852).

P. acco, Elwes, P. Z. S. 1882, p. 400.

Of this rare and very curious species we know hardly anything. It seems to be confined to the elevated desert regions of Ladak, and not more than six or seven specimens are known to exist in collections, viz. two in the British Museum (the types), two in Messrs. Godman and Salvin's collection, one in my own, which I owe to their kindness, and one, which I have also examined, in Baron Felder's. The two first of these were collected along with the types of *P. charltonius* and *P. simo* in Ladak many years ago by Major Charlton, at about 16,000 feet. The next three were taken by the late Mr. Shaw on his journey to Yarkand, at Lapsang, south of the Karakoram pass, about 17,000 feet above the sea, and were given by him to Mr. Bates, whose collection of Lepidoptera passed into Messrs. Godman and Salvin's hands. The last was taken by the late Dr. Stoliczka on the Samanda pass, 17,000 feet, near Lake Tsomoriri in Ladak.

I have also a single small specimen, which came, along with *P. sikkimensis*, from the Tibetan frontier, north of Sikkim, and which I cannot separate from *P. acco*, though in size and colour it is more like *P. simo*, and led me at first to consider those two species as one when I first received it.

They all agree very well in the important characters, having black antennæ and whitish fringes; but the most remarkable character is the pouch, which in this species develops a keel of such extraordinary depth, that when sitting on level ground the abdomen of the insect must be elevated at a considerable angle. This remarkable pouch is similar in two perfect specimens, the one figured (Plate II. fig. 3) being from Mr. Godman's collection.

A more minute examination of them shows that the fringes of the wings of *P. simo* are very different, and though neither the British Museum nor Hewitson's specimen has the pouch in a perfect condition, yet I have little doubt that the pouch of *P. simo* will be also found to be different from that of *P. acco*.

Since 1881 I have had several collections from the same part of Tibet, and obtained a few more specimens of *P. sikkimensis*, but this single one of *P. acco* remains unique from that region, and none of the numerous collections made at Darjiling, which sometimes contain specimens from high elevations, have, as far as I know, ever included any *Parnassius* except *P. hardwickei*.

P. SIMO.

Parnassius simo, Gray, Cat. Lep. Brit. Mus. p. 76, t. 12. figs. 3, 4.

Of this species almost nothing is known; there exist in all museums, to my knowlenge, but four specimens—two in the British Museum, collected by Major Charlton in Ladak, and two others, of which one is in the Hewitson and one in M. Oberthür's collection, and both

from their flattened appearance and age seem to have come from the same source.

I have been able to find out the route which Major Charlton followed in Ladak, or Chinese Tartary as it was called in those days, and among the few scientific travellers who have been to that remote and inhospitable region, none seem to have again found this curious little insect. It may, however, be distinguished from *P. acco* and *P. sikkimensis* by the fringes of the wings, which are black in the fore wing and greyish white in the hind, whilst in *P. acco* they are all whitish. The antennæ are black, the pouch is unknown; and the position of the species in the genus must therefore remain doubtful, though I should imagine that it will be found nearly allied to *P. acco*.

P. JACQUEMONTI.

Parnassius jacquemonti, Boisduval, Sp. Gen. p. 400 (1836) (in part).

? *P. jacquemonti*, Gray, Cat. Lep. Brit. Mus. p. 76, t. xii. figs. 1, 2 (1852), ♂.

? *P. jacquemonti*, Moore, P. Z. S. 1865, p. 488.

P. epaphus, Oberthür, Et. Ent. liv. iv. p. 23 (1879).

? *P. actius*, var. *rhodius*, Honrath, Berl. ent. Zeit. 1882, p. 178, t. ii. fig. 6, ♂.

P. epaphus, var. *sikkimensis*, Elwes, P. Z. S. 1882, p. 399, t. xxv. figs. 4, 5, 6, ♀.

The synonymy of this species is the only one which has given me any trouble to clear up, and this arises principally from the fact that Boisduval probably used examples of two species in writing his description, and that his female type is not now to be found either in the Paris Museum, where the other specimens collected by Jacquemont which Boisduval described are preserved, or in his own collection, now in the possession of M. Oberthür. The point on which the whole question turns, is the fact that Boisduval says in describing the male that the fringes are entirely white, which is not the case in this species; and of the female he says that it is like the male, "La poche de l'extrémité de l'abdomen assez développée, plissée en travers et *sans carène longitudinale*." As no other species is known to exist in which a pouch of the *apollo* type is without a keel, this fixes Boisduval's female with certainty; and though the name *jacquemonti* might perhaps be applied to the species of which he described the male—my *actius*, var. *himalayensis*—using Oberthür's name of *epaphus* for the species now in question, yet, as Oberthür's name was applied to Gray's insect of which he had only seen a plate, of which he did not know the female, and which, after having seen the specimens figured by Gray, I cannot distinguish from *actius*, I think it is more correct to apply Boisduval's name to a species of which there can be no possible doubt he described one sex. With regard to the insect described by Honrath, from specimens collected by Stoliczka, as *actius*, var. *rhodius*, I cannot distinguish the male sex from that of *P. jacquemonti*. Charlton's specimens figured by Gray may be one or the

other, and the same may be said of those which I possess from Tibet, collected by Lang, and from Murghi, Ladak, 17,000 feet, both of which are males, like those in the British Museum. I have, in fact, of this species only one doubtful female, which was taken near the Shigri glacier in Lahoul, at 13,000 feet, on August 25, 1884, the abdomen of which is too much damaged for determination; a single pair from Ladak lent me from the Indian Museum, Calcutta; and three pairs of the small variety *sikkimensis*, which I received through native collectors from the Chumbi valley on the Tibetan frontier of Sikkim, and which agree absolutely with the Shigri specimen in fringes and antennæ. All the females from the Sikkim locality, of which I have received several, agree perfectly in the pouch of the female, which is without a keel, like the one figured here (Plate II. fig. 1), and seem to differ only in being of a smaller size than those from Tibet, Ladak, and the north-west.

I cannot hear of any variation in the pouch of *P. actius*, which is keeled and indistinguishable in form from that of *P. discobolus*; and am certain that the female of the species figured by Oberthür as Boisduval's type also has a keel, so that the following points seem clear:—

1st, that Boisduval confounded two species in his description, of which one (my *actius*, var. *himalayensis*) has a keeled pouch, and the other, *jacquemonti verus*, has not.

2nd, that *actius*, var. *rhodius*, of Honrath, =*epaphus*, Oberthür, may be either *P. actius* or *P. jacquemonti*, as no reference to the female is made by either author, and the figures of the male cannot be distinguished from *P. jacquemonti*.

The habits of the insect are little known, but the notes of Capt. Lang quoted by Moore may be applicable to the true *P. jacquemonti*. He says, P. Z. S. 1865, p. 488:—"It replaces *P. hardwickei* on the high passes of Upper Kunawur, Spiti, and Tibet. I first saw it on the Kongma pass, leading from Kunawur into the Chinese province of Gughe in Tibet, at an altitude of 18,000 feet. This pass is 16,000 feet, but I ascended its flank another 2000 feet to enjoy the far view over the distant Tibetan ranges, brown and treeless, closed to European foot, and backward among the sharp icy pinnacles of our own more familar Himalayan ranges; and here I saw this *Parnassius* coursing rapidly up and down the frozen snow-beds, where beaches as it were of boulders and stones cropped out. What could tempt *Parnassius* there I know not, for I saw not a *Sedum*, nor a *Saxifraga*, nor any other vegetation. I met this *Parnassius* again at high elevations, in similar situations along the confines of Kunawur and Tibet. It does not occur apparently with the next" (*P. hardwickei*).

In Sikkim it also occurs at great elevations and flies in August and September. I took myself, on the 20th September, 1870, a pair of this species *in copulâ*, on an unnamed pass above 18,000 feet elevation, by which I crossed from the Upper Lachoong valley in Sikkim to the Cholamoo lake in Tibet. These specimens were given to the late Mr. Atkinson, and now stand in the Hewitson Collection as *P. simo*, along with one genuine example of that very distinct species from Ladak.

In describing the Sikkim form of this species (P. Z. S. 1882, p. 399) I said that it might be distinguished by the smaller size, and by the more distinct alternation of the black and white in the fringes. I am still unable to compare these with a series from Ladak, as no specimens except the few I have mentioned exist to my knowledge in collections; but the smaller size seems to me now not a sufficient distinction, and the spotting of the fringes is almost, if not quite, as marked in the specimen from Shigri. The name *sikkimensis* had better therefore be dropped until a constant and more marked distinction than that of size is shown to exist.

P. HARDWICKII.

Parnassius hardwickei, Gray, Lep. Nepal, t. 4 (1846); Cat. Lep. Brit. Mus. p. 76, t. 12. figs. 8–11 (1852); Moore, P. Z. S. 1865, p. 488.

Var. *charino*, Gray, *l. c.* t. 12. fig. 12.

P. jacquemonti, Koll. (nec Boisduval), Hügel's Kashm. p. 407, t. 2. figs. 3, 4.

This distinct and pretty species occurs at very various elevations, in most parts of the North-west Himalaya from Kashmir to Sikkim, at elevations varying from 6000 to 12,000 feet and probably higher, but in the north-west it occurs at much lower elevations than in Sikkim. It seems to fly at almost all times of the year in various localities, and varies very much in coloration, and especially in the number of the red and blue ocelli, at almost all the places where it is found. The five bluish ocelli on the hind wing, generally pupilled with white, but in some cases reduced to mere specks, are, however, present in all the specimens I have seen; and as a rule the greater the amount of black scales, which in some female specimens almost cover the wings, whilst in others of the male sex they are entirely wanting, the larger and more numerous are the red ocelli.

The variety *charino*, Gray, is the darkest form, but does not seem to be either a local or a seasonal variety, as I have it from Simla, taken in May, from Gulmurg in Kashmir in August, and from the Chumbi valley in September.

The red spot at the base of the hind wing above is more or less well marked in four out of twelve females in my collection, and convinces me that it cannot be looked on as a specific character in this genus.

Of the life-history of this species we know something, and, strange as it may seem to European naturalists, I have little doubt that the species is double-brooded. Capt. Lang (P. Z. S. 1865, p. 488), says, "There appear to be two broods, early spring and late autumn. I have seen it in December and February on bright days, succeeding weeks of snow storms." Hocking took 16 specimens, of which one was a female, flying over snow in March, at 8000 feet elevation.

Capt. Graham Young, writing from Kulu, says:—"Undoubtedly *P. hardwickei* is double-brooded; the second brood appears in August and September, and a few even in October in favourable seasons; some of these hybernate, reappearing in March along with the spring

brood, which has hybernated in the pupa: of this fact I have no manner of doubt." In another letter he says, "When coming over the Rhotang pass about October 10, 1874, I saw numbers of the larvæ of *P. hardwickei* on the low herbage, and have no doubt myself but that some of this species hybernate as butterflies, but by far the greater number in the pupa; that this insect is double-brooded no one who knows its habits disputes; the larva feeds on various species of Saxifrage." In another letter Capt. Young says, "In the outer Himalaya (I speak of Kulu only) *P. hardwickei* does not vary; but in the interior it varies from typical *hardwickei*, through light and dark grey, to the high-level form *charino*."

Capt. Lang says, in P. Z. S. 1865, p. 488, that this species in Kunawur commences at the Runang pass, becoming commoner as we travel south and west towards Lower Kunawur and Simla, not extending nearer the plains than Simla, however. It is tolerably abundant on the Mahasoo ridge, near Simla, on bare grassy hilltops, just clear of oak-woods; grassy open downs it certainly affects, and at high elevation, 8000 feet. It has a strong but slow flight, somewhat like that of *Pieris*, keeping low over the rocks which crop up amongst the grass."

The form of the pouch in this species separates it widely from any other of the genus (see Plate II. fig. 5). The fringes of the wings are white and long, the antennæ black.

P. DELPHIUS.

Parnassius delphius, Evers. Bull. Mosc. 1843, iii. p. 540, t. 7. fig. 1 *a*, *b*.

Var. *namagana*, Stgr. MSS.

P. staudingeri, Haas, Berl. ent. Zeit. 1882, p. 163, t. 11. figs. 7, 8, 8 *a*.

Var. *infernalis*, Stgr. MSS.

I think there can be little doubt that *P. delphius* and *P. staudingeri* are one species, and time will show whether the Himalayan ally, *P. stoliczkanus*, can be separated from them; but from whatever point of view they are regarded, these three form a very natural group, differing widely from all other species in the form of the pouch, which, though it has some analogy with that of *P. hardwickii* in being divided into two lobes, is, as the plate shows, quite unique in form.

P. delphius was first described from the Tarbagatai range by Eversmann with *P. clarius* and *P. actius*; and it should be noted that though he says these species came from the southern slopes of the Altai Mountains, yet Kindermann, who collected in the true Altai Mountains, is quoted by Lederer in Zool.-Bot. Ver. Wien, 1853, p. 353, as follows:—"It will perhaps be wondered that I did not find in the district I explored (which lies on the upper Irtisch between Ust Kamenogorsk and Ust-buchtarminsk) the species described by Eversmann in the Moscow Bulletin as from the Altai. These, however, do not inhabit the Altai, but are only indigenous 700–1000 versts to the south, and were collected by Herr Schrenck,

a botanist of St. Petersburg, in the Tarbagatai and *Allakan* Mountains." [1] It has since been taken abundantly by Alpheraky in the Thian Shan Mountains, above 9000 feet elevation, in July and August. It frequents steep stony mountains up to 12,000 feet, where there are great abundance of Saxifrages. Haberhauer also took it in the Alatau, and in the Sultan Hazret mountains, south of Samarkand, which form the western termination of the Alatau, in great quantity between the 10th June and the beginning of August.

This last was described by Herr Bang-Haas as *P. staudingeri*, but after having seen large numbers of the two forms, three pairs of each of which are in my collection, I fail to find any difference by which they may be distinguished. Both are very variable, but both have the antennæ, fringes of the wing, pouch of the female, and all important characters absolutely identical.

Bang-Haas relies principally on the supposed broader fore wings, and the purer yellowish white ground-colour with much sharper blacker markings; but when he wrote he had not yet received the specimens of *P. delphius*, collected in Ferghana by Haberhauer, which vary extremely. Some of these (? var. *namagana*) have blue ocelli on the hind wing, as in *stoliczkanus*. Some of the females of *P. staudingeri* (var. *infernalis*, Stgr.) are very dark, almost black in their ground colour.

The antennæ in this species are in the male sex black, but in all my six females the lower part is more or less grey, not distinctly ringed. The fringes are very narrow, whitish in colour, but sometimes darker; and, as Bang-Haas points out, the horny substance of the pouch forms a complete ring round the hinder segment of the body.

Dr. Staudinger says it varies from a uniform grey colour with feebly marked blackish spots to a very dark colour with reddish-yellow, red, or yellow ocelli on the hind wings, and in one specimen two small red spots on the costal margin. The bluish scales of the two black round ocelli on the hind wing also seem to be often wanting in the freshest specimens. I noted in his collection a very curious looking organ protruding from the abdomen of a male specimen of *P. staudingeri*, which, having some analogy in shape to the pouch of the female, led Dr. Staudinger to think it was a hermaphrodite. This organ, however, which, owing to his kind loan of the specimen, I am able to figure (Plate II. fig. 14), is I believe only the ordinary male claspers protruded from the body, perhaps owing to forcible separation from the female.

P. STOLICZKANUS.

Parnassius stoliczkanus, Feld. Reise Novara, Lep. ii. p. 138 (1865), iii. t. 67. figs. 2, 3 (1867).

With regard to *P. stoliczkanus* we know but little, as it is an inhabitant of remote and inaccessible districts in Ladak and the northern frontier of the North-west Himalaya. The late Dr. Stoliczka

[1] Perhaps this is a misprint for Alatau, as I can find no such name in the best modern maps.

took a single pair at Narka, in the province of Rupshu, which were described and figured by Felder. Two females in the Hewitson collection are marked Darjeeling, but there is no evidence that they came from Sikkim; and though both have larger red ocelli on the hind wing than the Ladak specimens I have seen, yet they are probably from Atkinson's collection, which was made at many places in the Himalaya as well as at Darjeeling. M. L. de Nicéville, who is the only living entomologist who has seen this species alive, took three specimens (of which a pair are now before me) on July 18, 1879, on the Baralacha pass, north of Lahoul, at 18,000 feet. Both of these have small ocelli on the margin of the hind wing, three of which in the ♀, and one in the ♂ have bluish pupils. The male has no red markings at all, whilst the ♀ has two ocelli in the usual place on the hind wing; none that I have seen have the red ocellus on the costal margin of hind wing, which is found in all specimens of *P. delphius* and *P. staudingeri*. The fringes and antennæ, however, agree perfectly with those of *P. delphius*, excepting that the antennæ of the ♀ *P. stoliczkanus* are all black; and though I hardly consider that the few specimens of this species existing show any structural characters of sufficient importance to separate them certainly from *P. delphius*, yet the absence of the costal ocellus on the hind wing would if constant be a good secondary character of distinction; and there appears to be some difference in the internal structure of the pouch, though its external appearance is nearly the same as that of *P. delphius*.

In a very interesting account of his journey through the Alai Mountains in the southern part of Khokand, M. Grumm Grshimailo describes a new species of *Parnassius* shortly, under the name of *P. romanovi*, which, though I have not yet been able to see a specimen, is possibly a form of this, but more probably allied to *P. charltonius*. He says:—"The fore wings like *delphius*, the hind wings show a great red patch of 1 centimetre in diameter, a second of much smaller dimensions, and a band which is formed of three red marks; behind this red band, nearer the outer margin, are five beautiful blue ocelli surrounded by black shining scales."

This splendid insect was found near Katta-Karamuk, and also at Karasu, on the north side of the Tersagar pass, 10,000 feet, in company with *P. actius*, *P. staudingeri*, var. nova, *Parnassius* sp., and many splendid species of *Colias* and other insects.

Another new form, named, but not described, by the same explorer, is *Parnassius cæsar*, which was found at Kizil Art, on the Alai Pamir plateau, at a great elevation, and said to be a splendid, quite unique species of great variability, and will no doubt be soon published in the Grand Duke Nicholas's 'Mémoires sur les Lépidoptères,' which have already added so much to our knowledge of Russian Lepidoptera.

It will be impossible to say where these species belong in the genus, until they are fully described and figured [1].

[1] After this paper was read I received, through the kindness of the Grand Duke Nicholas Mikhailovitch of Russia, two pairs of *P. romanovi*, which is

P. TENEDIUS.

Parnassius tenedius, Eversm. Bull. Mosc. 1851, ii. p. 631; Mén. in Schrenk's Amurl. vol. ii. Lep. p. 14, t. 1. fig. 3, ♀.

Of this remarkable species but little is known, though it has a wide range in Eastern Asia, and has been collected recently in some numbers by Herr Tancré's collector in some parts of the southern Altai Mountains, in April and May. Eversmann received it first from Irkutsk. I have a female specimen collected by Puzilo at Albasin on the Zeya river in upper Amurland. Ménétries describes and figures a female from Olekminsk on the Lena river. I have seen specimens in the St. Petersburg Museum, collected by Czernakowsky on July 14, 1873, on the lower Tunguska. Major von Hedemann also collected this species at the Schilka, in the upper Amur region, in May.

P. tenedius has a pouch-like appendage unlike that of any other of the genus, though it has some analogy to that of *P. imperator*. It is very delicate and wax-like in substance, open at the bottom and difficult to examine, but the figure I have given will explain its structure better than words. In a female collected by Maack, which I saw in the St. Petersburg Museum, the pouch is not developed, but eggs of apparently full size are visible inside the abdomen, and I possess another in which it is only partially developed; but the two perfect females in my collection, together with at least five others which I have examined, all agree in the general form and substance of this curious appendage. See Plate II. fig. 9.

The antennæ are black, the fringes of the wings show a narrow black line distinctly edged with white. The hairy covering of the body is less abundant in the males of this species than in most other *Parnassius*; the number and size of the red markings vary just as in other species, but those from Amurland appear generally to have them most abundantly.

Nothing is published as to the habits of this species, which is very scarce in collections at present.

P. IMPERATOR.

Parnassius imperator, Oberthür, Bull. Soc. Ent. France, 1883, p. 79; Et. Ent. ix. p. 11, t. 1. fig. 4, ♀.

This splendid species at first sight presents the most remarkable resemblance to *P. charltonius*, but as soon as one examines the abdominal appendage, which in this case cannot be called a pouch, it is evident that a more different and peculiar structure cannot exist. I must refer my readers to the drawing (Plate III. fig. 4), as a description alone would give no true idea of its form, which, though in

evidently very nearly allied to *P. discobolus*, and indeed hardly separable from it. These specimens do not agree with the description above given, which makes me think that the name has probably been transferred from the original insect described above to what is now sent as *P. romanovi*. I have to thank the Grand Duke also for a pair of *P. muzaffir*, Gr. Grsh., which also appears to be a form of *P. actius*, and Herr Christoph informs me that *P. charltonius* was also included in M. Grumm Grshimailo's collection from the same region.

some degree analogous to that of *P. tenedius*, is utterly unlike that of any known *Parnassius*. It is very curious that though M. Oberthür has received many examples of the female, he has as yet no male, as it will be most interesting to examine the clasping organs, in order to see whether they differ from those of *P. charltonius*, which I have figured, in as marked a manner as the female appendage does; M. Oberthür, who figures this organ well, says that he has two virgin females in which it is not developed.

There is some variation in the number of the large blue ocelli on the hind wing of this grand insect; normally they are two in number, but one specimen figured by M. Oberthür has two additional small ones above, which gives it even a stronger resemblance to *P. charltonius*, in which five is the usual number. The antennæ are black, the fringes of the fore wings black, edged with white, and of the hind wings plain white.

This grand species was discovered by the French missionary bishop of Tibet, M. Félix Biet, at Ta-tsien-lo, a town near the frontiers of China and Tibet, at about 7500 feet elevation, where it flies all the summer, and may probably extend throughout that very inaccessible tract of mountains which have yielded so many zoological and botanical treasures to the researches of Abbé David, and from whence so many new butterflies have recently been described by M. Charles Oberthür.

P. CHARLTONIUS.

Parnassius charltonius, Gray, Cat. Lep. Brit. Mus. p. 77, t. xii. fig. 7, ♂ (1852); Moore, Yarkand Mission, Lep. p. 5, t. 1. fig. 3, ♀.

This splendid species must be considered, with *P. imperator*, as the grandest of the whole genus. The superficial resemblance which it bears to *P. imperator* first led me to study the question of the pouches in this genus, which have been so much neglected, and which in this species is so remarkable.

First discovered by Major Charlton at Lapsang, in his journey in Ladak, so memorable in the history of the genus, and figured by Gray, along with *P. acco*, *simo*, *jacquemonti*, and *hardwickei*, *P. charltonius* remains one of the rarest and least known of the genus. Dr. Stoliczka found it again at Kharbu, 13,000 feet, in the same province, and the same naturalist during the Yarkand expedition obtained a female.

M. Lionel de Nicéville and Capt. Young have both found it at Koksir, below the Baralacha pass, in the province of Lahoul, from 12,000 to 14,000 feet elevation, where in some seasons it is not uncommon from the middle of July to the middle of August, when the females are still fresh.

Having had the whole of the specimens collected by these gentlemen under comparison, I find that, in this locality at least, they vary less than most species. None have any red in the usual spots on the fore wing, but on the hind wing is a small red ocellus ringed with black, and sometimes nearly obsolete, near the costa; a large

central ocellus usually with white pupil, and in the female sex a red oblong patch at the anal angle. Near the outer margin is a series of five large bluish-grey ocelli, broadly edged with black on the outside.

The fringe of the wings is white, broader and more distinct on the hind wings than on the fore, but never spotted; the antennæ are shining black; the thorax and abdomen in the male are black, thickly covered with short downy hairs on the thorax, and with longer paler ones on the abdomen, which extend over the base of the fore wing and the inner margin of the hind wings, as far as the anal angle.

The abdomen of the female is black with a few pale hairs down the centre of the upper surface, and divided into eight segments by distinct rings of a greyish colour; the terminal segment in the female is furnished with a tuft of short grey hairs, which, when the pouch becomes developed, turn up almost at right angles to the body. The pouch is a remarkably shaped one, different from that of any other species of *Parnassius* (see Plate III. fig. 5).

P. MNEMOSYNE.

Parnassius mnemosyne, Linn. S. N. x. p. 465.

Var. *nubilosus*, Christoph, Hor. Ent. Ross. x. p. 19 (1873).

This is the type of a large and widely distributed section of the genus. Some form of the group is found in almost every region where *Parnassius* occurs, and *P. mnemosyne* itself is of very wide distribution in Europe and Western Asia, but replaced in Eastern Asia and N.W. America by allied forms differing from it in minor characters, but preserving a very strong general resemblance in all important ones.

It is found in the Pyrenees at Cauterets (Oberthür), in thousands on meadows on the Spanish slopes near Gavarnie, at 6600 feet (Pierret *fide* Speyer), in the Neapolitan and Sicilian mountains, in Auvergne (Sand), in many parts of the French, Swiss, Styrian, and Italian Alps, from about 2300 to 5000 feet; but apparently of very local distribution, as Meyer-Dur had never seen it himself, and Dr. Staudinger told me that he had been equally unfortunate, whilst I have taken it abundantly in three different places. In many parts of N.E. Prussia, in Bavaria, the Hartz, in many parts of Austria, it is more or less common, and often at quite low elevations. I have taken it at Mödling, close to Vienna, on a low rocky hill among bushes. In the south of Russia, and in the north of Europe, it seems to be an insect of the steppes and forests rather than of the mountains. It occurs locally in Denmark, Scandinavia, Finland, and as far north as Archangel. In Asia Minor and the Caucasus, it is in many places abundant, and according to Lederer always at a considerable elevation up to 8000 feet, developing a smaller darker variety (*nubilosus*, Christoph) in Armenia and North Persia. In Asia it is found in the mountains of N. Persia, in various parts of Turkestan, and as far south as the Alai Mountains of Khokand, but not apparently in the Thian Shan or Altai, where it is replaced by *P. clarius*.

As far as I have personally observed, it is found in meadows where vegetation is rather rank; and at Berisal, on the Simplon pass, where it is most abundant at 4500 feet, the meadows where it flies have a north aspect, while *P. apollo* confines itself to the hot slopes on the other side of the ravine.

With regard to its life-history little is known. Meyer-Dür says that Kindermann discovered the *apollo*-like larva in April and beginning of May on *Corydalis halleri*, and that it pupates under fallen leaves in a strong web, the pupa being yellowish and like that of the Zygænidæ. I have made several endeavours to discover the larva myself without success, but I have strong doubts that *Corydalis* is the only, if even it is the usual food-plant, for this reason, that it is a spring flowering plant of very short duration; whilst *P. mnemosyne* must be an autumn-feeding larva, as the insect flies in spring or early summer very soon after the melting of the snow, and there could be no time for the larvæ to feed up after it melted.

From observations made in Wallis, in June 1884, and again in May 1885, I believe that the larva more probably feeds on an umbelliferous plant (? *Heracleum*, sp.), which was very abundant in the places where the insect was numerous, and on which the females often sat, whilst *Corydalis* was either absent or withered at the same date. Herr Bang-Haas thinks that in Denmark the larva is a night-feeder, but knows nothing certainly about it. I was very anxious to investigate the development of the pouch in this species as well as in *P. apollo*, and with this object visited Wallis in May 1885. On May 24, I found the males abundant at about 3000 feet on the south side of the valley, near Brieg, and caught several males and fresh females, all of which had the pouch perfect. In the previous year I found, a month later, at Berisal, that the males were worn, and the females, though they were in two or three cases taken *in copula*, had apparently been flying for some time, and had a perfect pouch. After a good deal of searching I found a female fresh from the pupa, at about 11 A.M., sitting on an umbelliferous plant, either *Æthusa* or *Heracleum*. I took her home and put her in a birdcage covered with gauze at about 2 P.M., and at 2.30 one of the males which had been fluttering round her for some time commenced copulation. The female held on to a grass stem with the head upwards and the male hung to her with head down. At 2.45 the female crawled up to the top of the cage, carrying the male with her; he made no attempts to use his feet or hold on, and was supported entirely by the abdomen. At intervals of a few minutes there were slight movements of the abdomen of the male, but otherwise he remained quite torpid till about 4 P.M., when the pair suddenly separated without any appearance of a pouch on the female, whose abdomen remained large and swollen as at first. At 6 P.M. there was not the least change in her appearance; she remained quietly holding on to the gauze, whilst the male crawled about the cage. In the evening I put another fresh caught male in, and on the following morning put the cage in the hot sunshine at 7.30 A.M. All three insects fluttered and crawled about the cage for some time, but showed no

P. stubbendorfi ab ♀ *melanophia*, Honrath, Berl. ent. Zeit. 1885, p. 274.

This species appears to have been first discovered by Lehmann near Kansk in Central Siberia, and has since been found in Dahuria by Radde, and in many parts of the Amur region down to the coast by Christoph, Graeser, and others, where it appears to be abundant in many places, and flies from the 19th of May to the end of June or later. On the island of Askold it is not rare, four males in my collection from this place being larger than those from the Amur, and showing traces of the black patches on the cell of fore wing, which are conspicuous in *mnemosyne*. In Corea a form occurs which seems intermediate between this species and *P. glacialis*, but has not the yellow body of the latter; and though I have seen no specimens from the western limit of its distribution, I should expect to find a similar transition to *P. mnemosyne*. Graeser, however, in Verh. Ver. Hamburg, 1879, p. 201, says that when all the specimens sent by Consul Lühdorf and Dorries from various parts of the Amur are compared, he doubts the distinctness of this species from *P. mnemosyne*, as they show great variation in the amount and distinctness of the black markings, which sometimes are so distinct as to form a complete transition to *P. mnemosyne*.

The pouch of the female is similar to that of the last-named species, and in five females in my collection varies only in length, and is sometimes more produced behind than is usual in *P. mnemosyne* and generally darker in colour.

P. GLACIALIS.

Parnassius glacialis, Butler, Journ. Linn. Soc., Zool. ix. p. 50 (1866).

? *P. citrinarius*, Motsch. Bull. Mosc. 1866, i. p. 189.

This form, which appears to be found locally in some of the higher mountains of Japan, is undoubtedly very nearly allied to *P. stubbendorfi*. It differs from that species in its larger size and in the well-marked yellow hairs of the neck and breast, which in *P. stubbendorfi* and *mnemosyne* are found in the female only. The ground colour of the males is also of a much yellower tint than in *P. stubbendorfi*. The two females in my collection, which are all that I have seen, have a blackish pouch resembling that of *P. clodius* in being considerably shorter than the pouch of *P. mnemosyne* or *stubbendorfi*.

Mr. Pryer says of this species, in his Catalogue of the Lepidoptera of Japan:—"I have taken this abundantly at Nikko in June and July, and received many from Yesso. It varies considerably in size, colour, and markings. I have eleven specimens in my cabinet, no two of which are exactly alike. Yesso specimens are generally whiter than those from Nikko, from whence I have a specimen almost black. Some are without the dark patch on disk of fore wing, others have one and two patches, and a dark band on the outer margin of the fore wing, which sometimes extends to the hind wing. The female has sometimes a peculiar horny sheath attached to the underside of the abdomen." Mr. Strecker says he has re-

ceived *P. glacialis* from Corea, but some from that country in Mr. Godman's collection are more like *P. stubbendorfi*, which is also found in the island of Askold.

There is little or no doubt that Motschulsky's name of *citrinarius* was applied to this species, and would certainly be preferable to Butler's, which is without signification, there being nothing whatever glacial in the habitat of the insect. As, however, the priority of publication is doubtful, and Butler's name is in common use, it may be retained for the sake of convenience.

The law of priority is no doubt an excellent one, but may be carried too far, and in all cases where the type of an insect is unknown, or where, as is so often the case, in old descriptions, or in variable species, it is impossible to fix it with certainty to a known and sufficiently defined form, it is better to ignore it than to run the risk of confusion by altering the accepted name. I must say, however, that many of the names applied to Lepidoptera by some modern authors, among whom Messrs. Butler and Moore are conspicuous, seem to be most faulty. A specific name should, I think, always be given with regard either to some peculiarity of size, colour, form, or structure of the species, or should give some clue either to the locality, or to a person in some way connected with the insect. If, however, nonsensical or barbarous names such as *nicconicolens*, Butler, *rabdia*, Butler, *rikuchina*, Butler, or misleading names such as *glacialis* in this case, or *Terias hybrida*, Butl., or names derived from Hindoo mythology, often incorrect, as *Sabbaria peeroza*, Moore = *Papilio polyctor*, and numerous others of the same character, then it becomes much more difficult to remember the name at all, and to remember to which species it belong. And I have personally found this difficulty to be much greater among the Lepidoptera than it is among birds or plants, which are, as a rule, much more rationally and sensibly named than butterflies.

P. EVERSMANNI.

Parnassius eversmanni, Mén. Enum. part 1, p. 73, t. 1. fig. 2 ♂ (1855); W. H. Edwards, Butt. N. A. p. 27, t. 7. figs. 6, 7.

P. wosnesenskii, Mén. *l. c.* p. 74, t. 1. fig. 3, ♀.

? *P. felderi*, Brem. Lep. Ost-Sibiriens, p. 6, t. 1. fig. 5.

? *P. thor*, H. Edw. Papilio, vol. i. p. 2 (1881).

Whether I am right in uniting the above species time alone will show, but I can see no difference except that of colour between some of the varieties of *P. eversmanni* and *P. felderi*; and though the males appear very different, yet it would be perhaps impossible to say to which species some of the females belong. The examples which I have seen, however, in the collections of Messrs. Dieckmann, Honrath, Staudinger, Fixen, the Hewitson and Godman collections, and that of the St. Petersburg Museum, though somewhat numerous, have never been all compared together, and it is possible that some characters may exist which would serve to separate them.

This species was first made known by a single specimen sent from Kansk, in Siberia, by Dr. Stubbendorf, and figured by Ménétries,

It is a bright yellow male, and resembles those afterwards collected in some parts of the upper Amur region, which are in Hewitson's and Godman's collections, and also the single male from the Yukon river, Alaska, figured by Edwards. The specimen figured as type of *P. felderi* by Bremer, and which appears to be a female, though nothing is said as to sex, was taken by Dr. Radde in the Bureija Mountains north of the Amur river; and the dark and apparently worn female figured by Ménétries as *P. wosnesenskii* was brought from Ochotsk in N.E. Asia. Since then it has remained a rare species, but some examples of *P. felderi* were taken by Christoph at Raddefskaia, on the Amur; and I have seen others in Dr. Fixen's collection, taken at Starikova, on the Amur, and at Raddefskaia, on the 7th and 29th of July. Besides these, a small number of *P. eversmanni* have been recently collected near Nikolaievsk, on the lower Amur, by Herr Graeser, and sent to Herr Dieckmann of Hamburg, and others I believe have since been taken in Alaska. It is said by Christoph to be local, and hard to catch, flying over deep bogs. Dr. Staudinger has a male from the Yenesei river, and others from Nikolaievsk at the mouth of the Amur.

In most specimens of *P. felderi* the yellow colour fails almost entirely, and the red ocelli are often absent in the male sex; the yellow hairs of the body and costæ are, however, the same in both forms, though not so abundant in *P. felderi* as in *P. eversmanni*. The pouches, which are quite of the same form and size as in *P. mnemosyne*, are alike in both species, and until we know more about them it will be difficult to separate them. The variety named *thor* by Mr. H. Edwards was described from a single male specimen taken in June 1877, 800 miles up the Yukon river, in Alaska, not far from the place where the specimen of *P. eversmanni* figured in the 'Butterflies of North America' came. It is described as differing not only in the ground colour, which is sordid white as in *P. clarius*, but in the broader black base of the fore wings, the wider bands, and the much larger proportion of black on both wings. The red spots also are more numerous. The description seems to correspond very fairly with the plate of *P. felderi* given by Bremer. Mr. Edwards hesitated long before describing this as a distinct species, and says that it may ultimately prove to be an extreme variety of *P. eversmanni*. In this I quite agree with him, but the propriety of separating any species in so difficult a genus as this on a single specimen of one sex is in my mind most questionable.

Ménétries says that the pouch of *P. wosnesenskii* is very large, nearly like that of *P. mnemosyne*, of a dirty white, with a longitudinal groove below, and another on each side; but on examining his type specimen, which is in very bad order, I noted that the pouch seemed rather like that of *P. clodius* (of which, however, no specimen was available for comparison) than like that of *P. mnemosyne*.

P. CLODIUS.

Parnassius clodius, Mén. Enum. p. 73 (1855); W. H. Edw. Butt. N. A. i. p. 18, t. 4. figs. 5, 6.

P. clarius, Boisd. Ann. Soc. Ent. Fr. 2nd sér. vol. x. p. 283.
P. baldur, W. H. Edw. Can. Ent. xi. p. 142 (1879).
P. clarius, W. H. Edw. Butt. N. A. i. p. 17, t. 4. figs. 1–4.
P. menetriesii, H. Edw. Proc. Cal. Acad. Dec. 18, 1876.

This species, which was described by Ménétries from a specimen brought by Wosnesensky from California, is confined to the Western United States, from California northwards at least to British Columbia, and probably further. For an account of its variations, I cannot do better than quote Mr. H. Edwards's notes on the genus *Parnassius* in Proc. Cal. Acad. July 15, 1878. He says:—"Our most common species is *P. clodius*, Mén., which has a wide range and varies much in different individuals. The typical form of this species, which has the red spots very large and distinct, and the wings nearly opaque, occurs sometimes nearly at sea-level, having been taken by Mr. Behrens at Bodega about 500 feet above the sea, and more recently in large numbers at Tomales in Marin Co. As it approaches the mountains it becomes smaller in size, with the wings more transparent and the spots smaller. It is now known as *baldur*, Edw.=*clarius*, Bdv. nec Eversmann. This form is abundant in some portions of the Sierra Nevada, particularly from about Emigrant Gap to the summit of the Central Pacific Railway, 4500 to 8000 feet. Another form, still more distinct, in which the spots are nearly obliterated, the female closely resembling the male of the *clodius* type, I have ventured to describe as *P. menetriesii*. This is to be taken also at high elevations, my specimens coming from Lake Tahoe and neighbourhood, 4000–5600 feet, and one female from the Wahsatch Mountains, Utah, where it was captured by Mr. J. D. Putnam. Mr. Mead took a grand female recently in the Yosemite Valley, at 4200 feet, and induced her to lay eggs on a plant of *Sedum*, and so we may reasonably hope to know something of the transformations of this exquisite species."

Mr. Edwards says further:—"I have no doubt these are all forms of one species, subject to certain variations from change of food, temperature, and other conditions."

In Mr. Edwards's 'Butterflies of North America,' what he now calls *P. baldur* was described and figured as *clarius*, and he still considers it distinct from *clodius*; but there is little doubt that, as Mr. Henry Edwards says, they are varieties of the same species. The form which I have from Washington Territory is the larger one, and some from Plumas Co., California, are intermediate in size. Mr. Crotch took the larger form in Vancouver's Island; but I do not know how far north it extends, or whether it meets with *P. eversmanni* on the coast of British America, which is not improbable.

The principal character in which it differs from the true Siberian *P. clarius* is the form of the pouch, which in five specimens in my collection is always shorter and broader than in other forms of this group (see Pl. IV. fig. 1); but the yellow hairs of the body and neck and breast will also serve to distinguish it, as these parts are black or grey in *P. clarius*.

Mr. H. Edwards says that *P. clodius* flies with a short jerky

motion, not unlike that of many Hesperidæ, taking short flights, settling frequently, and being very easy to capture.

In 'Canadian Entomologist' Mr. Edwards describes the eggs of this species as a little larger than those of *P. smintheus*, of the same shape, covered in the same way with a crust of hexagons; colour pale coffee-brown: laid on species of *Sedum*. The young larva is not distinguishable in shape, markings, or colour from those of *P. smintheus*. Some of the eggs brought by Mr. Mead in September from Nevada hatched in a warm room in February, but the larvæ, though fed on *Sedum*, which some eat pretty well, soon died.

P. CLARIUS.

Parnassius clarius, Eversm. Bull. Mosc. 1843, iii. p. 539, t. ix. f. *a–c*; Stgr. Stett. ent. Zeit. 1881, p. 258.

This species was discovered by Schrenck, in the Tarbagatai Mountains, and described by Eversmann, and has since been found by Kindermann between Ustkamenogorsk and Ustbuchtarmnisk in the Altai, and by Haberhauer at moderate elevations near Dschemine near Saisan, in Central Asia. Dr. Staudinger says of the specimens from this place that they are not so strongly marked as those from the Altai, and that the yellow spot on the inner border of the hind wing is wanting, and in one female the yellow ocelli of the hind wing are entirely wanting. The blackish band on the fore wing beyond the cell is also absent, giving the specimen quite the appearance of *P. mnemosyne*, which is found neither in the Tarbagatai, Altai, or Alatau Mountains, but appears again in the mountains of Samarkand. Dr. Staudinger thinks that *P. clarius* is very close to the North-American *P. clodius*, but that the yellowish instead of red ocelli well distinguish it. I would, however, remark that some Altai specimens of *P. clarius*, which I received from Herr Tancré, have the ocelli rather red than yellow, and that the best character by which the two species may be separated is the form of the pouch, which in *P. clarius*, though quite of the same character, is much longer than in any specimens of *P. clodius* I have seen.

Little or nothing is known about the habits of this species, and its range does not seem to extend far to the east or west.

A variety named *dentatus* in some German collections does not appear to have any marked characters, and the name was perhaps given rather for commercial than scientific purposes. Names of this class which have been largely adopted by professional horticulturists, seem likely to become also prevalent among mercantile lepidopterists, and should be treated as they deserve, when discovered. Scientific collectors owe so much to commercial enterprise both in plants and insects, that we must not criticize these practices too severely; but as soon as the love of science becomes obscured by the love of gain, and species-making becomes profitable to the pocket, naturalists must be doubly careful before they accept novelties of this nature.

P. NORDMANNI.

Parnassius nordmanni, Mén., Nordmann, Bull. Mosc. 1851, p. 423, t. xiii. figs. 1–3.

Var. *minima*, Honrath, Berl. ent. Zeit. 1885, p. 272, t. viii. figs. 2, 2 *a*.

P. clarius, Herr.-Schäff. Pap. Eur. t. liv. figs. 257, 258.

This species appears to have a limited range, being confined to certain districts north and south of the Caucasus, where it seems to represent its near ally, *P. clarius*.

The two species have, in fact, little to distinguish them except colour; but in the type specimens of *P. nordmanni* which I have examined I find the neck is covered with yellow hairs, whilst the palpi and hair of the head, legs, and feet are black, and this is the case in other specimens which I have seen. In one specimen in the St. Petersburg Museum, collected by Haberhauer, and in another which I possess, and which from their small size I believe to be from Daghestan (var. *minima*), the palpi and hair of the head and neck are white. In *P. clarius* the body and legs are greyish; but perhaps the pouch affords the best distinction, as in *P. clarius* it is very long behind, and opens rather upwards; whilst in *P. nordmanni* it is much shorter behind, and cut off in a different way at the opening.

Nordmann says of this species that it flies with *P. delius* in the highest mountains of Adshara in July. He took it in some numbers on the road from Osurgeti in Georgia direct over the Somlia Mountains to Achalzich, on the slope of the peak called Dshuaruto. Since then no one except Haberhauer seems to have taken it south of the Caucasus, and we have no details of his captures; but Christoph, in his account of his explorations in Daghestan, Hor. Ent. Ross. xii. p. 17, says that it flew on the bare stone-covered slopes of the mountain Bazardjusi, at 13,000 feet elevation. The specimens I have seen from here are all much smaller than those from Georgia, and have been separated by Honrath as "var. *minima*." Ménétries, in his Catalogue, gives Akbasia as a locality, and the Grand Duke Nicholas, in his Catalogue of the Lepidoptera of the Caucasus, says it is found at Kourouch in Daghestan. It remains, however, a rare insect in collections, and its distribution is obscure.

EXPLANATION OF THE PLATES.

All the objects are magnified 5 times, except the eggs.

PLATE I

Fig. 1. Side view of pouch of a female *P. apollo*, from Eperies, Hungary.
2. The same, from behind.
3. Side view of clasping-organs of male *P. apollo*, from Brunnen, Lucerne, taken June 27, 1884. Denuded of hair whilst fresh.
4. End view of same when exposed.
5. Claspers detached from their position.
6. Valves seen from below, when detached.
7. Point of one of the valves, seen from above.
8. Penis.

Fig. 9. Side view of female *P. delius*, taken in Gantherthal, Valais, July 1, 1884.
10. The same, from behind.
11. Side view of organs of male *P. delius*, exposed by removal of external covering on one side.
12. Egg of *P. delius* from fresh specimen, highly magnified.
13 *a*. Side view of female *P. smintheus*, from Colorado, U.S.A.
14 *a*. End view of same.
13 *b*. Side view of female *P. bremeri*, from Amur.
14 *b*. End view of same.

PLATE II.

Fig. 1. Side view of female *P. jacquemonti*, from Ladak.
2. End view of the same.
3. Side view of female *P. acco*, from Lapsang, Ladak.
4. End view of the same.
5. Side view of female *P. hardwickei*, from Mandi.
6. End view of same.
7. Side view of male *P. hardwickii*, the organs exposed by removal of the outer covering.
8. The same, as seen from above.
9. Side view of female *P. tenedius*, from Albasin, Amur.
10. The same, viewed from behind.
11. Egg found adhering to the same, highly magnified.
12. Side view of pouch of female *P. staudingeri*, from Turkestan.
13. End view of the same.
14. Male organs of *P. staudingeri* as seen protruded in a specimen lent by Dr. Staudinger, which appears to have been forcibly separated from the female during copulation.

PLATE III.

Fig. 1. Side view of female of *P. stoliczkanus*, from Baralacha Pass, Himalaya.
2. End view of the same.
3. Side view of female *P. imperator*, from Ta-tsien-lo, Tibet.
4. End view of the same.
5. Side view of female *P. charltonius*, from Lahoul.
6. End view of the same.
7. Side view of male organs of *P. charltonius*, exposed by removal of side plates.
8. Side view of female *P. mnemosyne*, from Berisal, Valais, July 2, 1884.
9. End view of the same.
10. End view of male organs of *P. mnemosyne* when opened by artificial means, from a specimen in spirit, to show their probable position during copulation.
11. The same, as they appear in their natural position.
12. Side view of male organs of *P. mnemosyne* when exposed by removal of side plate.
12 *a*. Egg of *P. mnemosyne*, highly magnified.

PLATE IV.

Fig. 1. Side view of female *P. clodius*, from Washington Territory.
2. End view of same.
3. Side view of female *P. eversmanni*, from Amurland, in mus. F. D. Godman.
4. End view of the same.
5. Side view of *P. clarius*, from Altai Mountains.
6. End view of the same.

2. On the Mammals presented by Allan O. Hume, Esq., C.B., to the Natural History Museum. By Oldfield Thomas, F.Z.S.

[Received November 16, 1885.]

(Plates V. & VI.)

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Accompanying the magnificent donation of Indian birds recently made to the National Museum by Mr. A. O. Hume, there is a collection of nearly 400 mammals, which, although appearing of small account beside the enormous ornithological series, is yet, viewed on its own merit, one of the finest collections of mammals ever received by the Museum. This is due not only to the large number of the specimens and the excellence of the skins, which are both in preparation and conservation very far above the average, but also to the careful manner in which they have been labelled, nearly all of them having their exact localities and dates recorded. Thus of the 371 specimens retained in the Museum, only 59 are undated, and only some 10 or 12 are without exact localities, while such large series of perfect skins, especially of the Squirrels and other small mammals, have probably never before been brought together.

The collection consists of a few specimens respectively from Simla, Delhi, the Nilghiris, and the Andaman and Nicobar Islands, but the great mass of it came from four separate localities, viz. Sambhar, in Rajpootana, Manipur, Tenasserim, and the Malay peninsula, and I have thought it better not to give one list of the whole, thereby confusing the localities and destroying any use the list might have for faunistic purposes, but to give four separate lists, each of which forms a distinct contribution to the fauna of a well-defined locality.

The total number of species represented in the collection is 106, of which 19 are from Sambhar, 19 from Manipur, 25 from Tenasserim, and 28 from the Malay peninsula, the remainder being from the other localities above mentioned.

Before commencing the detailed lists, I must express my obligations to Mr. W. T. Blanford for the assistance he has given me in working out this collection, an assistance the more valuable as he is himself preparing a work on the mammals of India, and has therefore the whole subject at his fingers' ends. For help also in making out details of localities, dates, &c. I must thank my colleague Mr. R. Bowdler Sharpe, who himself fetched the collection from Simla, and to whose careful packing the excellent condition in which the specimens now are is partly due.

I. The Sambhar Collection.

The collection from Sambhar, Rajpootana, was formed in the winter of 1877–78 by Mr. R. M. Adam, to whom ornithologists are indebted for the "Notes on the Birds of the Sambhar Lake," published in 1873[1].

The interest possessed by such a series as the present consists in the aid it gives in fixing the north-westerly distribution of the commoner Indian mammals, a point on which we are as yet exceedingly ignorant, and for which authentic lists of the mammals of different localities are much needed. For this purpose Sambhar is an especially useful locality, as it is in this region that the fauna begins to lose its ordinary Indian character and to show signs of the desert influences so marked further west in Sind and the Punjaub.

The collection consists of 42 skins referable to 19 species. The skulls have all been cleaned and sent separately, and too much credit cannot be given to Mr. Adam for the care and trouble he has taken in preparing this valuable part of his mammal collection.

1. Felis chaus, Güld.

a. ♂. Sambhar, 2/2/78. *b*. ♂. Kishungurh, 26/12/77.

2. Felis torquata, F. Cuv.

a. ♀. Sambhar, 17/12/77.

3. Felis ornata, Gr.

a–e, 4 ♂ and 1 ♀. Sambhar, 12/77 and 1/78. *f*. ♀. Kishungurh, 28/12/77.

Mr. Adam obtained no less than six specimens of this rare and beautiful species, which has been hitherto represented in the national collection by only a single half-grown individual collected by Capt. Boys, and by a skull from the Salt Range, obtained by Mr. Theobald. Mr. Adam's series is particularly valuable, as it proves incontestably the validity of the species, which has been confounded by Blyth, Jerdon, and others with *F. torquata*.

4. Viverricula malaccensis, F. Cuv.

a. ♂. Sambhar, 17/12/77.

This seems to be the most westerly Indian locality from which the Lesser Civet has been recorded, but the species turns up again on the other side of the Indian Ocean in Socotra, the Comoro Islands, and Madagascar, to all of which it has probably been introduced by natives.

5. Paradoxurus niger, Desm.

a–c. Sambhar, 8 and 9/77.

[1] Stray Feathers, i. p. 361, 1873.

6. Herpestes griseus, Geoffr.[1]
a–c. Sambhar, 1, 3, and 4/78.

7. Herpestes smithii, Gray.
a. ♂. Sambhar, 13/1/78.

8. Hyæna striata, L.
a. Sambhar, 17/1/78.

9. Canis pallipes, Sykes.
a. Sambhar, 23/1/78.

10. Canis aureus, L.
a. ♂. Jodhpur, 28/1/78. *b*. ♂. Nawa, Sambhar Lake, 23/12/77. *c*. ♀. Goodha, Sambhar, 26/12/77. *d*. Sambhar.

11. Vulpes bengalensis, Shaw.
a. ♂. Sambhar, 17/1/78.

12. Vulpes leucopus, Bly.
a–c. ♂. and 2 ♀. Sambhar, 9 and 12/77. *d*. ♂. Jodhpur. 26/1/78.

13. Mellivora indica, Bodd.
a. ♀. Sambhar, 14/1/78.

14. Sciurus palmarum, L.
a. ♂. Sambhar.

15. Nesokia bandicota, Bechst.
a. ♂. Sambhar, 13/3/78.

16. Nesokia hardwickei, Gr.
a–e. 3 ♂. and 2 ♀. Sambhar, 6/77 and 1/78.

[1] There has been considerable diversity of opinion as to the name the common Indian Mungoose should bear, some authorities thinking the early name of *Viverra mungo* (Gmelin, Linn. S. N. i. p. 84, 1789) is applicable to it, and others that the *Ichneumon griseus* of Geoffroy (Descr. Egypte, Hist. Nat. ii. p. 138, 1812) includes an African as well as an Indian species, and is therefore not tenable. As to the first point, *V. mungo* was based by Gmelin primarily on the "*Viverra ichneumon* β" of Schreber (Säug. iii. p. 430, pls. cxvi. and cxvi. B). But the latter is made up of a conglomeration of different animals from various localities, the two plates representing, the first *H. griseus* and the second the South-African *Crossarchus fasciatus* (see P. Z. S. 1882, p. 91). In addition *Viverra mungo* includes *Herpestes persicus*, Gay. (= *H. auropunctatus*, Hodg.) as Mr. Blanford has pointed out (Zool. East Persia, p. 42, 1876). In my opinion therefore the only rational method of treating *Viverra mungo* is simply to ignore it altogether.

Passing to the second point, as to the applicability of Geoffroy's *Ichneumon griseus* to this species, I find that although Geoffroy quoted Buffon's "Nems" said to be East African, as identical with his animal, yet his description agrees in every respect with the Indian Mungoose, and he distinctly states that his species came from the "Indes Orientales," so that there is no valid reason why the time-honoured name of *Herpestes griseus* should be superseded.

17. Mus rattus rufescens, Gr.

a. Sambhar.

Being now quite convinced of the specific identity of *Mus rattus* and *alexandrinus*, I use the Linnean name *rattus* in preference to that of *alexandrinus* provisionally employed in my review of the Indian Rats and Mice [1].

18. Hystrix leucura, Sykes.

a. ♂. Sambhar, 27/1/78.

19. Lepus ruficaudatus, Geof.

a–c. Sambhar, 12/77 and 1/78.

II. The Manipur Collection.

The series from Manipur contains some of the rarest and most interesting of all the mammals presented by Mr. Hume, as was, indeed, to be expected, that country being as yet but little explored, and its mammal fauna being practically unknown. The collection consists of 61 specimens, belonging to 19 species, of which the greater part are decidedly Himalayan in character, the others being either peculiar to Manipur or only otherwise known from Burma. One species and one variety only are new to science, but many are rare and obscure, and all are of the greatest value as filling up an important gap in our knowledge of the fauna of Further India.

With regard to the smaller mammals also, collections from this region are of especial value, owing to the large number of Burmese species described by Blyth that still require proper identification. Notably is this the case among the Rodents, and it is with the greatest satisfaction that I am able to identify several of his species in the present and the Tenasserim collections.

The most important contributions to our knowledge of the mammal fauna of the Manipur region are :—

1. Blyth's posthumous "List of the Mammals of Burma" published as an extra part of J. A. S. B. xliii. 1875, which contains references to all the species then known to inhabit Burma, and in which the greater part of the species represented in Mr. Hume's collection are mentioned; and

2. Dr. Anderson's 'Zoological Results of the two expeditions to Western Yunnan,' 1878, which is less a list of the specimens obtained by the expeditions than a series of monographs of the chief Indian genera of mammals. These monographs, especially those of the *Sciuridæ*, have been of great value to me in working out the Hume collection, and I have made constant references to them throughout.

Mr. Hume has not as yet published his intended account of the Birds of Manipur, but when he does, he will no doubt give full particulars about the localities at which the mammals were obtained.

[1] P. Z. S. 1881, p. 583.

1. HERPESTES AUROPUNCTATUS BIRMANICUS[1], var. nov.[2]

a. Boori bazar, 11/3/81.

This specimen belongs to a race which for some time both Mr. Blanford and I have thought to be new, and of which the Museum possesses two other specimens, one from "Burma" (probably Tonghu) presented by Mr. R. G. Wardlaw-Ramsay and exhibited to this Society as *H. auropunctatus* by Mr. Alston in 1879[3]; and the other from Pegu (10/4/81) presented and collected by Mr. Eugene Oates. Mr. Blanford has also in his own collection a specimen of it from Cachar.

These four specimens are all nearly precisely alike and differ from ordinary Nepalese *H. auropunctatus* by their larger size, heavier build and slightly darker coloration, their superiority in size being especially well marked in their skulls and dentition.

The following are the comparative measurements of Mr. Oates's Pegu specimen, which I will consider as the type of the variety, and of the type of *H. auropunctatus* from Nepal, a fully adult male :—

	Head and body.	Tail.	Hind foot.
	mm.	mm.	mm.
H. auropunctatus, type[4], ♂ ..	320	212	48
Var. *birmanicus*, ♂	392	214	55[5]

Skulls :—	Length.	Breadth.	Palate-length.	Palate-breadth.	Incisors to cross-line.	Basi-cranial axis[6].
H. auropunctatus,	59·0	30·0	33·0	19·5	23·0	23·0
Var. *birmanicus*,	62·7	34·0	34·0	21·8	23·0	25.3

Teeth.—Greatest diameter of	pm^4	m^1	m^2	Greatest breadth of pm^4 at right angles to greatest diameter.
H. auropunctatus, ...	7·0	5·9	3·0	3·2
Var. *birmanicus*, ...	8·0	6·4	3·1	3·6

It is possible that this variety will hereafter have to be raised to

[1] The question as to whether this should be "*birmanicus*" or "*burmanus*" has given rise to much doubt. Roma makes *romanus* and therefore Burma should make *burmanus*, especially as Burma is undoubtedly the correct, and the French Birmanie an incorrect and corrupt form of the name. Unfortunately, however, not only have the French corrupted the word into Birmanie, but the Italians, to whom we must look as the representatives of the ancient Romans, have also made the same change, calling it "Birmania," whence "*birmanicus*," which I think we must accept as the nearest to the proper Latin for Burmese.

[2] Preliminary diagnosis in Ann. Mag. N. H. (5) xvii. p. 4, Jan. 1886.

[3] P. Z. S. 1879, p. 665.

[4] Measurements taken as explained, P. Z. S. 1882, p. 65, except that in deference to what is now becoming the common practice, I take the "length of skull" from the front of the premaxillæ to the basion, instead of to the back of the condyles.

[5] In the Manipur specimen 58 mm.

[6] Combined lengths of basioccipital and basisphenoid, not including prephenoid as accidentally stated before.

the rank of a species; but until series from intermediate localities are collected it would be unsafe to presume that the differences between the typical *H. auropunctatus* and this variety will not be bridged over.

Some of Dr. Anderson's specimens of *H. auropunctatus*[1] no doubt also belong to this Burmese race.

2. HELICTIS PERSONATA, Geof.

a. b. Manipur, 28/2 and 6/3/81.

Dr. Anderson[2] places this species as a synonym of *H. moschata*, Gray; but the most cursory examination either of the original figure or of that given by De Blainville, both referred to by him, would have shown him that it was really different, as the teeth are depicted of a size even larger than is found in either *H. nepalensis* or *orientalis*, the two usually recognized representatives of the large-toothed group, while *H. moschata* is the type of the small-toothed section of the genus.

The very large size of the teeth seems to be a character of the continental lowland race, in contrast to the comparatively small-toothed Nepalese and Javan forms, these having in their turn far larger teeth than the Chinese *H. moschata*. Whether now *H. nepalensis* and *orientalis* are even varietally distinct from each other I am very doubtful, but in any case *H. personata*, although coming from a more or less intermediate locality, is sufficiently distinct from both by its larger teeth and greyer colour, to merit specific separation.

The distribution and relations of these three races, *H. nepalensis*, *orientalis*, and *personata*, form an interesting comment on Mr. Wallace's remarks on the Himalayan, Javanese, and Malay faunas[3].

3. TUPAIA BELANGERI, Wagn.

a. Aimole 11/4/81. *b.* Machi 1/5/81.

4. PTEROPUS MEDIUS, Temm.

a. ♂. Kotschim-kooleh, 7/4/81.

5. VESPERUGO (VESPERUS) PACHYPUS, Temm.

a. Aimole, 14/4/81.

This somewhat rare species has been found at isolated localities over nearly the whole of the Oriental Region.

6. VESPERUGO ABRAMUS, Temm.

a. Aimole, 14/4/81.

7. SCIUROPTERUS ALBONIGER, Hodgs.

a.–d. Machi, 4–10/5/81.

This species differs much more from *S. fimbriatus*, Gray, than is generally recognized. The shape and proportions of its skull and the colour of its incisors are markedly different, and it has no trace of the minute extra hind foot-pad characteristic of *S. fimbriatus*.

[1] *Op. cit.* p. 173.
[2] *Op. cit.* p. 193.
[3] Island Life, p. 358 (1880).

I cannot agree with Dr. Anderson as to the identity of the genera *Pteromys* and *Sciuropterus*, which he has united on the plea that the dentition is much the same in both, and that the distichous arrangement is not purely distinctive of the smaller species, but is found partially in some of the larger, while, on the other hand, some of the so-called *Sciuropteri* really have bushy tails. He goes on to say, "The wing-parachute in all the members of the group is the same, although some naturalists have described it in *sagitta* as having an expansion in front of the fore limb which does not exist in the other species; but this is unquestionably an error."

In order to settle the question, I have examined specimens in spirit both of *Pteromys* and *Sciuropterus*, and I find that not only do *both* have an antebrachial membrane, arising from the back of the cheek and inserted in the front of the carpus, but that there really are important differences in the development and insertion of the parachutes, comparable in some respects to those observable in the wing-membranes of the Chiroptera, differences which, as in the case of the antebrachial membrane, Dr. Anderson must have overlooked through examining dried skins only.

In *Pteromys* there is a broad well-defined interfemoral membrane, inserted externally at the point where the *tendo achillis* is attached to the calcaneum, and internally to the tail from two to three inches from its base, and there is in some of the larger species nearly three inches depth of membrane clear of the hind limb.

On the other hand, in *Sciuropterus* there is either no interfemoral membrane at all, or what there is merely consists of a slight expansion of skin behind the knee, attached externally to the *tendo achillis*, about halfway down, and internally to the hinder side of the hips and *never involving any part of the tail*.

The lateral membrane also is distinctly narrower, especially below the knee, in *Sciuropterus* than in *Pteromys*, although the longer fringes of hair in the former hide this fact in dried specimens.

Adding to these differences the well-known one in the arrangement of the hairs of the tail, to which I am unable to see the exceptions mentioned by Dr. Anderson, and also those in the dentition described by various authors, I think that it will be admitted that two such natural groups as *Pteromys* and *Sciuropterus* should be allowed to stand as distinct genera.

8. Sciuropterus pearsoni. Gray.

a. Machi, 7/5/81.

This rare species would be naturally expected to occur in Manipur. It has previously been recorded from Sikkim, Assam, and Yunnan.

9. Sciurus indicus, Erxl.

a. ♂. Gurung R. 8/2/81.

The present is by far the most easterly locality as yet recorded for this species, and extends its known range very considerably, the Terai region of Nepal (*Hodgson*) and Cuttack (*Anderson*) having

been hitherto its most easterly localities recorded. I am altogether unable to perceive on what grounds Dr. Anderson keeps *S. maximus*, Gm., separate from this, as although he gives detailed descriptions of both, he omits any comparison between the two. In my opinion the two are certainly specifically identical, and Dr. Jentink is also of the same opinion[1].

10. Sciurus erythræus, Pall.

a–c. Noong-zai-bau, 2/2/81. *d.* Koomberong, 6/2/81. *e–i.* Aimole, 13 to 19/4/81. *j*, *k.* Machi, 30/4 and 1/5/81.

Of these specimens all those from Noong-zai-bau and Koomberong are comparatively darker, both above and below, and more finely punctulated than any of those from Aimole and Machi, and more nearly approach the "*S. punctatissimus*" of Gray.

As all the first set were taken in February, and all the second in March, the difference, judging from Mr. Hume's series only, might have been suspected to depend on date and not on locality; but this idea is dispelled both by the absence of any patchiness or other sign of change in the skins, and by the fact that a specimen of *S. punctatissimus* in the Museum, from Cachar, is dated June, whereas, were the change seasonal only, this form should, on the evidence of the Manipur specimens, represent the winter and not the summer dress of *S. erythræus*.

The species seems, in fact, to be peculiarly susceptible to local influences, as every locality represented in the combined Museum and Hume collections has a more or less different race. Thus Bhotan and Western-Assam specimens are dark with a rufous tinging, an Eastern-Assam one pale with a yellowish wash, this leading naturally into the pale Aimole and Machi Manipur specimens. After these, again, comes the darker Noong-zai-bau and Koomberong race, which finally grades into the extremely dark, finely punctulated *S. punctatissimus* from Dilkoosha, Cachar.

11. Sciurus lokrioides, Hodgs.

a–d. Machi, Aimole, and Phalel, 4/81. *e*, Jherighat, 1/2/81.

12. Sciurus lokriah, Hodgs.

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13. Sciurus macclellandi, Horsf.

a–g. Aimole, 13–25/4/81. *h.* Machi, 7/5/81. *i.* Loanglol, 13/2/81.

These specimens are interesting as being almost precisely intermediate between the *S. macclellandi typicus* of Nepal and Assam, and the Tenasserim *S. macclellandi barbei*, Bly. *S. macclellandi swinhoei*, M.-Edw., of Moupin, Thibet[2], seems also to be a recognizable race of the present species.

S. macclellandi possesses six mammæ, one lateral and two inguinal pairs.

[1] Notes Leyd. Mus. 1883, p. 106.
[2] Rech. Mamm. i. p. 308 (1868–1874).

indistinct tuft of orange-tipped hairs in front of the basal notch. Tail well haired, but not pencilled, markedly bicolor, the hairs black above and white below, but the scales, even of the lower side, are uniformly brown.

Ears large and evenly rounded, with a small projection in the middle of their inner margins; laid forward they reach to the posterior corner of the eye. Tail about as long as the body without the head. Fifth front toe unusually short, its claw barely reaching to the bottom of the division between the 2nd and 3rd toes, giving the foot, at first sight, the appearance of being only provided with three toes. Fifth hind toe reaching just to the base of the fourth. Foot-pads 5–6. Mammæ 8, 2 pectoral and 2 inguinal pairs.

Skull, both in size and shape, almost identical with that of *Golunda ellioti*[2], Gr., with the two following exceptions:—(1) The front

[1] Preliminary diagnosis published Ann. Mag. N. H. (5) xvii. p. 84, Jan. 1886.
[2] Figured by Blanford, J. A. S. B. xlv. pl. x. (1876).

14. Mus bowersi, Anders.[1]

a. ♀. Machi, 8/5/81.

There is nothing in Dr. Anderson's description of his *Mus bowersi* absolutely to prevent the present specimen belonging to it; but the differential characters of these *Muridæ*, obvious enough on actual comparison, are often so difficult of description that I should not be suprised if the present were to turn out to be distinct from *M. bowersi*, especially as the figure of that animal is by no means identical with Mr. Hume's specimen, but is more similar to the species of the group to which *M. germaini*, M.-Edw., belongs. However, there can be no question that for the present the Manipur Rat should rather be referred to *M. bowersi* than be described as new. Dr. Anderson's type was obtained at Hotha, Yunnan, at an elevation of 4500 feet.

15. Mus berdmorei, Bly.

a. ♀. Kamma, Thall, 11/3/81.

edge of the anterior zygoma-root is concave, with an overhanging point[1] instead of being convex, (2) the palate is produced to behind the edge of the last molar, instead of ending opposite its centre. The first of these characters, although fairly common among the Australian Muridæ, is, to the best of my knowledge, not found in any of the other Muridæ either of Asia or Africa. In all other characters, in the development and direction of the supraorbital ridges, the length and shape of the nasals, the angles formed by the sutures on the brain-case, the length of the palatine foramina, &c., the two skulls are absolutely identical.

Teeth large and powerful; incisors short and stout, the lower ones projecting only about 3 mm. beyond the bone, smooth, rounded, and ungrooved in front, dark orange-yellow above, rather lighter below; molars broad and heavy, their structure as in *Mus*, and with no resemblance to those of *Golunda*; last molar nearly as large as the second, consisting both above and below of two well-defined equal-sized laminæ.

Measurements of the largest skin, a female. Head and body 125 mm.; tail 106; hind foot 25·0. Of a specimen softened and placed in spirit, head and body 118·0; hind-foot 26·5; heel to front of last foot-pad 12·0; forearm and hand 31·5; ear, above crown, 12·0.

Skull. Length, bregma to nasal-tip 26·0; greatest breadth 15·0; length of face 14·5; nasals, length 10·0; interorbital breadth 4·5; palate, length 16·0; incisors to m^1 8·3; palatine foramina 5·1; molar series 5·8; length of anterior zygoma-root 4·0; lower jaw, length (bone only) 18·3; to incisor-tips 19·2; projection of incisors (behind) 4·5.

The general appearance of this species is infinitely more like that of the Gulandi (*Golunda ellioti*) than that of any of the other Indian members of the genus *Mus*. So like *Golunda* is it, indeed, in colour, proportions, and even in the general shape of its skull, that it might easily be mistaken for this animal, were it not for its slightly longer tail, less spiny fur, ungrooved incisors, and a few other little prominent characters which might easily be overlooked by a superficial observer. It thus seems to bear the same interesting relationship to the Gulandi that *Sigmodon hispidus*, S. and O., does to *Rheithrodon alstoni*, Thos.[2]

The only species to be referred to in describing *M. humei* as new is *Mus erythrotis*, Blyth[3], from the Khasia hills, the colours of which agree very closely with those of this species, but which is stated to be only 57 mm. in length, with a tail 60 mm. long, and a hind foot, *including the claws*, only 17·4 mm. long, a difference in size far too great to admit of any question as to the specific distinction of the two animals.

[1] This type of zygoma-root is figured Ann. Mag. N. H. (5) ix. p. 414, fig. 3 (1882).

[2] See P. Z. S. 1880, p. 693.

[3] J. A. S. B. xxiv. p. 721 (1855).

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14. Mus bowersi, Anders.[1]

a. ♀. Machi, 8/5/81.

There is nothing in Dr. Anderson's description of his *Mus bowersi* absolutely to prevent the present specimen belonging to it; but the differential characters of these *Muridæ*, obvious enough on actual comparison, are often so difficult of description that I should not be suprised if the present were to turn out to be distinct from *M. bowersi*, especially as the figure of that animal is by no means identical with Mr. Hume's specimen, but is more similar to the species of the group to which *M. germaini*, M.-Edw., belongs. However, there can be no question that for the present the Manipur Rat should rather be referred to *M. bowersi* than be described as new. Dr. Anderson's type was obtained at Hotha, Yunnan, at an elevation of 4500 feet.

15. Mus berdmorei, Bly.

a, *b*. Kopum Thall, 11/2/81.

These two specimens agree so closely with Blyth's short description[2] that I have no hesitation in referring them to his species, even though Blyth himself afterwards placed *M. berdmorei* as a synonym of *M. robustulus*, Bly. (=*M. rattus rufescens*, Gr.), and though the locality of Blyth's specimen, Mergui, Tenasserim, is so distant and has so different a fauna from Manipur.

The following description, based on Mr. Hume's two skins, will serve to supplement the short and unsatisfactory one given by Blyth:—

General colour clear slaty grey, the tips of some of the hairs brown and of others white, the mixture giving a very finely grizzled appearance to the back, in which no trace of yellow or fawn is present; chin, chest, and belly pure white. Ears outside brown, inside silvery; feet white; tail bicolor, black above and white beneath for half its length, the terminal half white all round; the tip not pencilled.

Fur of only one sort, stiff and hispid, but with no trace of spines. Tail about the length of the head and body combined, or a little shorter. Ears large and evenly rounded; fifth hind toe reaching to the middle of the first phalanx of the fourth. Foot-pads large and prominent.

Skull with its facial portion unusually long, nasals long and narrow, surpassing in length the ascending premaxillary processes; supraorbital ridges well defined; anterior plate of zygoma well developed, very convex forward. Palate very long, the interval between the back of the incisors and the molars very much longer than usual; palatine foramina rather short, terminating about 1 mm. in front of m^1; posterior nares opening at the level of the hinder edge of m^3.

Incisors pale yellow, lightening to white at their tips, directed

[1] Zool. Yunn. Exp. p. 304, pl. xvii. (1878).
[2] J. A. S. B. xx. p. 173 (1852).

much more forward than usual. Molars very small in proportion to the size of the animal, their pattern as usual.

Measurements. Head and body 174 mm.; tail 172; hind foot 36; fore arm and hand 44; ear (above crown) 16; heel to front of last foot-pad 17·4.

Skull. Bregma to tip of nasals 35·0; greatest breadth 21·5; nasals, length 16·0; interorbital breadth 7·0; length of face 21·8; palate, length 22·4; incisors to m^1 14·1; palatine foramina 7·8; molar series 6·1; anterior zygoma-root 4·7; lower jaw, bone only, 25·1; to incisor tips 30·6.

This species is allied to *Mus blanfordi*, Thos., and *Mus confucianus*, M.-Edw., but differs from both by its clear grey colour, without any trace of yellow in it, by its shorter tail, forwardly directed and paler-coloured incisors, longer palate, and smaller molars.

16. Mus humei, sp. n.[1] (Plate V.)

a–f. 2 ♂ and 4 ♀. Moirang, 23/3/81.

The collection contains six specimens of this striking new species, which I have much pleasure in dedicating to the donor of the present magnificent addition to the National Collection of mammals.

General colour above exceedingly like that of *Golunda ellioti*, Gr., viz. coarsely grizzled grey, lightest on the head and gradually turning to deep rufous on the rump, the tips of the great majority of the hairs being white or yellowish white on the head and fore quarters, and gradually becoming rich rufous on the hind quarters, their bases in all cases deep slaty-blue. The other hairs are black throughout, and form the black element in the general grizzling. Sides like the fore quarters. Belly yellow or orange, mixed with the slate of the hair-bases; no black-tipped hairs below. The inner sides of the thighs and all round the base of the tail rich rufous.

The fur throughout is soft, and unmixed with flattened or spinous bristles.

Feet grizzled yellowish white. Ears thinly covered outside with black hairs, and inside with black and yellow or red ones; an indistinct tuft of orange-tipped hairs in front of the basal notch. Tail well haired, but not pencilled, markedly bicolor, the hairs black above and white below, but the scales, even of the lower side, are uniformly brown.

Ears large and evenly rounded, with a small projection in the middle of their inner margins; laid forward they reach to the posterior corner of the eye. Tail about as long as the body without the head. Fifth front toe unusually short, its claw barely reaching to the bottom of the division between the 2nd and 3rd toes, giving the foot, at first sight, the appearance of being only provided with three toes. Fifth hind toe reaching just to the base of the fourth. Foot-pads 5–6. Mammæ 8, 2 pectoral and 2 inguinal pairs.

Skull, both in size and shape, almost identical with that of *Golunda ellioti*[2], Gr., with the two following exceptions:—(1) The front

[1] Preliminary diagnosis published Ann. Mag. N. H. (5) xvii. p. 84, Jan. 1886.
[2] Figured by Blanford, J. A. S. B. xlv. pl. x. (1876).

edge of the anterior zygoma-root is concave, with an overhanging point [1] instead of being convex, (2) the palate is produced to behind the edge of the last molar, instead of ending opposite its centre. The first of these characters, although fairly common among the Australian Muridæ, is, to the best of my knowledge, not found in any of the other Muridæ either of Asia or Africa. In all other characters, in the development and direction of the supraorbital ridges, the length and shape of the nasals, the angles formed by the sutures on the brain-case, the length of the palatine foramina, &c., the two skulls are absolutely identical.

Teeth large and powerful; incisors short and stout, the lower ones projecting only about 3 mm. beyond the bone, smooth, rounded, and ungrooved in front, dark orange-yellow above, rather lighter below; molars broad and heavy, their structure as in *Mus*, and with no resemblance to those of *Golunda*; last molar nearly as large as the second, consisting both above and below of two well-defined equal-sized laminæ.

Measurements of the largest skin, a female. Head and body 125 mm.; tail 106; hind foot 25·0. Of a specimen softened and placed in spirit, head and body 118·0; hind-foot 26·5; heel to front of last foot-pad 12·0; forearm and hand 31·5; ear, above crown, 12·0.

Skull. Length, bregma to nasal-tip 26·0; greatest breadth 15·0; length of face 14·5; nasals, length 10·0; interorbital breadth 4·5; palate, length 16·0; incisors to m^1 8·3; palatine foramina 5·1; molar series 5·8; length of anterior zygoma-root 4·0; lower jaw, length (bone only) 18·3; to incisor-tips 19·2; projection of incisors (behind) 4·5.

The general appearance of this species is infinitely more like that of the Gulandi (*Golunda ellioti*) than that of any of the other Indian members of the genus *Mus*. So like *Golunda* is it, indeed, in colour, proportions, and even in the general shape of its skull, that it might easily be mistaken for this animal, were it not for its slightly longer tail, less spiny fur, ungrooved incisors, and a few other little prominent characters which might easily be overlooked by a superficial observer. It thus seems to bear the same interesting relationship to the Gulandi that *Sigmodon hispidus*, S. and O., does to *Rheithrodon alstoni*, Thos.[2]

The only species to be referred to in describing *M. humei* as new is *Mus erythrotis*, Blyth [3], from the Khasia hills, the colours of which agree very closely with those of this species, but which is stated to be only 57 mm. in length, with a tail 60 mm. long, and a hind foot, *including the claws*, only 17·4 mm. long, a difference in size far too great to admit of any question as to the specific distinction of the two animals.

[1] This type of zygoma-root is figured Ann. Mag. N. H. (5) ix. p. 414, fig. 3 (1882).

[2] See P. Z. S. 1880, p. 693.

[3] J. A. S. B. xxiv. p. 721 (1855).

17. Mus cervicolor, Hodgs.

a. Boori-bazar, 11/3/81.

This is evidently Blyth's *M. cuniculoris*[1] described from the Khasia hills, and bears out my suspicion that that is merely a synonym of *M. cervicolor*[2].

18. Vandeleuria oleracea, Benn.

a, *b*. Boori-bazar, 11/3/81.

Dr. Anderson (Zool. Yunn. Exp. p. 313, 1878) has already noted the presence of this interesting little species in Burma and the neighbouring countries. It seems probable that *Mus badius*, Blyth (J. A. S. B. xxviii. p. 295), described from the valley of the Sitang, should be added to the synonyms of *V. oleracea*.

19. Rhizomys badius, Hodgs.

a–f. 4 adult and 2 young. Boori-bazar, 11 and 12/3/81. *g*, *h*. 2 young, Moirang, 22/3/81.

The young specimens are interesting as showing that this species only assumes its rich chestnut-colour in adult age, as they are all of a hue more resembling that of *Rh. pruinosus*, Bly., than that of the adult animals along with which they were caught, and of which they are presumably the young.

III. The Tenasserim Collection.

Next in interest to the Manipur mammals come those from Tenasserim, collected nearly entirely by Mr. Davison in 1877 and 1878, at the time when Mr. Hume was bringing together materials for the valuable paper on the Birds of Tenasserim published in 1878[3]. In this paper may be found a description (p. 522) of all the localities at which Mr. Davison worked, and at which therefore these mammals were obtained. It was on this collection that Mr. Blanford's paper "On some Mammals from Tenasserim"[4] was based, and in the present account there are therefore no novelties to be described, that author having then named, described, and figured the two remarkable species *Prionodon maculosus* and *Sciurus rufigenis*, the typical specimens of which are in Mr. Hume's collection. As Mr. Blanford's paper is not, however, a full account of the collection, but merely consists of notes on the rarer and more interesting species, I have considered it advisable, notwithstanding his paper, to write a list of the Tenasserim as well as of the other mammals of the Hume collection.

Tenasserim mammals are of interest chiefly on account of the passage that takes place in that country from the Burmese to the Malay fauna, as we find that the South Tenasserim species, those from Bankasun, are more or less Malay in character, and add several species to the list of the mammals of British India, while on the

[1] J. A. S. B. xxiv. p. 721 (1855).
[2] 'Stray Feathers,' vol. vi. 1878.
[3] P. Z. S. 1881, p. 548.
[4] J. A. S. B. xlvii. p. 150 (1878).

other hand those of North Tenasserim are nearly entirely Burmese, although but few of them, again, are the same as the species found still further north in Manipur.

The careful and conscientious manner in which Mr. Davison's collecting and labelling is done is nowhere more conspicuous than in the beautiful series obtained by him in Tenasserim, so that the number and excellence of the skins, and above all, the careful preservation of the dates of capture, have been to me, and I hope will be to others, of the greatest possible service in making out the problems of distribution, and of local, sexual, and seasonal variation.

The collection contains 86 specimens, referable to 25 species.

1. Hylobates lar, L.

a, *b*. Myawadi[1]. *c*. Kanksryit, 13/1/77. *d*–*g*. Bankasun, 4–6/77.

2. Semnopithecus femoralis, Horsf.

a. Bankasun, 15/4/77.

This rare species forms an addition to the fauna of Tenasserim, the few localities as yet recorded for it being all either in the south of the Malay peninsula or in Sumatra. Mr. Davison's specimens precisely agree with Horsfield's type preserved in the Natural History Museum.

3. Semnopithecus obscurus, Reid.

a, *b*. 5000′, Mt. Mooleyit, 30/1/77. *c*. Foot of Mt. Nwa-la-boo, Tavoy, 10/4/78. *d*. Bankasun, 25/5/77.

Specimen *d* is a very remarkably coloured individual differing from all others that I have seen in having its crest, nape, arms and legs, and tail yellow, contrasting markedly with the dark hues of the face, body, and feet. It is, however, led up to by a specimen in the Museum from Malacca, collected by Dr. Cantor[2], which has its crest yellow and its limbs and tail lighter than usual. I am therefore indisposed at present to look upon the Bankasun specimen as more than an individual variety. It must, however, be mentioned that its auditory bullæ are larger and more projecting, and its teeth smaller than is usually the case; but with only a single specimen, these characters are not sufficiently tangible to found a new species upon.

4. Macacus cynomolgus, L.

a. Wimpong, Thatone.

5. Prionodon maculosus, Blanf.

a. Bankasun (co-type of species. Figured J. A. S. B. xlvii. pl. vi. 1878).

This is the original skin described and figured by Mr. Blanford,

[1] Specimens to which no collector's name is attached were obtained by Mr. Davison.

[2] No. 79. 11. 21. 596.

while the spirit specimen from Moulmein, mentioned at the same time, has already been generously presented to the National Collection by him.

6. Paradoxurus hermaphroditus, Pall.

a. Wimpong, Thatone.

As Mr. Blanford has shown (P. Z. S. 1885, p. 794), Pallas's *P. hermaphroditus* should be referred to the common Malay Palm-civet, which has hitherto been known either as *P. musanga*, Raff., or *P. fasciatus*, Gr.

7. Mustela flavigula, Bodd.

a. Mt. Nwa-la-boo, Tavoy, 7/4/78. *b*. Bankasun, 20/6/77.

8. Gymnura rafflesi, Vig. and Horsf.

a. Bankasun (Blanford, *tom. cit.* p. 150).

Its only known occurrence within British India.

9. Tupaia belangeri, Wagn.

a–h. various localities, Tenasserim.

This is the *T. peguana*, of Mr. Blanford's list. It may generally be distinguished from the next species by the presence of a well-developed internal cusp on its second upper premolar.

10. Tupaia ferruginea, Raff.

a. Bankasun, 27/4/77. *b*, *c*. Tenasserim.

11. Pteropus medius, Temm.

a. Amherst, near Moulmein.

This appears to be about as far south-eastwards as this species has been recorded, its place further south being taken by *Pt. edulis*, Geoffr.

12. Rhinolophus trifoliatus, Temm.

a, *b*. Mergui (Hume).

It is important to have additional localities for this rare species, of which the exact range is by no means satisfactorily settled.

13. Pteromys cineraceus, Bly.

a. Wimpong, Thatone, 21/12/76. *b*. Kankaryit.

This species seems to be hardly more than a geographical race of the well-known Indian Flying-squirrel (*P. petaurista*, L.). The measurements of *a* were published by Mr. Blanford (l. c. p. 165).

14. Sciurus bicolor, Sparrm.

a, *b*. Thoungyah, 26 and 30/9/78 (Darling). *c*. Mergui, 10/1/79. *d*, *e*. Bankasun, 18/3/77 and 3/6/77.

No seasonal change is appreciable among the large series of this species in the Tenasserim and Malayan collections.

15. SCIURUS CANICEPS, Gray.

a, *b*. Moulmein. *c*. Kankaryit, 13/1/77. *d*, *e*. Thoungyeen River, 9 and 10/77 (Bingham). *f*, *g*. Thoungyah, 16/1/77 (Davison), 10/10/78 (Darling). *h*. Myawadi, 2/10/77 (Bingham). *i*. Tavoy, 16/3/78. *j-l*. Bankasun, 6/77 (*S. phayrii*, Bly.). *m*, *n*. Pahpoon, W. Tenasserim. *o*. Thatone, 23/11/77.

This fine series, with the seven Malayan specimens from Kussoom, (27/5/79), Taroar (12/2/79), Poongah (8/79), and Salanga (2 and 3/79), collected by Darling, form an invaluable addition to the material for making out the relations, variation, and distribution of this troublesome species and its allies.

Dr. Anderson, although he gives separate headings in his monograph to *S. pygerythrus*, *caniceps*, *phayrei*, *blanfordi*, and *griseimanus*, states that he believes that they are all closely related to one another and should not perhaps be specifically separated.

On laying out, arranged as it were on an imaginary map, the whole available series of skins, 70 in number[1], belonging to the above species, one is able to make out five recognizable forms grading into each other in various degrees, of which two occur in North Tenasserim, one in Pegu and Upper Burma, another in Cambodja and Cochin China, and the fifth in S. Tenasserim and N. Malaysia; but anything more complicated than their inter-relations it is hard to conceive, and they seem to be only definable by a free use of trinomial nomenclature.

As the easiest method of explaining their relationships I will attempt to trace out the history of *S. caniceps*, which appears to have been something as follows:—

The original of the species, occurring about the centre of the present range, would be such an animal as summer non-breeding specimens of the true *S. caniceps* of N. Tenasserim now are, viz. grizzled yellowish grey above and grey below, the sides of the neck and the sides of the belly being more or less tinged with yellow (85. 8. 1. 177[2]). The struggle for existence then necessitated a richer ornamentation, at least in the breeding-season, and this was accomplished in various ways in different parts of the animals' range. North-western specimens, those of Burma and Pegu, became rich yellow underneath (*S. pygerythrus*, 81. 12. 2. 7), and eastern ones, in Cambodja &c., a duller yellow below, with whitish feet (*S. griseimanus*, 78. 6. 17, 29), both forms having occasionally, presumably by atavism, ordinary grey-bellied specimens, *e. g.* 81. 12. 2. 9 from Pegu and 62. 8. 16. 4 from Laos. Southwards, beginning about at Tavoy, and reaching down to Malacca, the yellow tinge of the sides of the neck and belly were replaced by rich orange-red,

[1] Of these, 22 belong to the Hume, 25 to the old Museum collection, and 23 have been kindly lent to me by Mr. Blanford out of his own collection.

[2] These numbers are those of the registers in the Natural History Museum, and will always identify the particular phase of fur referred to.

forming a very handsome ornamentation (82. 3. 9. 5, Junkceylon). This race represents *S. concolor*, Bly.[1]

These three forms are all without any marked seasonal change of colour; but in the next race, which is the original stock living in N. Tenasserim, an entirely different sort of ornamentation has been set up in the form of the assumption, during the rutting-season only, of a brilliant orange-yellow back, the sides and belly still remaining dull grey (*S. caniceps typicus*, 85. 8. 1. 178).

Further to complicate matters, the north-western yellow-bellied race (*S. caniceps pygerythrus*) has again spread southwards and overlapped the range of *S. caniceps typicus*, which, being now provided with a highly specialized seasonal change of colour, has driven it to adopt a still further development of its own form of ornamentation, namely, the production of a dark brown stripe between the upper grey and the lower yellow, which shows up the latter in the most brilliant manner possible (*S. phayrei*, 85. 8. 1. 175, Thatone).

The original grey *S. caniceps* has thus, except in the unornamented summer race of var. *typicus*, become entirely extinct, and has been replaced by its variously decorated offshoots.

With regard to nomenclature I think it is impossible to express the present state of things in a binomial manner, but by using the following trinomials we may perhaps approach more closely to the truth :—

S. CANICEPS PYGERYTHRUS[2], Geof.

(*S. blanfordi*[1], Bly.)

No seasonal change; belly yellow.

Burma and Pegu.

S. CANICEPS PHAYREII, Bly.

No seasonal change; belly rich orange, with brown lateral stripes.

Pegu and N. Tenasserim.

S. CANICEPS GRISEIMANUS, M.-Edw.

(*S. inornatus*, Gr., *S. leucopus*, Gr.)

No seasonal change. Belly pale yellow. Feet white. Black tail-tip nearly obsolete.

Cambodja &c.

[1] J. A. S. B. (xxiv. p. 474, 1855), apud Blanford (J. A. S. B. xlvii. p. 161, 1878), who in describing the present series of Bankasun specimens belonging to this form says, "These dark olivaceous forms may perhaps be sufficiently distinct to constitute a local race for which Blyth's name *S. concolor* may be retained, but they are not, I think, really separable from *S. caniceps*." Anderson, on the other hand, places *S. concolor* as a synonym of *S. modestus*, without any remark; but pending a renewed examination of the type, I prefer to take Mr. Blanford's authority, as this course enables me to avoid giving the southern race a new name.

[2] The full references to all these names will be found in Dr. Anderson's 'Monograph,' pp. 227–253.

S. CANICEPS TYPICUS.

(*S. chrysonotus*, Bly.)

A seasonal change. In summer all grey, in winter back brilliant orange-yellow.

N. Tenasserim.

S. CANICEPS CONCOLOR, Bly.

No seasonal change. Sides of neck and of belly rufous, dull in northern, brilliant in southern specimens.

S. Tenasserim to Malacca.

The alternatives, under the binomial system, of either splitting this species into five, or of lumping all the varieties under one head, are both too unsatisfactory for adoption. For the first there are far too many intermediate specimens and gradations, and for the second the differences between fully ornamented specimens of *S. phayrei*, of *S. concolor*, and of breeding specimens of *S. caniceps typicus*, are infinitely too striking.

The manner and dates of the seasonal change in *S. caniceps typicus* are well illustrated by the series from N. Tenasserim. In October the yellow begins to appear in small patches on the back among the grizzled grey (85. 8. 1. 184). By November the whole of the back is rich yellow (85. 8. 1. 182), and this remains at its best until January[1], and then gradually becomes duller and dirtier-looking (77. 10. 25. 2), until about March the summer grizzled grey hairs begin again to appear in patches in the midst of the yellow (77. 10. 25. 1), and soon entirely supersede it. Males and females alike go through this change.

16. SCIURUS ATRODORSALIS, Gray.

a. Kankaryit, near Moulmein, 10/1/77. *b*. Doonsa, near Moulmein, 8/3/77. *c*, *d*. Lathorge, near Myawadi, 19 and 22/1/77. *e*. Maitho, Thoungyeen R. 29/10/77 (*Bingham*). *f*, *g*. Mt. Nwa-la-boo, Tavoy, 5/4/78.

The evidence of the fine series before me, consisting of 40 specimens[2], tends to show that the variation in the colour of this species is not so much a sign of season as of locality, southern specimens being, as a rule, more rufous and generally without the black back.

It unfortunately happens, however, that nearly all the dated specimens that I have seen were obtained in the winter, when the black back is certainly present in most cases. However, Capt. Beavan[3] has described a July specimen as having a black back, and

[1] One specimen in Mr. Blanford's collection, labelled as from Thatone, January, has no yellow on its back as might be expected, and forms therefore a striking exception to the general rule. It should be noticed, however, that this is the very specimen of which Mr. Blanford wrote in 1878 (J. A. S. B. xlvii. p. 162), "The skin so precisely resembles the peculiarly dark olive specimens from Bankasun, that I am inclined to suspect the label must have been changed by accident."

[2] Many of these were kindly lent to me by Mr. Blanford.

[3] P. Z. S. 1866, p. 428.

therefore this character cannot be merely a sign of the rutting-season, as I had originally suspected.

17. Sciurus rufigenis, Blanf.

a. 5500′, *b*. 6300′, Mt. Mooleyit, 1/2/77 and 31/1/77 (Co-types of species).

I have nothing to add to Mr. Blanford's excellent description of this species. There can be no doubt that it is, as he suggests, nearly allied to *S. pernyi*, M.-Edw., but it may easily be distinguished by its brilliant red cheeks, that species having them grey like the back. The unusual length of the muzzle is equally found in both, and together they seem to lead from the ordinary Squirrels towards the still longer-nosed *Rhinosciurus* of Gray. It is, of course, quite natural that if the Tibetan *S. pernyi* were represented in Tenasserim, it would be by a species living at the considerable altitudes at which alone *S. rufigenis* has been found.

18. Sciurus berdmorei, Blyth.

a, *b*. ♀. Myawadi, 18 and 20/1/77.

I cannot share the doubts expressed by Mr. Blanford[1] as to the identity of these specimens with the true *S. berdmorei*. Although the markings differ in their intensity, their general plan and disposition is precisely the same in the two forms represented by the names *S. berdmorei* and *S. mouhoti*, Gr. It has also a remarkably long and narrow muzzle, very nearly as much as in *S. rufigenis*, a point which has apparently never been noticed before.

19. Sciurus macclellandi barbei, Bly.

a. ♂. 9/2/77 (*Bingham*). *b*, *c*. Thoungyah, 11/10/78 (*Darling*). *d*. Myawadi, 18/1/77. *e*. Kankaryit, 12/1/77. *f*–*i*. Tavoy, 3 and 4/78. *j*. Bankasun, 1/6/77.

20. Mus rattus rufescens, Gray.

a. Moulmein, 8/3/78.

The *Mus robustulus* of Blyth, as Mr. Blanford has suggested, is identical with this, the common Tree-rat of the whole of India.

21. Rhizomys badius, Hodgs.

a. Thatone.

This seems to be the first recorded occurrence of *R. badius* in Tenasserim, though Blyth's specimens of the so-called "*R. castaneus*" came from Arrakan and Pegu.

22. Atherura macrura, L.

a. Thoungyah, 3/10/78 (*Darling*).

23. Tragulus napu, Raff.

a–*d*. Bankasun, 5 and 6/77.

[1] J. A. S. B. xlvii. p. 162 (1878).

24. Tragulus kanchil, Raff.

a–c. Bankasun, 5 and 6/77.

Mr. Blanford[1] has fully described the differences between the two Tenasserim species of Chevrotain.

25. Manis javanica, Desm.

a. Bankasun, 1/75.

IV. The Malay Peninsula Collection.

The mammals from the Malay Peninsula are 105 in number, and belong to 28 species, of which no less than 13 are Sciuridæ, a group always well represented in collections made by ornithologists. As in the case of the other series, the greater part of this set were collected by Mr. Davison, although some few were obtained by Mr. J. Darling at Salanga and on the mainland adjoining, and by Mr. Syers in Salangore.

As might be expected, these specimens, while of considerable value in fixing the northward and southward distribution of the species along the narrow Malay peninsula, belong for the most part to common species. There is, however, among them a specimen representing a beautiful new species of *Sciuropterus*, which I have dedicated to its discoverer, Mr. Davison, and there are many which render important service in contributing additional information as to the exact localities and other particulars about the species to which they belong.

The only previous paper of any importance on the mammals of this district is that published by Dr. Theodore Cantor in 1846[2], which gives a complete list of the species then known to occur in the "Malay Peninsula and Islands," but which, excellent as it is for the date at which it was written, is now, of course, somewhat obsolete, and would well bear the addition of such information as may be gleaned from Mr. Hume's valuable collection.

Many of the localities at which the collection was obtained are referred to or described in the two following papers:—

A. O. Hume. "A First Tentative List of the Birds of the Western Half of the Malay Peninsula," 'Stray Feathers,' viii. p. 37, 1879.

A. O. Hume. "The Birds of the Western Half of the Malay Peninsula, Second Notice, *tom. cit.* p. 151.

1. Semnopithecus femoralis, Horsf.

a. Klang, Salangore, 25/7/79[3].

2. Semnopithecus siamensis, Müll. & Schl.

a. "Interior of Malay peninsula, beyond Klang." 4/79.

A curious whitish specimen, far paler than usual, but apparently

[1] *Tom. cit.* p. 166.

[2] J. A. S. B. xv. pp. 171 and 241.

[3] As in the last list, all specimens to which no name is appended were collected by Mr. Davison.

not specifically different from Cantor's specimens of *S. albocinereus*, which Dr. Anderson has shown to be identical with *S. siamensis*.

3. Nycticebus tardigradus, L.
   a. Salanga, Junkceylon, 19/2/79 (*Darling*). *b*. Malacca, 7/77.

4. Hemigale hardwickei, Gray.
   a. ♂. Jaffaria, Johore, 20/3/80.

5. Paradoxurus hermaphroditus, Pall.
   a. Salanga, 27/2/79 (*Darling*). *b*. ♀. Klang, 4/3/79.

6. Arctogale leucotis, Blyth.
   a. ♂. Salangore, 2/11/79 (*Syers*).

7. Putorius nudipes, F. Cuv.
   a. ♂. Klang, 18/4/79.

8. Galeopithecus volans, L.
   a, *b*. Ding-ding Islands, S. of Pinang, 3/79. *c*. Malacca, 9/75.

9. Crocidura murina, L.
   a. Singapore, 7/77.

10. Tupaia ferruginea, Raff.
    a, *b*. Malacca, 9/75. *c*. ♂. Jelang, Salangore, 24/6/79.

11. Tupaia javanica, Horsf.
    a. Salangore, 17/11/79 (*Syers*). *b*. Johore, 8/75.

12. Pteropus edulis, Geof.
    a, *b*. Klang, 3 and 8/79.

13. Cynopterus marginatus, Geof.
    a. Jerome, Salangore, 12/8/79. *b*. Singapore island, 3/2/79.

14. Phyllorhina diadema, Geof.
    a. Gunnong Pulai, Johore, 7/3/80.

15. Phyllorhina bicolor, Temm. (?).
    a. ♂. Klang, Salangore, 13/7/79.

This specimen has more pointed ears, a broader horizontal nose-leaf, and a much more largely developed projection between the nostrils than is usually the case in this species; but without seeing specimens properly preserved in spirit I do not care to describe it as new.

16. Pteromys nitidus, Desm.
    a. ♂. Klang, Salangore. *b*. ♂. Malacca, 7/77. *c*. Gunnong Pulai, Johore, 7/3/80.

These specimens all belong to the so-called species *Pt. melanotis*,

Gr., which Dr. Anderson, in his Monograph of the genus [1], keeps separate from *Pt. nitidus*, although he described an intermediate specimen seen by him in the Leyden Museum. As the two forms are not geographically separate, and their skulls are quite identical, I do not think there is sufficient difference in their colour to distinguish them from one another, even as varieties.

17. Pteromys tephromelas, Günth.

a. ♂. Klang, Salangore, 27/8/79. *b*. ♀. Jaffaria, Johore, 18/3/80.

These two specimens are of value as showing that the characters of the fully adult animal are practically the same as those of the young specimen described by Dr. Günther. The colours and proportions are almost identical, the only difference I can see being that the shining black hairs on the back are somewhat longer and more prominent in the adult, thus giving a less woolly appearance to the whole animal. The skull of the adult also shows that the species is distinguished by the very small relative size of its molars. The measurements of the male specimen are as follows:—Head and body 330 mm., tail 365, hairs at tip 50, hind foot 73, forearm and hand 148, ear, above crown (shrunk) (*c*) 25·0.

Skull:—Occiput to tip of nasals (*c*) 64, length of face 30·7; greatest breadth 42; nasals, length 18·6, breadth 11·4; interorbital breadth 15·0; palate, length 32·8, breadth outside m^2 16·0, inside m^2 8·0; diastema 16·0; palatine foramen 5·0; molar series (exclusive of pm^1) 12·0; lower jaw, bone only, 41·5; to tip of incisors 45·0.

18. Sciuropterus davisoni, sp. n.[2] (Plate VI.)

a. Malacca[3], 7/77.

General colour above much as in *S. pearsoni*, Gr., viz.:—dark slaty grey, with the tips of the hairs bright rufous orange. Parachute similar to back, its edges, especially along the supporting cartilage, rich orange. Below the belly is pale orange, the orange becoming deeper and richer to the edges of the parachute; no intermixture of slate except on the parachute just above the hips. Feet and ears brown. Tail markedly distichous, dark brown above, rich rufous orange below, the latter colour showing somewhat on the upper surface between and beyond the brown hairs.

Ears large, naked, triangular, obtusely pointed, their greatest breadth nearly or quite equal to their height above the crown of the head. Hind feet slender, unfringed, their soles provided with one proximal and four distal well-defined foot-pads.

The skull of the type is unfortunately very imperfect, but there is enough to show that it is distinguished from that of *S. pearsoni* by its broader interorbital space, more heavily built muzzle, broader

[1] Zool. Yunn. Exp. p. 292.

[2] Preliminary Diagnosis, Ann. & Mag. N. H. (5) xvii. p. 84, Jan. 1886.

[3] The following note is written on the back of the label of this specimen:—"This species occurs also in Tenasserim. Seen near Myawadi by Davison."

and darker-coloured incisors, and longer and narrower molars. From that of *S. lepidus* it differs by its much larger size in every way, and its stouter and more powerful teeth. From both also it differs by not possessing any trace of the minute first upper premolar generally present in the genus, a character usually fairly constant in the true Squirrels, but on which too much stress must not be laid on the evidence of a single specimen only.

Measurements (of a skin and therefore merely approximate):—Head and body 142, tail 172, hairs at end 23; hind foot 36; heel to front of last foot-pad 16; ear (above crown) 18·5.

Skull. Length of face[1] 23·0, greatest breadth (*c*) 30·0, interorbital breadth 11·2, tip to tip of postorbital processes 18·0; nasals, length 14·1, breadth 7·0; diastema 11·5; palate, length 23·8, length of molar series 9·5, breadth across palate outside m^1 9·7, inside 5·1.

This beautiful little species reminds one superficially both of *S. pearsoni*, Gr., and *S. lepidus*, Horsf., with the latter of which I consider *S. spadiceus*, Bly., should be amalgamated. From *S. pearsoni* it differs in its broader, naked, and untufted ears, and its longer and more distinctly distichous tail, while from *S. lepidus* it is distinguished by its larger size, much larger and broader ears, orange instead of brown parachute, clear instead of slate-mixed belly, and by the brilliant orange of the underside of its tail.

S. sagitta, Linn., which Dr. Anderson was unable to identify, seems to me to be unquestionably the species commonly known as *S. horsfieldi*, Waterh., the original description agreeing in almost every respect, and the locality being the same. The differences between *S. sagitta* and *S. davisoni* are too obvious to need pointing out.

It is with the greatest pleasure that I take the opportunity of naming this beautiful species after my friend Mr. W. Davison, the collector of the greater part of the Hume mammals, and to whose powers of observation and collection, the sciences of ornithology and mammalogy are so largely indebted. Mr. Davison obtained himself for Mr. Hume nearly the whole of the Tenasserim and Malay peninsula collections, and also the whole of the specimens from Simla and from S. India presented with them.

19. Sciurus bicolor, Sparrm.

a, *b*. Salanga, Junkceylon, 2 and 3/79 (Darling). *c*. Dingding R. 24/2/79. *d*–*g*. Klang. *h*. Malacca, 9/75. *i*. Jaffaria, Johore, 17/3/80. *j*–*l*. Gunnong Pulai, Johore, 7 & 8/79.

With the exception of three or four of the cream-coloured examples so common in this species, all these specimens represent the typical black and yellow *S. bicolor*. This Squirrel has six mammæ, all in the inguinal region.

[1] From the tip of nasals to a point on the forehead above the constriction between the cerebral and olfactory chambers. The "length of brain-case," when given, is from the same point backwards to the most posterior point of the interparietal bone.

20. Sciurus caniceps concolor, Bly.

a to *g*. Kussoom, Taroar, Poongah, and Salanga, Junkceylon (*Darling*).

This very uniform series has already been referred to in the Tenasserim list (*supra* p. 70).

21. Sciurus hippurus, Geof.

a–c. Klang, 2, 3, and 4/79.

This species seems to be the Malay representation of *S. erythræus*, Pall., which does not, however, extend further south than Manipur, while Klang seems to be about as far north as *S. hippurus* has been found.

[Sciurus atrodorsalis, Gray.

a. ♂. Klang, 5/77.

There is possibly some mistake in the labelling of this specimen, as the species is not otherwise known to occur south of Tavoy, Tenasserim, and the specimen exactly matches some of Mr. Davison's Moulmein skins.]

22. Sciurus tenuis, Horsf.

a–d. Salangore, 11/79 and 1/80 (Syers). *e–g*. Klang. *h*. Ulu Langhat, Salangore, 6/4/79. *i*. Malacca. *j*. Gunnong Pulai, Johore, 3/3/80. *k*. Singapore, 10/2/79.

These specimens are all very similar and precisely agree with Horsfield's type. This species has six mammæ, one lateral and two inguinal pairs.

23. Sciurus prevosti, Desm.

a. Salangore, 5/11/79 (*Syers*). *b–j*. Klang, Salangore, 2–4/79 (*Davison*). *k, l*. Malacca, 9/75.

24. Sciurus badging, Kerr[1].

a. Lumut, Ding-ding Islands, 24/2/79. *b–d*. Jerome, Salangore, 12 and 14/8/79. *e–o*. Klang, Salangore, 2, 3, and 7/79. *p, q*. Birman, Salangore, 28/7/79 (*Syers*). *r*. Salangore, 24/11/79 (*Syers*). *s, t*. Malacca, 9/75. *u–a'*. Gunnong Pulai, Johore, 7–9/79 and 3/80. *b', c'*. Singapore, 2/79. *d'*. Acheen, Sumatra, 1/2/73.

By the help of this magnificent addition to the Museum series one is able to prove the specific identity of the Squirrels to which the names of *S. badging* (=*S. plantani*), *S. vittatus*, Raff., and *S. nigrovittatus*, Horsf., have been given.

On laying out our series geographically, one is struck at once by

[1] Linn. Anim. Kingd. p. 269, 1792. I regret to have to use this barbarous name for the well-known Plantain Squirrel (*S. plantani*, Ljung, 1801); but the evidence is too clear to be disputed. Both Ljung and Kerr founded their names on the "Plantain Squirrel" of Pennant, and therefore the identification that has always been admitted for the one must unfortunately apply equally to the other.

the greater prevalence and greater intensity of the red colour of the belly in the northern Malay specimens as compared with the southern ones, and by the absence of white-and-yellow bellied specimens among the mainland series as compared with those from Sumatra, Java, and Borneo. Blue-bellied specimens seem to be proportionately most numerous in the Johore region, our series of seven from there having no less than five of that tint, while of nineteen from Salangore only one single specimen is blue-bellied, the others all having the rich rufous bellies characteristic of most mainland specimens. On the other hand, in insular specimens, the red, when present, is generally paler and poorer in tone, and is commonly replaced either by yellow, white, or, as in the mainland series, by blue. No definable varieties, however, can be made out, as in any given locality specimens are found belonging to several of the different forms; intermediate ones also are by no means rare; thus the Museum specimen No. 49. 1. 8. 5, from Java, is marked with mingled patches of blue and white on the belly, and the white of others is led up to from the deepest rufous through various shades of red and yellow. Red-bellied specimens have in all cases red-tipped tails, while white-and yellow-bellied ones have the tip annulated like the rest of the tail.

With regard to the influences that cause these very remarkable variations, it would seem as if there were some property in mammals tending occasionally to the production of red-tinted varieties in a somewhat erratic manner, comparable to the way in which albinistic and melanistic varieties are produced. The striking fact that all the red-bellied specimens of *S. badging*, and the red-bellied specimens only, have red-tipped tails, is by itself a sign that the red is produced by something which affects the whole animal, and is not merely a colour put on to a particular part for sexual or protective purposes, as is usually the case. Albinistic and melanistic varieties are well known to occur much more frequently in some localities than in others[1]; and in the same way what may be termed "erythrism" seems in some places to succeed to such an extent that red specimens are in the majority, although a tendency still remains for the production of such atavistic non-rufous individuals as the blue-bellied specimens to which the name of *S. nigrovittatus* has been applied.

This theory of "erythrism" is not suggested to account for the present case only, there being many other instances in which the presence of red colour has turned out to be exceedingly deceptive as a specific character, and in which the red of usually red-marked species has been found to have a way of disappearing unaccountably, while more or less red-tinted individuals of grey species are by no means unknown. Erythrism is particularly common among the Mungooses, and is responsible for a large number of the untenable species which have been formed in that group.

I can find no reliable evidence of the occurrence of *S. badging*

[1] Notably in the case of the black specimens of *Arvicola amphibius* from Scotland, or, in this very region and group, in the remarkable case of *Sciurus ferrugineus germaini*, M.-Edw., a permanently black geographical race inhabiting the island of Pulo Condor. (See Milne-Edwards, Rev. Mag. Zool. 1867, p. 193.)

north of Pinang, although in his list of the magnificent series in the Leyden Museum, Dr. Jentink mentions one specimen from Canton[1] and two from Nepal[2], but my reasons for doubting the testimony of these are in the subjoined footnote.

S. badging possesses four inguinal mammæ only.

25. Sciurus insignis, F. Cuv.

a. Klang, Salangore. *b*. Salangore (*Syers*), 18/11/79. *c*. Jaffaria, Johore, 20/3/80.

This species, like *S. berdmorei*, has six mammæ, viz.:—one lateral and two inguinal pairs.

26. Sciurus (Rhinosciurus) laticaudatus, Müll. & Schl.

a. ♀. Klang, Salangore, 5/5/79.

This seems to be the most northern locality as yet recorded for the Long-nosed Squirrel.

27. Chiropodomys gliroides, Bly. (?).

a. Jaram, Salangore, 23/12/79 (*Darling*).

This specimen belongs to the rare and interesting genus *Chiropodomys*, described by Peters in 1868[3], but afterwards[4] erroneously identified by him with *Pithecochirus*, F. Cuv.[5], a very different and much larger animal. The specific name, however, to be applied to this specimen is a matter of some doubt. Blyth's description of *Mus gliroides* from the Khasia hills[6], based on a specimen with an imperfect tail, seems to agree very closely with the present animal, and his *Mus peguensis*[7] is also possibly the same thing; but unfortunately we have no evidence as to whether *C. penicillatus*, as it was called by Peters, ascends as far north as Assam or Pegu, or is a purely Malay species, and pending an examination of Blyth's type, it is therefore difficult to decide what its proper specific name should be.

So far as I know, the only examples of this genus that have as yet come to Europe are two specimens in the Museum collection obtained by Mr. Wallace at Sadong, Borneo; Peters's type in the Berlin Museum, unfortunately without locality; two spirit-specimens

[1] It is suspicious that two Squirrels so peculiarly characteristic of the Malay region as *S. tenuis* and *S. badging* should have been referred by Müller and Schlegel to Canton (*cf.* Jentink, 'Notes Mus. Leyd.' 1883, pp. 126 and 134). Probably they were deceived as to the locality of the collection containing the specimens.

[2] The great mass of Mr. Hodgson's Nepal collection is in the Natural History Museum, a few duplicates merely having been given to the Leyden and other Museums, and it is therefore unlikely that if he really obtained this species in Nepal, no specimens should be in our National Museum, and no reference to it made in his published lists of Nepal mammals.

[3] MB. Ak. Berl. 1868, p. 448, pl. i.

[4] Apud Trouessart.

[5] H. M. Mamm. livr. lxvi. 1833.

[6] J. A. S. B. xxiv. p. 721, 1855.

[7] J. A. S. B. xxviii. p. 295, 1859.

with several young, also without locality, in the Leyden Museum; and the present individual from Salangore.

28. TRAGULUS KANCHIL, Raff.

a. Salanga, Junkceylon, 16/2/79 (*Darling*). *b*. Taroar, 4/2/79 (*Darling*). *c–e*. Klang, Salangore, 5 and 10/79, and 2/80. *f*, *g*. Singapore island, 8/2/79.

3. On an apparently new Species of Duck (*Dafila*) from the Central Pacific. By H. B. TRISTRAM, D.D., F.R.S.

[Received November 14, 1885.]

(Plate VII.)

I lately received a small parcel of birds collected by Mr. J. V. Arundel, at Sidney Island, Phœnix Group, lat. 4° 30′ S., long 171° 20′ W. The island, which is a mere coral-lagoon island, has never, so far as I know, been visited by any naturalist. But, alas, Mr. Arundel was not able to discover any land birds whatever, beyond *Charadrius fulvus* and *Totanus incanus*. He has, however, sent three specimens, one male and two females, of a Duck which appears to be hitherto undescribed. The only note I have respecting it is, that there were no Ducks on the island on Mr. Arundel's arrival, but that afterwards they appeared, and were tolerably numerous for a time. I gather from this remark that it is probably a migrant from one island to another; and a glance at the position of Sidney Island on the map will show that a Duck may enjoy a considerable range of migration in those regions, without necessarily coming under the eye of a collector. It is now nine years since Dr. Streets described a new Gadwall from Washington Island (Bull. Nuttall Club, i. p. 46), and yet the species has not since that time been met with.

The bird before us is a plain-coloured Pintail of diminutive size. The male specimen is just discarding the young or summer dress, and assuming the delicately vermiculated and pencilled plumage of the flanks and back which characterize our own Pintail in breeding-dress. On the flanks only two or three young feathers remain.

I propose to name it, from its extreme simplicity of plumage,

DAFILA MODESTA, sp. nov.

♂. *Supra cinerea, lineis albidis spissis vermiculata: pileo brunneo nigro et subfusco minute striato, gula rufescente, collo postico brunneo, albido minute striato, subtus albido, brunneo minutissime penicillato; remigibus cineraceis, intus pallidioribus, scapis albis; secundariis cinereis, extus metallice viridibus, late albo terminatis; tectricibus alarum cinereis, castaneo terminatis: cauda brunnea, acuta, supracaudalibus brunneis, albo marginatis: corpore toto subtus fulvo, indistincte maculato: lateribus transfasciatis et sicut dorsum vermiculatis: axilla-*

ribus albidis; rostro et pedibus nigricantibus. Long. tot. in. 20·5, *rostri*, 2, *alæ* 10·6, *caudæ* 4, *tarsi* 1·4.

♀. *capite et collo mari similibus, nec gula rufescente: dorso brunneo, plumis albo et castaneo arcte marginatis: alis sicut in mare coloratis: secundariis viridescentibus albo terminatis: cætera ut in mare.*

If this bird be correctly discriminated, it adds a fourth to the three recognized species of *Dafila*, the others being *D. acuta*, extending over the whole northern hemisphere; *D. spinicauda*, and *D. bahamensis*, both neotropical species.

4. Note on *Aporia hippia*. By A. G. Butler., F.L.S., F.Z.S., &c.

[Received January 18, 1886.]

The British Museum has received specimens of the imago, larva, and pupa of *Aporia hippia*, reared in the Society's Gardens under the care of Mr. A. Thomson during the past season (see his report, above, p. 3). I beg leave to offer a few remarks on them.

Aporia hippia.

Pieris hippia, Bremer, Bull. de l'Acad. St. Pétersb. iii. p. 464 (1861); Lep. Ost-Sibiriens, p. 7, n. 12, pl. 3. fig. 1 (1864).

Leuconœa cratægioides, Lucas, Ann. Soc. Ent. France, 4^me^ sér. t. 5, p. 503, pl. 11. fig. 11 (1865).

Although, as appears from the above, this species has been twice figured, neither figure can be called a characteristic one; both are too pale and fail to show the grey expansion at the extremity of the nervures; nothing is said of the earlier stages in either Bremer's or Lucas's descriptions, indeed the latter author evidently imagined it to be a "pretty variety" of *A. cratægi*, although he described it as if a distinct species; he did not, however, call it "*Leuconœa cratægi*, var. *cratægoides*" (*sic*) as quoted by Kirby.

Staudinger failed to quote the original description; but this sort of omission is of frequent occurrence in his Catalogue, and leads to errors innumerable; thus, in the case of *Chrysophanus dido* of Gerhardt's 'Monograph of Lycænidæ,' Staudinger (who appears entirely to have overlooked the work) quoted Herrich-Schäffer's figure of the male "asabinus, H. S. 527. 8" only, and subsequently Kirby, in his Catalogue, referred the figure of the female to *C. chryseis*, and regarded it as a variety of the *C. hippothoe* of Linnæus.

To return, however, to *A. hippia*, it is undoubtedly nearly allied to *A. cratægi*, but is as certainly distinct; the blackish veins and yellow under-surface of the secondaries and apex of primaries readily serve to distinguish it.

Among the specimens in the Museum, all of them reared and presented by the Society, is a female which shows an interesting aberration of vein-structure, the radial vein of the right-hand hind

wing being forked beyond the middle. In a paper in the 'Proceedings,' for 1870, pp. 777–8, I recorded similar modifications of the first subcostal branch in the hind wings of *Acræa andromacha*, and in 'Lepidoptera Exotica' I described and figured modifications of the upper radial in the front wings of *Morpho sulkowskyi* (p. 113*a*, pl. xlii. figs. 1, 1*a*): the case of *A. hippia*, however, is more interesting, as it exhibits, in a partial manner, a low type of venation in which two radial veins are present in place of one, and thus tends (so far as this character is concerned) to support Mr. Bates's view of the affinity of the *Papilionidæ* to the Heterocera: it would be still more interesting if it could be shown that the *Hesperiidæ* showed a greater tendency to reproduce the same vein.

The larva of *A. hippia*, judging from a nearly full-grown specimen preserved in spirit, presented by the Society to the Museum, has rather the aspect of some of the shorter-haired larvæ of the *Arctiidæ* than of what one would expect in the caterpillar of a butterfly; this, again, seems to point to a nearer relationship between the *Papilionidæ* and the Heterocera than one sees in the *Nymphalidæ*: the larva above referred to is of a dull flesh-colour, with lateral and dorsal series of conspicuous black spots, the head, first dorsal segment, and anal claspers black [1], the third, fourth, and twelfth segments clothed with dense rust-red hair down to the lateral series of black spots, the second segment (first dorsal) and head clothed with stiff, porrected, greyish hairs, and the remaining segments with pale testaceous hair: the pupa is either bright gamboge-yellow or cream-coloured, mottled and spotted with black, in some specimens differing in no respect from that of *A. cratægi* in pattern, but frequently with the black markings united into bands and patches.

February 2, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

Mr. W. B. Tegetmeier, F.Z.S., exhibited and made remarks upon a skin of a Pheasant from the Persian borders of Transcaucasia, which appeared to be referable to the true *Phasianus colchicus*.

Mr. C. A. Wright exhibited a specimen of a Dove from Malta, which seemed to be a semi-albino variety of *Turtur auritus*.

Mr. Sclater exhibited, on behalf of Mr. W. H. Dobie, 22 Upper Northgate Street, Chester, a young specimen of Sabine's Gull (*Xema sabinii*). Mr. Dobie stated that the bird had been shot at Mostyn on the coast of Flintshire, North Wales, in a field adjoining the shore, by Mr. John Williams, who watched it for some hours before he was able to obtain a shot. It was quite alone and did not

[1] In a beautiful coloured drawing submitted to me by Mr. Thomson, the claspers are represented as flesh-tinted at the sides, a probable variation.

accompany any other gulls; Mr. Williams indeed did not take it for a gull at all.

The date of its capture was not noted; it came into Mr. Thompson's hands November 1st, 1884, and had been then some days dead. It was therefore probably shot at the beginning of the last week in October. The sex was not ascertained.

Mr. Henry Seebohm exhibited a fully adult male of Ross's Gull (*Larus rossi*) which had been shot on the 15th of June, 1885, in the neighbourhood of Christianshaab on the south shore of Disco Bay in Greenland, about latitude 69°. It was shot at the nest, and both bird and egg were sent by Mr. Paul Müller to Copenhagen. The egg is of exactly the same character as that of Sabine's Gull (*Larus sabinii*), but is rather larger, measuring 1·9 by 1·3 inch. Mr. Seebohm exhibited a coloured photograph of the egg, which has never been obtained before. The bird is so rare that the British Museum does not possess an example, though there is one in Edinburgh and one in Liverpool, from Melville Peninsula, and one in Cambridge, besides three in Copenhagen, the last four from Disco Bay. In the fully adult breeding bird the delicate salmon-colour of the head, rump, and under-parts, contrasting with the black ring round the neck, make it an exceptionally beautiful object. The bill is black, the legs and feet coral-red with black nails, and the orbits deep orange or pale vermilion.

A communication was read from Prof. R. Collett, C.M.Z.S., containing an account of the external characters of the Northern Finwhale (*Balænoptera borealis*). This memoir had been based upon the examination of numerous specimens of this Whale killed on the coast of Norway during the past summer.

This paper will be published, with illustrations, in the Society's 'Transactions.'

The following papers were read:—

1. Notes on Freshwater Entomostraca from South Australia. By George Stewardson Brady, M.D., F.R.S., F.L.S., Professor of Natural History in the Durham College of Science, Newcastle-upon-Tyne.

[Received January 5, 1886.]

(Plates VIII.–X.)

The Entomostraca here described were collected by Professor Ralph Tate, of the University of Adelaide, South Australia, and by Mr. T. Steel. Prof. Tate's specimens were sent by him to Prof. T. Rupert Jones, F.R.S., to whose kindness I am indebted for the

opportunity of describing them. Those collected by Mr. Steel were submitted to me by Messrs. James Steel, of Glasgow, and Thomas Scott, of Greenock, to whom, as well as to Prof. Rupert Jones, my best thanks are due. I have had no opportunity of comparing these specimens with authenticated types of the species to which they are in some cases referred, but have had to depend entirely upon the published descriptions. The general likeness of these Australian Ostracoda to European freshwater forms is no more than might be expected; it is, indeed, rather remarkable that in no case do they come so near to any known European species as to be difficult of discrimination.

As the literature of the subject is not easily accessible, I give here a list of all the Australian freshwater Entomostraca which have been described up to the present time:—

PHYLLOPODA.

Lepidurus viridis, Baird, P. Z. S. 1850. Van Diemen's Land.
Lepidurus angasii, Baird, P. Z. S. 1866. Adelaide, South Australia.
Lepidurus viridulus, Tate, Proc. Roy. Soc. Austr. 1878-9. Adelaide, South Australia.
Limnadia stanleyana, King, Papers & Proc. Roy. Soc. Van Diemen's Land, vol. iii. pt. i. 1855. New South Wales.
Limnadia sordida, King, *ibidem*. New South Wales.
Linnetis macleayana, King, *ibidem*. New South Wales.
Artemia proxima, King, *ibidem*. New South Wales.
Estheria birchii, Baird, P. Z. S. 1860. Wanoi River, Australia.

It may be well to note that two New-Zealand Phyllopoda (*Lepidurus kirki* and *L. compressus*) have been described by Prof. Thomson in the Transactions of the New Zealand Institute, vol. xi. p. 260, pl. ii. fig. E, 4, 5.

The following Cladocera, found living in New South Wales, are described and figured by the Rev. R. L. King in the 'Papers and Proceedings of the Royal Society of Van Diemen's Land,' vol. ii. pt. 2, 1853, and vol. iii. pt. 1, 1855:—

Daphnia carinata, *King*.
—— elizabethæ, *King*.
—— honorata, *King*.
—— mucronata, *Müller*.
Macrothrix spinosa, *King*.
Moina lemnæ, *King*.
—— macleayii, *King*.
Eurycercus spinosa, *King*.
—— cookii, *King*.
—— cunninghami, *King*.
Chydorus leonardi, *King*.
—— angustus, *King*.
Alona bairdii, *King*.
—— pulchella, *King*.
—— diaphana, *King*.
—— karua, *King*.
—— mascula, *King*.
Dunhevedia crassa, *King*.
—— podagra, *King*.

Also by the same writer the following Copepoda, from South Australia, are mentioned or briefly described, *ibid.* vol. iii. pt. 1, 1855:—

Cyclops australis, *King*.
Diaptomus pollux, *King*.
—— uxorius, *King*.
—— maria, *King*.
—— cookii, *King*.

And, in the same work, vol. iii. pt. 1, 1855, the following South-Australian Ostracoda are described and figured :—

Cypris carinata, *King*.
—— stobarti, *King*.
—— bennelong, *King*.
—— clarkii, *King*.
—— scottii, *King*.
—— minna, *King*.
—— lateraria, *King*.
—— sydneia, *King*.
Cypris candonoides, *King*.
—— varrovillia, *King*.
Candona stanleyana, *King*.
—— lutea, *King*.
Newnhamia (Notodromas) fenestrata, *King*.
—— gulielmi (?), *King*.

The species now described and figured are the following :—

Limnetis tatei, nov.
Eulimnadia rivolensis, nov.
Lepidurus viridulus, *Tate*.
Estheria lutraria, nov.
—— packardi, nov.
Cypris viridula, nov.
—— stanleyana, *King*.
—— tatei, nov.
Cypris mytiloides, nov.
Chlamydotheca australis, nov.
Cypridopsis minna, *King*.
—— funebris, nov.
Notodromas fuscatus, nov.
Candona lutea, *King*.
—— tenuis, nov.

Order PHYLLOPODA.

Family LIMNADIADÆ, Baird.

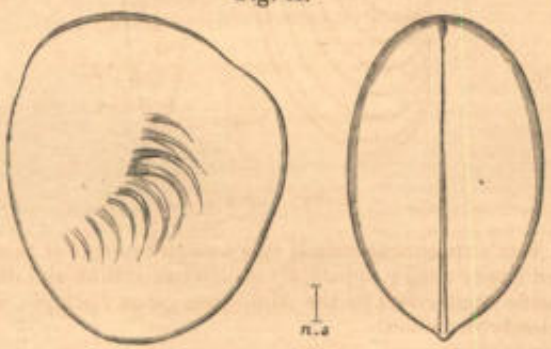
Subfamily LIMNETINÆ, Packard.

Genus LIMNETIS, Lovén.

LIMNETIS TATEI, n. sp. (Fig. A.)

Shell smooth, subspherical. Seen from the side it is broad and

Fig. A.



Limnetis tatei.

subtruncate in front, narrower and rounded behind; the dorsal margin is but slightly arched; ventral convex, with a considerable protuberance toward the front; seen dorsally, the outline is broadly

oval, the width equal to more than half the length, broadly rounded behind, subacuminate in front. The shell is granular in structure, without any concentric ridges. Length $\frac{1}{8}$ of an inch, height $\frac{1}{16}$, width $\frac{1}{16}$.

Hab. Freshwater pools, Rivoli Bay, South Australia (*Prof. R. Tate*).

Subfamily Estherianæ, Packard.

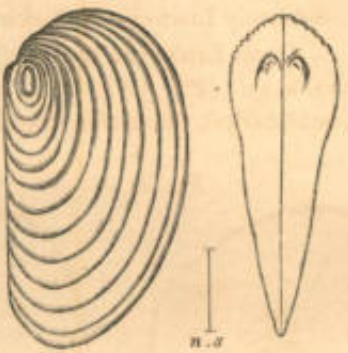
Genus Estheria, Rüppell.

1. Estheria lutraria, n. sp. (Fig. B.)

Valves oblong, compressed, membranous; beak near the anterior extremity, lines of growth about twelve; seen laterally, the dorsal line is quite straight, ventral convex, anterior extremity broadly rounded, posterior narrowed and somewhat oblique; seen from above it is much compressed behind the middle, and sharply pointed at the extremity; broadly rounded in front. Colour yellowish brown. Length $\frac{7}{16}$ of an inch; height $\frac{4}{16}$.

Hab. Cooper Creek, at Innaminka, Central Australia (*Prof. R. Tate*).

Fig. B.



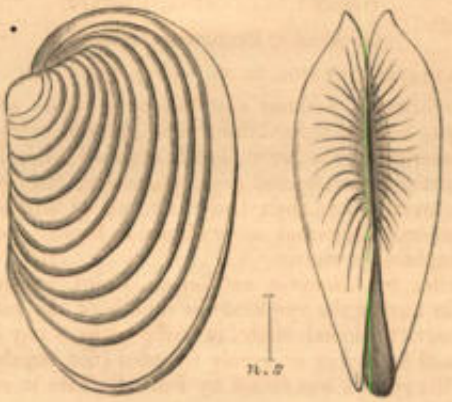
Estheria lutraria.

Prof. Tate's specimens include only a single example of this species —a dried empty shell; apparently somewhat shrunk and distorted. The specific name refers to the Molluscan genus *Lutraria*, which it rather closely resembles.

2. Estheria packardi, n. sp. (Fig. C.)

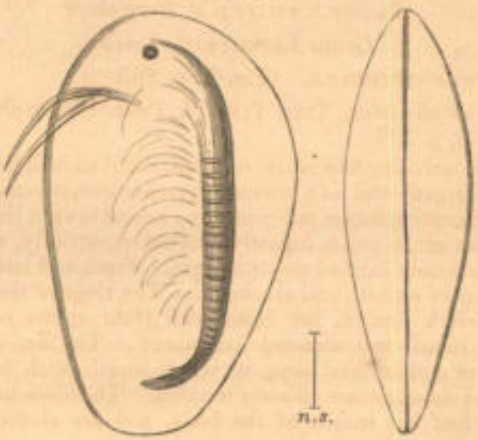
Valves, seen laterally, subelliptical, beak prominent and situated near the anterior extremity, extremities rounded, the anterior much the wider of the two, dorsal margin straight in the middle, ventral convex; lines of growth 12–15, not sharply marked. Shell rather

Fig. C.



Estheria packardi.

Fig. D.



Eulimnadia rivolensis.

hard and dense, dark brown (one of the specimens has a broad white marginal band). Length $\frac{5}{16}$ of an inch; height $\frac{3}{16}$.

Hab. Lake Bonney, River Murray, South Australia; also Fowler Bay, Great Australian Bight (*Prof. R. Tate*).

Genus EULIMNADIA, Packard.

(*Limnadia*, Brongniart, in part.)

EULIMNADIA RIVOLENSIS, n. sp. (Fig. D.)

Shell membranous, without any lines of growth; seen from the side, subovate, highest toward the front; anterior extremity broadly rounded, posterior narrow, very slightly rounded; dorsal margin well arched, almost gibbous, ventral slightly convex; the dorsal aspect is compressed, ovate, more than thrice as long as broad, tapered and acuminate behind, somewhat more obtuse in front. Length $\frac{36}{100}$ of an inch; height $\frac{22}{100}$, width $\frac{10}{100}$.

Very similar to *Limnadia antillarum*, Baird, but much larger; differs also in having the eye near the middle of the anterior margin instead of near the dorsal angle, in being without any distinct lines of growth, and in having an evenly rounded (not angulated) anterior margin. This species was found by Prof. R. Tate in company with *Limnetis tatei*.

Inside the valves of a specimen of this *Eulimnadia* I found on dissection a large colony of a protozoon, possibly *Arcella dentata*, Ehrenberg, at any rate very closely resembling that species, as figured by Professor Leidy.

Family APODIDÆ, Burmeister.

Genus LEPIDURUS, Leach.

LEPIDURUS VIRIDULUS. (Fig. E, p. 88.)

Lepidurus viridulus, Tate, Trans. & Proc. Philosoph. Soc. Adelaide (1879), p. 136.

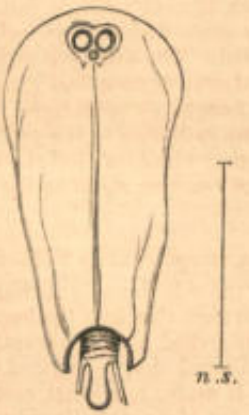
"Animal, including flap of tail-segment, about an inch long, carapace rounded, elongate-oval, of a brownish-green colour, covering the whole abdomen excepting flap of tail-segment; keeled toward the extremity, ending in an acute point, lunately notched posteriorly, and sharply and conspicuously hooked on its margin. Front and lateral margins of the carapace smooth and thickened. The rings of the abdominal segments, dark brown, are beset with stout spines equidistantly placed all round and directed backwards. The flap of the tail-segment has a blunt keel along its whole length, with blunt prominences, and its edges are ciliately serrated. The filaments of the tail are about half the length of the body, and are clothed with fine cilia.

"*Hab.* Collected by Thomas Tate, October 1878, in the floodwaters of the 'Reedbeds,' near Adelaide.

"Two Australian species of the genus have been described. *L. viridis*, so called from its colour, inhabits Tasmania, and was diagnosed

by Dr. Baird (Proc. Zool. Soc. 1850, p. 254); and *L. angasi* of the same author, 1866, which is of a pale horny colour, and is common in the rain-pools about Adelaide. *L. viridis* is characterized by its fine green colour, by its oval carapace covering less of the body than in *L. angasi*, and the edges of the lower half of its length being serrated; *L. angasi* is distinguished by its horny colour, its rounded carapace

Fig. E.



Lepidurus viridulus.

covering nearly two thirds of the body, and by the smooth edges of the sides of the carapace.

"*L. viridulus* differs from *L. angasi* in colour, in the carapace covering more of the abdomen, its keel limited to the hinder part and in the narrower and more spathulate tail-flap."—Trans. & Proc. & Report of the Philosophical Society of Adelaide, South Australia, for 1878–9, p. 136 (published 1879), afterwards called the Royal Society of South Australia.

Order OSTRACODA.

Family CYPRIDIDÆ.

Genus CYPRIS, Müller.

1. CYPRIS VIRIDULA, n. sp. (Plate VIII. figs. 1, 2.)

"Carapace oblong, compressed, reniform, greatest height situated in the middle, and somewhat less than half the length; seen from the side the extremities are well rounded, the anterior somewhat the narrower of the two, dorsal margin almost flat or very slightly arched, ventral sinuated in the middle; seen from above, compressed, ovate, twice as long as broad, widest in the middle, gradually tapered towards the anterior extremity, which is subacuminate, posterior extremity narrowed and rounded; surface smooth and polished, the

anterior half marked with a fine reticulated sculpture, colour greenish, clouded with bands of a darker shade. Length $\frac{1}{20}$ of an inch.

Collected by Mr. Thomas Steel at Condong, on the Tweed River, near Sydney, New South Wales.

2. Cypris stanleyana (King). (Plate VIII. figs. 3, 4.)

Candona stanleyana, King, 1855, Pap. Proc. R. Soc. Van Diemen's Land, vol. iii. pt. 1, p. 66, pl. x. H.

This is very much like *C. viridula*, but the height is somewhat less, the dorsum is more decidedly arched, and the extremities are less obliquely rounded. The surface is marked everywhere with fine, very closely set, and deep longitudinal grooves. Colour light green, slightly clouded. Length $\frac{1}{20}$ of an inch.

Taken in the same gathering as the preceding species. Mr. King refers this to the genus *Candona*; but the lower antenna is provided with a brush of setæ reaching about to the extremity of the terminal claws.

3. Cypris tatei, n. sp. (Plate VIII. figs. 5, 6.)

Shell, seen from the side, broadly reniform, greatest height in the middle, and equal to more than half the length; extremities rounded, dorsal margin boldly arched, sloping abruptly behind, more gradually towards the front, ventral deeply sinuated in the middle; seen from above, the outline is ovate, somewhat compressed in front, widest behind the middle, anterior extremity subacuminate; posterior wide and rounded; valves unequal, that of the right side the larger. Surface smooth, colour yellowish brown, with darker clouded markings. Length $\frac{1}{15}$ of an inch.

Taken by Prof. R. Tate in "brackish pools in a dry creek at Adelaide."

This species, though considerably more tumid, has very much the general character of *C. prasina*, Fischer (*fretensis*, Brady & Robertson), and of *C. incongruens*, Ramdohr, especially as to the curiously compressed anterior extremity. It is remarkable, too, that all of these are inhabitants, almost exclusively, of brackish water. I have pleasure in naming the species after Prof. Ralph Tate, by whom it was found, and to whose kindness I am indebted for the opportunity of describing it.

4. Cypris mytiloides, n. sp. (Plate IX. figs. 1–3.)

Shell, seen laterally, elongated, siliquose, highest in front, produced behind into a very acute, tapering beak; height equal to less than one half the length; anterior extremity broad and boldly rounded, dorsal margin boldly arched, highest near the front, thence sloping at first with a gentle curve, but more abruptly towards the posterior extremity, in front of which it is deeply sinuated; ventral margin almost straight, with a slight median sinuation; seen from above, compressed, oblong, widest near the middle, about thrice and a half as long as broad; extremities acute, the posterior the more

slender of the two. The right valve is the smaller of the two, and has the dorsal margin less arched. The inner aspect of the valves shows a large shelf-like flange fore and aft. The terminal claws of the second pair of antennæ are slender and finely pectinated on the inner margin. Postabdominal rami slender, with one long terminal claw, one short seta at the base of the claw, and one a little removed on the margin of the ramus. Margins of claws and ramus minutely pectinated. Shell thin, horny, of a smoky hue. ("Colour in life light-brown, with darker zebra-like markings." *Prof. R. Tate.*) Length $\frac{1}{2}$ of an inch.

Collected by Prof. R. Tate in fresh water, at Kangaroo Island, Australia.

Though quite abnormal in shape of shell, the soft parts of the animal agree in every important respect with those of the genus *Cypris*.

Genus Chlamydotheca, de Saussure[1].

"Testa undique pilosa, antice posticeque rotundata, appendice anteriore cum margine valvulæ dorsali sensim coalescente, cum margine ventrali autem angulum manifestum efficiente; appendice posteriore minima. Altitudo maxima pone medium et propius ventralem quam dorsalem marginem sita, exinde pars postica crassior quam antica. Margo ventralis vix sinuata, dorsalis valde armata. Impressio muscularis paulo ante medium sita."

The anatomical structure agrees exactly with *Cypris*. The author (de Saussure) refers to a paper by Sir John Lubbock, in which a similar species, *Cypris brasiliensis*, is described[2].

The genus *Cypridea*, Bosquet[3], if not identical with, is at least very nearly allied to, the forms now under discussion. No undoubted recent specimens of *Cypridea* have, however, as yet been seen, and Prof. Rupert Jones, in a recent paper "On the Ostracoda of the Purbeck Formation,"[4] says that the "hinder margin is definitely straight along the middle third or more of the dorsal edge, with the hinge-angles more or less defined, and is oblique to the main axis of the valve. The left valve is the largest, and receives the dorsal edge and a straight ridge of the other valve in grooves on its dorsal and ventral contact-margins." These characters are not to be found in *Chlamydotheca*. Moreover, from the figures given by Prof. Rupert Jones, it seems that both valves of *Cypridea* are provided with the notch and hatchet-like anterior process, whereas in *Chlamydotheca* only the left valve is so formed.

[1] "Mémoire sur divers Crustacés nouveaux des Antilles et du Mexique," par M. Henri de Saussure. (Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, 1856.)

[2] "On the freshwater Entomostraca of South America." (Trans. Entom. Soc. Lond. new series, vol. iii. part vi. 1855.)

[3] "Entom. fossil. des Terrains tertiaires de la France et de la Belgique." (Mém. couronnés Acad. Royal de Belgique, vol. xxiv. 1852.)

[4] "Ostracoda of the Purbeck Formation, with notes on the Wealden species." (Quarterly Journal of the Geological Society, August 1885.)

CHLAMYDOTHECA AUSTRALIS, n. sp. (Plate IX. figs. 4–8.)

Shell, seen from the side, subovate, greatest height equal to rather more than half the length, and situated in the middle, anterior extremity rounded, produced at the inferior angle so as to form a ventral beak, posterior extremity narrower, rounded, dorsal margin boldly arched, ventral slightly sinuated in the middle, more deeply in front, behind the beak; seen from above, the outline is ovate, twice as long as broad, anterior extremity forming a large, broad, obtusely-pointed, and twisted prominence, posterior slightly narrowed and produced, but rounded off. The valves are unequal, the left being the larger, overlapping on the ventral, and less distinctly on the dorsal margin. The outline of the right valve is more evenly rounded than that of the left, presenting no ventral beak nor sinuation, nor are the margins, either ventral or dorsal, so much incurved; the inner aspect of the valves shows shelving flanges both before and behind, and in that of the left side there is a curious twisted ridge separating the anterior beaked portion from the body of the shell. The substance of the shell is rather thick; surface closely marked with small circular impressions; colour fuscous. Length $\frac{1}{13}$ of an inch. The specimens are all empty shells, so that the structure of the soft parts is as yet unknown.

Penola (*Prof. R. Tate*).

Genus CYPRIDOPSIS, Brady.

1. CYPRIDOPSIS MINNA (King). (Plate X. figs. 1–3.)

Cypris minna, King, 1855, Pap. Proc. R. Soc. Van Diemen's Land, vol. iii. pt. i. p. 64, pl. x. B.

Shell very tumid; width and height about equal, length about one fourth greater. Seen from the side, subcircular, highest in the middle, extremities broadly rounded, dorsal margin excessively arched, ventral nearly straight in the middle; seen from above very broadly ovate, obtusely pointed in front, the hinder part forming almost a complete circle; end view subcircular, obscurely pointed above, slightly keeled and emarginate below. Surface smooth, beset with small impressed circular puncta; colour olivaceous, clouded irregularly with darker patches. Anterior margins of the valves slightly crenulated. Length $\frac{1}{25}$ of an inch.

Hab. Condong River, Australia (*Mr. T. Steel*). "Ponds, everywhere" (*Rev. R. L. King*).

2. CYPRIDOPSIS FUNEBRIS, n. sp. (Plate VIII. figs. 7–9.)

Shell, seen from the side, subtriangular; greatest height a little in front of the middle and equal to nearly two thirds of the length; extremities rounded, the anterior wide, posterior narrower and not so well rounded, dorsal margin elevated and almost gibbous near the middle, thence sloping almost in a straight line backwards, and with a gentle curve towards the front, ventral almost straight; seen from above, ovate, widest in the middle, width equal to two thirds of the

length, anterior extremity obtuse, scarcely rounded, posterior rounded off and rather wider than the front. End view subcircular. Surface smooth, cream-coloured, with transverse black bands after the manner of *C. vidua*. Length $\frac{1}{20}$ of an inch.

Hab. Condong, Tweed River, New South Wales (*Mr. T. Steel*).

Genus NOTODROMAS, Lilljeborg.

(*Newnhamia*, King, 1855, Pap. Proc. R. Soc. Van Diemen's Land, vol. iii. pt. 1, p. 67.)

NOTODROMAS FUSCATUS, n. sp. (Plate X. figs. 4–6.)

Shell, seen laterally, subtriangular, height equal to three fourths of the length, extremities very broadly rounded, the anterior somewhat the narrower of the two, dorsal margin excessively arched, highest a little behind the middle; ventral nearly straight; seen from above, the outline is ovate, scarcely twice as long as broad, tapered and acuminate in front, rounded off behind. Surface of the valves somewhat rough and furfuraceous, colour brownish, with darker cloudings. The ventral aspect of the shell is ribbed almost exactly as in *N. monachus*; the "ocular" tubercle is large and distinct; by transmitted light the shell is seen to have a polygonal reticulated structure, and the reticulations are visible also by reflected light on the anterior portion of the valves.

Hab. At Condong, with the foregoing species.

This is very much less tumid and less angular in outline than *Newnhamia fenestrata*, King, and its lateral outline differs in the same way from *Notodromas monachus*, Müller.

Genus CANDONA, Baird.

1. CANDONA LUTEA, King. (Plate X. figs. 7, 8; & ? Plate VIII. figs. 10, 11.)

Candona lutea, King, 1855, Pap. Proc. R. Soc. Van Diemen's Land, vol. iii. pt. i. p. 67 pl. x. k.

Male. Shell, seen from the side, subreniform, depressed in front, greatest height near the posterior extremity and equal to half the length; anterior extremity narrow and well rounded, posterior wide, obliquely rounded; dorsal margin forming a flattened arch, sloping with a gentle curve to the front, and abruptly backwards, ventral sinuated in the middle; seen from above, compressed, ovate, about thrice as long as broad, gently tapered towards the front, which is subacuminate, rounded off behind. Shell smooth and polished, pellucid, white or straw-coloured. Length $\frac{1}{21}$ of an inch.

Hab. Condong, with the foregoing species.

The shell figured in Plate VIII. figs. 10, 11, occurred in the same gathering, and possibly may be the young of *C. lutea*.

2. CANDONA TENUIS, n. sp. (Plate X. figs. 9, 10.)

Shell elongated, compressed, reniform; seen from the side it is at least twice as long as broad, the greatest height being a little behind the middle, extremities rounded, dorsal margin boldly arched, ventral

deeply sinuated in the middle; the dorsal view is elongated, ovate, quite thrice as long as broad, widest in the middle; extremities narrowed, the anterior subacuminate, posterior rounded off; left valve rather larger than the right. Shell smooth, pellucid, cream-coloured, with opaque cloudings. Length $\frac{1}{12}$ of an inch.

Taken in company with the preceding species.

EXPLANATION OF THE PLATES.

PLATE VIII.

Fig. 1. *Cypris viridula* (p. 88), seen from left side.
2. " " seen from above.
3. " *stanleyana* (p. 89), seen from left side.
4. " " seen from above.
} × 40.

5. " *tatei* (p. 89), seen from left side.
6. " " seen from below.
} × 20.

7. *Cypridopsis funebris* (p. 91), seen from left side.
8. " " seen from above.
9. " " seen from front.
} × 40.

10. *Candona lutea*, jun. ? (p. 92), seen from left side.
11. " " seen from above.
} × 80.

PLATE IX.

Fig. 1. *Cypris mytiloides* (p. 89), seen from left side.
2. " " seen from above.
} × 6.

3. " " postabdominal ramus. × 40.

4. *Chlamydotheca australis* (p. 91), seen from left side.
5. " " seen from below.
6. " " seen from front.
7. " " left valve seen from inside.
8. " " right valve seen from inside.
} × 28.

PLATE X.

Fig. 1. *Cypridopsis vinna* (p. 91), seen from right side.
2. " " seen from below.
3. " " seen from front.
} × 40.

4. *Notodromas fuscatus* (p. 92), seen from left side.
5. " " seen from below.
} × 40.

6. " " shell structure. × 400.

7. *Candona lutea*, male (p. 92), seen from left side.
8. " " seen from above.
9. " *tenuis* (p. 92), seen from left side.
10. " " seen from above.
} × 40.

2. Contribution to a Knowledge of the South-Italian Chiroptera. By Fr. S. MONTICELLI, D.Sc. (Communicated by Dr. H. WOODWARD, F.R.S., F.G.S.)

[Received January 5, 1886.]

Bonaparte[1] was the first naturalist who wrote upon Italian Chiroptera; but his researches are too general, and there are no indications of southern localities contained in his work.

Later on, Prof. C. G. Costa gave in 1839[2] a catalogue of

[1] 'Iconografia della Fauna Italica': Roma, 1832–41.
[2] 'Elenco dei Mammiferi e Supplemento.' (Fauna del Regno di Napoli.)

Chiroptera of the kingdom of Naples; but after him, excepting Major [1], who announced the discovery of *Vesperugo leisleri* in South Italy, no one else has written about the Chiroptera of this country. Quite recently, however, Camerano and Lessona [2] have given notices of some of the Southern species. Prof. Costa's work in 1839 enumerates the following species:—*Rhinolophus bihastatus*, *Vesperugo serotinus*, *Vespertilio bechsteinii*, *Vespertilio murinus*, *Dysopes cestoni*, *Plecotus auritus*, and *Myopterus daubentoni*. From this catalogue of Costa must be excepted *V. bechsteini*, which I have not yet met with, and *Myopterus daubentoni*, which is not a European species; but there are to be added thirteen other species, so that the number of Chiroptera of South Italy now consists of at least eighteen species. Amongst the thirteen species to be added to the catalogue of Costa there are many very important as regards the geographical distribution of the different species in Italy; such as *Synotus barbastellus*, which so far has only been found in Northern Italy; and also a species altogether new to Italy, which I have recently described as *Vespertilio oxygnathus*.

I am preparing descriptions, carefully compiled, of all the South-Italian Chiroptera; but for the present I give this preliminary catalogue of them, with indications of the localities where they are found.

1. Nyctinomus cestoni, Savi.

This species does not seem to be common in the South, but it is not rare at Naples. I have not been able to procure specimens from other points of the Mediterranean side of Italy, but it is possible that it may be found on the Adriatic side, where so far no researches have been made.

2. Rhinolophus ferrum-equinum, Schr.

This species is very common, and easy to find anywhere.

3. Rhinolophus euryale, Blas.

Although Camerano and Lessona say this species is less common than the preceding, and is found particularly in North Italy, I have also found it equally distributed in South Italy.

4. Rhinolophus hipposideros, Bechst.

Less common than the preceding, but not rare. I have not met with *R. blasii*, Peters, although Blasius says that he found it in Middle and Southern Italy and Sicily, and Camerano obtained it in Sardinia.

5. Miniopterus schreibersi, Natt.

Very common throughout the whole of South Italy.

[1] "Vertebrati Italiani nuovi o poco noti": Atti Soc. Tosc. Natur. Pisa, vol. iii. 1876.

[2] 'Compendio della Fauna Italiana': Torino, Loescher, 1885.

6. PLECOTUS AURITUS, Linn.

This Bat seems to be more common on the Adriatic than on the Mediterranean side of Italy.

7. SYNOTUS BARBASTELLUS, Schreb.

This species has been hitherto said to be found only in North Italy. It occurs also in South Italy.

8. VESPERUGO (VESPERUS) SEROTINUS, Schr.

This species is not very frequently observed, but is found everywhere.

9. VESPERUGO NOCTULA, Schr.

Not common in South Italy, but not rare. Up to the present time it has been found only on the Adriatic side.

10. VESPERUGO LEISLERI, Kuhl.

A very rare species in Italy. There are only two specimens in the Museum of Florence, which were obtained in the province of Lecce.

11. VESPERUGO SAVII, Bp.

This Bat is very common everywhere.

12. VESPERUGO KUHLI, Natt.

Very common everywhere; found both in town and country. There are many variations in the colour and size of specimens; I have found some all white, and others black. These may be considered as two distinct varieties: the former I call "var. *albicans*," the latter "var. *pullatus*."

13. VESPERUGO PIPISTRELLUS, Schreb.

A species common everywhere. In some places it is met with in great numbers.

14. VESPERTILIO BLASII, Major.

Vespertilio majori, Ninni, Fauna Venet.[1]

Up to the present time a very rare species. I have seen only one specimen, which is in the collection of the Zoological Museum of Naples.

15. VESPERTILIO MURINUS, Linn.

Generally distributed over the whole of Southern Italy.

16. VESPERTILIO OXYGNATHUS, Mont.[2]

I have founded this new species on specimens found at Matera (province of Basilicata). It is very closely allied to *V. murinus*, but is at once distinguished by the ears, which are as long as the head, the great development of the glands of the muzzle, by the

[1] 'Materiali per una Fauna Veneta': Venezia, 1878; Atti R. It. Venet.
[2] Ann. Acc. Or. Costa d. Asp. Natur. Era 3, vol. i., con tavola.

acutely pointed muzzle, and the prominent nostrils, which open sublaterally, as also by the small upper premolar, the form of the ear, the tragus with a distinct lobe at the base of outer margin, and by its small feet.

The wing-membrane does not extend so far outwards along the foot, and its colour is darker.

This new species has also many characters common with *V. africanus*, Dobson, *V. dobsoni* (*murinoides*), and *V. chinensis*.

17. VESPERTILIO EMARGINATUS, Geoffr.

In the Museum of Florence there are many specimens of this species found in different localities of South Italy, but I have not succeeded in procuring other specimens.

18. VESPERUGO NATTERERI, Kuhl.

This species does not seem to be very common. I know of only two specimens from the South.

The following Italian species of Chiroptera I have not yet found in the South :—

1. *Rhinolophus blasii*, Blas.
2. *Vesperugo nathusii*.
3. *Vesperugo discolor*.
4. *Vesperugo leucippe*.
5. *Vespertilio daubentoni*.
6. *Vespertilio mystacinus*.
7. *Vespertilio beckstеinii*.

Naples, Nov. 1885.

3. Notes on Specimens in the Hume Collection of Birds. By R. BOWDLER SHARPE, F.L.S. &c.

No. 1. On the Hawfinch from Attock.

[Received January 14, 1886.]

Three specimens of a Hawfinch were collected at Attock in the Punjab, in March 1869, and in February 1870, by Colonel Delmé-Radcliffe. They are mentioned by Mr. Hume in 'The Ibis' for 1869, p. 456, and again in 'Stray Feathers' for 1877, vol. vii. pp. 413, 462, and are there referred to *C. vulgaris*, i. e. *C. coccothraustes* (Linn.). In the Hume Collection there were no specimens of true *C. coccothraustes* from Europe ; and the comparison of these specimens was therefore doubtless made with plates of the European bird ; but on comparing the three birds with a series of true *C. coccothraustes*, it seems to me certain that they are distinct from the European Hawfinch.

The female differs from the corresponding sex of *C. coccothraustes* in being ochreous brown above, pale ashy ochreous on the lower

back, rump, and upper tail-coverts, while *the crown of the head is ashy grey like the hind neck*; sides of face also ashy grey washed with ochreous; breast and sides of the body ochreous buff, instead of vinaceous brown; centre of breast and abdomen white. Total length 6·75 inches, culmen 0·75, wing 3·9, tail 2·35, tarsus 0·8.

The male differs less from *C. coccothraustes* than the female, but it is distinguished by its paler coloration, and by the breast and sides of the body being light orange-brown instead of vinaceous. Total length 6·9 inches, culmen 0·8, wing 3·8, tail 2·1, tarsus 0·8.

I may add that the Attock bird is not *C. japonicus*, for it has a greater extent of pure white on the wing-coverts than in even true *C. coccothraustes*. *C. japonicus* is scarcely to be distinguished from the European bird; and differs only in having the median and greater wing-coverts pale drab at the ends instead of white. I propose to call the *Coccothraustes* from Attock after my friend Mr. Hume, *C. humii*. Whether it is the Hawfinch recorded by Lieut. Barnes as a permanent resident at Chaman in Southern Afghanistan (Str. F. ix. p. 456) must remain a question to be decided by an examination of specimens, which I have not yet had the opportunity of doing.

4. Preliminary Notice of the Isopoda collected during the Voyage of H.M.S. 'Challenger.'—Part III. By Frank E. Beddard, M.A., F.R.S.E., F.Z.S., Prosector to the Society [1].

[Received January 25, 1886.]

The present paper completes the preliminary description of the new species of Isopoda collected during the voyage of the 'Challenger.' This paper includes the families *Munnidæ*, *Asellidæ*, *Arcturidæ*, *Cymothoidæ*, *Sphæromidæ*, *Tanaidæ*, *Anceidæ*, and *Anthuridæ*, of all of which there are specimens in the 'Challenger' collection, representing about 45 new species, besides a number of others previously known. Among the shallow-water species the largest number of new forms are from Kerguelen, in spite of the investigations into the marine fauna of that region carried out by the British 'Transit of Venus Expedition,' and the exploring voyage of the German S.S. 'Gazelle.' I have to add quite as many new species as those previously known to the fauna of Kerguelen and the adjacent islands (Prince Edward's Island, &c.).

Among the deep-sea species the most remarkable and interesting is undoubtedly a new genus of *Cymothoadæ*, which is described below under the name of *Anuropus branchiatus*; there are also numerous representatives of other deep-sea forms, as might be expected from the nature of the explorations carrried out by the 'Challenger.'

[1] Published by permission of the Lords Commissioners of the Treasury.

Fam. Munnidæ.

Genus Munna, Kröyer.

1. Munna maculata, n. sp.

A single male example of this species was dredged in shallow water at Kerguelen. It measures about 4 millim. in length. The body is smooth, and the integument has numerous black pigment-spots. The shape of the body is characteristically that of a female, being broader anteriorly than posteriorly; the head is about as long as the first two segments of the thorax; the anterior margin is straight and fringed with a row of stiff hairs; the eye-stalks are well developed. The four anterior segments of the thorax are subequal; the three posterior are narrower; the thoracic segments have short rounded epimera. The *antennules* consist of a four-jointed peduncle, the two distal joints of which are much shorter than the proximal joint; the flagellum consists of four joints, which are elongated and narrow. The antennæ are very long, about twice the length of the body; the flagellum is shorter than the peduncle: the last two joints of the peduncle are elongated and subequal.

Kerguelen, 25 fathoms.

2. Munna pallida, n. sp.

This species, like the last, is represented by a single male specimen, measuring rather less than 3 millim. Like other species, the male is of approximately uniform diameter throughout. The species is pale and transparent, without any trace of pigment. The head terminates in a truncated anterior margin; the eyes are sessile—not stalked. The first segment of the thorax is longer than any of the three following, which are subequal; their margins are rounded and furnished with small rounded epimera; the three posterior segments are curved backwards; the first is very short, the rest increase slightly in length progressively. The abdominal shield is oval, ending in an obtusely rounded extremity. The *antennules* are like those of the last species, but the flagellum is only three-jointed.

Kerguelen, 30 fathoms.

Genus Ischnosoma, Sars.

1. Ischnosoma bacillus, n. sp.

This species is only represented by a single fragment, including the abdomen and four last thoracic segments, which is, however, sufficient to determine with at least probability its systematic position; it measures 10 millim. The fourth and fifth segments of the thorax, as in Sars's species, are closely connected and form an hourglass-shaped structure, the two pairs of appendages belonging to these segments being placed at each extreme of the conjoined segments. The fourth and fifth segments are each provided with long spine-like epimera. The presence of spines upon the fifth segment of the thorax distinguishes this species from both *I. bispinosum* and *I. quadri-*

spinosum, and from the next species *I. bacilloides*. The specimen is a female.

Station 158; 1800 fathoms.

2. Ischnosoma bacilloides, n. sp.

This species is closely allied to the preceding, but presents certain differences which appear to necessitate its separation as a distinct species. The single specimen is a fragment consisting of the same segments as *I. bacillus*, save for the fact that the fourth segment of the thorax is incomplete; unlike the foregoing species, it is a male; hence the supposed specific difference may be sexual. This species is to be distinguished from *I. bacillus* by the fact that the sixth segment of the thorax as well as the fifth has a pair of lateral spines. In both species the uropoda are simple, each consisting of two joints.

Station 302; 1450 fathoms.

3. Ischnosoma spinosum, n. sp.

This species is more closely allied than either of the foregoing to Sars's two species *Ischnosoma bispinosum* and *Ischnosoma quadrispinosum*, and, like them, comes from the Northern Hemisphere.

The single specimen measures 6 millim. in length. The general shape of the body is similar to *I. quadrispinosum*; the head is narrower and shorter than the first segment of the thorax; there is no trace of eyes. The first segment of the thorax is larger than either of the two succeeding, which are subequal; the fourth segment is much longer and broader anteriorly than posteriorly, where it is closely applied to the fifth segment, which is the longest of all; the sixth and seventh segments are short. The whole of the dorsal surface of the thorax is roughened and tubercular; the lateral margins of the first three segments are furnished with two or three longish stout spines, of which one on each side is particularly long; the dorsal region of these segments is not only tubercular but furnished with a few longish spines; the fourth segment has no long lateral spines like those of the preceding segment; the remaining thoracic segments have likewise no lateral spines. Between the thorax and abdominal shield is a single free abdominal segment; the anterior half of the latter is oval; there is a deep notch behind this, just in front of the articulation of the uropoda, which are borne upon a short truncated process; the extremity of the abdominal shield is prolonged for some way behind the uropoda, and terminates abruptly in a straight margin. The abdomen is roughened and tubercular like the rest of the body; there is a row of short spines on either side of the dorsal median line.

Station 78; 1000 fathoms.

Astrurus, nov. gen.

This genus comes near to *Pleurogonius*, Sars, but may be distinguished by the spiny body, the long bifid rostrum, and the long epimeral spines, which are themselves covered with shorter spines;

the thoracic appendages are slender and not greatly elongated; they terminate in a single claw; the first pair are subcheliform. The uropoda are rudimentary, consisting of only a single conical setose joint.

1. ASTRURUS CRUCICAUDA, n. sp.

This species is represented by a large number of individuals dredged in shallow water off Kerguelen; the largest individuals only measure 4 or 5 millim. in length.

The body is more or less pear-shaped, the anterior region of the thorax being wider than the posterior. The head is narrower than the succeeding segment of the thorax; it is prolonged anteriorly into two long slightly divergent processes, each of which is as long as the head itself; laterally is a longish process on either side, which terminates in a slightly swollen extremity; these processes resemble the eye-stalks in *Munna*, and they contained some orange-coloured pigment in the interior, but no recognizable trace of lenses; the surface, moreover, is covered with numerous short spines like the rest of the body. The four anterior thoracic segments are of nearly equal length, but they increase in width up to the third; the median region of these segments is convex and densely covered with short spines; the lateral margins are prolonged into long stout spines, which are themselves covered with short spines like the thoracic segments and the rest of the body. The three posterior segments are all much shorter than the fourth segment, and decrease gradually in length; their lateral margins are without the greatly elongated spines of the anterior segments; only on the fifth and sixth segments one of the spines which fringe the body is rather more elongated than the rest. The abdominal shield is oval, tapering posteriorly; it terminates in four somewhat flattened spines arranged in the form of a cross. The *antennules* consist of a two-jointed peduncle and a five- or six-jointed flagellum; the proximal joint of the peduncle is broader and shorter than the succeeding joint. The *antennæ* are not so long as the body but considerably longer than the antennules; the two proximal joints of the peduncle are elongated, the flagellum is shorter than either of these. The *mandibles* have a three-jointed palp. The first pair of thoracic appendages are modified into a prehensile limb; the remaining thoracic appendages are slender and elongated, particularly the three posterior pairs. The *uropoda* are rudimentary as in *Munna*.

Kerguelen, 120 fathoms.

NEASELLUS, F. E. B.

Neaselus, F. E. Beddard, Narr. Chall. Exp. vol. i. p. 882. fig. 326.

This new genus is represented by a single species from Kerguelen. It comes near to *Pleurogonium* and *Leptaspidia*, but is distinguished by the great horizontal elongation of the head, which is as wide as the following segment and bears the antennary organs at the

extreme lateral margin; eyes are absent. The thoracic segments are separated by deep incisions; the first segment is much the largest, and is fused mesially with the following segment; the margins of the segments are rounded; and the whole body is fringed with numerous leaf-like flattened spines.

1. Neasellus kerguelenensis, F. E. B., *loc. cit.*

The extreme length of the single individual of this species is 2 millim.

The body is extremely flattened and depressed, pear-shaped in general outline, being much broader anteriorly than posteriorly. The head is immensely extended laterally, being as wide as the following segment of the thorax, from which, however, it is separated by deep lateral incisions. The central region is convex; the anterior and lateral margins are fringed with peculiar flattened spines, which also border the body throughout. The two first segments of the thorax are together about equal in length to the head in its middle region; the line of suture separating these two segments is obliterated except laterally; the remaining segments are short and subequal, each is about $\frac{1}{5}$ of the length of the conjoined anterior segments; the third, fifth, and sixth segments have lateral processes, fringed with the peculiar spines referred to, which are absent from the fourth and seventh segments. The shape of the abdominal shield, which is, as in *Pleurogonium* &c., separated from the last segment of the thorax by a single free abdominal segment, is rhomboidal; it is notched posteriorly and laterally where the uropoda articulate. The *antennules* and *antennæ* arise from the extreme lateral margin of the head; in the *antennules* the basal joint is short and stout, the second rather elongated, the third and fourth narrower and shorter than the second, the flagellum has two joints. The *antennæ* are more than half the length of the body, the peduncle has six joints, the flagellum is a little longer than the distal joint. The *mandibles* are furnished with a palp. The first thoracic appendages are cheliform, the remaining thoracic appendages are not greatly elongate. The *uropoda* are as in *Pleurogonium*.

Kerguelen, Christmas Harbour, 120 fathoms.

Genus Pleurogonium, Sars.

1. Pleurogonium albidum, n. sp.

This species is represented by a single female example measuring 3 millim.

The general shape of the body is like the other species described by Sars; the epimera of the first four thoracic segments are prolonged into spines, which are of equal size upon all the segments; the three posterior segments of the thorax are separated from each other and from the fourth by deep lateral incisions; their epimera are prolonged into stout spiny processes, which are shorter than in the anterior segments; the dorsal surface of each of these three segments is traversed by a narrow ridge. Between the

seventh thoracic segment and the abdominal shield is a narrow free abdominal segment, which is ridged like the posterior segments of the thorax. The abdominal shield is almost circular in its outline anteriorly; posteriorly it terminates in a triangular-pointed extremity; the posterior region is slightly serrated.

Kerguelen, 120 fathoms.

2. Pleurogonium serratum, n. sp.

This species, like the last, is represented by a single female example measuring 3 millim. in length.

The head is small and almost enclosed by the following segment of the thorax; the frontal margin is straighter than in the last species, and the articulation of the antennæ is not so near to the posterior boundary of the head; the hinder margin of the semicircular notch which lodges the antennæ is prolonged outwards into a longish pointed process, which extends laterally nearly as far as the epimeron of the first thoracic segment. The thoracic segments are so like the last species that no special description is needed. The most characteristic and obvious difference between the two species is in the abdominal shield, which has, however, the same general shape in *P. serratum* as in *P. albidum*; in the former species the lateral margin as far back as the articulation of the uropoda is strongly serrated; there is no trace of any such serrations in *P. albidum* except along the posterior extremity of the caudal shield behind the uropoda, in which situation they are absent in *P. serratum*.

Kerguelen, 120 fathoms.

3. Pleurogonium minutum, n. sp.

The third new species of this genus is represented by a single female example, dredged off Tristan da Cunha. It measures about 1 millim. in length.

The general shape of the body is like that of the other species. The epimera of the thoracic segments are not prolonged into spines as in the last two species, but are rounded in the four most anterior segments and truncated in the posterior thoracic segments. The abdominal shield is oval, tapering posteriorly; anteriorly the margins of the abdominal shield are serrated, but the serrations are not nearly so marked, nor do they extend over so great an area as in *P. serratum*. In the two last species the antennæ are twice the length of the antennules; in the present species they are longer, but only half as long again: in this respect therefore *Pleurogonium minutum* is more typical, that is to say it agrees more closely with the northern forms described by Sars.

Off Tristan da Cunha, 100–150 fathoms.

Acanthomunna, nov. gen.

This genus is like *Munna* in outward form, and is furnished with a pair of eyes elevated on stalks as in that genus; the thoracic limbs are entirely like those of *Munna* except that they terminate in a

single elongated claw; the antennule has a four-jointed peduncle and a long multiarticulate flagellum; the uropoda are defective but evidently are of considerable size, judging from the socket of articulation. The whole body is covered with short slender spines of varying size, but nowhere very long.

1. ACANTHOMUNNA PROTEUS, n. sp.

This species, the only one referable to the genus, is represented by two individuals, both males, dredged off New Zealand in 700 and 1000 fathoms respectively. The larger specimen measures 7 millim. in length. The general shape of the body is as in *Munna*, but differs in being covered with innumerable spines, many of which are branched; the spines are nowhere of very great length. The head is furnished with a pair of eyes situated laterally; these are elevated upon short stalks; the abdominal shield is preceded by a short free abdominal segment; it is extremely convex anteriorly, and the point of articulation of the uropoda is upon the dorsal surface, though near to the lateral margin; behind the articulation of their appendages, the abdominal shield is flattened and terminates in a truncated, slightly concave extremity. The *antennules* have a four-jointed peduncle, the third joint being the longest, and a multiarticulate flagellum longer than the peduncle. The *mandibles* have a palp. The first pair of thoracic appendages are shorter than the rest and subcheliform; the remaining thoracic appendages are very long, owing to the elongation of the fourth and fifth joints; they terminate in a single claw; these appendages are covered with slender unbranched spines, which arise from tubercles. The uropoda are defective, but appear to have been larger than those of *Munna*, &c., and possibly more fully developed.

Station 168; 1100 fathoms. Station 169; 700 fathoms.

Fam. ASELLIDÆ.

Genus STENETRIUM, Haswell.

1. STENETRIUM HASWELLI, n. sp.

A single species of this genus, the only known deep-water species, was dredged off the coast of S. America in 600 fathoms. The specimen is a male, and measures 16 millim. in length.

The diameter of the body is everywhere much the same except the head and the terminal region of the abdominal shield. The head is prolonged into a short rostrum; eyes are present of narrow linear shape, and set obliquely. The thoracic segments are subequal in length as well as breadth, and the dorsal surface is quite smooth; the margins of the first thoracic segment are prolonged into a triangular spiny process; in the second segment the margin is furnished with a smaller spine-like process; in the two following segments there is in addition a smaller posterior spine; in the fifth segment the antero-lateral spine is much wider, occupying nearly the whole of the lateral margin; in the two remaining segments, the lateral

region is straight. The epimera are fused with the tergum in the first thoracic segment, elsewhere distinct but small. The abdominal shield is as long as the three last segments of the thorax; it is subquadrangular in outline. The *antennules* have four basal joints and a long flagellum, longer than the peduncle. The *antennæ* are furnished with a rudimentary exopodite. The *mandibles* have a palp. The first pair of thoracic limbs are extremely long and prehensile; the remaining thoracic limbs are slender and short, they terminate in two claws. The *uropoda* are biramose, the endopodite and exopodite being equal.

Station 320; 600 fathoms.

Iolanthe, nov. gen.

This genus appears to be closely allied to *Acanthoniscus*, Sars, with which it agrees in the absence of eyes and in the presence of long spiny epimera and long dorsal spines, and in the shape of the uropoda. It differs in that the thoracic appendages are biunguiculate and in a number of other points, which may be gathered from the following description of the single species referable to the genus.

1. Iolanthe acanthonotus, n. sp.

This species is founded on a single female dredged in deep water in the Antarctic Ocean. It measures 24 millim. in length.

The head is as wide as the succeeding segment of the thorax; its margins are prolonged on either side into two spines, of which the anterior is much the longest; the anterior margin of the head is produced into a long rostral spine, which is curved slightly upwards. There is no trace of eyes. The thoracic segments are subequal in antero-posterior diameter; in the dorsal-median line of all the segments is a stout long vertical spine; the lateral margin of the first segment is furnished with a long spiny process; on each of the three succeeding segments are two such spines, the anterior being the longer; in the remaining segments only the anterior spine is present. These spines are not outgrowths of the epimera, which are small and lie beneath them. The abdominal shield is almost circular in form; on either side are three spines arranged at equal distances, which are much shorter than the lateral spines of the thorax. The *antennules* have a four-jointed peduncle, of which the second joint is the longest. The flagellum consists of 24 joints, and is about as long as the three distal joints of the peduncle. The *antennæ* are half the length of the body; the second joint of the peduncle has a spiny process on the outer side as in *Ianthe*, which corresponds (?) to the exopodite; the flagellum is nearly as long as the peduncle. The *mandibles* have a palp. The thoracic appendages are all similar to each other and terminate in two claws. The *uropoda* have a very long proximal joint; the endopodite is extremely short, though larger than the minute exopodite.

Station 153; 1675 fathoms.

Genus Janira, Leach.

1. Janira abyssicola, n. sp.

The present species is represented by a single female example, dredged off Fiji in very deep water.

The head has a rounded anterior margin; the eyes are completely absent. The first three segments of the thorax are of about equal length; the next two segments are much shorter, being about one half the length of the anterior segments; the sixth segment has an antero-posterior diameter about equal to that of either of the anterior segments, while the seventh segment is longer than any. The *antennæ* are longer than the body of the animal; the flagellum is much longer than the peduncle. The *mandibles* have a palp. The thoracic limbs are all similar to one another. The *uropoda* are as long as the abdominal shield; they are biramose; the endopodite is stouter and longer than the exopodite.

Station, 1350 fathoms.

2. Janira tristani, n. sp.

The head is broader than long, with very large, laterally placed eyes; it is prolonged into a long stout rostrum with a rounded extremity. The first two segments are of about equal length; the three succeeding segments progressively diminish in length; the last two are again somewhat longer. The abdominal shield is subpentagonal and terminates in a short blunt process. The *antennules* have a long flagellum; the peduncle is composed of four joints, all of which are short. The *mandible* has a three-jointed palp. The thoracic appendages are all similar to each other.

Off Tristan da Cunha, 100–150 fathoms.

Genus Jœropsis, Köhler.

1. Jœropsis marionis, n. sp.

The only previously known species of this genus was described by M. Köhler, from the island of Sark; the present species was dredged off Marion Island in 100 fathoms. The single specimen measures 4 millim. in length.

The head is roughly quadrangular in outline; the anterior margin is prolonged between the antennæ into a rostrum, which is deeply notched at the extremity; the eyes are of fair size, and dorsal in position; the lateral margins of the head are serrated. The head is about as long as the first two segments of the thorax taken together; the latter are subequal, the third is slightly shorter, the fourth and fifth subequal and very much shorter again; the last two segments are quite as long as the two first; the segments are separated by deep lateral incisions; the lateral margins of the segments are feebly serrated. The abdominal shield is somewhat triangular in outline, and terminates posteriorly in a three-jointed process; in the two notches separating these processes lie the uropoda; the lateral margins are serrate. The *antennules* are very short; the flagellum

has two joints, the distal one being very minute. The *antennæ* have a five-jointed peduncle and four- or five-jointed flagellum; the third joint of the peduncle is longer than the two basal joints, the fourth joint is shorter than the third, the fifth longer. The thoracic appendages are all similar and biunguiculate.

Off Marion Island, 100 fathoms.

Genus Trichopleon, nov. gen.

A single specimen of a deep-sea Isopod dredged at Station 215 does not fall very conveniently within any known genus of the *Asellidæ*.

The general shape of the body is like that of *Asellus*, with which it also agrees in the uniunguiculate thoracic appendages; eyes are completely absent; the first four thoracic segments are furnished on either side with a forwardly-directed lateral spine. The antennæ have a movable scale attached to the second joint, as in *Janira* and *Stenetrium*. The surface of the body is quite smooth.

1. Trichopleon ramosum, n. sp.

The specimen is an immature female, measuring 5 millim. in length.

The head is narrower, but longer than the succeeding segment of the thorax; it is prolonged into a short wide process anteriorly. There is no trace of eyes. The three first segments of the thorax are subequal in length; the fourth segment is shorter; the three posterior segments gradually increase in length but diminish in breadth; the antero-lateral margin of the first four segments is furnished with a short, acute, forwardly-directed spine. The abdominal shield is oval, but wider anteriorly than posteriorly; it terminates behind in the middle line in a short spiny process. The *antennules* are about as long as the head and first two segments of the thorax together; the peduncle has four joints, of which the second joint is the longest; the flagellum consists of about fifteen joints. The *antennæ* are about equal in length to the body; the flagellum is longer than the peduncle; the two basal joints of the peduncle are very short, the third a trifle longer, with an articulated scale on the outer side; the two distal joints are long and subequal. The *mandibles* have a palp. The thoracic appendages are similar to each other, terminating in a single claw. Uropoda moderately long, biramose, each ramus one-jointed.

Station 214; 500 fathoms.

Fam. Arcturidæ.

Genus Arcturus, Latreille.

1. Arcturus myops, n. sp.

The present species differs from any other *Arcturus* at present known by the fact that the eyes are entirely or almost entirely aborted. The only trace of eyes left are a pair of rounded tubercles, which appear to contain no pigment and are not faceted. The largest

individual measures about 9 millim. The first four thoracic segments are subequal in length; each is ridged posteriorly, the ridge widening out laterally to occupy the whole of the segment, it is covered with fine granulations; in the fourth segment the ridge is higher than in the preceding segments; anteriorly between the ridge and the anterior margin of the segment is a shorter ridge, likewise covered with numerous minute tubercles; on the first thoracic segment is a third ridge; of the three posterior segments the first is the longest; on each is a posterior ridge-like elevation beset with numerous tubercles. The abdominal shield is oval, tapering towards its extremity, which is slightly upturned; like the thorax, it is tuberculate. The proximal joints of the antennæ and of all the thoracic limbs are beset with tubercles.

Station 169; 700 fathoms.

2. ARCTURUS ANNA, n. sp.

This single specimen of this large species measures 37 millim.; the antennæ are nearly twice the length of the body. The head is excavated in front; the antero-lateral margin of the head is notched ventrally. The first four segments of the thorax are subequal; each is traversed by a ridge, which dorsally is narrow and only occupies the posterior portion of the segment, laterally it is widened out and occupies the whole of the segment; in front is another shorter ridge, which does not reach the lateral region of the segment; at the extreme lateral margin is a stout spine, inclined nearly at right angles to the longitudinal axis, which overlies the epimeron; behind are one or two shorter spines along the postero-lateral border of the tergum. The epimera, which are short, are likewise furnished with one or two short spines; these are only conspicuously developed upon the last two of the segments, especially upon the last, where one of the spines equals in length the tergal spine which it directly underlies. Of the three posterior segments the first is decidedly the largest; they are ridged like the anterior segments, the ridge widening out laterally; each segment has a short lateral spine corresponding to those on the anterior segments; the epimera are also furnished with a stout spine, that of the fifth segment with an additional spine directed forwards. There are two completely free abdominal segments, the third being to a large extent fused with the abdominal shield; on the ventral side of the first abdominal segment is a short spine on either side anteriorly and another pair of longer spines posteriorly; this segment as well as the next has a short lateral spine; the third abdominal segment has on either side a long curved spine at the postero-lateral margin. The abdominal shield has a central convexity occupying nearly the whole of its extent and bordered by a flattened rim, which is serrated, and terminates posteriorly in a pair of pointed processes projecting behind the central area, which terminates posteriorly in a short pointed spine. The thoracic limbs of the second, third, and fourth pairs have one or two longish spines on the three proximal joints.

Station 320; 600 fathoms.

3. Arcturus cornutus, n. sp.

This species, like the last, is represented by a single female example, measuring 36 millim.; the length of the antennæ is 64 millim. The margin of the head is excavated dorsally and anteriorly; the antero-lateral margin of the head below and in front of the eyes is notched; between the eyes are a pair of long, forwardly-directed spines; and behind the eyes a pair of blunt tubercles. The first three thoracic segments are subequal, and each is a little longer than the fourth. Each of the segments is ridged as in the last species; the lateral margin of the tergum has a long spine in each of their segments, and there is another spine of equal length placed halfway between the dorsal median line and the lateral margin of the segment; on the fourth segment there is an additional lateral spine placed behind the principal spine; there are indications of a corresponding spine in the anterior segments. The epimera of segments 2–4 have a single spine near to their posterior margin, the lengths of which increase progressively from before backwards; in front of the posterior tergal ridge are a pair of blunt tubercles united by a slight elevation; the first segment has also a single tubercle placed in front of this. Each of the three posterior segments is ridged as in *A. anna*; laterally is a long spine which overlies a similar spine upon the epimeron; the first of these segments has also a somewhat longer epimeral spine directed forwards. Each of the three free abdominal segments has a long lateral spine; the first segment has ventral spines as in the last species. The abdominal shield has the same shape as in *A. anna*, but there is a distinct longitudinal keel terminating in a sharp upturned point; on either side is a single row of curved hook-like spines. The 2nd, 3rd, and 4th pairs of thoracic limbs have spines similar to those of the last species.

Station 214; 500 fathoms.

4. Arcturus brunneus, n. sp.

This species measures 19 millim. in length, the antennæ being of about the same length. The head is furnished with a pair of long spines between the eyes, and a pair of shorter spines behind these, which are, however, longer in the female. The first four thoracic segments are subequal, ridged as in the last two species; on this ridge are implanted a number of long, straight, slender spines. In the male the first segment has four equidistant spines and a minute epimeral spine at the extreme lateral margin; on the second segment the epimeral spine is longer, and there is a minute tubercle between it and the lateral tergal spine; in the third and fourth segments the lateral tubercle is developed into a spine, and there is also a short median dorsal spine; on the second, third, and fourth segments there is a transverse row of longish spines near to the anterior margin of the segment in both sexes; in the female the spines are longer. Each of the three posterior thoracic segments bears a ridge, with a single row of long spines arranged at equidistant intervals; there are three pairs of these spines, one pair epimeral; in the

female there are several shorter ones in addition. The first abdominal segment has a single row of comparatively short backwardly-directed spines; on the second and third segments these spines get to be considerably longer, especially the lateral spine on either side, which marks the commencement of the abdominal shield. The abdominal shield in both sexes is covered with longish curved spines; just above and near to the termination of its lateral margins are an extremely long pair of spines directed outwards and slightly upwards. The proximal joints of the antennæ and of the thoracic appendages are furnished with spines. The uropoda are tuberculate in the male and spiny in the female.

Station 147; 1600 fathoms.

5. ARCTURUS PURPUREUS, n. sp.

This species is represented by a single female, which is of a purplish colour. It measures 18 millim., the length of the antennæ is 31 millim.

On the head between the eyes are a pair of long forwardly curved spines; the hinder portion of the head is occupied by a rounded median convexity; on the antero-lateral margin is a very short forwardly directed spine, beneath which the margin is excavated by a semicircular notch. Of the first four thoracic segments, the fourth is rather the shortest; each of the segments bears an outwardly directed spine on each side of the body, corresponding in position to those upon the head; close to the lateral margin of each segment and projecting over the epimeron is another long spine; the first segment differs from the succeeding in having no free epimera, and the lateral margin has two spines instead of one, of which the anterior is the longer; the fourth segment has also a second spine at its postero-lateral margin. Of the three posterior thoracic segments the first is the largest; the epimera of all have a long outwardly directed spine; the first of these segments has in addition a tergal spine on either side exactly overlying the epimeral spine. The first abdominal segment has a pair of long lateral spines and a pair of short ventral spines; the third segment has a pair of lateral spines. The abdominal shield is oval, with a faintly marked central keel, terminating posteriorly in a long spine; its lateral margins are flattened and unite posteriorly; on either side are two flattened spines situated at equidistant intervals. The antennæ and anterior thoracic limbs have a few spines upon the proximal joints; the uropoda are granulated, but bear no spines.

Station 23; 450 fathoms.

6. ARCTURUS SPINIFRONS, n. sp.

This species reaches to a length of 13 millim., the antennæ measuring 20 millim. The body is extremely tuberculate, but there are no spines except a single pair upon the head; the lateral margin of the head, as in *A. anna*, is notched ventrally. The four anterior thoracic segments are subequal, each has a posterior ridge which

widens out laterally; the ridge is concave forwards, dorsally, and closely embraces a median oval convexity which lies in front of it; the fourth thoracic segment has a row of short tubercles, arranged in a semicircle with the concavity directed forward, on the ventral surface. Of the three posterior thoracic segments the first is the largest, the second and third being smaller and subequal; each of the segments is traversed dorsally by a strong ridge, which is tuberculate; the first of these segments has a number of short tubercles scattered over the ventral surface, and the two succeeding segments are ridged in the same region. The segments of the abdomen are comparatively smooth, being only slightly roughened laterally. The abdominal shield is smooth with the exception of the lateral margins, which are serrate; it terminates in a short median spine. The thoracic appendages are tuberculate on the proximal joints; the uropoda bear a single median longitudinal row of tubercles.

Station 174; 600 fathoms.

7. Arcturus spinosus, n. sp.

This is the largest of the deep-sea species, measuring up to 48 millim., the antennæ measure 60 millim. The males differ slightly from the females, the latter being wider in the thoracic region and more spiny. The anterior margin of the head is excavated; between and a little in front of the eyes are a pair of long spines, behind these are a pair of shorter spines; in the female there is an additional pair of spines situated outside these latter. Of the first four thoracic segments, the fourth is slightly the longest in the male; in the female all four are subequal. On the first three thoracic segments, the posterior ridge bears three pairs of long spines situated at equidistant intervals; the fourth thoracic segment has only two pairs, but the epimera have each a long spine, wanting in the anterior segments. In the female the first thoracic segment has four pairs of spines, the other segments being as in the male; between these principal spines there are, however (in the female), numerous smaller spines, and the margins of the epimera are furnished with short spines; each of these segments has in both sexes an anterior ridge covered in the male with blunt tubercles, in the female these tubercles are pointed. Of the three posterior thoracic segments the first is the longest; the posterior ridge is tuberculate, the tubercles being more strongly marked in the female; the epimera of these segments have a large lateral spine. The three first abdominal segments are distinct; the last free segment has a long lateral spine on either side in the female. The abdominal shield terminates in a single median spine, and in two longer upwardly curved lateral spines. The surface of the abdominal shield is tuberculate in the male and covered with short spines in the female; in this sex there are in addition a pair of moderately long lateral spines, situated just in front of the posterior lateral spine. The thoracic appendages in the female have a few short spines; in the male only the three last pairs are thus provided; the uropoda are tuberculate.

Station 146; 1375 fathoms.

8. Arcturus glacialis, n. sp.

This new species comes near to the last, but may readily be distinguished by the fact that the spines are more numerous, shorter, and more slender. The single example, a female, measures 32 millim. The dorsal surface is densely covered with short slender spines, which extend on to the thoracic appendages and uropoda; the spines are of uniform length. The anterior margin of the head is excavated by a shallow semicircular notch; between and in front of the eyes are a pair of long spines, inclined somewhat away from each other; the spines on the thoracic segments are disposed in the following way:—each of the first four segments has a posterior and anterior ridge as in other species; both these are covered with spines, as are also the epimera; between the two ridges in all but the first segment are a pair of short spines; each of the three posterior thoracic segments is ridged, the ridge being beset with spines except in the median dorsal line. The abdominal shield is beset with spines, except in the dorsal median line, where it is grooved longitudinally.

Station 153; 1675 fathoms.

9. Arcturus abyssicola, n. sp.

This species was obtained from two stations in the Pacific Ocean, but near to each other.

The length is about 20 millim., the length of the antennæ 42 millim. Of the first four thoracic segments the second and third are equal in size and rather longer than the first and fourth; each of these segments is ridged posteriorly as in other species; laterally the tergum is produced into a short tubercle and there is a similar tubercle upon the epimera; on the first segment this tubercle is prolonged into a spine; on the inferior surface of the fifth segment is a short median transverse ridge; the first abdominal segment has a pair of ventral tubercles; the abdominal shield is keeled and terminates in a blunt spine, it is covered with a few low scattered tubercles. The anterior thoracic appendages are furnished with one or two spines upon the proximal joints; as in *A. anna* the posterior thoracic appendages have not these spines.

Station 184; 1400 fathoms. Station 281; 2385 fathoms.

10. Arcturus studeri, n. sp.

The extreme length of this species is 28 millim., length of antennæ 30 millim. The head has two pairs of long spines situated one behind the other, behind these again is a ridge bearing a few short spines; the antero-lateral region of the head is notched ventrally as in *A. purpureus*, &c. The four anterior thoracic segments are subequal; on the posterior ridge of the first segment are a pair of minute tubercles on either side of the median dorsal line; laterally are two long spines equidistant from each other and the dorsal tubercles; the lateral margin of the tergum is prolonged into two outwardly directed spinous processes; in front of the posterior ridge are four minute tubercles arranged transversely; the second segment

is similar; the third and fourth segments have in addition another spine upon each side, placed between and behind the two lateral spines; the margins of the epimera are prolonged into three short spines. Each of the three posterior thoracic segments has two or three long spines on either side; the epimera are large and terminate in two stout spines. The two anterior abdominal segments each consist of two portions—a narrower anterior and a smaller posterior portion; the former is smooth, the latter beset with spines and tubercles; on the first segment are two particularly long spines, one situated close to the ventral margin of the tergum, exactly above this is the other, which is of equal length; on the second segment is a lateral spine of great length, but situated more dorsally; the third segment has also a pair of lateral spines. The abdominal shield has a dorsal keel which is prolonged posteriorly into a curved spine. The whole of the dorsal surface is covered with minute pointed tubercles; the lateral region of the abdominal shield is flattened as in *A. anna*, &c., and terminates posteriorly on either side in a flattened triangular spine.

Kerguelen, Royal Sound; 28 fathoms.

11. Arcturus oculatus, n. sp.

Five specimens of this small species were dredged in shallow water off Melbourne, South Australia. The largest measures no more than 7 millim. The most remarkable point about this species, and one which serves at a glance to distinguish it from any other recorded species of the genus, is the elevation of the eyes on to stalks as in the genus *Munna*. The frontal margin of the head is broad and truncated; it is not excavated as in so many other species. The first four thoracic segments are subequal in length, they are convex posteriorly and flatter anteriorly; the surface of these segments is quite smooth and free from tubercles or spines; in the last three of these segments the epimera are furnished with a long spine. The posterior thoracic segments, like the anterior, possess an epimeral spine; each of these segments has also a lateral tergal spine. Of the three free abdominal segments the first and third are furnished with a lateral spine on either side, which is absent from the middle segment. The abdominal shield is very convex, and terminates in a median dorsal spine as in so many other species; the lateral margin of the caudal shield is beset with a series of somewhat curved spines situated at equidistant intervals, the lateral margin terminates in a longish flattened spine as in *A. anna*. On either side of the dorsal median line is another row of spines, which run from end to end of the caudal shield.

Station 161; 38 fathoms.

Family Cymothoidæ.

Anuropus, nov. gen.

Among the Isopoda dredged during the cruise of the 'Challenger,' there are not many deep-sea species which present any striking differences from the Isopoda of shallow water. One of these species

is represented by a single specimen, which was dredged in the Pacific Ocean at Station 218, in 1070 fathoms of water. It is a large Isopod, measuring upwards of two inches in length, and agrees in most particulars with such genera of the Cymothoidæ as *Æga*; but at the same time it presents certain remarkable peculiarities analogous to those exhibited by the aberrant genus *Bathynomus* lately described by Prof. A. Milne-Edwards from deep water in the North Atlantic. M. Milne-Edwards's preliminary account of *Bathynomus* was communicated to the French Academy[1], and a translation of his note has appeared in the Ann. & Mag. of Nat. Hist.[2] Apart from its huge size, the most remarkable feature in the organization of *Bathynomus* is the great development of branchial organs: "it appears," says M. Milne-Edwards, "that the respiratory apparatus of an ordinary Isopod is insufficient to supply the physiological needs of *Bathynomus*, and that the development of special organs of a greater functional power has been rendered necessary. The abdominal limbs, which usually in this group constitute the sole branchial apparatus, in *Bathynomus* only serve the function of a covering to the gills which lie beneath them." The gills of this Crustacean are in fact represented by a series of complicated branched outgrowths of the body-wall in the ventral region of the abdomen. The same end is attained by the Crustacean, which forms the subject of the present remarks, in a different manner. Instead of a development of accessory respiratory organs, *Anuropus* (as I may term the genus from its chief structural peculiarity) exemplifies one extreme of the Isopodan type, in that *all the abdominal appendages are converted into respiratory organs*; the increase of respiratory surface is thus attained by an exaggeration of a structural character, which is common to all the members of the family, and which indeed is an important basis of distinction from other families of Crustacea. In all the members of this group more or fewer of the abdominal limbs are soft foliaceous appendages, which permit of an easy exchange of gases between the contained blood and the sea-water. There is no instance, however, among the Isopoda in which all the abdominal appendages are similar, functioning as respiratory organs, except in this deep-sea genus *Anuropus*. *Bathynomus*, as regards the uropoda, is quite a typical Isopod; these appendages form a pair of swimming-feet as they do in the other Cymothoidæ[3].

The modifications of the terminal pair of abdominal appendages or uropoda serve to divide the Isopoda into natural families, which prove to be allied in other particulars; and some stress, therefore, from a classificatory point of view, should perhaps be laid upon the fact of their modification in *Anuropus*, though it is always open to question how far a purely adaptive character is of value. Since the present genus agrees with the Cymothoidæ in the general form of the body, in the number of free abdominal segments, and in fact in all essentials, it would perhaps be hardly permissible to remove it

[1] 'Comptes Rendus,' Jan. 1879.

[2] Ann. & Mag. Nat. Hist. 1879 (vol. iii.), p. 241..

[3] There is a figure of *Bathynomus* in an interesting work recently published by M. Filhol and entitled 'La vie au fond des mers,' Paris, 1885.

from that family on account of the branchiate uropoda; but *Anuropus* should at least be regarded as the type of a special subfamily equivalent to any of the other four, viz. *Cymothoadiens errants*, *C. raviseurs*, *C. branchifères*, and *C. parasites*, into which MM. H. and A. Milne-Edwards have divided the family. *Anuropus* has a further "abyssal character" in the absence of eyes, and it is also remarkable for the abortive antennules, which are only represented by two joints—a stout basal joint, and a longer stout curved distal joint, which is possibly the equivalent of a metamorphosed flagellum. The single species I may term

1. Anuropus branchiatus, n. sp.

The extreme length of the specimen, which is a female, is 70 millim. The head is small, and entirely without eyes; the body is extremely convex; the thoracic segments are subequal, the six posterior are furnished with distinct epimera; the abdominal segments are all smaller than the thoracic segments and subequal; the fifth segment is fused with the telson and forms a caudal shield, which is rounded and flattened in shape. There is no trace of eyes; the *antennules* are short and thick, consisting of a thick basal joint and a longer, somewhat curved distal joint. The *antennæ* are longer and more slender, and quite normal in structure; the *mandibles* have a three-jointed palp. The abdominal appendages are all similar to each other, consisting of a short, stout, basal joint, and two equal rami flattened and rounded in form.

Station 218; 1070 fathoms.

Fam. Sphæromidæ.

Genus Cymodocea, Leach.

1. Cymodocea abyssorum, n. sp.

This species is the only representative of the family at present known from deep water; it is represented by two individuals, one a male, the other a female. The body in both is flattened, and is evidently incapable of being rolled into a ball. The eyes are small and whitish from the absence of pigment; the first thoracic segment is broader than the head, the following segments are subequal, and with well-developed sickle-shaped epimera, absent in the last of the segments. Abdominal shield with two blunt conical spines on the dorsal surface, one behind the other; posterior extremity obtuse and rounded. *Uropoda* with the rami subequal in the female, the outer being slightly the longer; in the male the outer ramus is very much longer than the inner and curved inwards.

Station 218; 1070 fathoms.

Fam. Apseudidæ.

Genus Apseudes, Leach.

1. Apseudes antarctica, n. sp.

The largest specimen of this small species measures 4 millim. in length. The cephalothorax is nearly as long as the first four segments

of the thorax; it terminates in the middle line anteriorly in a sharp rostral prolongation. The free thoracic segments increase in length, but decrease in width up to the fourth, but there is less difference between the first three than between the third and fourth; the fourth and fifth segments are subequal; the sixth is shorter, but not perceptibly narrower than the fifth; in the first segment the epimera are prolonged into a spine; on the fourth and fifth segments are two knob-like projections on either side, equidistant from each other, and from the epimeron; on the terminal segment there is a single process; the five anterior abdominal segments are subequal, and furnished laterally with sharp spiny epimera. The caudal shield is hourglass-shaped, being constricted in the middle, it narrows rapidly to the obtusely pointed extremity. The outer flagellum of the *antennules* has eight joints, the inner only three. The *uropoda* are extremely elongated; the endopodite has two joints, the exopodite six.

Kerguelen; 120 fathoms.

Typhlapseudes, nov. gen.

This genus is distinguished from *Apseudes* by the almost complete disappearance of the ocular lobes, which are represented by a small triangular process without any trace of ocular structures; by the absence of an exopodite to the chelipeds and fossorial limbs; and by the fact that the exopodite of the abdominal appendage is distinctly biarticulate. In the last character this genus agrees with *Sphyrapus*.

1. Typhlapseudes nereus, n. sp.

This species attains to a length of about 10 millim. The body is somewhat flattened and depressed, very much wider anteriorly than posteriorly; the cephalothorax terminates in front in a sharp rostrum; to the outside of the antennules is the triangular pointed ocular lobe, which contains no optic structures; some way below this is a pointed lateral process. The free thoracic segments diminish in breadth, but increase in length up to the fifth; the sixth is narrower but shorter than the fifth; the epimera of the first thoracic segment project as a spiny process; the lateral margins of all but the first two segments are furnished with a short spine placed halfway between the epimera and the anterior margin of the segment; on the ventral median line of the thoracic segments is a spiny process; similar minute spines exist upon the abdominal segments. The abdominal segments with the exception of the last are furnished with small pointed epimera; the last segment is as long as four of the anterior segments, it terminates in a straight truncated extremity, in the middle of which is a short knob-like process. The *antennæ* have a rudimentary exopodite. The *chelipeds* and *fossorial limbs* are normal in structure, but possess no exopodite. The *uropoda* are extremely long, as in *Apseudes*.

Station 23; 450 fathoms.

Leiopus, nov. gen.

This genus is closely allied to the last, but differs in that the chelipeds and fossorial limbs have an exopodite. The chelipeds are extremely slender and delicate in their structure, and this, together with the characters of the abdominal appendages, serves to distinguish the genus from *Apseudes*.

1. Leiopus leptodactylus, n. sp.

This species attains to a length of 13 millim.

The cephalothorax is prolonged in front into a long rostrum; the ocular lobes are large and pointed anteriorly; there is no trace of any optic structures; behind the ocular lobes are two long spiny processes, one on either side. The first free segment of the thorax is as wide as the cephalothorax; the following segments decrease in width, the first suddenly, the rest more gradually; the length of these segments increases up to the fourth; the fifth is of equal length with the fourth, the sixth rather shorter; the first segment has well-developed spiny epimera; the last three segments of the thorax have also short spines upon the epimera, which are wanting in the intermediate segments; upon all the free thoracic segments, with the exception of the first, are a pair of long lateral spines like those of *Typhlapseudes*, but longer. On the ventral surface of both the thoracic and abdominal segments, with the exception of the last, is a median spine. The abdomen is much as in the last-described species. The outer flagellum of the *antennules* has twenty-seven joints, the inner only six. The *antennæ* have a rudimentary exopodite. The *chelipeds* are very slender and delicate. The *uropoda* are as in *Apseudes*.

Station 78; 1000 fathoms.

Fam. Tanaidæ.

Genus Tanais, Audouin & Milne-Edwards.

1. Tanais hirsutus, n. sp.

The extreme length of this species is 9 millim.

The body is elongated, the anterior region is wider than that which follows; the last thoracic segment and the first three abdominal segments are again wider, after which the body narrows towards the termination. The cephalothorax has a short obtuse rostrum; the two first segments of the thorax are short and subequal, the third segment is narrower but longer; the two following segments increase progressively in length, the first is about twice the length of the preceding segment; the last thoracic segment is wider than the preceding, but shorter. The first three segments of the abdomen are wider as well as longer than the following; the terminal segment ends in a blunt, rounded extremity. The *antennules* have a three-jointed peduncle and a two- or three-jointed palp; the extremities of the joints of the peduncle are surrounded by a circle of fine delicate plumose hairs of great length. The *antennæ* are similarly beset

with fine hairs. The *uropoda* are uniramous and consist of twelve joints.

Off Prince Edward's Island; 50–150 fathoms.

Genus Typhlotanais, G. O. Sars.

1. Typhlotanais kerguelenensis, n. sp.

The individuals of this species measure up to 3 millim. in length. The cephalothorax is short and wide; it is prolonged between the antennæ into a short pointed triangular process; eyes completely aborted. The first segment of the thorax is shorter than the rest which are subequal, diminishing slightly towards the posterior extremity of the body; the first segment has a compressed forwardly-directed spine arising from the median ventral surface; there is a trace of a similar process on the second segment. The first pair of thoracic appendages arise close to the anterior border of their segment, the second pair further back, the third pair from about the middle of the segment; the three posterior pairs of thoracic appendages arise close to the posterior boundary of their segments. The *antennules* are about as long as the cephalothorax. The *chelipeds* are rather slender. The *uropoda* are biramose, the outer ramus one-jointed, the inner two-jointed.

Kerguelen, Christmas Harbour; 120 fathoms.

2. Typhlotanais brachyurus, n. sp.

The length of this species is 8 millim. The cephalothorax is hardly longer than the first free thoracic segment; the first thoracic segment is one third less than either of the two following, which are subequal; the fourth segment is hardly shorter than the third, the fifth and sixth decrease progressively. The first pair of appendages is attached close to the anterior border of the segment; the two following pairs are moved a little way back, but are still quite close to the anterior extremity of their segments; the three posterior pairs are attached close to the posterior border of their segments. There is no ventral spine on the first free segment. The abdomen is short, and not so long as the last two segments of the thorax. The *antennules* are rather shorter than the cephalothorax. The *chelipeds* are short and stout. As in the last species, the three following pairs of appendages are more slender than the three posterior pairs. The *uropoda* are as in the last species.

Station 246; 2050 fathoms.

Neotanais, nov. gen.

This genus comes nearest to *Heterotanais*, but differs in the great length of the endopodite of the uropoda, and in the fact that the chelæ are fully developed and of the normal structure in the male; a well-marked character of this genus is the specialization of the thoracic appendages into an anterior and posterior series; in the first three pairs the distal joint of the limb is a single, somewhat curved

claw; in the posterior appendages this terminal joint is furnished at its distal extremity with a circlet of slender spines and a long, mesial, slender hair.

1. NEOTANAIS AMERICANUS, n. sp.

The species is represented by two specimens, both males, measuring about $\frac{2}{3}$ millim. The body is elongated and everywhere of approximately the same diameter. The cephalothorax has a convex anterior margin; on either side of the antennules are the minute, but separate, ocular lobes, which, however, show no traces of ocular structures. The thoracic segments increase in length up to the fourth, after which they diminish. The five anterior abdominal segments are subequal, the terminal segment is of course longer, it terminates in a minute, median, triangular process. The *antennules* consist of a three-jointed peduncle, and a four-jointed flagellum, the joints of which are very minute. In the *antennæ* the peduncle is five-jointed, and the flagellum consists of four joints. The *chelipeds* are short and stout. There is no difference in size between any of the succeeding thoracic appendages, only the difference in the terminal joint referred to above. All the abdominal appendages are present; the *uropoda* consist of a very stout basal joint, with which are articulated the long eight-jointed endopodite and the small two-jointed exopodite.

Station 45; 1250 fathoms. Station 323; 1900 fathoms.

Genus LEPTOGNATHIA, G. O. Sars.

1. LEPTOGNATHIA AUSTRALIS, n. sp.

A single female example of this species was dredged in shallow water at Kerguelen, it measures 4 millim. The body is extremely narrow and elongated. The cephalothorax is longer than the first segment of the thorax, but not so long as the first two segments; the eyes are completely absent; the first segment of the thorax is shorter than any of the three following, which are subequal, and each about half as long again as the first segment; the fifth segment is shorter than the fourth, but a trifle longer than the first; the last segment of the thorax equals the first in length; the first pair of thoracic appendages are articulated close to the anterior margin of their segment; the second, third, and fourth pairs at about the middle of their respective segments; the last two pairs are articulated a very little nearer to the posterior margin. The abdomen is altogether as long as the last two segments of the thorax and one half of the fourth. The *antennules* are not so long as the cephalothorax, they are four-jointed. The *chelipeds* are stout and robust, all the joints are smooth, the distal joints are not serrated as in *L. longiremis*, the three anterior pairs of thoracic appendages are more slender than the posterior pairs. The rami of the *uropoda* are both biarticulate, but the endopodite is much longer and stouter than the exopodite.

Kerguelen, Christmas Harbour, 120 fathoms.

Genus Paratanais, Dana.

1. Paratanais bathybrotis, n. sp.

The single specimen measures 4 millim. The cephalothoracic shield is about as long as the following two segments of the thorax; it is prolonged anteriorly into a wide obtusely pointed rostrum. Eyes are present and well developed. The first segment of the thorax is rather shorter than the rest, which are subequal. The length of the abdomen is about one fourth of that of the entire body. The *antennules* have a very characteristic form; they are composed of four joints; the basal joint is as long as the rest of the appendage, and is extremely wide and flattened; the following joint is short and wide; the third joint is no longer, but is narrower; the terminal joint, which represents the flagellum, is short and conical in form. The *antennæ* are shorter than the antennules, but, like them, consist of four joints; the first joint is wide and flattened, the second joint has the same shape, but is shorter, the third joint is narrow and cylindrical; the distal joint is short and narrows towards its termination.

Station 246; 2050 fathoms.

2. Paratanais dimorphus, n. sp.

A very considerable number of individuals of a small species of *Paratanais* were dredged in shallow water at Kerguelen, which are to be distinguished by a very pronounced sexual dimorphism. The female is like many other species of the genus; but the male is remarkable on account of the more slender body and the great difference in the structure of the chelipeds. Both males and females measure, in most cases, 3 mm. in length. In the male the cephalothorax is rather long and narrow, and equals in length the first three segments of the body together with half of the fourth; the first free segment of the thorax is the shortest; the second is twice the length of the first; the third segment is half as long again as the second; the fourth and fifth are subequal and about half as long again as the third; the last segment is about equal in length to the third. The abdomen equals in length the last two thoracic segments. The *antennules* consist of five joints; the *antennæ* of six. In the female the antennary organs are shorter, the antennules being three-jointed and the antennæ five. The *chelipeds* are long; both the moveable and the fixed 'finger' are of great length; the latter is, however, not as in other Tanaids a mere prolongation of the penultimate joint, but is freely moveable, being articulated with it. In the female the chelipeds are quite normal in structure. The *uropoda* are biramose, each ramus being two-jointed.

Kerguelen, Christmas Harbour, 120 fathoms.

Fam. Anceidæ.

Genus Anceus (Praniza), Risso.

1. Anceus bathybius, n. sp.

Only a single fragment of this species was obtained from deep-water; the abdomen was entirely wanting. The specimen is a male

and measures 10 millim. The head terminates anteriorly in a very long obtusely pointed rostrum. Eyes are completely absent. The first three segments of the thorax are, as usual, much shorter than the two following. The surface of the body is smooth. The first pair of thoracic appendages are operculiform and consist of five joints, the second being much the most important; the two following pairs of appendages differ from the two last in being very much more slender, otherwise their structure is much the same.

Station 76; 900 fathoms.

2. Anceus gigas, n. sp.

This large species is represented by a number of individuals both male and female; the largest specimens measure as much as 16 millim., the females being hardly smaller than the males. In the male the anterior margin of the head is almost straight, being only broken by three minute processes, one of which is median. The thoracic segments are quite like those of other species; the lateral regions of these segments are roughened, the dorsal smoother. The abdominal segments are furnished with well-developed sickle-shaped epimera, which instead of projecting outwards from the body are bent down. The first thoracic appendages agree with those of the last species in having six joints; the remaining thoracic appendages are all similar to each other.

Kerguelen, Christmas Harbour, 120 fathoms.

3. Anceus tuberculosus, n. sp.

A second species of *Anceus* was obtained at Kerguelen, which cannot be confounded with the preceding; it is represented by a considerable number of specimens, both males and females. The largest male measures only 5 millim. in length. The head is prolonged in the middle line into a short rostrum, which is squarish in outline and has a semicircular notch at its extremity. The dorsal surface of the head is very convex, and is covered with numerous tubercles, which are especially abundant posteriorly and laterally. The three anterior segments (including the rudimentary first free segment) are similarly beset with tubercles; the remaining segments are smooth. The segments of the abdomen gradually increase in length, they are furnished with well-developed sickle-shaped epimera, which project outwards. The ambulatory limbs are all similar to each other; the five anterior abdominal appendages are flattened and smooth, without any hairs.

Kerguelen, Christmas Harbour, 120 fathoms. Kerguelen, Royal Sound, 30 fathoms.

4. Anceus latidens, n. sp.

A single male specimen of this species measures 2·5 mm. The anterior margin of the head is prolonged into three short, blunt protuberances, of which the median one is the largest. The head and

the first four segments of the thorax are tuberculate, the two remaining segments and the rudimentary terminal segment being smooth. The abdominal appendages have epimera, which are directed downwards as in *A. gigas*. The operculiform first pair of thoracic appendages are like those of the majority of species in consisting of a single large basal joint, a small second joint, and a minute rudimentary third joint. The remaining thoracic appendages are similar to each other; the proximal joints are stout and bent, with short stout spines. The abdominal appendages differ from those of the last species in that both rami are setose, the outer perhaps more so than the inner.

Flinder's Passage, North Australia, 7 fathoms.

The forty-four species which have been briefly described in the foregoing pages do not include all the novelties in the 'Challenger' collection; there are a few other species which I have not yet examined with sufficient care to report upon, but which, so far as I am aware at present, are undescribed forms. These include one species of *Arcturus*, one of the allied genus *Astacilla*; two species, one from deep water, the other from Kerguelen, which are representatives of the genus *Paranthura*. The total number of new species of Isopoda obtained during the voyage of the 'Challenger' is therefore about 70, comprising 10 new genera.

Geographical and Bathymetrical Distribution.—It is interesting to note that all the existing families of Isopoda without a single exception[1] are to be found in the deeper waters of the ocean; but the number of deep-sea species differs very considerably in the different families; the most characteristic are evidently the Munnopsidæ and Arcturidæ, and, in a somewhat less degree, the Tanaids, Asellids, and Serolidæ; the occurrence of a single species each of the Anceidæ, Cymothoidæ, Anthuridæ, and Sphæromidæ may perhaps be taken as an indication that these families are not largely represented in the deep-sea fauna.

In most cases the deep-sea species are distinct from the shallow-water species; only one or two (e. g. *Arcturus furcatus*, Studer) are known, which are common to shallow water and the great depths. In many cases the deep-sea genera are distinct, and this is particularly so in the Asellids; of this group, *Acanthoniscus*, Sars, *Acanthomunna*, *Trichopleon*, *Iolanthe*, are absolutely confined to deep water, while *Ischnosoma* has four deep-sea species and only one which is an inhabitant of shallow water in the extreme north, where the conditions of temperature are much the same. Very frequently the deep-sea Isopoda are distinguished by the extremely spiny character of the body; this is largely the case with the deep-sea *Arcturi*, and there are other instances. The great development of spines upon the body is not, however, confined to the deep-sea Isopoda, but is also found in many species from the colder regions, at Kerguelen,

[1] Sars has described a species of Idotheidæ, *Glyptonotus megalurus*, which enables me therefore to enunciate the general statement.

and in the Arctic Ocean; it appears therefore to be correlated in some way which is not understood with a low temperature of the water.

The majority of the deep-sea Isopoda are entirely blind, or have, at most, rudimentary eyes devoid of pigment; of the deep-sea species obtained by the 'Challenger' only 25 p. c. have well-developed eyes, and all these species but three belong to the Arcturidæ, which form a very striking exception to the general rule. In every instance but one the genera which are confined to the deeper waters are blind; and it is just possible that the presence or absence of eyes may be an indication of the time which the species has inhabited the deep sea.

It is commonly believed that the deep-sea species are larger than their shallow-water allies; the examination of the 'Challenger' Isopoda lends some support to this view. Of the families Serolidæ, Munnopsidæ, Arcturidæ, Asellidæ, and Munnidæ the deep-sea species are certainly the larger.

With regard to the range in depth, the greatest depth at which any species has been met with is 2740 fathoms; the species obtained at this great depth is *Eurycope intermedia*. Only a few species descend below the 2000-fathom line, indeed only three to any extent. The majority of the deep-sea forms were dredged in the intermediate zone of 1000–2000 fathoms—twenty-three species out of a total of forty-four, and this does not include five species which were dredged just below the 1000-fathom limit, viz. in 1000–1070 fathoms. I hope to discuss more fully the distribution of the deep-sea Isopoda in my forthcoming Report.

5. On a Variety of *Anthocharis eupheno*, from Mogador. By J. H. Leech, F.Z.S.

[Received January 18, 1886.]

During a recent excursion to Mogador I obtained examples of a new form of orange-tip Butterfly, which I propose to call

ANTHOCHARIS EUPHENO, var. ANDROGYNE.

The male of this variety differs from the typical *A. eupheno* in its larger size, and in the fainter markings of the underside of the hind wings, which are rarely strong enough to be discerned from the upper side.

The female is much larger than typical specimens of *A. eupheno*, agreeing with the male in markings and in the shape and greater depth of the fore wings. The orange blotch, instead of being confined to the tip of the fore wing in the usual manner, extends as far as the discoidal spot and is bounded (usually) on its inner margin by a black band, which sometimes suffuses the whole tip of the wing. The ground colour of the fore wing varies from pure white to pale

lemon; the hind wings are always yellower than in the typical form, in some specimens being nearly as dark as in the males. The markings of the underside of the hind wings are very indistinct, they are usually of a greyish-green tint, but sometimes approach a rusty-red colour which is found in the typical form, although both forms occur in Algeria.

This distinct local form I took at Mogador in March 1885. It was somewhat common at a little distance from the town; the females, as is always the case in this genus, being much scarcer than the males.

I have only been deterred from describing this variety as a new species by the kindness of M. C. Oberthür in forwarding me a specimen of *A. cupheno* from Central Algeria, which is intermediate between the above-described variety and the type.

Similar cases of the two sexes (usually very different) approaching the same form of colouring are not uncommon; for example—*Lycæna alexis*, in many localities; *Hepialis humuli*, in Shetland; *Odonestris potatoria*, in which it is not unusual to find males with the paler colouring of the females, and females possessed of the darker tint of the males.

6. On a new Species of Bird of the genus *Copsychus*.

By R. G. Wardlaw Ramsay, F.Z.S., F.L.S.

[Received February 2, 1886.]

Among a few birds which I obtained some months ago out of a collection made by Mr. Harry Pryer at Elopura, in N.E. Borneo, are examples of a very interesting and hitherto undescribed species of the genus *Copsychus*.

Mr. R. B. Sharpe, in his 'Catalogue of the Birds in the British Museum,' has recognized three good species of *Copsychus*, viz.:—

1. *C. mindanensis*.
2. *C. seychellarum*.
3. *C. saularis*.

Under the latter he treats as local races *C. musicus* and *C. amœnus*.

I am inclined to doubt the propriety of uniting *C. amœnus* to *C. saularis*, and prefer to keep it distinct.

The new species, which I propose to name *Copsychus niger*, is of about the same size as *C. amœnus*, from which it differs in having a much smaller amount of white on the wing-coverts and none on the secondaries and in having the tail entirely black.

In its general appearance it more resembles *C. seychellarum*, which, however, has its black plumage glossed with green instead of blue as in *C. niger* and the other species of the genus. Length 9·2, wing 4·35, tarsus 1·25, tail 4·5, bill from gape 1·25 inches.

The five species may be easily distinguished as follows:—

1. *C. seychellarum.* (Seychelles.)	Belly black.	Tail entirely black.
2. *C. niger.* (N.E. Borneo.)	Belly black.	Tail entirely black.
3. *C. mindanensis.* (Philippine Islands.)	Belly white.	Tail entirely black.
4. *C. amœnus.* (Java, Borneo.)	Belly black.	Outer tail-feathers white.
5. *C. saularis.* (Ceylon, India, Assam, to Malay Peninsula, and China, Andaman Islands, Sumatra, Java, Borneo.)	Belly white.	Outer tail-feathers white.

February 16, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of January 1886:—

The total number of registered additions to the Society's Menagerie during the month of January was 97. Of these 9 were by birth, 64 by presentation, 12 by purchase, 8 by exchange, and 4 were received on deposit. The total number of departures during the same period, by death and removals, was 118.

The most noticeable additions during the month were:—

1. A Many-marked Snake (*Rhagerrhis multimaculata*), presented by the Rev. G. H. R. Fisk, C.M.Z.S., and received January 1, 1886. Amongst several collections of the Snakes of the Cape Colony lately received from our excellent correspondent is a single small example, about a foot long, of this species, as kindly determined for us by Dr. Günther. It is the *Coronella multimaculata* of Smith (Illust. Zool. of South Africa, pl. 61), but properly referable to the genus *Rhagerrhis* of Peters (Monatsb. k. Preuss. Ak. Wissen. Berlin, 1862, p. 274).

2. Eight Tree-Snakes, born alive in the Society's Reptile House, on the 9th of January. The mother, a fine example of *Dryophis prasina*, presented by Dr. F. H. Bauer, C.M.Z.S., of Buitenzorg, Java, was received on the 15th of August last, so that she must have been for upwards of five months without any possibility of intercourse with a male of the same species. The young ones were all born on the same day at irregular intervals between 11 A.M. and 4.30 P.M. They were removed to another case, where they quickly

took refuge amongst the leaves of a fresh plant. Although they have not fed, they seem to be lively and doing well[1].

Mr. Sclater exhibited a specimen of the new Paradise Bird, *Paradisornis rudolphi*, lately discovered in the Owen Stanley Mountains of New Guinea by Mr. Hunstein, and described and figured by Drs. Finsch and Meyer in a recent number of the 'Zeitschrift für die Gesammte Ornithologie' (1885, p. 385), and pointed out the characters in which it differs from typical *Paradisea*.

The Secretary exhibited on behalf of Mr. L. Taczanowski, C.M.Z.S., the skin of an Owl from the south-east of the Ussuri country, on the frontiers of Corea, which appeared to be referable to *Bubo blakistoni*, Seebohm, P. Z. S. 1883, p. 466, and Ibis, 1884, p. 42 et p. 183, pl. vi.

Two adult females of this Owl had been obtained by Mr. J. Kalinowsky, during his recent stay in Kamtschatka, from the environs of the river Sidemi in Russian Mantchuria, on the frontiers of Corea, where they were collected in the latter part of May 1885. They appeared to agree with Japanese specimens of *B. blakistoni* in the National Collection, where Mr. Sharpe had kindly made the comparisons.

Mr. Edward Gerrard, Jun., exhibited specimens of the heads and skulls of two African Rhinoceroses (*Rhinoceros bicornis* and *R. simus*), obtained by Mr. Selous in Mashuna-land, and mounted for the South-African Museum, Capetown.

Prof. Ray Lankester exhibited and made remarks on a drawing of a restoration of *Archæopteryx*.

The following papers were read:—

1. Notes on a striking instance of Cranial Variation due to Age. By Oldfield Thomas, Natural History Museum.

[Received February 16, 1886.]

(Plate XI.)

Dr. Gulliver, of St. Thomas's Hospital, has recently submitted to me for determination three skulls from Canada, collected by Mr. Hayden. The skulls turn out to be referable to the fairly common Canadian Marten or Pekan (*Mustela pennanti*, Erxl.), but they show to such a remarkable extent the cranial changes that occur in

[1] See Miss Hopley's account of this event in 'Nature,' vol. xxxiii. p. 295.

later life among this group of animals, that I have thought it worth while to have them figured, and to make a few notes on the causes and extent of the changes presented by them. This is the more called for owing to Mammalogists who have not access to large series of specimens being as a rule far too ignorant of these changes to judge by the numerous so-called "new species" which are constantly being described on variations of a corresponding nature. These changes have been pointed out at various times, as for example by Berthold [1], Nathusius [2], Hensel [3], and others; and the object of the present paper is therefore merely to give further publicity to a fact which has a very considerable bearing on the value of the cranial differences brought forward as characteristics of freshly-described species.

The three skulls, which I will speak of as A, B, and C, consist evidently of two males and one female, the latter being far smaller and lighter than the other two. Of their specific identity there can be absolutely no question, although I have found it difficult to make most people to whom I have shown them believe in that fact.

B (Plate XI. fig. B) is a skull of the ordinary type, showing no special peculiarities; it is fully adult, as is proved by the basilar, sphenoid, and other cranial sutures being closed, although some of the facial ones are still visible, and by the teeth showing signs of commencing wear. Compared to such a skull as this, the aged skull A (fig. A) shows the changes that take place in later life to a most remarkable extent, well worthy of some special notice.

All the changes are connected with an increase in the power of biting, and the consequent development of the biting muscles, but the connection of some of the changes with the biting muscles is not so obvious at first sight as to be readily perceived by any one not specially on the look-out for it.

To commence with, the canines of A are apparently very much longer and more powerful than those of B, a difference not due to individual variation, but to the fact that they are as a whole pushed further outwards as time goes on and additional dentine is deposited round their bases; the absolute length of the enamel-covered portion from the cingulum to the tip being precisely the same in both.

The next difference is one too commonly recognized to need much remark, viz. the development of the occipital crest; but it is here carried to a relative extent greater than in any other skull I know of, not even excepting the Hyænas and Sea-lions. In B the crest has scarcely commenced to grow at all, while in A it is no less than 20 millim. (nearly an inch) in vertical height above the brain-case.

The temporal muscles, passing from these enormous crests down through the zygomata to the lower jaw, have then by their constant pressure on the bone caused it to absorb in certain places, and have thus induced three remarkable changes in the skull that might easily be, and have in fact often been, taken as marks of specific distinction. Firstly, they have pressed against and bowed outwards the zygomata,

[1] Isis, 1830, p. 570.
[2] Arch. f. Nat. iv. p. 130 (1838).
[3] "Craniologische Studien," N. Act. Ac. Nat. Cur. xlii. p. 127 (1881).

until the zygomatic spread in A is no less than 74 per cent. of the length of the skull, as compared to 59 per cent. in B, the actual breadth being nearly one third greater. Secondly, they have pressed upon the inner walls of the temporal fossæ, and have thereby reduced the breadth of the skull at the interorbital constriction to such a degree that in A its least width is only 16 millim. (36 per cent. of the basi-cranial axis) as compared to 23·5 millim. (57 per cent.) in B. That the width at this constriction grows *absolutely*, as well as relatively, less in many mammals has been observed by several authors, but it is, I think, by no means sufficiently realized. Thirdly, the great biting muscles have pressed upon and thereby constricted the posterior narial passage, its outside breadth being only 10·5 millim. in A as against 11·9 in B. Inside the brain-case again, the constriction of its anterior part has reduced the cranial capacity from 40 c.cm., as it is in B, to 35 in A, the smaller capacity being therefore found in the larger and older skull.

These various differences are shown in the drawing (Pl. XI.) better than they can be explained by any amount of description.

Finally, I would again lay special stress on the fact that B is absolutely adult, so far as any definition of adult age can be drawn up, and has therefore no sign whatever of immaturity, such as would put the species-maker on his guard, and yet that in a skull so adult as this such changes may take place in advanced life as to alter its whole appearance and proportions, and even its cranial capacity.

To disprove the natural suggestion that the differences above noted are due to sex, there comes fortunately the skull C, collected at the same time and place, which in its age-characters is intermediate between A and B, but is far smaller and more lightly built, and is quite obviously the female form corresponding to the other two.

The following are the measurements of the three skulls for comparison:—

	A. ♂.	B. ♂.	C. ♀.
Length [1]	112	107	93
Greatest breadth	83	63	56
Palate, length	63	60	52
Palate, breadth	36	34	31
Interorbital constriction	16	23·5	19
Basicranial axis [2]	45	41	35
Capacity (in cubic centimetres)	35	40	31

[1] Basion to front of premaxillæ.
[2] Basion to anterior edge of basisphenoid.

2. On a new Madreporarian Coral of the Genus *Stephanotrochus* from the British Seas, with Notes on its Anatomy.

By W. L. Sclater, B.A., F.Z.S., Assistant to the Jodrell Professor of Zoology, University College, London.

[Received February 15, 1886.]

(Plates XII.–XIV.)

I. Introductory remarks, p. 128.
II. Description of the Corallum, p. 128.
III. Comparison of *S. moseleyanus* with other species of the genus, p. 130.
IV. Distribution of the genus *Stephanotrochus*, p. 132.
V. Anatomy of *S. moseleyanus*, p. 132.
VI. List of publications on the subject, p. 135.

I. *Introductory.*

Professor Moseley has kindly placed in my hands for examination and description a specimen of a Madreporarian coral, which I have now the pleasure of exhibiting to the Society. The coral is of much interest, as being the finest and largest of the genus *Stephanotrochus*, lately instituted by Professor Moseley (1)[1] ('Challenger' Report on Corals, p. 151), and also as being the first example of this form that has been dredged in British seas.

The coral is a solitary form; it was procured on the expedition of H.M.S. 'Triton' in the summer of 1882: "station 13; August 31st, 1882, lat. 59° 51′ 2″ N., long. 8° 18′ W.; depth 570 fathoms; bottom, ooze; bottom temperature, 45°·7 F. (7°·7 C.). Trawl."

Station 13 is situated almost in a straight line and about halfway between the Faröe Isles and the northern point of the Hebrides; it lies to the south-west of the Wyville-Thomson ridge, so that it is well within the warm area described by Murray and Tizard (2).

The coral is interesting, since it is by far the largest solitary form that has yet been discovered in British seas; its nearest allies were dredged off the Azores and Pernambuco during the 'Challenger' Expedition. The coral was well preserved in absolute alcohol, so that I have been able to make a fairly satisfactory investigation of its anatomy by means of sections and other microscopical preparations. It is to the kindness of Professor Moseley that I am indebted for this coral; and since the genus and the other four species belonging to it were all described by him in his report on the 'Challenger' Corals, I propose to dedicate this new British species to him under the name of Stephanotrochus moseleyanus.

II. *Description of the Corallum.*

The corallum is white where covered by the soft tissues; the base is of a bluish-grey colour; it is saucer-shaped, the base being very nearly flat, but forming a very low cone; and from this base the side-walls of the theca rise, making an angle of about 60°.

In the centre of the base is a very small pedicel of attachment;

[1] The numbers refer to the List of Publications at the end of the paper.

there was no trace of any shell or other foreign body to be detected as was the case with two other species of the same genus as described by Prof. Moseley (1, page 154). From the pedicel radiate costæ corresponding to the primary, secondary, and tertiary septa. The costæ are formed by ridges along which are a series of blunt points.

Between the basal costæ the corallum is granulated, the granules running in lines and corresponding, not to the septa, but to the interstices between them.

On the side-wall of the corallum, however, the ridges and points become much sharper, and there arise costæ corresponding to the quaternary and quinary septa; these are smooth and do not bear the points with which the primary, secondary, and tertiary costæ are provided.

The single specimen from which this species is described has unfortunately been broken and has re-mended itself, so that it is malformed, for there are only nine larger septa (*i. e.* primary and secondary); no doubt had the specimen been an uninjured one it would have possessed the typical Madreporarian number of twelve (*i. e.* six primary and six secondary).

The coral will therefore be described on this assumption. There are five cycles of septa—six primary, six secondary, twelve tertiary, and forty-eight quinary, in all ninety-six.

The secondary septa are distinguished from the primary by bearing large stout pallial elevations, each septum bearing two, the smaller one being the more central; the primary septa also bear pali, but they are not so large or distinct as those of the secondary septa. The tertiary septa are also slightly thickened at their inner ends.

The ends of the primary, secondary, and tertiary septa are all fused with a very thick up-rising of calcareous matter, the columella, which bears five or six rounded projections resembling the true pali, but much lower, showing how the columella has been formed by the central ends of the septa and their pali. This knobby top of the columella forms a floor to the central part of the enteron of the polype, and it is much shallower than the surrounding chambers between the septa, where the floor is formed by the true base of the corallum.

The quaternary septa do not quite reach the columella, but they are bent inwards so as to touch the tertiaries; those lying to the immediate left of the tertiary septum being shorter and joining the tertiary septum at a point nearer the circumference than those on the right, as is best seen in the figure (Plate XII. fig. 1).

The quinary septa are much shorter than the others, only reaching halfway along the base of the theca and ending in two small upgrowths which seem to represent two rudimentary pali; no rudiments of pali could be seen on the quaternaries.

All the septa are extremely exsert, the primary and secondary septa more especially so, so that in the specimen the tissues did not cover their sharp edges; but this is probably due to the contraction caused by the spirit.

It is only the outer halves of the primary and secondary septa

that are so prominent, the edge towards the columella dips down so that the septum has a strongly concave upper margin, as is shown in the figure (Plate XIII. fig. 5).

The quinaries resemble the primaries and secondaries in shape, but are of course much smaller; those quinaries which are adjacent to the primaries and secondaries being much larger and more prominent than those adjacent to the tertiaries, and joined to the primaries and secondaries by an upgrowth of the wall. The tertiaries and quaternaries resemble one another, since they both have a straight upper margin, not concave as is that of the primaries, secondaries, and quinaries. All these details with regard to the arrangement of the septa will be best understood by the examination of the drawing (Plate XII. fig. 1), which gives a diagrammatic representation of the septa, tentacles, and mesenteries.

All the septa are covered with granules arranged in lines showing the lines of growth.

The measurements are as follows:—longer diameter 5 centims.; shorter diameter 4½ centims.; height of the corallum from the base to the tip of the highest septum 2 centims.; height of the edge of the cup 1 centim.

III. *Comparison of* Stephanotrochus moseleyanus *with other Species of the Genus.*

In comparing *S. moseleyanus* with other species of the genus *Stephanotrochus*, which are four in number, all described by Moseley, from the deep sea, the first point that is noticed is the much greater development of the pali, which in all the other species are merely slight thickenings of the internal ends of the septa, but which in *S. moseleyanus* form a crown of stout upgrowths, supporting the internal edge of the oval disk.

Again, compared with all the other species of the genus, the primary and secondary septa are very much stouter and more exsert, the line between the palus and the other end of the septum is very much more concave (see Plate XII. fig. 5). The septa form five complete cycles, and are remarkable for their regularity; this is also the case in *S. diadema*, but not in the other species of the genus. There is no plain distinction of size between the primary and secondary septa in *S. moseleyanus* as there is in *S. platypus*, *diadema*, and *discoides*; but the primary and secondary septa are equal in size, and can only be distinguished by their position with regard to the long axis of the coral, as in *S. nobilis*.

On the other hand, *S. moseleyanus* agrees best in general shape with *S. diadema* and *platypus*, and differs from *S. nobilis*, in which the corallum is deep and cup-shaped, whereas that of *S. moseleyanus* is flat and saucer-shaped.

The differences between the five species are shown by the accompanying diagrams (p. 131), which illustrate the arrangement of the septa in each species of the genus; it will be seen that *S. moseleyanus* agrees best with *S. platypus* in this matter, from which it differs only in having the internal ends of the quaternaries turned in on to the tertiaries, while in *S. platypus* all the septa are quite straight.

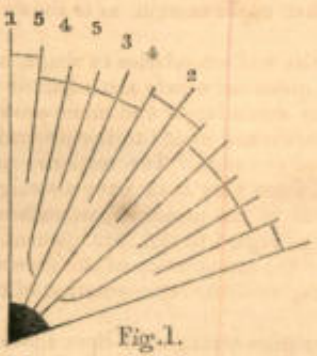


Fig.1.

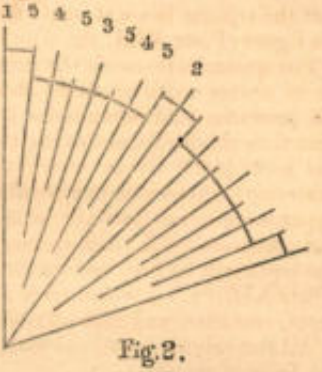


Fig.2.

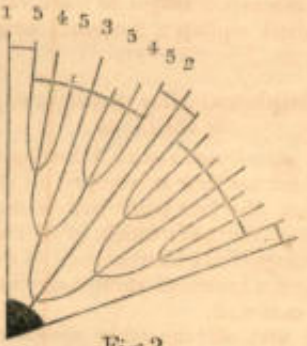


Fig.3.

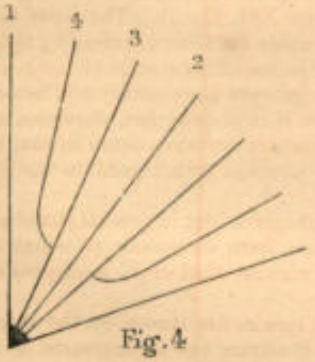


Fig.4

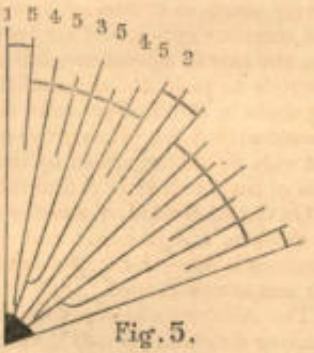


Fig.5.

Diagrams of the arrangement of the septa in the five different species of *Stephanotrochus*. The septa are numbered.

1. *S. nobilis*. 2. *S. platypus*. 3. *S. diadema*. 4. *S. discoides*. 5. *S. moseleyanus*

The genus *Stephanotrochus* belongs to the section of the Madreporaria known as the Madreporaria aporosa, to the family Turbinolidæ of Milne-Edwards and Haime, and to the section Discocyathoida of Martin Duncan (3), which is characterized as follows:—"Simple Turbinolidæ, discoid in shape, not increasing much in height with growth. Free or not. With or without pali in one crown. Columella variable; epitheca also." *Stephanotrochus moseleyanus* agrees in every way with the above definition except in the point about the pali, since in *S. moseleyanus* there are distinctly two crowns of pali.

IV. *Distribution of the Genus* Stephanotrochus.

All the species of *Stephanotrochus* hitherto described are deep-sea forms, the depths from which they come varying from 410 to 1009 fathoms; *S. moseleyanus* comes from a depth of 570 fathoms.

The geographical distribution, considering the fewness of the specimens dredged, is extraordinary; seven specimens have been obtained belonging to five different species, procured from such distantly separated places as Pernambuco, the Azores, Sydney, N.S.W., and the Faroe Channel.

As was mentioned above, *S. moseleyanus* was dredged in the warm area of the Faroe Channel, where the bottom temperature is very high, 46°·5 F.

V. *Anatomy of* Stephanotrochus moseleyanus.

The soft tissues of the polype extend from the edge of the cup some distance down the outside wall of the corallum, gradually thinning out; the line of the extension of the soft parts is marked in the dry corallum by the change of colour from a glistening white to a greyish blue, the colour of the basal parts uncovered by soft tissues.

As far as I was able to observe, the enteric cavity does extend round the edge of the theca to the outer side, so that the tops of the smaller septa would probably stand up free in the enteron; the primary and secondary septa are so extremely exsert that the tissues are abnormally stretched to cover them, and so have by the action of the alcohol been split.

This would rather seem to confirm Koch's theory (5) that the theca is formed from the fused peripheral ends of the septa.

The oral disk, the tentacles, except at their tips, and the outer soft wall of the coral are all of a dark madder-colour; this colour is due to a substance called by Prof. Moseley (6) Polyperythrin; it is distinguished by peculiar properties: it is insoluble in water, glycerine, alcohol, ether, ammonia, potash, or picric acid, but is soluble in strong hydrochloric acid; it is also distinguished by a peculiar absorption spectrum, a broad black line including the line D. Prof. Moseley found it in *Stephanotrochus diadema*, in *Flabellum*, *Fungia*, and *Stephanophyllia*, and many other Cœlenterata.

The soft wall of the coral is divided up by a series of longitudinal furrows, which correspond to the insertions of the mesenteries; the ridges between the furrows are further crossed by a number of transverse ridges, so that the whole wall assumes a very wrinkled

appearance, doubtless exaggerated by the action of the alcohol in which the coral is preserved.

The tentacles are in four cycles; the innermost cycle are of the largest size, and correspond in position to the primary and secondary septa, and are therefore twelve in number. The second cycle correspond to the tertiary septa, and are also twelve in number. The third cycle correspond to the quaternaries, and are twenty-four in number. These differences between the three cycles are very slight, consisting only of small differences in size. The fourth cycle, placed considerably nearer the circumference of the coral, are very much shorter and more stumpy than the other three cycles; they correspond to the quinary septa, and, as will be seen below, are evaginations of intermesenterial spaces [exocœlic, Fowler, (4)], not of the *intra*-mesenterial chambers [entocœlic, Fowler (4)] as are the others; they are forty-eight in number; so that there are altogether ninety-six tentacles.

The mesenterial chambers are forty-eight in number; there are two cycles of mesenteries, larger and smaller, forming larger and smaller chambers; the larger chambers contain septa of the first, second, and third order; the smaller chambers septa of the fourth order. From these chambers the tentacles of the first three cycles are evaginated; the fifth cycle of septa, on the other hand, are placed in the spaces between the mesenterial chambers, *i. e.* exosepta, Fowler; and the fourth cycle of tentacles are in the same way evaginated from these exocœlic spaces. The whole arrangement will best be understood by reference to the diagram (Plate XII.).

In all the chambers, with the exception of those in which are placed the primary septa situated at the long ends of oval mouth-opening, the longitudinal muscles are placed, facing one another; but in the chambers above mentioned, the muscles are placed on the outer faces of the mesenteries; these therefore are the directive mesenteries. So that in the arrangement of the muscles on the mesenteries, *Stephanotrochus* exactly corresponds to the Hexactinian type, as do all other Madreporarian corals that have been hitherto examined.

The tentacles are all of one shape, they are simple conical evaginations of the cœlenteron; they end in a knob separated from the rest of the tentacle by a narrow neck; the knob contains no pigment, and is of a white colour; the main part of the tentacle is madder-coloured like the rest of the polype.

A section of the knob and part of the conical part of the tentacle is figured (Plate XIII. fig. 6); the knob is packed full of nematocysts, and in fact is a single immense battery of thread-cells. The ectoderm consists of a series of very long and very narrow cells, which are nucleated; there are also gland-cells present, but the elements are difficult to distinguish; the endoderm cells of the knob are much longer than those lining the other parts of the cœlomic cavity of the tentacle. I was unable to distinguish any muscular elements in the knob; it is perhaps in consequence of this that the outline of the knob appears straight, since it apparently has not been contracted by the action of the spirit, as has been the rest of the tentacle.

The ectoderm of the tentacle (Plate XIII. fig. 6) also contains a series of nematocyst batteries; the cells, however, differ from those of the knob in the following points: they are very much smaller, they are pigmented, from them are developed the longitudinal muscle-fibres; in the endoderm of the main part of the tentacle the elements are not nearly so high as are those of the knob, and at their bases are found the circular muscle-fibres.

The tentacle therefore differs little in structure from the actinian type as described by Hertwig (7).

The muscles are very well developed on both sides of the mesenteries; the arrangement is shown in figures 8 and 9 of Plate XIV., where figure 8 represents the arrangement on the ectocœlic face, figure 9 the arrangement on the entocœlic face. The edge of the mesentery is occupied by a thick packed mass of mesenteric filaments above, and by the ova, also packed thick, below; ova and mesenteric filaments seem to be well developed in all the mesenteries, except on the directives, where I have been unable to detect any sign of ova, but I have only been able to examine two directives, one of which was malformed, so that I am unable to make sure of this point.

Plate XIII. fig. 7 represents a small portion of a section of a mesentery highly magnified, showing the folding of the surface on one side in order to increase the surface for the muscle-slips, but in no case have I detected the inclusion of masses of muscles in the mesoderm, as has been figured by Hertwig (7) in *Actinolobia* and *Tealia*, and other Actiniæ.

The only example of this Coral I have been able to examine contained ova; no spermatozoa could be detected, so that the Coral may be considered dioecious.

The development of the ova differs slightly from that described in the Actinians by Hertwig; in *Stephanotrochus* the mesodermal lamella in which the ova lie is reduced to a thin string (Plate XIV. fig. 10), and the entodermal cells on either side have become very long and thin, resembling, perhaps, the "Cambium Zellen" described by Weissman in certain Hydroids which nourish the ova at their own expense. In the figure there will be seen several ovarian cells which have not yet entered the mesodermal lamella, but which are still lying in the endoderm; and in one case there is an ovarian cell figured lying half in the endoderm and half in the mesodermal lamella; the ripe ovum is full of deutoplasm, and the germinal vesicle and germinal spot are very clearly seen.

Besides the ovarian string, the mesenteric filaments can be seen in section (Plate XIV. fig. 10), consisting of a mesodermal string and high endodermal cells, with many pigment-cells scattered among them; they are cut in section in different planes.

Beyond the ova the mesoderm again thickens slightly up to the end of the mesentery, where it splits to line the hard septal walls, since this section is from part of the mesentery low down where the mesentery is inserted between the columella and the two adjacent septa, all of which are lined by the mesodermal lamella with a layer of calycoblastic cells interposed.

Calycoblastic cells were first detected by Heider (8), who showed

that all the hard parts of the coral are laid down by these cells, which can be always found between the mesodermal lamella and the hard parts. Koch (9) showed that the calycoblasts were really the remains of the basal ectoderm-cells of the embryo, so that the whole of the corallum is laid down by ectoderm, and is really, morphologically, outside the coral. This of course corrects the old view which regarded the basal ectoderm of a coral as having disappeared from the outside of the corallum, since what remains of the basal ectoderm is really within the corallum, and is the very means of forming the corallum. Koch (9, plate xx. fig. 9) gives a representation of three calycoblastic cells, which seem to be merely ordinary high epithelial cells, nucleated and filled with granules.

I have found everywhere between the corallum and the mesoderm lamella a tissue or series of cells, represented in Plate XIV. figs. 10–13, *cal.*; these I believe to be the calycoblasts described by Heider and Koch. That these cells must be calycoblasts is, I think, evident from their position, since they are everywhere found between the corallum and the mesoderm lamella. But in form they are very different from the calycoblasts figured by Koch, for, whereas Koch's calycoblasts are, as was said above, ordinary granulated epidermic cells, the cells which I have found in *Stephanotrochus* are not quadrangular but of irregular shape, and separated from one another by intervals, so that they seldom form a definite layer; also they are striated in a most extraordinary way, as is shown in figure 12.

Whether these cells are the calycoblasts of Koch I cannot with certainty say; it may be that the difference of appearance is due to the fact that Koch's figure represents these cells in a very young state, when they are doubtless more active than in the adult coral; or, again, the calycoblasts of Koch's form *Asteroides* may differ essentially from those of *Stephanotrochus*. The fact is, however, that until more is known of the anatomy of other corals, it is impossible to decide on the nature of these cells.

In conclusion I must thank Prof. Moseley for kindly allowing me to examine this coral, also for his advice and assistance; so, too, I must record my obligations to Prof. Ray Lankester, and my friend Mr. Fowler, for much help.

I append a list of the principal publications referred to; I have abstained from quoting the views and discoveries of the last few years with regard to Madreporarian corals, since a very complete history of recent researches on the subject will be found in Mr. Fowler's paper (4).

VI. *List of Publications on the subject.*

1. Moseley, H. N. Report on certain Hydroid, Alcyonarian, and Madreporarian Corals, procured during the voyage of H.M.S. 'Challenger.'—Report of the Voyage of H.M.S. 'Challenger,' Zoology, vol. ii. 1881. (Description of *Stephanotrochus*, p. 151.)
2. Tizard and Murray. Exploration of the Faröe Channel during the summer of 1880 in H.M's hired ship 'Knight Errant.'—Proc. Royal Soc. Edinburgh, no. 111. p. 638.
3. Martin Duncan, P. A Revision of the Families and Genera of

the Sclerodermic Zoantharia, Ed. and H., or Madreporaria.—Journ. Linn. Soc., Zool. vol. xviii. p. 1.
4. Fowler, G. H. The Anatomy of the Madreporaria, I.—Quart. Journ. Microsc. Science, vol. xxv. p. 577.
5. Koch, G. v. Bemerkungen über das Skelet der Korallen.—Morphol. Jahrbuch, vol. v. p. 316.
6. Moseley, H. N. On the Colouring Matters of various Animals.—Quart. Journ. Microsc. Science, vol. xvii. p. 1, 1877.
7. Hertwig, O. und R. Die Actinien. Jena, 1879.
8. Heider, A. v. Die Gattung *Cladocora*, Ehrenb.—S. B. Acad. Wien, vol. lxxxiv. p. 634.
9. Koch, G. v. Ueber die Entwicklung des Kalkskeletes von *Asteroides calycularis* und dessen morphologischen Bedeutung.—Mitt. Zool. St. Neapel, vol. iii. p. 284.

EXPLANATION OF THE PLATES.

Plate XII.

Fig. 1. Diagram of *Stephanotrochus* to show the arrangement of tentacles, mesenteries, and septa; on the left-hand side are shown the tentacles, arranged in four cycles, *a*, *b*, *c*, and *d*; on the right side above are seen the mesenteries, shaded, in pairs of two sizes *I* and *I''*, with longitudinal muscles facing one another; at *D* is seen the directive mesentery, with its longitudinal muscle facing outwards; the septa in five cycles are numbered from 1 to 5; *p'* and *p''* denote the pali, *C* the columella.

Plate XIII.

Fig. 2. Oral view of *Stephanotrochus mosleyanus*, with the soft parts removed from all except the left upper corner of the coral (nat. size).
3. Aboral view, the tissues being left in the right upper corner.
4. Side view of the coral.
5. View of a secondary and quinary septum, seen from the side: *p'*, palus of secondary; *p''*, palus of quinary septum; *k*, costæ, with blunt points.
6. Section of the end of the knob of a tentacle: *Ec*, ectoderm; *M*, mesoderm; *En*, entoderm; *Th.c*, thread-cells; *Lm*, longitudinal muscle-fibres; *Cm*, circular muscle-fibres.
7. Part of a longitudinal section of a mesentery, showing—*En''*, entocœlic endoderm; *En'*, ectocœlic endoderm; *m''*, longitudinal muscle-fibres of the entocœlic face; *m'*, oblique muscles of the ectocœlic face; *M*, mesoderm lamella.

Plate XIV.

Fig. 8. Ectocœlic face of a larger mesentery, showing arrangement of muscle-fibre lines: *mf*, mesenterial filaments; *o*, ova.
9. Entocœlic face of the same mesentery, showing the longitudinal muscle-fibre lines.
10. Longitudinal section of the ventral end of a mesentery: *cal*, calycoblasts which lay down the columella; *M*, mesoderm; *ov*, ova in all stages of development; *En*, endoderm; *m.f*, mesenterial filaments with pigment-cells, *p*.
11. Central end of a mesentery, with calycoblasts scattered all along the corallum-facing side of the mesoderm; the mesodermal lamella of the mesentery splits to line the columella on each side, and then turns back to line the septum.
12. Shows two isolated calycoblastic cells.
13. Drawn from a flat preparation of calycoblastic cells.

March 2, 1886.

Dr. St. George Mivart, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of February 1886 :—

The total number of registered additions to the Society's Menagerie during the month of February was 79, of which 3 were by birth, 40 by presentation, 14 by purchase, 1 by exchange, and 21 were received on deposit. The total number of departures during the same period, by death and removals, was 99.

Amongst the additions during the month attention may be called to :—

1. Five examples of a large Batrachian of the Argentine Republic, there called "Escuerzo" (*Ceratophrys ornata*), presented by Dr. Frederick C. Strutt, and received February 13th.

2. A Mantled Buzzard (*Leucopternis palliata*) from Brazil, purchased February 15th, being the first example of this fine bird of prey received by the Society.

Mr. John G. Millais, F.Z.S., exhibited an adult male specimen of the Ivory Gull (*Larus eburneus*), which he had shot himself at Thurso, Caithness, on December 30, 1885, during a severe snowstorm from the north. The base of the bill to the end of the nostril in living specimen was light blue, and the point of the same orange-yellow; feet black, and eye surrounded by a ring of orange; the rest of the plumage being entirely white.

Mr. Millais also exhibited an immature specimen of the same species killed at East Haven, Forfar, in January 1879.

Mr. T. D. Cockerell exhibited a living specimen of a variety of *Parmacella valenciennesi*, Webb and Van Beneden, collected by J. H. Ponsonby, Esq., at Tangier, and made the following remarks :—The specimen differs from the typical *P. valenciennesi* in that it is marked with black, the original figure of the species being quite uniform. It may possibly prove to be distinct, but until further details are ascertained it is best classed merely as a variety of *P. valenciennesi*.

A precisely similar form is found at Gibraltar, of which there are details in the 'Journal of Conchology' for January 1886.

The following papers were read :—

1. On a new Pediculate Fish from the Sea off Madeira.

By Robert Collett, C.M.Z.S.

[Received February 12, 1886.]

(Plate XV.)

Fam. Ceratiidæ.

Linophryne, n. gen.

Head enormous; the body slender, compressed, mouth oblique. Spinous dorsal reduced to a single cephalic tentacle, the basal part of which is erect, not procumbent. Teeth in the jaws, on the vomer, and the upper pharyngeals. Gill-openings exceedingly narrow, situated a little below the root of the pectorals. Soft dorsal and anal very short; ventrals none. Abdominal cavity forming a sac, suspended from the trunk. Skin smooth; a long tentacle on the throat.

Linophryne lucifer, sp. nov. (Plate XV.)

The head tetrahedral, with a supraorbital spine; its length is to the total length as 1 to 2·7. Eyes small, situated high up on the side of the head. Teeth of the jaws uniserial, very long; 7 to 9 on each side in each jaw; one or two in front longer than the others; all are movable inwards and covered with skin. Gill-openings narrower than the diameter of the eye. Length of the intermaxillary bone is contained three times in the total length. Cephalic tentacle thick, with a large bulb; the guttural tentacle long, with the end cleft and provided with small papillæ. Colour uniformly black, the top of the cephalic tentacle and the papillæ of the guttural tentacle white (phosphorescent?). Total length of the single specimen 49 millim.

I D. 1; 2 D. 3; A. 2; P. 14–15; C. 9.

Habitat. One specimen, total length 49 millim., from the sea off Madeira (36° N. lat., 20° W. long.), May 1877; preserved in the Zoological Museum at Christiania.

Measurements.

	millim.
Total length to the end of the caudal fin	49
Length to the root of the caudal fin	35
Length of the head to the hind margin of the operculum	18
" " to the end of its spine	22
Length from the snout to the hinder margin of the eye	9
Length to the edge of the distended abdominal sac	39
Length of intermaxillary	16
Length of lower jaw	17
Breadth of the lower jaw	4·5
The greatest depth of the head	19
The depth of the head from the base of the orbital spine	10

	millim.
Breadth of the head across the jaws	16
,, ,, across the base of the orbital spine	10
Length of the body to the commencement of the second dorsal	26
Base line of the second dorsal	6
Depth of the root of the tail	4·5
Diameter of the eye	2·5
Length of the cephalic tentacle (first dorsal)	9
Length of the guttural tentacle	23
Length of the caudal fin	14·5
Length of the pectorals (with the pseudobrachium)	5
Length from the snout to the pectorals (to the root of pseudobrachia)	16

The structure of the body in its natural state can hardly be correctly described from this specimen, in which the whole of the belly exhibits an abnormal distension in consequence of the fish having swallowed a Scopeloid fish, the total length of which is one half longer than itself.

The head is very large, with an enormous mouth and long teeth. The body itself is short and slender, compressed, and with the heavy dependent abdominal cavity, of which the hindermost part extends far beyond the end of the vertebral column.

The greatest depth of the body is at the back of the head, and is precisely the same as the length of the head. The body itself is apparently much lower, and the root of the tail narrow and low.

A thick cephalic spine is to be found on the snout; and under the throat a long tentacle divided at the end, which undoubtedly is phosphorescent, as well as the end of the cephalic spine.

The gill-openings are so narrow that they can only be distinguished with difficulty; their openings are not much larger than the head of a pin.

The head.—Its appearance when viewed from the front is nearly tetrahedral, somewhat compressed, and broadest downwards. Its greatest width is across the angle of the mouth, and is about equal to the length of the intermaxillary bones. The upper profile of the head exhibits a somewhat projecting and slightly outwardly inclined spine above each eye. The breadth of the head across the base of these spines (which form the upper corners of the square when the head is seen from the front) is one third less than the breadth across the angles of the mouth (or the lower corners of the square).

The forehead in front of the orbital spines is concave, with a deep furrow leading to the end of the snout, bounded on each side by a ridge, on which also the orbital spines are projecting; the concavity is somewhat broader downwards than it is above.

There are altogether three spines on each side of the head. One orbital spine is directed upwards and slightly forwards. One spine at the back of the operculum is directed backwards; also a small spine at the back of the lower jaw sloping inwards and downwards;

the last is, however, in the uninjured specimen scarcely perceptible beyond the common skin which covers the head.

The length of the head from the end of the lower jaw to the base of the spine on the operculum is to the total length as 1 to 2·7, this measured to the end of the caudal fin, but only 1·9 in the length to the root of the caudal. Thus the head is about the same as the rest of the body without the caudal fin.

The highest part of the skull is indicated by a protuberance at the back of the head, probably formed by the point in which the *os mastoideum* (*occipit. posterius*) adjoins to the shoulder-girdle.

The mouth is enormously large, with the cleft oblique; the lower jaw is slightly longer than the intermaxillary, and has backwards a considerable width (or about ⅓ of its length).

The length of the jaws is to the total length (to the end of caudal fin) as 1 to 2·8–3·0. At the back of the lower jaw there is a spine slanting inwards and downwards, the length of which scarcely equals the orbital spines.

The eyes are well developed, although small on the whole; the lens is particularly small (about 1 millim.). The diameter of the eye is about 2·5 millim.; it is placed somewhat far forward, or a little more than two orbital diameters from the margin of the upper jaw.

The gill-covers are but incompletely ossified, but their construction cannot be properly examined in this single specimen. The operculum is present as a long styliform bone, which towards its lowest end sends out a backward-directed spine the length of which is 3 millim. (which, however, is completely enveloped in the common skin of the head).

The *præoperculum* appears to be unossified.

The *gill-openings* are extremely small, and are situated at a distance of about half an eye's diameter below the pectoral fins; they form a crescent-formed slit, the height of which is only 2·2 millim.

The *gills* are 2½ pairs, as the second and third branchial arches have a double series, the fourth a uniserial gill. *Pseudobranchiæ* are wanting.

The branchial arches are smooth on their inner surface, without a trace of protuberance or teeth.

The branchiostegals appear to be but five in number; and I cannot, in this little and frail specimen, discover a sixth, which may possibly exist.

The *teeth* are placed in a single row in each half jaw, with a distinct space between each tooth, and consist of long and slender teeth, some of which are very long, while the rest are somewhat shorter. They are finely streaked throughout their length, pointed like awls, and movable inwards, so that the long front teeth lie backwards, the side teeth inwards.

All of them are covered with a jet-black skin, the extension of which cannot with certainty be determined in this specimen; a few of the shorter teeth are still completely covered with it; but the points of long teeth have probably always been bare.

The number of teeth in each half of the jaw is 7–9, to which

should be added one or more accessory teeth, which are quite short, and are situated immediately at the base of the longest teeth; probably these accessory teeth are meant to supplant the others when these are shed or lost, which may often happen when devouring the huge prey.

In the intermaxillary, the longest teeth in front have a length of 6 millim., and are quite straight (on the left side it is not fully developed); the other teeth are shorter, not more than 3 millim. long. The total number of teeth in each intermaxillary is 8 or 9, to which must be added 2–3 accessory teeth situated at the base of the longest.

In the lower jaw the two foremost teeth (and the 4th) are particularly long, the others somewhat shorter. In each half jaw there are seven teeth, to which must be added the two accessory teeth situated at the base of the longest. The innermost tooth in the jaw is quite small.

Of the two long front teeth, the first is somewhat shorter than the second, considerably curved; its length is 4·5 millim. The second is the longest of all the teeth; it is 8 millim. in length, and is also a little curved. It is placed a little inside of the row of other teeth, and has a short tooth at its base. The fourth has a length of 5 millim., and it also has an accessory tooth; the others are shorter.

The upper pharyngeal bones have each a group of about six teeth forming two long irregular rows. The lower pharyngeals do not appear to have teeth.

The vomer has a single tooth, which, like the pharyngeal teeth, is about the length of the shorter teeth in the jaws, and is slightly curved.

Cephalic spine.—The first dorsal appears as a single tentacle on the forehead (the cephalic spine). Its basal element is not subcutaneous and procumbent, but erect and continuous with its distal part. When laid back its bulb reaches to the hind margin of the eyes, or just between the two orbital spines, in which position it fills up the concavity on the forehead. It is situated at the front margin of the snout. Its length is 10 millim., of which half comprises the peduncle, which is rather thick, especially towards its base, the other half the head, which forms an oblong bulb, the breadth of which is 3 millim., or about the same as the diameter of the eye.

The bulb ends in a pair of exceedingly short and slender threads, which, in a good light, can be seen to have small papilla-shaped bodies on one side, of the same kind as the papillæ on the guttural tentacle, but much smaller (probably answering to the "scales" which, according to Lütken, cover the threads of the tentacles of the Himantolophoids). The colour of this cephalic spine is jet-black as far as the middle of the bulb; its other half is white (perhaps silvery in the living specimen), as in most or all the other species of the Ceratiidæ.

The fins.—The second dorsal is situated far behind, close into the caudal fin, although separated from it by a distinct space. It has three single rays, which at their base are enveloped with a thick

skin, a continuation of that of the body. It is directed backwards, and the point of the fin extends a little beyond the root of the caudal fin (about an eye's length).

The anal fin is much like the second dorsal, and is placed right beneath it; it has two rays, which also are single.

The caudal fin consists of nine rays, four in the upper, five in the lower half. Of these the outermost are somewhat shorter than the middle ones; thus the fin is somewhat pointed. The four middle rays are bifid from below the centre; the others are simple.

The ventral fins are wanting.

The pectorals are small and rounded; the pseudobrachia very short. On the right side there are 14, on the left side 15 rays, most of which are simple, and only the middle ones seem to be bifid at the ends. The length of the pectoral (including the pseudobrachium) is only 5 millim., or the length of the bulb of the cephalic spine.

The guttural tentacle is nearly 3½ times as long as the tentacle on the snout (23 millim.), or has about the same length as the distance from the front of the eye to the root of the tail. It is placed on the throat, at a distance from the symphysis about equal to half the length of the jaw.

It is thinner than the cephalic spine, and divides itself at the end into two short pointed blades, the length of each being 6 millim. Whilst the tentacle otherwise is black, the inner edges of these blades are white, like the upper half of the snout tentacle, and are furnished with a row of round papillæ, about 30 on each, resembling a chain of pearls. These small bodies undoubtedly have a use, either as organs of sense or as the source of the phosphorescent light [1].

The abdominal cavity is greatly distended, somewhat flattened underneath, which is in consequence of the position the swallowed fish has taken up. This fish, which undoubtedly is a *Scopeloid*, has a length of about 70 millim., and is therefore not far from being half a length longer than the specimen itself. It lies with the head and the caudal fin bent backwards and the belly turned down.

Anus. Its position cannot be given with certainty.

The skin is smooth throughout, and covers all the spines on the head as well as the teeth. Lateral line or mucous glands cannot be detected.

The colour everywhere is jet-black, with the exception of the upper half of the bulb of the tentacle on the snout, and the inner margins of the ends of the guttural tentacle, which (in the preserved specimen) are white, but which in the living fish have probably been silvery and phosphorescent.

The fin-rays are also black, the membrane blackish. The mouth is also black, as well as the covering of the teeth.

[1] A similar phosphorescent guttural tentacle is mentioned in *Eustomias obscurus*, captured from enormous depths during the voyage of the 'Talisman' ('La Nature,' 1884, p. 184; Day, 'Fishes of Great Britain and Ireland,' p. xxvii).

Affinities.—*Linophryne lucifer* belongs to the family *Ceratiidæ*, and resembles *Melanocetus johnsonii*, Günth. (Proc. Zool. Soc. 1864, p. 301) in several particulars, viz. that only one single spine in the first dorsal is developed (the nasal tentacle), in the enormous mouth, the almost square head, as well as in its small size, its black and smooth skin, and pendent abdominal cavity, besides in its having $2\frac{1}{2}$ pairs of gills and unarmed branchial arches; but it differs from this species by the formation of its teeth, the oblique mouth, its rudimentary gill-openings, its short and thick nasal tentacle, in the number of its fin-rays, the spiny armature of its head, and its comparatively well-developed eye.

It differs from all the *Ceratiidæ* in its having a long guttural tentacle, also in the low number of rays in its second dorsal and anal fins.

Locality.—A single specimen, with a total length of 49 millim., was caught by Capt. P. Andresen in May 1877 floating in the sea (about 36° north latitude, 20° west longitude) 3° N.W. of Madeira, and was presented to the Museum of the Christiania University. During several years it remained unnoticed in the private house of the late Director of the Museum, Prof. Esmark, but after his death it was returned to the Museum (December 1885).

Mr. Andresen, who is now residing in Christiania, reports to me that on the day mentioned he was on a voyage to the West Indies. He was capturing turtle in his boat; there was a heavy swell, but the water was smooth. After a time he caught sight of this little black fish, which lay on the surface quite alive, but almost motionless, which was not surprising when it was discovered that it had just swallowed a fish longer than itself. It did not lie on its side, but was apparently unable to swim away. By getting the bailer under it, he lifted it out with ease, and in order to keep it fresh he gave up his search for turtle and rowed back to the ship, where it was placed in spirit for preservation.

EXPLANATION OF PLATE XV.

Fig. 1. Full view of *Linophryne lucifer*, ½.
2. Front view of head, showing open mouth.
3. Guttural tentacle, ½.

2. Note on the External Characters of *Rhinoceros simus*. By P. L. Sclater, M.A., F.R.S., Secretary to the Society.

[Received February 24, 1886.]

(Plate XVI.)

The heads of the two African Rhinoceroses exhibited by Mr. E. Gerrard, Jun., at the last meeting of the Society, and again placed on the table this night by Mr. Gerrard's kind permission, have

enabled me to make a comparison between *Rhinoceros bicornis* and *Rhinoceros simus*, which I have never before had an opportunity of doing. Indeed, as is well known, such specimens of the latter species, with the exception of a single immature example in the British Museum, are almost unknown in Europe.

On looking at the two heads now before us side by side, the points by which this part of the two animals may be distinguished present themselves very appreciably. In the first place, as is already well known, the "White" or "Square-nosed" Rhinoceros, as it is much better called, is distinguished by its short upper lip, which is quite apparent in the example now before us. In *R. bicornis* the central portion of the upper lip is far extended, and forms a quasi-prehensile organ. This is sufficiently manifest in the specimen now on the table, but is still better seen in the living example of the same animal in the Society's Gardens.

A second point in which the heads of the two African Rhinoceroses differ materially is in the size and shape of the ears. In *R. bicornis* (Plate XVI. fig. 2) the ear-conch is much rounded at its extremity and edged by a fringe of short black hairs which spring from the margin. In *R. simus* (Plate XVI. fig. 1) the ear-conch is apparently much more elongated and sharply pointed at its upper extremity[1], where the hairs which clothe its margin constitute a slight tuft. While the upper portion of the ear-conch is much more expanded in *R. simus* than in *R. bicornis*, in the lower portion the two margins are united together for a much greater extent, and form a closed cylinder, which in the present specimen rises about 3 inches above the base. The total length of the ears in the present specimens is, in *R. simus*, 12·5 inches and in *R. bicornis* about 9·5 inches.

A third point in which the two species appear to differ is in the shape of the nostrils, which, judging from the present specimens, are, in *R. simus*, elongated in a direction parallel with the mouth, while in *R. bicornis* they are more nearly of a circular shape. Again the eye in *R. simus* appears to be placed further back in the head than in *R. bicornis*.

As regards the well-known differences in the skulls of these two Rhinoceroses, which are obvious enough on a glance at the specimens on the table, I will say nothing on the present occasion, but simply refer to De Blainville's figures (Ostéographie, Rhinoceros, pl. iii. and iv.), and to Prof. Flower's remarks on this subject in the 'Proceedings' of this Society for 1876 (p. 452).

[1] This peculiar feature is well shown in the figures of *R. simus* given by Smith (Ill. S. Afr. Zool. Mamm. t. xix.), and Harris (Portraits, &c. pl. 19).

3. Note on the Air-sacs of the Cassowary. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society.

[Received March 1, 1886.]

The following note refers to a male *Casuarius uniappendiculatus* which died in the Society's Gardens on February 15th of the present year.

Since no description of the respiratory organs of this bird has, so far as I know, been published, I have thought it worth while to bring a note upon the subject before the Society, to supplement Prof. Huxley's paper upon the respiratory organs of *Apteryx*[1] and Prof. W. N. Parker's 'Note' upon the same structures in *Rhea*[2].

As regards its air-sacs the Cassowary appears to resemble *Apteryx* much more closely than *Rhea*, though differing slightly from the former. In *Apteryx* the main difference in the air-sacs from those of Carinate Birds is in the small extent of the abdominal air-sac. "In *Apteryx* the whole of this sac is enclosed between the oblique septum and the pulmonary aponeurosis, the dissepiment between its loculus and that of the posterior intermediate sac being situated almost midway between the second dissepiment and the posterior extremity of the pneumatic chamber. In the Duck, on the contrary, the dorsal end of this dissepiment is attached close to the posterior extremity of the lung, and thence slopes very obliquely backwards. The capacity of the posterior intermediate air-sac thus becomes greatly increased. But, as the capacity of the posterior air-sac is also vastly greater than in *Apteryx*, its posterior wall has been, apparently, driven out, like a hernial sac, between the peritoneum and the parietes, and projects into the abdominal cavity." (*Loc. cit.* p. 566.)

In *Rhea* "the anterior and posterior intermediate and the posterior air-sacs are almost precisely similar to those of the Duck. The dorsal end of the dissepiment between the posterior intermediate and the posterior sac slopes backward; and the posterior wall of the latter has been, as Prof. Huxley describes it, 'apparently driven out like a hernial sac, between the peritoneum and the parietes' projecting almost to the posterior end of the abdomen." (Parker, *loc. cit.*)

In *Casuarius uniappendiculatus* the anterior and posterior intermediate air-sacs are of about the same size and are separated from each other and from the posterior sac by erect, almost vertical dissepiments, which are entirely parallel with each other; the dissepiment which separates the posterior air-sac from the one in front does not slope backwards any more than does the dissepiment in front of it. The posterior air-sac is entirely shut off from the abdominal cavity by the oblique septum; there was no trace whatever of any prolongation of its walls among the coils of the intestines; the whole of the sac, as in *Apteryx*, is enclosed between the oblique septum and the

[1] P. Z. S. 1882, p. 560.

[2] P. Z. S. 1883, p. 141.

pulmonary aponeurosis. The shape of the posterior air-sac is, however, rather different from that of the corresponding air-sac in *Apteryx*. In the latter bird, according to Prof. Huxley's figure (*loc. cit.* figs. 1 and 2, v.), the posterior air-sac is rather smaller than the preceding posterior intermediate air-sac, and does not extend further back than the lung. In *Casuarius* the posterior air-sac forms anteriorly a rounded capacious cavity, which pretty nearly corresponds in size to that of the posterior intermediate sac; the cavity is, however, prolonged for some way backwards as a narrow interspace between the oblique septum and the parietes, but this posterior region is altogether outside the abdominal cavity and does not in the least resemble the condition of the posterior air-sac which is characteristic of the Carinatæ.

The pulmonary aponeurosis is thick, and costo-pulmonary muscles arising from the ribs are spread out over its surface; the oblique septum itself is stout and thick.

Each lobe of the liver is contained in a separate compartment as in so many other birds (see P. Z. S. 1885, p. 836); the gizzard is enveloped in a special coat of peritoneum, while the intestines are covered below by a stout horizontal septum which laterally becomes indistinguishably fused with the oblique septum; in this respect therefore the Cassowary agrees with the Emu and with many Carinatæ. Between the horizontal septum and the ventral peritoneum was a large mass of fat.

The special resemblance between *Casuarius* and *Apteryx* in the structure of the respiratory organs is not altogether in accord with the results obtained from the study of the structure of other organs.

Prof. Garrod [1] divides the Struthiones into three families, *Apteryx* being the type of one; *Casuarius* and *Dromæus*, *Struthio* and *Rhea* form the two other families. A study of the osteology has led Prof. Mivart [2] to a similar conclusion. The results contained in the present Note confirm the opinion expressed by these two authors that *Casuarius* and *Rhea* should be separated. I have not had the opportunity of examing the air-sacs of the Ostrich, but, judging from a sketch left by the late W. A. Forbes, they appear to be like those of *Rhea*. In *Dromæus* the air-sacs are not similar to those of *Casuarius*, but agree with *Rhea* in the extension of the posterior air-sac into the abdominal cavity. At the end of his paper "On the Axial Skeleton of the Struthionidæ" Prof. Mivart represents the affinities of the Struthious birds in a phylogenetic scheme. Removing *Dromæus* from *Casuarius* and placing it nearer to *Rhea* and *Struthio*, that scheme will exactly represent the position of the different genera of *Struthiones* as indicated by the structure of their respiratory organs.

[1] Coll. Papers, p. 219.

[2] Trans. Zool. Soc. vol. x. p. 21.

4. On the Syrinx and other Points in the Anatomy of the Caprimulgidæ. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society.

[Received March 1, 1886.]

It has been known for a long time, and the fact is recorded in most text-books of comparative anatomy[1], that *Steatornis* among the Caprimulgidæ and *Crotophaga* among the Cuculidæ are distinguished from the other genera of their respective families, as well as from all other birds, by the possession of a bronchial syrinx. The voice-organ of these two birds, instead of being situated at the junction of the trachea with the bronchi, as in the vast majority, or being formed by a modification of the lower portion of the trachea, as in the tracheophone Passeres, is produced by a modification of certain of the bronchial rings some way from the bifurcation of the bronchi. The structure of the syrinx of the Guacharo was first made known by Johannes Müller[2], and subsequently described and figured by Garrod[3]. I am unacquainted with any exact description of the syrinx of *Crotophaga*, which, as I have myself indicated[4], presents the following resemblances to, and differences from, the syrinx of *Steatornis*. In both types the bifurcation of the trachea to form the bronchi takes place precisely as it does in the Mammalia; that is to say, the anterior bronchial rings are complete rings, and in no way different from the rings of the trachea. The membrana tympaniformis does not commence until about the tenth (*Crotophaga*) or thirteenth (*Steatornis*) bronchial rings; at this point the rings not only cease to be complete rings but alter in their character, being narrower and softer than the anterior bronchial rings, and separated from each other by wider intervals of fibrous tissue; the single intrinsic muscle is inserted on to the first of these modified bronchial rings; the last two or three rings before that on which the muscle is inserted are semirings, the membranous intervals between their inner extremities, which constitute the upper part of the membrana tympaniformis, becoming gradually less and less, until it disappears entirely and the rings are complete rings. These, however, although they support the anterior part of the membrana tympaniformis, agree in their structure with the tracheal and anterior bronchial rings; like them they are placed close together and ossified; there is no transition between the anterior and posterior bronchial semirings; their character abruptly changes at the semiring on to which the intrinsic muscle is attached. In *Crotophaga* the membrana tympaniformis extends back unto the entrance of the bronchus into the lung; in *Steatornis* the membrana tympaniformis

[1] Huxley, 'The Anatomy of Vertebrated Animals,' London, 1871, p. 315; Gegenbaur's 'Comparative Anatomy,' French Trans. by C. Vogt, p. 776.

[2] Bericht d. Akad. Wiss. Berlin, 1841, p. 172; Müll. Arch. 1842, p. 1; Stimmorg. d. Passerinen, Berlin, 1847, p. 9.

[3] Coll. Papers, p. 188.

[4] P. Z. S. 1885, p. 173.

is of less extent, and there is an interval between it and the lung occupied by *complete* bronchial rings.

In the paper referred to I have described the syringes of other genera of the Cuculidæ: in some genera (e. g. *Cuculus*) the syrinx is tracheo-bronchial; in others (e. g. *Centropus*) the syrinx presents a very close approximation in its structure to the bronchial syrinx of *Crotophaga*. In these Cuckoos the intrinsic muscles of the syrinx are, as in *Crotophaga*, attached a long way down the bronchus, but the bronchial rings anterior to the attachment of these muscles are not complete rings as in *Crotophaga*, but are very nearly so, inasmuch as their free extremities are separated by a very short extent of membrane, which widens out below the attachment of the syringeal muscles to form the membrana tympaniformis; there is, moreover, a similar change in the nature of the bronchial semirings at the point where the syringeal muscles are inserted.

In the Caprimulgidæ there is a variation in the structure of the syrinx which is closely parallel to that of the Cuculidæ.

Three types of syrinx can be recognized in this group, in the genera which I have myself been able to examine, which are:

Caprimulgus.	*Batrachostomus.*
Chordeiles.	*Podargus.*
Nyctidromus.	*Steatornis.*
Ægotheles.	

In the first four genera the syrinx is tracheo-bronchial; in *Batrachostomus* and *Podargus* the syrinx approximates in structure to the purely bronchial syrinx of *Steatornis*.

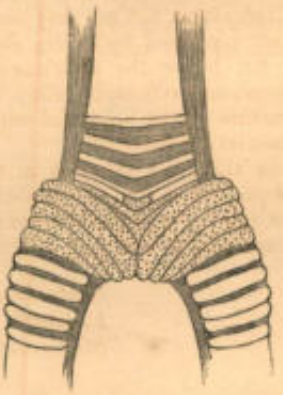
I need not redescribe the syringes of *Caprimulgus* and *Chordeiles*, which are already known from the investigations of Cuvier, Nitzsch, and Audubon. The remaining genus which possesses a tracheo-branchial syrinx, viz. *Nyctidromus*, has not, I believe, been described.

In *Nyctidromus* (fig. 1) the syrinx is not widely dissimilar from that of *Caprimulgus*. The tracheal rings are separated mesially, both on the anterior and posterior aspect, by considerable membranous intervals; the last four are, however, closely applied, as shown in the accompanying drawing (fig. 1), which represents the syrinx viewed from in front; the terminal rings of the trachea are much more slender than the bronchial semirings, and the last appears to be defective laterally, or is covered by the succeeding first bronchial semiring. The last two rings of the trachea, as well as the first five bronchial semirings, are ossified; the ossification has also extended on to the sixth bronchial semiring and the antepenultimate tracheal ring. The intrinsic muscles are attached on to the first bronchial semiring. Posteriorly is a rhomboidal ossified plate, to which the pessulus is attached; it represents the middle portion of the last four or five tracheal rings, but is separated from them completely.

The syrinx of *Ægotheles* is displayed in the accompanying drawing (fig. 2). The syringeal muscles are inserted on to the third bron-

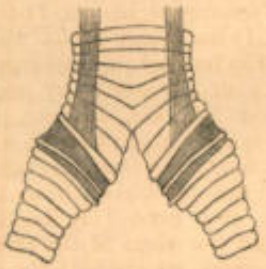
chial semiring, which differs from the two preceding in being more slender; the two first bronchial semirings are stout and closely applied. The terminal ring of the trachea is pointed downwards anteriorly, as shown in the figure; posteriorly it is incomplete; the penultimate, antepenultimate, and the next tracheal rings are

Fig. 1.



Syrinx of *Nyctidromus albicollis*.

Fig. 2.



Syrinx of *Ægotheles novæ-hollandiæ*.

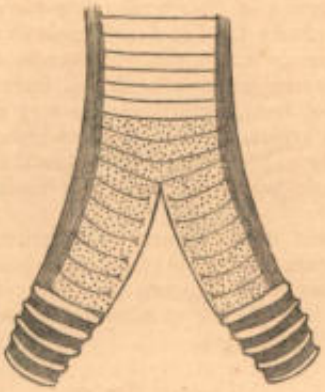
separate anteriorly, but posteriorly are fused for a short space in the middle line, and are continuous with the pessulus, which arises anteriorly from the last tracheal ring.

Batrachostomus.—I am indebted to the kindness of Mr. R. Bowdler

Sharpe for the opportunity of examining a syrinx of this bird. The accompanying drawing (fig. 3) illustrates the syrinx as seen from behind.

The last ring of the trachea is complete in front and incomplete behind. The intrinsic muscles are attached to the middle of the sixth bronchial semiring, though, when viewed from behind, it would appear that the seventh bronchial semiring served for the attachment of these muscles; this appearance is caused by the incomplete terminal tracheal ring. The six anterior bronchial semirings are ossified and firmly united to each other and to the trachea; both the anterior and posterior extremities of the successive semirings are united by a continuous bar of cartilage. The remaining bronchial semirings differ to a very

Fig. 3.



Syrinx of *Batrachostomus*.

marked degree from the anterior ones; they are slender and unossified, and separated by widish membranous intervals; there are about ten of these rings in either bronchus. The membrana tympaniformis, which unites together the opposite sides of each bronchus, forming its inner wall, is of equal diameter both in the posterior and anterior regions of the bronchus; there is a marked constriction, however, at the point which divides the anterior from the posterior region of the bronchus.

Podargus cuvieri.—The syrinx of this Goatsucker appears to be formed upon the same type as that of *Batrachostomus*, and to show the same characters even to a greater degree. I have not been able to examine the organ itself; the following remarks are based upon a sketch made by the late Prof. Garrod[1].

[1] There is a brief description, unaccompanied by any figure, in Stannius' 'Lehrbuch der Vergleichenden Anatomie,' Bd. ii. p. 321.

The intrinsic muscles of the syrinx are inserted on to the fifteenth or sixteenth bronchial ring, much lower down therefore than in *Batrachostomus*; the first two bronchial rings are complete; the following fourteen are semirings, but are wide, firmly united to each other, and ossified; the membrana tympaniformis forms the inner wall of this and of the following section of the bronchus. The posterior section of each bronchus, as in *Batrachostomus*, is formed of slender cartilaginous semirings separated by wide membranous intervals.

As far as the structure of the syrinx is concerned *Steatornis* stands alone; *Podargus* and *Batrachostomus* are closely similar to each other, and are transitional between such genera as *Caprimulgus* and *Steatornis*; the insertion of the intrinsic muscles so far down the bronchus, and the similarity between the anterior rings of the bronchus and those of the trachea, is evidently an approach in structure to the bronchial syrinx of *Steatornis*. *Ægotheles* resembles *Batrachostomus* more closely than it does *Caprimulgus*, but the number of bronchial semirings which intervene between the trachea and the insertion of the syringeal muscles is still further reduced. *Caprimulgus*, *Chordeiles*, and *Nyctidromus* are very closely allied in the structure of their syrinx, which is tracheo-bronchial, and shows no approach to the bronchial syrinx of *Steatornis*, as do the syringes of *Podargus*, *Batrachostomus*, and (to a very much less extent) *Ægotheles*.

The arrangement of the genera of Caprimulgidæ, as indicated above by the structure of their syrinx, is, I believe, in accord with the opinion of most ornithologists. With regard to other structural characters, the following notes upon certain of the viscera and muscles appear to be worth recording.

Visceral Anatomy.

The intestines of the Caprimulgidæ are furnished with cæca, with the exception of those of *Ægotheles*. Mr. Forbes has left a MS. note to this effect, and I cannot find any trace of cæca in the spirit-preserved specimen of the last-mentioned form. In all the genera the left lobe of the liver is rather the smaller, and a gall-bladder is present save in *Chordeiles*[1].

The air-sacs in one specimen of *Steatornis* were rather peculiar in structure. The points in which they were found to differ from other birds are in the posterior intermediate air-sac. This sac on both sides of the body is considerably larger than the preceding anterior intermediate sac, and is furnished with two principal ostia placed near to the external border of the lung. These apertures have a different position in relation to each other on either side of the body; in the right lung these apertures do not both open into the posterior intermediate air-sac as they do on the left side of the body; the most anterior of the two ostia opens into a small wedge-shaped air-cell, which is completely separated by septa both from the posterior

[1] Garrod MS.

and anterior air-sacs; towards the median line, however, its limiting septa coalesce, and here the anterior and posterior intermediate air-sacs follow each other directly; this supplementary air-sac therefore is placed upon the outer margin of the lung and does not extend to the middle line. The other specimen of *Steatornis* unfortunately had the lungs destroyed, so that I cannot positively state whether the above-described peculiarity is merely a variation or characteristic of the bird, though on one side there were certainly two ostia to the posterior intermediate sac.

Myology.

The disposition of the *tensores patagii* varies characteristically in the different genera. In *Caprimulgus*, *Nyctidromus*, and *Chordeiles* there is a biceps-slip, which is absent in *Steatornis*, *Podargus*, and *Ægotheles*. Prof. Garrod has figured the patagial muscles of *Steatornis* (*loc. cit.*), and I find them to be exactly similar in *Podargus*. *Ægotheles* is a little different from either of these genera: there is no anterior branch to the tendon, or only just a trace of one, close to the insertion on to the extensor muscle. In *Caprimulgus*, *Chordeiles*, and *Nyctidromus* there is an absolute similarity in respect of these muscles; since *Caprimulgus* has been already figured by Garrod (*loc. cit.* p. 185), there is no necessity to illustrate the two remaining genera, as it would be merely a repetition of his figure.

A peculiarity in the myology of *Steatornis* is not referred to by Prof. Garrod in his account of the anatomy of that species; that is the presence of an *expansor secundariorum*. In a later paper, where a list is given of those families that are characterized by having an expansor secundariorum muscle, he states that the Coraciidæ are the only Anomalogonatous birds which are thus provided. In the specimen of *Steatornis* before me there is a well-developed expansor secundariorum arising in the usual way and attached to the *teres* near to its insertion. The termination of the expansor secundariorum in *Steatornis* is therefore similar to that which has been recorded by Garrod in *Ortyx*, *Numida*, &c. Since noting this fact I see that Mr. Forbes[1] has already mentioned it.

The *biceps* muscle is split about halfway down into two distinct tendons of insertion, which are severally attached to the radius and ulna. In *Podargus*, *Ægotheles*, and *Nyctidromus* the biceps is similarly divided into two, the division passing for a certain distance into the substance of the muscle itself, and not being merely restricted to its tendon of attachment. This structural feature is not peculiar to the Caprimulgidæ, but is found in other families of birds.

In all the Caprimulgidæ that I have dissected, the *anconeus longus* has a tendinous humeral head.

The *peroneal* muscles vary in the different genera of Caprimulgidæ: in *Steatornis* and *Ægotheles* only the *peroneus brevis* is present; in *Podargus* both peroneals are present with the usual attachments; in *Nyctidromus* I could only find the *peroneus longus*.

[1] Coll. Papers, p. 346.

Dr. Gadow, in Bronn's 'Thierreichs' (Bd. vi. Abth. iv. p. 177), has referred to the double condition of the tendon of the *tibialis anticus* in *Podargus*; this statement I am able to confirm from my own dissection of that bird; but in the other genera this muscle has a more normal arrangement, being undivided at its extremity. The only other birds in which I have found a similar disposition of the tibialis anticus are the Owls (*Strix pratincola*); but Dr. Gadow has mentioned *Chrysotis* as another instance.

Steatornis differs from the other genera in having no femoro-caudal muscle; in the remaining genera the formula on Garrod's system is AXY[1].

Steatornis therefore agrees with *Podargus* and *Ægotheles* in the absence of a biceps slip to the patagium; while those genera which agree with each other in the possession of a tracheo-bronchial syrinx, viz. *Caprimulgus*, *Nyctidromus*, and *Chordeiles*, have a biceps slip; *Steatornis* is peculiar in the absence of the femoro-caudal muscle, and in the presence of an expansor secundariorum; while *Ægotheles* appears to differ from its allies in having no cæca, and also in the structure of the patagial tendons.

I am unfortunately unable to give any account of the visceral anatomy and myology of *Batrachostomus*, which I should imagine will be found to agree pretty closely with *Podargus*.

All these facts lend additional confirmation to the generally accepted view that *Steatornis* is a peculiar type of Goatsucker and needs a special subfamily to itself. It evidently, however, comes nearest to *Podargus*, *Batrachostomus*, and *Ægotheles*; and the fact that all these genera lay white eggs[2] is so far confirmatory of the anatomical resemblances; in the other Goatsuckers the eggs are coloured. A second subfamily will include *Podargus* and *Batrachostomus*, while *Ægotheles* ought perhaps to be regarded as the type of a third subfamily. The remaining genera, *Caprimulgus*, *Chordeiles*, and *Nyctidromus*, belong to the fourth subfamily.

The Steatornithinæ are at one extreme, and the Caprimulginæ at the other; *Podargus*, *Batrachostomus*, and *Ægotheles* are much nearer to *Steatornis* than to *Caprimulgus*, but should be placed in an intermediate position.

This view of the affinities of the different genera of Caprimulgidæ almost entirely bears out the scheme of classification proposed by Mr. Sclater (*loc. cit.*).

[1] Coll. Papers, p. 346.
[2] *Cf.* P. L. Sclater, P. Z. S. 1866, p. 127.

March 16, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

Mr. F. D. Godman, F.R.S., exhibited a series of examples of a Butterfly, *Danais plexippus*, from various localities, and made remarks on its distribution, which seemed to be gradually extending itself all over the world.

Professor Bell stated that the species of *Balanoglossus*, an imperfect example of which he had exhibited to the Society on November the 17th of last year, had been described and named by M. R. Koehler, who had called it *B. sarniensis* [1]; the specimen on which his description was based had also come from the island of Herm. Since the reading of that description, M. G. Pouchet [2] had reported to the Academy of Sciences that the species in question had been found at various localities on the northern and north-western coasts of France.

The following papers were read:—

1. On new Genera and Species of *Endomychidæ*.

By the Rev. H. S. Gorham, F.Z.S., F.E.S.

[Received March 5, 1886.]

(Plate XVII.)

The object of the following descriptions is to make known several most interesting and beautiful Coleoptera of the family *Endomychidæ* from various sources, but which are chiefly due to Mr. George Lewis's collections made in Ceylon in 1882–3. A portion, however, are species that have been long known to me, as they are based on specimens collected by Mr. Bates on the Amazons. Of these there were mostly but one or two of each species, and it would no doubt have been satisfactory to have seen more examples; of this, however, there seems but slender hope, while if left undescribed the specimens are practically lost. Two or three most interesting species, forming a new genus, are from examples in Mr. Cowan's Madagascar collection; for the opportunity of describing these my thanks are due to Dr. Sharp.

Spathomeles.

1. Spathomeles inflatus. (Plate XVII. fig. 5.)

Oblongus, niger, nitidus; elytris piceo-purpurascentibus, marginibus nigris, humeris calloso-inflatis. Long. 10 *millim.* ♀?

Hab. Ceylon.

Head, antennæ, legs, prothorax, and underside shining black.

[1] Comptes Rendus, cii. (25 Jan. 1886) p. 224.
[2] *L. c.* p. 272.

Head with a few scattered but distinct punctures; club of the antennæ rather lax and dull. Thorax shining, not punctured, but with the surface uneven; anterior margin deeply excavated for the head, and with the anterior angles turned inwards; the sides much rounded in front; the disk with a short central elongate impression, and a round one on each side; the sides much puckered. Elytra smooth and waxy, impunctate; all the disk of a pitchy-purple tint, which in life was, as Mr. Lewis informs me, of a most beautiful violaceous colour. They have a double, not much elevated, tumidity each side of the scutellum. The humeral callus is much inflated, to the extent of about a quarter of the length of the elytra; this tumidity is scarcely carinate and not spinose; the reflexed margin of the elytra is complete, running as a fine line beneath the callus up to the basal angle; the epipleural fold is black and shining. The anterior tibiæ are very faintly incurved, and compressed into a shallow spoon-shaped hollow at their apices, and the middle pair are more strongly incurved at their tips, the hind pair slightly so; all the tibiæ have the apices pubescent inwardly; the hair at the tips is golden.

Of this very singular and beautiful *Spathomeles* a pair were beaten off a dead branch in the jungle by Mr. Lewis at Dickoya, at 5000 feet elevation.

2. Spathomeles ornatus.

S. decorato *valde affinis, oblongus, niger, nitidus; elytris subviolaceis, maculis tribus elevatis, una basilari rotundata, una ante medium transversa in medio constricta, una subapicali sublunulata, luteis. Long.* 13–15 *millim.* ♂ ♀.

Mas. *Elytris spina dorsali brevi obtusa, femoribus anticis, tibiis mediis ante apicem dentatis, tibiis posticis ante medium angulariter late dentatis.*

Hab. Assam.

Very closely allied to *S. decoratus*, Gerst., and perhaps not more than a geographical form; the evident toothing of the hind tibiæ is, however, very important, and the union of the two middle yellow spots, which in *S. decoratus* are, so far as I have observed, always separate, seems to point to a permanent specific difference. The spots are all rather more developed than in *S. decoratus*; the basal one is round.

One male and two female specimens.

Stictomela, gen. nov.

Corpus ovatum. Elytris convexis, maris haud spinulosis. Prothorax antice ampliato-rotundus. Prosternum apice truncatum, coxas anticas superans. Mandibulæ apice bidentatæ. Palpi maxillares articulo ultimo conoideo apice minute truncato.

A genus very nearly approaching *Spathomeles*; the points in which it principally differs are, that in the males the elytra are not armed with a spine, and the prothorax is differently shaped, resembling more that of the *Amphisterni* of the second section without

spines. The apex of the prosternum is not so widely rounded but submucronate. The apex of the jaws is notched, much as in *Encymon* and *Engonius*, the teeth being of equal length and the exterior one not bifid. The front tibiæ of the males have a very small tooth near their apex. *Engonius*, to which this genus approaches in some of its characters, has the apex of the elytra obliquely truncate, so that they are open at the sutural angle; in the present genus the elytra are together uniformly rounded.

1. STICTOMELA CHRYSOMELOIDES. (Plate XVII. fig. 6.)

Oblonga, elytris apice æqualiter rotundatis, nigro-ænea, nitida; capite prothoraceque inæqualibus, crebre sat fortiter punctatis, hoc profunde canaliculato; elytris crebrius subtiliter punctatis, perobsolete subsulcatis, callo humerali modice elevato, obtuse carinato, punctisque quatuor aurantiacis, duobus basalibus, duobus subapicalibus, oblique positis. Long. 9 *millim.* ♂ ♀.

Mas. *Tibiis anticis ad apicem intus excisis, intermediis leviter curvatis, apice mucronatis.*

Hab. Dickoya, Ceylon.

Head brassy black, a little shining; epistoma thickly and strongly punctured, posterior part less thickly; antennæ as in *Spathomeles*, but the club rather lax, apical joint obliquely compressed at the tips. Thorax with the surface shining but uneven, the principal impression being a central channel with a punctiform pit on each side in the middle, a basal transverse line, and the ordinary basal sulci; the sides are, however, wrinkled; the lateral margins are much rounded in front, and the front margin rather deeply excavated and bisinuate, the front angles being acute. The humeral callus is raised into a blunt carina, terminating in the external one of two basal, orange, round spots; the two apical ones are placed somewhat obliquely, that nearest the suture being furthest from the apex, and oblong but irregular in shape. The femora are clavate and distinctly punctured; the tibiæ are bent a little in both sexes, but more strongly so in the male, and in that sex terminate inwardly in a short mucro; they are pubescent at the tips. The tarsi and claws are pitchy, clothed with golden pile beneath. The intercoxal plate of the basal ventral segment is sparsely but deeply punctate.

Four specimens, three males and one female, of this beautiful species were captured by Mr. Lewis.

2. STICTOMELA OPULENTA.

Oblonga, nitida, nigra; elytris confertim crebrius punctatis, singulis maculis sex rubris, tribus basalibus, tribus subapicalibus irregularibus, quasi fasciam formantibus. Long. 10 *millim.* ♂.

Mas. *Tibiis anticis dente parvo adjacente, juxta apicem infra dentem excisis; segmento apicali ventrali, tuberculo instructo.*

Hab. Ceylon.

Head strongly and deeply punctured, the epistoma especially so, with fewer and more scattered punctures; antennæ as in *Engonius*, but with the club a little more lax. Thorax uneven but shining,

with a marginal line round the entire edge uniting with the central channel in front; front margin deeply bisinuate; sides hardly so much rounded in front as in *S. chrysomeloides*. Elytra longer than in that species, thickly and distinctly punctured, hardly any trace of sulcation or striation; shoulders with a callus well raised, ending in a deep red spot, another spot near the scutellum, and a third between these two; posteriorly are two small oblong spots (united in the specimen described) near the suture about one third from the apex, and another between these and the margin. There is a fine sutural stria for the whole length of the elytra, and the margin is narrowly reflexed. Legs and underside shining black; femora punctate, but more finely than in *S. chrysomeloides*; anterior pair in the male compressed at the tip and with a very small fine calcar above the spatulate compression. The tubercle on the apical ventral segment is squarish and impressed on its top so as to seem faintly bidentate.

A single male specimen is all that Mr. Lewis secured of this species.

Cymones.

Characteres plerumque ut in genere Encymon; *differt mesosterno haud transverso, prothoracis basi medio vix marginato, sulco transverso nullo, antennarum clava elongata, laxe articulata, articulis nono et decimo vix latioribus, maris tibiarum anticarum dente lato.*

I have no doubt that the species for which I propose this new genus is the Madagascar representative of *Encymon*, with which it is associated in the form of the mandibles. It has, however, a different facies, principally owing to the form of the pronotum, which is more convex, with its margins even and scarcely at all reflexed. The longitudinal basal sulci are present, but the transverse one is quite obsolete. The mode of toothing of the front tibia of the male is, moreover, quite different to that of *Encymon*; in the only species of that genus in which I have seen it take place, and which is figured by me (Endom. Recitati, tab. f. 10), the tooth is small and close to the apex; here it is wide and strong and near the middle of the tibia.

1. Cymones sharpi. (Plate XVII. fig. 4.)

Piceus; prothorace elytrorumque apicibus flavis, illo guttis duabus magnis oblongis, punctisque tribus parvis nigris, capite femoribusque saturatius nigro-piceis; trochanteribus, femoribus basi, tibiis tarsisque ferrugineo-flavis. Long. 9 *millim.* ♂.

Mas. *Tibiis anticis dente basi latissimo, apice acuto infra medium, tibiis intermediis et posticis apice leviter incurvatis.*

Hab. Madagascar, Betsileo (*Cowan*).

Head black, mouth and palpi testaceous, epistoma with a few indistinct punctures, crown smooth, antennal orbits raised. Antennæ piceous, rufo-piceous at the base; the proportion of the joints as in *Encymon* till the ninth, which with the tenth and apical joints are elongate, only rather longer and more widened at their tips than

those preceding them. Thorax about as long as wide if the projecting front angles are taken in, widest a little below the front; basal angles right angles, sides a little sinuate not angular, front margin rounded and a little prominent, basal margin nearly straight; on the disk, which is very even and smooth, are two large inky-black oblong marks a little obliquely placed, a small dot on each side where the thorax is widest, and one in the middle, near the base. Elytra pitchy, inclining to brown, the apex is yellow, and this colour returns some way up the suture and the margins; they are convex, evenly ovate, and rounded at the apex, narrower at the base, and with a very obsolete sutural stria and scarcely at all widened margin; the epipleural fold is yellow. There is no visible punctuation on their surface; but it is not glabrous as in *Encymon angulatus*, but very finely alutaceous, though the sculpture is hardly visible at all.

Only two specimens of this insect have come under my notice; both are males. One is in Mr. Lewis's collection, and the other in Dr. Sharp's, by whom they were obtained from Mr. Cowan.

2. Cymones cowani. (Plate XVII. fig. 1.)

Nigro-subviolaceus; capite, prothorace, antennis (clava excepta) pedibusque rufis, abdomine rufo-piceo. Long. 6½ *millim.* ♂ ♀.

Mas. *Tibiis anticis dente acuto distante mediano, apicibus intermediis etiam leviter incurvatis.*

Hab. Madagascar (*Cowan*).

More parallel than *C. sharpi*, and with the thorax not so convex above, and more quadrate, smaller, and differently coloured. The head and thorax are rusty red, very little shining, and without punctuation; palpi red; antennæ of moderate length, and with the club, which is black, abrupt, and with its two first joints transversely heart-shaped. The thorax is transversely quadrate, with the front angles a little prominent, the sides a little sinuate, nearly straight, base obsoletely margined, and the sulci distinct but not deep. Elytra dark blackish purple, their apex ferruginous, slightly shining but not bright. Legs in the male example pitchy, in the female clear rusty red.

Although this species and the following one differ in several particulars of their structure from *C. sharpi*, I have not been able to find any characters of sufficient importance to warrant their separation generically. In the abruptly formed club of the antennæ and in the form of the thorax these two species are nearer to *Encymon*, but the strongly toothed tibiæ in the male, and the form of the body, less swollen, and with its sides more parallel than in any eastern species of that genus, indicate a radical divergence from that type.

Only two specimens have come under my notice; they were obligingly placed in my hands by Dr. Sharp for description.

3. Cymones helopioides. (Plate XVII. fig. 3, ♂.)

Niger; parum nitidus; prothorace transversim quadrato, cum elytris subopacis. Long. 6½–7 *millim.* ♂ ♀.

Mas. *Tibiis anticis dente acuto, adjacente, infra medium; intermediis apice incurvato, posticis leviter sinuatis.*

Hab. Madagascar (*Cowan*).

Entirely black, subopaque above, body beneath shining. Antennæ rather short, a little longer in the male than in the female, their club not very wide nor abrupt; head rather uneven, with a few scattered obsolete punctures. Thorax half as wide again as long, opaque; punctuation very obsolete, minute and scarcely visible, basal sulci distinct; front angles very little produced, scarcely at all in the female, sides nearly straight, base finely margined. Elytra half as wide again as the thorax and slightly widened behind, callus only faintly raised. The male specimen has two minute red dots near the apex of the elytra, in the female they are wanting. Metasternum (in male) depressed between the hind coxæ, and first ventral segment with scattered small punctures.

Two specimens from Dr. Sharp's collection.

Anidrytus, Gerst.

1. Anidrytus quadripunctatus.

Oblongus, parum ovatus, rufo-piceus, nitidus, crebre subobsolete punctatus, cupreo-pubescens; antennis nigris, articulis quatuor basalibus et apice summo rufis; prothorace punctis quatuor discoidalibus nigris. Long. 8 *millim.* ♀.

Hab. Brazil, Blumenau.

Head finely punctured, a little rugulose between the eyes; basal and three following joints of the antennæ pale ferruginous, the fourth joint being deeper in colour, and at its articulation with the third nearly black. Thorax just twice as long as wide, from the front angles the sides are very evenly rounded to near the base, where they become straight. The basal furrows are two distinctly impressed, converging, linear channels; within them, where they end on the front of the disk, halfway between the base and the front margins, are two round black points (as in *A. bipunctatus*); more in front and more widely apart are two other black points. The disk and sides of the thorax are evenly, thickly, not confluently punctured, but the surface of the black spots is smooth, or in the external spots with one or two punctures only. The elytra are somewhat parallel, not strongly convex, evenly and more thickly punctured; the punctures are (as is usual where they give rise to hairs) not pricked in, but irregular, somewhat linear, and flat-bottomed. Legs clear red, only a very little darkened at the base of the tibiæ. The underside wholly ferruginous red.

Although this appears to be a species very nearly allied to *A. bipunctatus*, Gerst. (a species also from Brazil), the description given above will show that it differs not only by the four black spots of the thorax, but by the colour of the underside and legs as well.

I have only seen one specimen, a female, which was sent to me by Herr Reitter, with other Coleoptera collected in the same district.

2. ANIDRYTUS LIQUEFACTUS, Gorh. Endom. Rec. p. 47.

I have received specimens of both sexes of what I consider identical with this species, of which the type is now in Mr. Lewis's possession from Peru, and one male from New Granada (?); but these have only *three* joints at the base of the antennæ red, and the apical joint is quite black. The size is from 7½–8½ millim.

3. ANIDRYTUS HUMILIS, Gorh. Endom. Rec. p. 48.

Further specimens were taken by Mr. Belt at Chontales, Nicaragua, and will be noticed in the 'Biologia Centr.-Amer.' in due course.

EPOPTERUS.

1. EPOPTERUS EGANUS. (Plate XVII. fig. 9.)

Ovatus, rufo-brunneus, nitidus; antennis nigris, articulis tribus basalibus testaceis; elytris singulis maculis tribus sat magnis eburneo-albidis nigro-cinctis, duabus basalibus oblique sitis, una subapicali. Long. 5–5½ *millim.* ♂ ♀.

Mas. *Tibiis anticis leviter curvatis, ad apices compressis.*

Hab. Amazon, Ega (*H. W. Bates*).

Head and thorax rather pale castaneous red, not perceptibly punctured, very finely and very sparsely pubescent at the sides of the latter, narrowed to the front angles, and very narrowly margined; basal sulci short, linear. Scutellum black. Elytra wider than the thorax, commencing to widen from the base to about one third from the base, whence they are evenly and ovally contracted to the apex; each with three large yellowish-white spots edged with black. The underside is brownish red, the tibiæ darker at their bases than the rest of the leg, as are also (but only very finely) the inner epipleural margins of the elytra.

Two examples from Mr. Bates's collection are now in Mr. Lewis's.

2. EPOPTERUS EPHIPPIGER. (Plate XVII. fig. 8.)

Ovatus, rufo-piceus, nitidus; elytris flavis macula magna discoidali communi nigra; antennis nigris, articulis tribus basalibus flavis; prothorace crebre, elytris parcius leviter punctatis. Long. 6 *millim.* ♂.

Mas. *Tibiis anticis ad apices interne compressis, leviter incurvatis.*

Hab. Amazon (*H. W. Bates*).

Nearly of the same oval form and of the size of *E. eganus*, but distinctly punctured. Head red, nearly smooth; thorax twice as wide as long, not so wide as the elytra at their base, thickly and distinctly punctured; basal sulci straight, a little converging, sides narrowing, slightly curved, margin distinct and faintly raised. Scutellum rufous, punctured. Elytra paler yellow than the thorax, punctures distinct, only a few scattered hairs at the sides; epipleuræ yellow, only very narrowly darker at their margins. Underside and legs uniformly pitchy red.

I have only seen one example of this species, a male. It is very distinct from any *Epopterus* yet described.

3. Epopterus lineoguttatus. (Plate XVII. fig. 7.)

Ovatus, rufo-piceus, nitidus; elytris pallide flavis, sutura margin ibusque lateralibus piceis, puncto humerali, lineolisque septem in singulis, 3, 3, 1, saturate piceis; antennis nigris, articulis tribus basalibus rufis. Long. 6 *millim.* ♂.

Mas. *Tibiis anticis interne sat fortiter incurvatis, ad apicem compressis.*

Hab. Amazon (*H. W. Bates*).

Head, thorax, underside, and margins of the elytra rather light pitchy red; punctuation of the thorax and elytra as in *E. ephippiger*, distinct. The curious marking of the elytra consists of a humeral small dot, two elongate dashes near the suture, two shorter ones in the middle of the disk, two still smaller near the margin above the middle, and one small one near the apex. These dashes are not placed regularly, but the three near the base form a sort of fascia, as do the three below the middle. The scutellum is pitchy black.

One small example.

Saula, Gerst.

1. Saula nigripes, Gerst. Mon. p. 224, t. 3. f. 2.

Several specimens met with by Mr. Lewis, two of which were found *in copulâ*, present no appreciable distinction between the sexes.

Stenotarsus.

1. Stenotarsus vallatus, Gerst. Mon. p. 342.

Four specimens which I identify with this species were obtained by Mr. Lewis in Ceylon at Dickoya. The antennæ are clear red; the series of punctures are more regular and not so coarse as in *S. russatus*.

2. Stenotarsus russatus, Gorh. Trans. Ent. Soc. 1874, p. 446.

One specimen met with by Mr. Lewis fully confirms my opinion as to the distinctness of this species, and I would only remark, in addition to the characters already given, that the raised thoracic margin has its surface distinctly flat in both species, indeed the edges of this margin are themselves raised, so that concave is the correct term. The dark, stout, and gradually thickened antennæ will easily prevent this being confounded with *S. vallatus*.

3. Stenotarsus sicarius.

Ater, valde convexus, pubescens; elytris basi thorace latioribus, distincte punctato-striatis; thoracis margine laterali deplanato, haud bene elevato, antrorsum subito latiore. Long. 3 *millim.*

Hab. Ceylon (*Lewis*).

At once distinguished from any other *Stenotarsus* known to me by its entirely black colour. It is allied to *S. vallatus* and *S. russatus*; but the form is different, the elytra suddenly widening from

the shoulder, and the thorax having the base narrower with the hind angles right angles, so that the insect is not so uniformly round as in its allies. The antennæ are formed much as in *S. vallatus*, the second to eighth joints being short and bead-shaped, but longer than wide, the club strong but laxly jointed, the apical joint quadrate and much (fully twice) wider than the ninth. The thorax is wider than long, narrowed to the front angles, but with its sides nearly straight in the basal two thirds; its flattened margin has its internal edge deeply impressed in front, where the flat part is widest, and it appears raised at the base only, where the disk is widely sulcate; the disk is convex, minutely but distinctly covered with small points, but the puncturing is much obscured by coarse floccose pubescence.

Only one specimen of this interesting species was obtained.

Panomœa.

1. Panomœa cingalensis. (Plate XVII. fig. 2.)

Rufo-testacea; capite et thorace basi piceis; antennarum clava, articulo basali externe, scutello, sutura elytrisque maculis quinque sat magnis nigris; antennis articulis decem. Long. 5 millim.

Hab. Ceylon, Hadley (*Lewis*).

Antennæ ten-jointed, the basal joint is stout, a little curved, the second is scarcely longer than broad, and the third is apparently longer than usual, and is possibly really composed of the third and fourth joints together, but I can see no suture; the fourth to the seventh very short, club lax, the eighth and ninth joints rather trigonal. Head pitchy, smooth; eyes coarsely granulate (as in typical *Panomœa*). Thorax as in *P. pardalina*, but anterior angles rather more prominent, scarcely punctured, but a little uneven at the sides, finely margined, except at the middle of the base. Elytra more cordate than in other species, and viewed sideways rising to a point so as to appear more gibbous than in its allies, finely but closely punctured, with five largish black spots—one humeral, two near the suture, one marginal (larger than the others), one subapical; this last in one example connected with the marginal one; the underside and legs are deep ferruginous red.

Five or six examples were obtained.

Endocœlus, n. g.

Mr. Lewis has met with a very curious small beetle in Ceylon, which apparently comes very near *Panomœa*, which itself is synonymous with *Cyclotoma* of Mulsant, and of which a short description will be sufficient to render its identification certain. The antennæ, however, appear to me to be ten-jointed, and the two basal joints to be stout, the third to the seventh to be very short, the three last forming an elongate lax club.

The tarsi are four-jointed, almost linear, very similar to those of *Rhymbus*.

1. ENDOCŒLUS ORBICULARIS.

Rotundatus, ferrugineus; elytris convexis, fortiter parce punctatis, setulosis, marginibus latius explanatis, apice subacuminato; thoracis margine elevato deplanato, basi sulcis duobus punctiformibus. Antennarum clava fusca. Long. 1½ *millim.*

Hab. Ceylon (*Lewis*).

Orbicular, elytra subglobularly convex, with their lateral margin much expanded in the middle, but the widened rim vanishing in the apex, where they are conjointly deflexed and acuminate; their disk is evenly and strongly punctured, the margins less distinctly; the extreme limb of the expanded margin is itself finely reflexed. The head is exserted, with small prominent coarsely granulated eyes. The maxillary palpi have their apical joint subulate. The thorax is short, narrowed in front, with the margin raised, thickened and flattened as in *Stenotarsus*, the front angles being rounded in to form the emarginate opening for the head, than which it is much wider; the base is narrower than the elytra at their base, and is furnished with two very deeply impressed punctiform sulci, which are about halfway between the centre and the hind angle, on each side. One specimen, taken at Dickoya.

EXPLANATION OF PLATE XVII.

Fig. 1. *Cymones cowani*, p. 158.
2. *Panomæa cingalensis*, p. 162.
3. *Cymones helopioides*, p. 158.
4. —— *sharpi*, p. 157.
5. *Spathomeles? inflatus*, p. 154.
6. *Stictomela chrysomeloides*, p. 156.
7. *Epopterus lineoguttatus*, p. 161.
8. —— *ephippiger*, p. 160.
9. —— *egenus*, p. 160.

2. On the so-called Pelvisternum of certain Vertebrates. By R. J. ANDERSON, M.D., M.A., Professor of Natural History, Queen's College, Galway.

[Received March 1, 1886.]

Prof. Paul Albrecht in 1883 described[1] an interpubic bone which he found present in *Dasypus sexcinctus*, *Bradypus cuculliger*, and *Cholœpus didactylus*. He compares the symphysial cartilage found in many animals and this bone with the parts of the sternum, shoulder-girdle, and os hyoides, and gives several very instructive and clear figures of specimens in the museums at Berlin and Königsberg. The figures of the Lacertilian pelves are copied from the papers of Profs. Huxley and Wiedersheim, and the scheme of homology he represents in a table at the end of his note.

[1] Bull. d. l'Académie royale de Belgique, nos. 9–10.

Pelvic girdle.	Shoulder-girdle.
1. Pubis.	1. Procoracoid.
2. Ischium.	2. Coracoid.
3. Ilium.	3. Scapula.
4. Subilium.	4. Subscapula.
5. Wanting.	5. Clavicle.
6. Wanting.	6. Interclavicle.
7. Pelvisternum. (Ischio-pubic symphysial cartilage. Osseous pelvisternum of Edentates.)	7. Omosternum. Coraco-procoracoid symphysial cartilage.
8. Hemi-pelvisternum.	8. Hemi-omosternum.
9. Ischio-pubic symphysis.	9. Symphysis coraco-procoracoid.
10. Prepelvisternum.	10. Preomosternum. Preomosterna of Anoura.
11. Hemi-pelvisterna. Epipelvic ossicles of Chameleons. Marsupial bones of Monotremes and Marsupials.	11. Hemi-preomosterna. Substernal bones of mammals.
12. Post-pelvisternum. Os cloacæ of Lacertilians.	12. Post-omosternum.

The pelvis of *Lacerta muralis* is figured by Prof. Hoffmann in Bronn's 'Thierreichs,' and Brühl also gives figures of the Amphibian forms. In a specimen of *Iguana tuberculata* in this museum the pubis is a separate bone, and contains a preacetabular foramen as well as a well-marked supra- or prepubic notch. A copula (bone) reaches from the anterior part of the ischium to the pubis, wider behind than in front. The os cloacæ fits into the ischial symphysis behind, and the ischial symphysis still shows the marks of union with the tuberosities. The ilia articulate each with two transverse processes, and the traces of union with the ischium are obliterated.

In the Australian *Monitor gouldii* which we have, a prepubic nodule fits in between the pubes in front; all traces of union between the parts of the ossa innominata are obliterated. A small nodule is situated in front of the ischial symphysis, and a distinct os cloacæ is present behind, and, as in the Iguana, fits in between the ischia. A prominent ischial spine behind is situated at the junction of the middle and outer third of the posterior border of that bone. In *Lacerta viridis* a prepubic nodule and a postischial are present. In the West-Australian *Moloch horridus* (marked 1845 in the catalogue) the postischial bone is quite evident, and a large copula runs forwards to the pelvis. In our Chameleon the three pelvic bones are short, and the os cloacæ seems to be cartilaginous; the ischio-pubic copula is reduced to a thread-like structure. The os cloacæ and prepubic bone are thin in our specimen of *Ameiva*, but they are very distinct.

Prof. Owen, in his 'Anatomy,' says that in the Potoroo there is a triangular ossicle developed at an early period, which is wedged into the posterior interspace of the ischio-pubic symphysis; and in his paper in this Society's 'Transactions' he figures the posterior epiphysial bone. In the skeleton of a Kangaroo in our museum the following measurements were made:—

	millim.
Length of ilium	140
Crest	20
Breadth opposite the acetabulum	35
Length of pubis	55
Interpubic bone, antero-posterior diameter	15
,, ,, breadth of one side	35

In *Phacochœrus* the bone occupies the position of the triangular ligament in man, and is three-cornered and wedge-like. The following measurements were made :—

	millim.
Length of os innominatum	250
Crest	120
Breadth of ilium above acetabulum	32
,, ,, at acetabulum	70
,, ,, below acetabulum	34
Arch of pubis	75
Interpubic bone, breadth	24
,, ,, superior depth	15
,, ,, inferior depth	30
,, ,, thickness at base	20

In the skeleton of the Beaver the bone is not so distinct as in *Phacochœrus*. The following are the measurements :—

	millim.
Length of os innominatum	160
Crest	30
Breadth opposite acetabulum	35
Arch of pubis	75
Depth of pubic bone	9
Breadth of one half	25

I do not find the bone present in any other mammalian skeletons that I have examined. The bone occupies the position of the triangular ligament and the os cloacæ of Lacertilians. Ligaments and fasciæ are so often the seat of ossifications, and bones in one set of animals are so often represented by ligaments in another set, that one is almost tempted to regard the bones above referred to as, in whole or in part, homologous with the triangular ligament of the urethra found in the higher animals.

The interpubic bone in *Bradypus* is mentioned by Prof. Flower in his 'Osteology.'

3. Note on *Bipalium kewense*, and the Generic Characters of Land-Planarians. By Professor F. Jeffrey Bell, M.A., Sec. R.M.S.

[Received March 16, 1886.]

(Plate XVIII.)

In the descriptions given by writers on Land-Planarians especial attention is always directed to the form of the head or, as more than one author has called it, the tail. This, no doubt, is partly due to the fact that in a number of the species the head is often seen to have a remarkable hammer-shaped or cheese-knife form, which has three times led to the institution of a genus for the reception of such species. In other cases, where the worm has been assigned to other genera, the head is described as obtusely rounded, or as not sharply distinguished from the body.

Having lately received from Mr. Osbert Salvin, F.R.S., a specimen of a Land-Planarian (apparently *Bipalium kewense*, Moseley), found by him among broken flower-pots in his garden in Sussex, of the origin of which nothing definite is known, I have been enabled to watch the creature exhibiting its activity. I had not long been studying it when I noted that the head varied considerably and almost constantly in form, so that I thought it well to at once enlist the skilful pencil of Mr. C. Berjeau to represent its various appearances.

Figure A represents the worm, not indeed at its greatest length, but in a position which it is apt to assume when in full activity; the head is carried a little higher than the rest of the body, its edges are sharp, its contour convex, and it is well marked off from the rest of the body. Figure B, on the other hand, shows the animal in a state of torpid quiescence; the head is now contracted, obtusely pointed, only separated by a shallow depression on either side from the surrounding region of the body. Fig. C shows an intermediate condition between A and B. Figs. D–G show various stages in the form of the head[1]—hammer-shaped, knob-like, tongue-shaped, or altogether irregular. The body may be not more than 2 inches long, when the creature looks like a leech or a slug, or it may extend itself to 6 inches and even more, when it has rather the appearance of a thread-worm. In fact, as one looks at it extended on a white dish, it calls to mind the *Amœba* more than any other animal known to the zoologist.

I insist on the variations in the form of the body, and especially of the head, because all writers (even those who, like M. Humbert, Prof. Moseley, or, the latest of all, Dr. J. C. C. Loman, have had the opportunity of examining these forms alive or under natural conditions) direct, in their descriptions, especial attention to the form of the head; indeed, land-planarians with cheese-cutter or hammer-shaped heads (*cf.* figs. A and D) have been by all naturalists

[1] All the figures are of the natural size.

assigned to the genus *Bipalium*[1]. The only writer who seems to have remarked the variability in the form of the head is M. Humbert, who figures[2] the head of *Bipalium diana*, as living and when it is greatly contracted; the differences are, however, quite slight as compared with those in the figures now given (Plate XVIII.). Moreover, M. Humbert continues to use the form of the head as a distinctive character, and seems to have only incompletely appreciated the moral of what he saw. Referring to the paper of Prof. Perceval Wright, M. Humbert says:—"Il donne une figure .... qui représente l'extrémité antérieure semilunaire et a du evidemment être faite d'après un individu conservé dans l'alcool, tandis que celle de la *D. grayia* a été dessinée d'après le vivant. C'est sans doute à ces deux manières d'observer, encore plus qu'à des particularités spécifiques qu'il faut attribuer les différences profondes que l'on remarque dans la forme des extrémités antérieures de ces deux espèces." But the differences shown in Prof. Wright's woodcuts of the two species are not as "profound" as those seen in the figures of the single living specimen here reproduced. So that, though M. Humbert recognized the difference between living heads and heads preserved in spirit, he does not seem to have recognized what is much more important—that the form of the head varies constantly during life.

If a Planarian in a torpid condition (Pl. XVIII. fig. I) be then and there seized and put into spirit, it will be found, no doubt, to have an obtusely blunted head, hardly wider than the body[3]; on the other hand, some, at any rate, if killed while in full activity, will be found to have heads shaped like a cheese-cutter or some modification thereof.

Hab. Mr. Salvin has lately received orchids from S. America and S. Mexico, and from Burmah; but he has also had specimens from Kew Gardens, whence the originals came to Mr. Moseley.

In 1883 Dr. Günther received some specimens from Welbeck Abbey[4], where they had been known for three or four years previously; Mr. Thiselton Dyer tells me that there is no history of any communication between the gardens at that place and Kew, and adds "we have probably therefore been stocked from a common source." A specimen found in a greenhouse in Clapham Park was sent to Dr. W. M. Ord, and is now in the possession of Prof. Ray Lankester; the early history of this specimen is unknown. In the hope of being able to extend our knowledge of this worm, I have written a note to the editor of the 'Gardener's Chronicle'[5], which may result in some further information, and perhaps in the discovery of fresh examples

[1] The French translator of the latest authoritative work on General Zoology by converting "Kopftheil durch Lappen-Vorsätze halbmondformig" into "Région céphalique en croissant par la présence de deux appendices lobés," shows that he too regards the lateral parts of the head as being constant in form and position; nevertheless they are not so.

[2] Mém. Soc. Genève, xvi. p. 303, figs. 1, 1 *a*.

[3] Fig. H in Plate XVIII. shows the form of the head in the specimen under description, now that it is dead and preserved in spirit.

[4] See his letter in the 'Gardener's Chronicle,' xix. (1883) p. 415.

[5] Published on March 13th, 1886.

and new localities[1]. I am inclined to think that such information will support Dr. Günther's supposition that the worm has become acclimatized in this country; Mr. Dyer tells me that it is still to be found in the Kew hothouses, where it has now lived since at any rate the beginning of 1878.

Prof. Moseley was able to observe in Ceylon that *Bipalium* suspends itself by the tough slime which it secretes. My specimen had no opportunity of showing if it could so support itself; but I noticed that minute offending objects could be got rid of by being entangled in the slime which it secreted, and which, being gradually secreted from a point, say, one inch behind the head forwards, was as a continuous sheet of mucus thrown off from the anterior end. A small earthworm which was placed near it, but which was not attacked, had the same mucous sheet thrown over it, to its obvious embarrassment.

There can be no doubt as to the sensitiveness of *Bipalium* to light. The specimen now under notice was sent by Mr. Salvin on February 7th, lived and was more or less active till February 26th; for this interval of time the town was either enveloped in fog, or surrounded by a darkness which needed not to be called back to our recollection.

But on the 26th of February the sun shone, and though the room in which the Planarian had been placed was not illuminated by its rays, yet the exposure to diffuse light, which on other and earlier days had been harmless, was on this day fatal; the worm broke transversely into three pieces, and on being touched fell into four. Had it been kept in darkness it is possible it might have lived longer. The temperature of the room varied from about 50° to 64° F.

DESCRIPTION OF PLATE XVIII.

Illustrating the various forms assumed by *Bipalium kewense*.

A. Extended and moving freely. B, C. In various states of contraction. D–G. Some of the various forms taken by the head. H. Head and anterior end after contraction in spirit. I. The worm coiled and at rest.

All the figures are of the natural size.

4. Note on the Structure of a large Species of Earthworm from New Caledonia. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society.

[Received March 15, 1886.]

(Plate XIX.)

Among a number of Earthworms forwarded to me from New Caledonia, through the kindness of Mr. E. L. Layard, F.Z.S., H.B.M. Consul at Noumea, were six specimens of a large worm several of which measured some 28 inches in length. All these specimens are referable to the same species, which belongs to the genus *Acantho-*

[1] Specimens have been found in the Zoological Society's Gardens, which have, and in gardens at Liverpool which have not had direct relations with Kew.

drilus[1]. This genus is already known to inhabit New Caledonia; M. Perrier has described two distinct species from that region. The species which forms the subject of the present communication may be identical with one or other of these. The descriptions given by M. Perrier of *Acanthodrilus obtusus* and *A. angulatus* are necessarily insufficient, owing to the poor condition and immaturity of the specimens at his disposal; but certain facts, such as the position of the generative apertures and of the clitellum, could hardly be mistaken even in specimens greatly injured through bad preservation; in these points the present species differs from both of those described by Perrier, as will be apparent from the following notes on its structure.

External Characters.—I have sketched (Plate XIX. fig. 1) the anterior segments of the body from the dorsal aspect to indicate the main external features which are visible upon that surface. The buccal lobe divides the first segment[2], as also in *A. dissimilis* and *A. novæ zelandiæ*, two species recently described by myself[3]. Of a fourth species of the genus, viz. *A. verticillatus*, M. Perrier writes[4]:—"La lobe céphalique n'entame pas le premier anneau et parait au contraire s'elargir à sa base de manière à ressembler à la partie supérieure d'un trèfle; mais cette apparence tient peut-être à un état particulier de conservation." I mention these facts because the genus *Lumbricus* has been split up into other genera mainly on this account. It does not appear to me advisable, while there are so many internal structural differences, to make use of so small an external character for classificatory purposes; but in the case of the genus *Acanthodrilus* this mark of difference between species appears to be correlated with other differences of structure, inasmuch as M. Perrier hesitates to include *A. verticillatus* in the same genus with *A. obtusus*; the male generative pores in the former species are upon the 17th and 18th segments and are not separated by an intercalated segment as in the latter and all the other species of the genus at present known. On either side of the buccal lobe, and consequently between the first and second segments of the body, is a single pore; these may perhaps correspond to the single median dorsal pore which is the only orifice of the kind found in the Oligochæta limicolæ.

The *clitellum* was fully developed in several specimens, and extended from the 13th to the 17th segments inclusive, with the exception of a portion of the 13th segment; the glandular tissue composing the clitellum was only visible on the posterior half of that segment; the clitellum extends occasionally for a short distance on to the 18th segment. The anterior region of the clitellum down to the 15th segment completely encircles the body; the 17th and 18th segments, on the contrary, have a very considerable median area upon which there is no glandular development; the lateral margins of this

[1] Perrier, "Recherches pour servir à l'histoire des Lombriciens terrestres," Nouv. Arch. d. Muséum, t. viii. (1872) p. 85.

[2] I have reckoned the first seta-bearing segment as the second segment of the body, in common with the majority of naturalists who have studied this group.

[3] P. Z. S. 1885, p. 813.

[4] *Loc. cit.* p. 93.

(*d*), which is a single tube, and not composed of two separate or incompletely fused halves as in *A. multiporus*[1] and other Earthworms, communicates with the ventral vessel by seven transverse hearts (*h*) situated in segments 8–14 inclusive—a pair to each segment. The first three pairs are of less calibre than the following four, and appear to arise simply from the dorsal vessel; the four posterior pairs of hearts communicate also with a small supra-intestinal vessel, which, as shown in the figure (*sa*), lies beneath the dorsal vessel but above the intestine; in the anterior part of the body a pair of lateral vessels (*l*) supply the body-wall; in the 11th or 12th segment these vessels pass beneath the intestine and unite to form a single subintestinal vessel. This vessel appears to be continuous posteriorly with a vascular space within the walls of the alimentary canal. Each of the two anterior pairs of hearts supplies the spermatheca of its own segment; a strong branch arises from the vessel just before it unites with the ventral vessel, and a corresponding branch from the latter is also distributed to the spermatheca.

Body-cavity.—The body-cavity, as in all other Earthworms, is divided into segments by mesenteries which extend from side to side of the body; in the six anterior segments the mesenteries are more or less distinct, but there are in addition a number of muscular bands and tendinous-looking threads which bend the pharynx down to the body-wall, often passing through the mesenteries on their way; the gizzard and a portion of the anterior region of the œsophagus are only attached to the body-wall by a very few slight threads, mesenteries being absent in this region of the body. The mesentery which bounds the tenth segment behind and the succeeding four mesentries are specially thickened and muscular.

Nephridia.—There is a very considerable variation in the characters of the nephridia in this genus, and I have already[2] referred to what has been written on the subject. In the present species the nephridia (fig. 6, *n*) are very conspicuous, especially in the anterior region of the body as far back as the 19th segment or thereabouts; in the posterior segments they are present but appear to differ slightly, principally in size, from the anteriorly placed nephridia. The external apertures are plainly visible in front of the dorsal pair of setæ in all the seta-bearing segments of the body; that is to say, the first segment of the body appears to be without nephridia and only this segment. The glandular portion of the nephridium forms a closely packed tuft of tubules which has much the appearance of the nephridia in those species of *Perichæta*[3] in which these organs have been described; this glandular tuft lies in the region of the ventral pair of setæ and close to the mesentery which forms the anterior wall of its segment; the nephridium communicates with the exterior by a long, widish, thin-walled duct.

[1] See F. E. Beddard "On the paired Dorsal Vessel of certain Earthworms." Proc. Roy. Phys. Soc. 1884–5, p. 424.

[2] P. Z. S. 1885, p. 822.

[3] E. g. *Perichæta indica*, Horst, Niederl. Arch. f. Zool. Bd. iv. (1879), pl. viii. fig. 3, *x*.

Generative System.—In the 12th segment are a pair of glands attached firmly to the mesentery which separates this segment from the one anterior to it; in two specimens these glands were paired, while in a third only the left-hand one of the two was present; in one specimen these glands have a racemose structure, and although a microscopic examination did not reveal any structure, I have little doubt that these glands are testes. Out of the seven examples at my disposal one specimen possessed a similar pair of glands in the 11th segment in addition to those found in the 12th segment; in all the remaining specimens save one, which was small and immature, the 10th segment (that which follows the segment containing the posterior pair of spermathecæ) has a pair of glandular-looking bodies which are very similar in general appearance to the structures which I have regarded as the testes; they are attached, however, to the posterior wall of their segment, which, as in other Earthworms, is not separated by a mesentery from the 9th segment; these two segments, which are thus fused, contain the gizzard.

The fact that these glands are attached to the posterior and not to the anterior wall of their segment is perhaps against the view that they represent an anterior pair of testes; at the same time it happens that the segment in which they occur has no anterior wall, being fused with the preceding 9th segment; these glands were not present in the only specimen that had two pairs of testes. In *Acanthodrilus capensis*[1] there are three pairs of testes situated in segments 10, 11, and 12; but out of a number of examples that I dissected only one had the three pairs developed. There is therefore nothing unusual in supposing that the present species, like *A. capensis*, has three pairs of testes, although all the other species that are known appear to have only two pairs. On the other hand, the gland in segment 10 is very similar to a curious structure which exists in *A. capensis* in a similar position, *i. e.* attached to the posterior wall of the segment. In this species, however, the gizzard happens to be placed in front of the copulatory pouches, and not in the segment which contains them; so that the two pairs of pouches are separated from each other and from the following segments by fully developed mesenteries, which, as already stated, is not the case with the species that forms the subject of the present communication; in this species the gizzard lies in the 9th and 10th segments. If, however, these structures correspond to those recorded by me in *A. capensis*, it is no explanation of their nature; in neither case is their function at all evident.

The *vasa deferentia* were not visible. Each of the four male genital apertures are furnished with a long sac containing a number of *penial setæ* which open on to the exterior in common with the duct of a long coiled *prostate* gland, which appears to be similar in structure to the prostates of *A. obtusus*[2]; on the other hand, the characters

[1] Proc. Roy. Phys. Soc. *loc. cit.* p. 375. I have written 11, 12, and 13 in error; the ovaries, as I have been able to assure myself by a subsequent examination, are in segment 13, and so presumably the testes are in the three segments anterior to that which contains the ovaries, viz. in segments 10, 11, 12.

[2] Perrier, *loc. cit.* p. 88.

of the penial setæ agree with those of *A. ungulatus* as described by Perrier [1].

The *ovaries* and *oviducts* I have been unable to find.

There are two pairs of *spermathecæ* situated in segments 8 and 9; each consists of a spherical thin-walled sac communicating with the exterior by a long stout-walled duct which is often curved (see figs. 5 and 6, *cp*); at the upper extremity of the duct, where it unites with the sac, it becomes somewhat bulged out on one side, though there is hardly so marked a diverticulum as is figured by Perrier in *A. ungulatus* [2].

A very characteristic and remarkable series of structures now remain to be described, before concluding the account of the generative system. In describing the external characters attention was drawn to the modification of the lowermost pair of setæ in segment 8; the ordinary setæ, at any rate on one side of the body, have disappeared and are replaced by a conspicuous orifice through which protrude one or more stout long setæ, which appear on a naked-eye inspection to be very similar to those which project through the male generative pores. Fig. 5 of Pl. XIX. represents the internal structures which correspond to these peculiarly modified setæ; the latter are contained in a thin-walled transparent sac (*s*) precisely as are the genital setæ; on either side of this sac is a long somewhat sausage-shaped glandular body (*g.b*), which communicates by a slender duct with the orifice through which the setæ project on to the exterior. The presence of these glands renders the whole structure more similar still to the male generative pore, except that the "prostates" are paired. These structures were only present on the left side of the body in one specimen; in two others they were only developed on the right side; in two other specimens both immature, without a clitellum, these structures were entirely absent on both sides of the body; in a sixth specimen, which was also immature, with the clitellum undeveloped and with very minute spermathecæ, the bundle of modified setæ was plainly visible on both sides of the body, but without its accessory glands; in the seventh specimen, also immature, there was no vestige whatever of these structures; wherever they were absent the setæ of the segment were perfectly normal.

I am not aware that any structures of this kind have been described in any other species of the genus or in any other Earthworm; they appear to be novel to the group. At the same time Perrier figures some structures in *A. ungulatus* [3] which may be identical, though the figure and his description are insufficient; the description (p. 92) is as follows:—"Les poches copulatrices sont situées aux anneaux huit et dix. Chacune est munie d'un lobe postérieur, assez petit, et n'a pas d'autre appendice. Dans le neuvième anneau se voient plusieurs sacs glandulaires, séparés par une glande multifide." The details are evidently different from the structures that I have just described, but the similarity of position, between the two spermathecæ, renders it possible that they are identical; in

[1] *Loc. cit.* p. 90, pl. ii. figs. 21, 22.
[2] *Loc. cit.* pl. ii. fig. 20.
[3] *Loc. cit.* pl. ii. fig. 18, *x*.

my species, however, these structures are in the same segment as that which contains the anterior spermatheca and are not in a segment intercalated between those which contain the anterior and posterior pairs of spermathecæ respectively. One of the setæ is displayed in the drawing (fig. 3), and the lower extremity, more highly magnified, in another drawing (fig. 4); the general aspect of these setæ is very similar to that of the penial setæ. The seta is curved slightly towards the extremity; its thickness diminishes gradually until near to the distal extremity, where it becomes again thicker and terminates in a swollen brush-like extremity, the exact shape of which can be gathered from an inspection of the figure. The distal extremity of the seta is ornamented with delicate transverse ridges projecting like the edges of scales and denticulated.

In *Lumbricus* Hering[1] has described, and Vejdovsky[2] confirmed for other species, the modification of certain of the setæ in the neighbourhood of the genital orifices; those of the ventral pair in "the 10th, 15th, or one of the neighbouring segments, and furthermore in the region of the 26th segment and on the clitellum from segment 31 to segment 38": these setæ are more slender than, and double the length of, the ordinary setæ of the body. In the work referred to Vejdovsky goes on to point out that the penial setæ in *Acanthodrilus* and other genera probably correspond to these and differ from the genital setæ of *Chætogaster* &c., which are developed during the breeding-season in the neighbourhood of the ordinary locomotor setæ, and in addition to them; the penial setæ of *Acanthodrilus* replace the ordinary locomotor setæ. Since in *Lumbricus* the modified setæ developed in the generative segments are not confined to a single segment or even to the segments bordering upon the male generative pores, it is perhaps not surprising to find that in the present species of *Acanthodrilus* there are additional sacs of penial setæ besides those normally found in the 17th and 19th segments of the body. The modified setæ of *Lumbricus* are also furnished with a gland which projects into the body-cavity; these are apparently the capsulogenous glands of D'Udekem and Lankester, which are the equivalents of the setigerous glands, being simply enlarged in order to assist in the generative function. In *Acanthodrilus multiporus* I have figured a pair of glands[3] corresponding to the setæ which are probably the homologues of these glands, and I imagine that in the species of which the present note treats the two large glands related to the modified setæ of segment 8 are in all probability to be referred to the same category and are not special structures.

After the foregoing notes on the structure of this Earthworm I may briefly refer to those points which seem to indicate that it is a distinct species differing from both the other two *Acanthodrili* which inhabit New Caledonia. With regard to external characters it appears to agree with *A. ungulatus* in the segments occupied

[1] Zeitschr. f. wiss. Zool. Bd. viii. p. 418.
[2] System und Morphologie der Oligochæten (Prag, 1884), pp. 156–7.
[3] Ann. Sc. Nat. 7e série, t. xix. pl. i. fig. 6 *b*.

by the clitellum, but to differ from both this and *A. obtusus* in the position of the male generative pores. The genital setæ of the 17th and 19th segments are almost exactly like those of *A. ungulatus*, but the prostate glands, as in *A. obtusus*, are cylindrical coiled tubes and not multilobate glands as in *A. ungulatus*; at the same time the prostate glands in several examples of my species are so closely coiled that they present an appearance which might easily be mistaken for that which has been stated by M. Perrier to be characteristic of *A. ungulatus*; it is just possible that the condition of the specimen dissected by M. Perrier may be responsible for the lobed appearance of the prostate glands. Another difference between my species and *A. ungulatus* is in the spermathecæ, which can hardly be said to have a diverticulum, and are in segments 8 and 9, not 8 and 10. The structures lying between the two spermathecæ of each side may, as I have already suggested, be identical with that described above, but evidently differ in detail. The most important difference between the species described here by myself and those of M. Perrier is undoubtedly in the position of the male generative pores; in so many species—in fact in all except *A. obtusus*, *A. verticillatus*, and *A. ungulatus*—the male generative pores are upon the 17th and 19th segments [1].

EXPLANATION OF PLATE XIX.

Fig. 1. *Acanthodrilus layardi*; anterior region of body, dorsal aspect.
2. Segments 13–20, from ventral side, to show position of female generative pores upon 14th, and the male generative pores upon 17th and 19th segments. The clitellum is indicated by shading.
3. Genital spicule from segment 8, magnified.
4. The lower extremity of the same, more highly magnified.
5. Spermathecæ and accessory genital glands: *cp*, spermathecæ; *v*, ventral blood-vessels giving off branch to the spermatheca; *s*, sac containing modified setæ (figs. 3, 4); *g.b*, glandular bodies opening in common with seta sac; *n*, glandular tufts of nephridium; *n'*, duct of nephridium.
6. Anterior region of body dissected: *cp*, spermathecæ; *n*, nephridia.
7. Principal vascular trunks of anterior region: *d*, dorsal vessel; *su*, supra-intestinal; *v*, ventral; *l*, lateral; *h*, "hearts."

[1] Referring to my paper already quoted upon the New-Zealand species of the genus, I find that the male generative pores are there stated to be upon the 16th and 18th segments. A reexamination of the specimens has convinced me that that statement is wrong, and that they are, as in the present species, upon the 17th and 19th segments, while the spermathecæ are in the 8th and 9th segments as indicated in the woodcut (P. Z. S. 1885, fig. 1, p. 815).

Should the specimens to which the present note relates prove to belong to a distinct species from either of those described by Perrier, I propose to term the species *Acanthodrilus layardi*.

April 6, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of March 1886 :—

The total number of registered additions to the Society's Menagerie during the month of March was 121. Of these 6 were by birth, 58 by presentation, 11 by purchase, 1 by exchange and 45 were received on deposit. The total number of departures during the same period, by death and removals, was 127.

The most noticeable additions during the month were :—

1. A second specimen of the Rough-billed Pelican of North America (*Pelecanus trachyrhynchus*)[1], purchased March 2nd.

2. An example of the White-tailed Ichneumon (*Herpestes albicauda*) from Lamoo, East Africa, presented by F. J. Jackson, Esq., F.Z.S., March 4th.

The Secretary exhibited, on behalf of J. B. Martin, Esq., F.Z.S., a large tusk of the Indian Elephant (*Elephas indicus*) belonging to the executors of the late Charles Reade, of which the length was stated to be 6 feet, and the weight over 100 pounds. The tusk was stated to have belonged to a "rogue Elephant" which had only one tusk, and which had been killed at Goruckpore in 1836, when the late Charles Reade was magistrate there.

Mr. Sclater exhibited the heads and horns of two species of Antelopes received by Lord Walsingham from Mr. F. J. Jackson, F.Z.S., having been obtained in the vicinity of Lamoo, East Africa. One of these belong to an adult specimen of *Strepsiceros imberbis*, Blyth; the two others to *Damalis senegalensis*, which, so far as Mr. Sclater knew, had not been previously obtained in this district. *Strepsiceros imberbis* had been already met with as far south as the Juba River on this coast[2].

Dr. H. Woodward exhibited specimens of animals commensal or parasitic in the shell of *Meleagrina margaritifera*, the Pearl-mussel, from the north coast of Australia, and read the following notes :—

"The Pearl-shell fishery is now a recognized and important branch of the commerce of Western Australia, and also of Queensland and South Australia, which Colonies own the rights of the northern shores of that vast continent.

"Mr. Thomas Harry Haynes has given me much interesting information regarding the pearl-shell fishery carried on by him and

[1] For notice of previous specimen see P. Z. S. 1883, p. 463, plate xlvi.
[2] See P. Z. S. 1884, p. 45.

his partners on the N.W. coast of Australia, and has submitted many shells to me which had been attacked by lithodomous Mollusca, or by worms and the burrows of *Cliona*.

"Some of these I have now the pleasure to exhibit. I have, moreover, to-day been permitted by Prof. Flower to examine a still more interesting specimen which he has just received from Henry Willett, Esq., F.G.S., of Arnold House, Brighton.

"It is that of a specimen of *Pinnotheres* which has been entombed in a cyst of pearl by a living pearl-mussel, into the shell of which he had ventured to intrude.

"It seems extraordinary and beyond belief that the *Meleagrina* should of all the Conchifera be the one to resent the commensalism of the Pea-crab, which has been known since the days of Cicero, Pliny, Oppian, and Aristotle to inhabit the shell of the *Pinna* and the Oyster, and has been recorded from *Astarte*, *Pectunculus*, and at least some half-dozen other bivalves, with whom it appears to live on the most friendly terms.

"It is the females, however, which constantly reside within the shells of the Conchifera, whilst the males are said to avail themselves of favourable opportunities to visit the females in their retirement.

"Whether or not in this case the unlucky male intruded himself upon *Meleagrina* at an unfavourable period, and finding no female *Pinnotheres*, penetrated so far beneath the mantle of the Pearl-mussel as to be unable to retreat, one thing is quite clear, namely that the *Meleagrina* entombed the intruder in a cyst of pearl from which the clever pearl-button maker alone liberated him.

"There is a large series of *Pinnotheres* in the Museum: the one from Australia is referred to *P. orientalis*, but as these are all females comparison is useless. These are from shells of *Pinna*, *Donax*, and *Pectunculus*. There are others from Broken Bay.

"Prof. Dana, U.S. Expl. Expedition, 1852, part i. text, pp. 380–381, and Atlas, pl. 24. fig. 3, describes a species under the name of *P. obesa* from Fiji Islands. The male, however, is said to be slightly broader than long, and the eyes (which in the adult female are quite hidden beneath the overreaching and protuberant carapace) can be seen in the upper view, and the front of the carapace is emarginated by the orbits. (Size $4\frac{3}{4}$ lines long, and $6\frac{1}{2}$ broad.)

"Mr. Willett's specimen is slightly longer than broad, and in size agrees very nearly with the male of *P. pisum*, which was formerly described by Leach as *P. latreillei*."

The following papers were read :—

1. On some Points in the Anatomy of *Chauna chavaria*. By Frank E. Beddard, M.A., F.R.S.E., F.Z.S., Prosector to the Society.

[Received March 15, 1886.]

Prof. Garrod has contributed to the 'Proceedings' of this Society some notes upon the anatomy, more particularly of the soft parts, of *Chauna derbiana* [1]. The recent death of one of the Society's specimens of *Chauna chavaria* has enabled me to supplement Prof. Garrod's observations by some notes on the structure of the second species of *Chauna*. As might have been expected, there are no great differences between the two species; and with the exception of the colic cæca and the distribution of the tracheal muscles, all the statements made by Garrod apply equally well to the present species; with regard to the visceral anatomy I am not able to institute a detailed comparison between the two species, since certain of the facts which I shall describe in the present paper have not been referred to by Garrod in his account of *Chauna derbiana*. To these facts I have paid particular attention in order to render more complete our knowledge of this interesting bird.

Air-sacs, &c.—On opening the body-cavity it was seen to be completely separated into a right and left half by a vertical septum attached above to the sternum and the ventral wall of the abdomen, and below to a horizontal fibrous septum which will be presently described. This vertical septum anteriorly separates the two lobes of the liver and runs as far forward as the pericardium; it corresponds to the umbilical ligament, a structure which has not usually so great an extent in birds; more generally the umbilical ligament only extends as far back as the gizzard and terminates in a semicircular free posterior margin. In *Chauna* this vertical ligament bears a blood-vessel which joins the portal system anteriorly and posteriorly divides into two trunks, one of which passes further back than the other; this vessel is situated near the dorsal attachment of the septum. The horizontal septum is an extremely thick brown-coloured membrane which passes across the abdominal cavity from side to side, and completely covers the coils of the intestine, being attached laterally to the walls of the abdomen. This tough brown membrane corresponds to a structure described by Weldon (P. Z. S. 1883, p. 640) in the Storks, and by myself (P. Z. S. 1885, p. 841) in the Cranes and other birds. This horizontal membrane when it reaches the gizzard splits into two layers which form a complete covering to that organ; between it and the gizzard, on the inferior surface of the latter, are numerous air-spaces which were easily distended by inflating the air-sacs.

The relations of the abdominal viscera are therefore, so far as the presence of this horizontal septum is concerned, indicative of an affinity with the Storks and Cranes, and more particularly with the

[1] 'Collected Papers,' p. 318.

former group, since the lobes of the liver are not shut off by septa from the space which lies between the horizontal membrane and the ventral abdominal walls. In the Cranes, as in the Struthious birds, the lobes of the liver are enclosed in separate compartments distinct from that underlying the horizontal membrane (*cf.* P. Z. S. 1885, p. 836).

There are other points in which *Chauna* approaches the Storks. In the paper already referred to, Weldon has drawn attention to a peculiarity in the air-sacs of the Storks which appears to be characteristic of this group, and is at any rate not to be found in the Ducks. The præbronchial air-sacs (in the Storks and *Phœnicopterus*) are divided by a complicated arrangement of transverse septa into smaller chambers.

In *Chauna chavaria* this subdivision of the præbronchial air-sacs is very much more marked, and the subbronchial air-sacs, which in the Storks and many other birds are fused into a single cavity, are in the same way divided up into an immense number of extremely small chambers, so that the whole air-sac presents the appearance of a crowd of air-bubbles closely pressed together of various sizes. It was quite impossible on this account to distinguish the præbronchial from the postbranchial sacs, that is to say at the points where they come into contact.

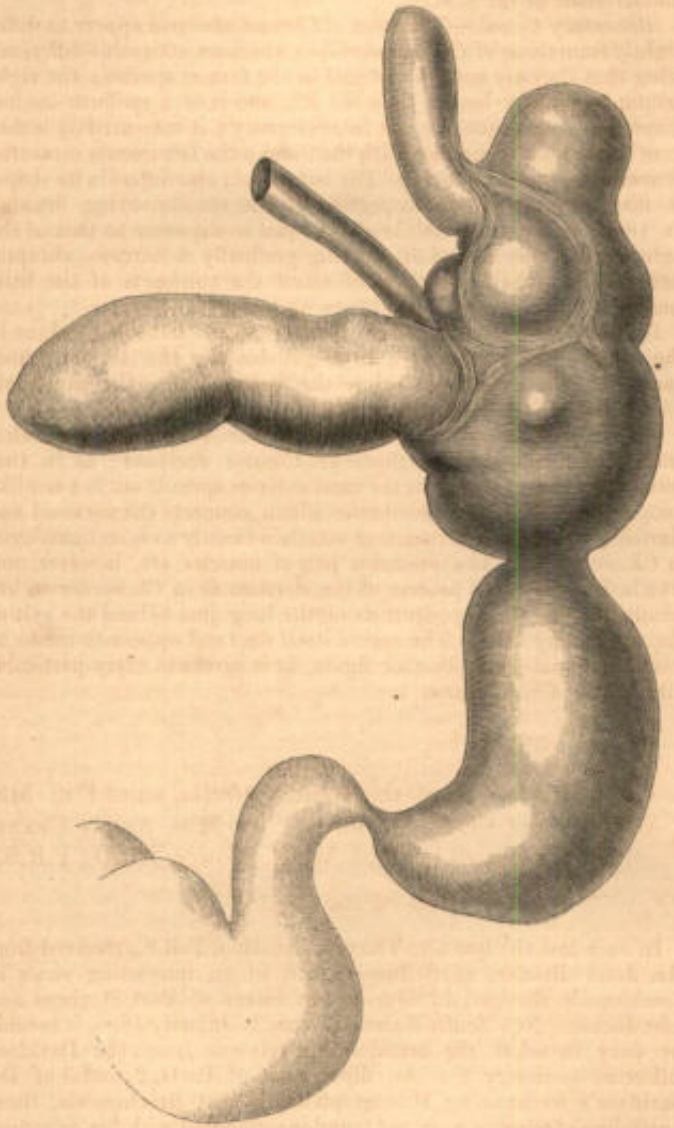
The prolongations of the subbronchial air-sacs into the axilla and into the space between the two pectoral muscles were similarly subdivided by innumerable septa.

There appeared to be nothing remarkable in the disposition of the abdominal air-sacs, and there were no indications of any subdivision of these chambers; the anterior intermediate air-sac communicates with the bronchus by two apertures placed side by side and at some distance from each other near the anterior end of the chamber; in the posterior intermediate sac, which was considerably the larger of the two, there was only a single pulmonary orifice.

The abdominal air-sacs present the usual character—the right being considerably larger than the left.

It appears to be the general rule that the thoracico-abdominal air-sacs are not divided up in the way that the cervical air-sacs are in *Chauna* and in the Storks; but I have met with occasional variations in the structure of their air-sacs in some few out of the numerous birds which I have had the opportunity of dissecting. In *Steatornis* I have already (*suprà*, p. 151) called attention to the fact that the posterior intermediate air-sac was either completely separated into two distinct compartments or had indications of such a division; in a specimen of *Strix flammea* there was a similar division of the posterior air-sac, at least on one side of the body. The third instance is *Platalea leucorodia*; in a specimen of this bird, on both sides of the body there were three "intermediate" air-sacs, the third being very small and interpolated between the anterior and posterior intermediate sacs. This may of course be an abnormality[1]; but the air-sacs of birds differ so little that any fact seems worth recording; and the

[1] A second specimen had the normal number of abdominal air-sacs.



Cæca of *Chauna chavaria*.

fact that the modification of the posterior air-sacs in *Platalea* was carried out on *both* sides of the body perhaps shows it to be a characteristic of the bird.

Alimentary Canal.—The cæca of *Chauna chavaria* appear to differ slightly from those of *Chauna derbiana*, the most noticeable difference being that they are not symmetrical in the former species; the right cæcum is slightly longer than the left, and is of a uniform conical shape, tapering slightly to the free extremity; it measured 3½ inches from the tip to the junction with the ilium; the left cæcum measured as nearly as possible 3 inches. The left cæcum also differs in its shape, as may be seen by an inspection of the accompanying drawing (p. 180); its proximal half is about equal in diameter to that of the right cæcum, but instead of tapering gradually it narrows abruptly into the distal half, which is of about the thickness of the little finger.

In the *liver* the right lobe is larger than the left lobe, and, as in the other species, there is a large gall-bladder the duct of which opens into the duodenum below the hepatic duct; the pancreatic duct is the most anterior of the three.

Trachea.—The extrinsic muscles of the syrinx are somewhat differently disposed from those of *Chauna derbiana*; as in that species, there are two pairs; the most anterior spreads out in a fan-like manner upon a tough membrane which connects the coracoid and clavicle; this muscle is therefore attached exactly as is its homologue in *Ch. derbiana*. The posterior pair of muscles are, however, not attached to the costal process of the sternum as in *Ch. derbiana*, but terminate upon the aponeurosis of the lung just behind the exit of the pulmonary vein. The syrinx itself does not appear to me to be worth a special description or figure, as it agrees in every particular with that of *Ch. derbiana*.

2. On a Brachiopod of the Genus *Atretia*, named in MS. by the late Dr. T. Davidson. By Miss Agnes Crane. (Communicated by Prof. W. H. Flower, LL.D., F.R.S.)

[Received March 15, 1886.]

In July last the late Dr. Thomas Davidson, F.R.S., received from Mr. John Brazier, of Sydney, a gift of an interesting series of Brachiopoda dredged by him in the waters of Port Stephens and Port Jackson, New South Wales. When, in January 1886, it became my duty to select the remaining specimens from the Davidson collection necessary for the illustration of Parts 2 and 3 of Dr. Davidson's forthcoming Monograph on Recent Brachiopoda, these Australian specimens were not found incorporated with his collection of living species. Possibly it was Dr. Davidson's intention to describe them in a separate paper. In February, when the collection of recent and fossil Brachiopoda (which, in accordance with Dr. Davidson's

desire, were presented to the nation) were removed to the Geological Department of the Natural History Branch of the British Museum at South Kensington, where he wished them to be deposited, Mr. Brazier's series was found apart from the recent specimens with the fossil collection. Each species had been placed in a separate box with a number inside, and this number was found to correspond with Mr. Brazier's list, which Dr. Davidson had copied into his letter-book with his remarks appended. The executor instructed me temporarily to retain the series for examination.

One very interesting new species of the remarkable genus *Atretia* was discovered. This Dr. Davidson had named after his friend and correspondent Mr. John Brazier, of Sydney, who has dredged so extensively in Australian waters. The name *Atretia brazieri* was attached in Dr. Davidson's handwriting. The specimens are so excellent that there can be no possibility of generic error on my part, and I have therefore thought it my duty to publish a short description of *Atretia brazieri*, Dav., n. sp. MS., to secure priority for his last species, which should be figured in Part II. of the Davidson Monograph of Recent Brachiopoda which I am now engaged in editing for the Transactions of the Linnean Society.

Atretia, as its name implies, is an imperforate genus. It may be as well briefly to recapitulate the history of the type species, first published by Dr. Gwyn Jeffreys under the name *Cryptopora gnomon* in 'Nature' for Dec. 1869. In the 'Ann. and Mag. Nat. Hist.' 1876, Jeffreys gave the earliest description of the species, substituting the generic name *Atretia* for *Cryptopora*; Dr. Davidson gave the first figures in his Supplement to the "Recent and Tertiary British Brachiopoda" (Pal. Soc. 1874), and again illustrated the species in one of the two plates he contributed to Dr. Jeffreys's paper on "The Mollusca (Brachiopoda) of the 'Lightning' and 'Porcupine' Expeditions," published in the Proc. Zool. Soc., April 1878. *Atretia gnomon* was dredged off the west coast of Ireland in from 1380–1443 fms.; during the 'Valorous' expedition, 1100–1750 fms., in Davis Straits. It was found by Dr. Friele (during the Norwegian Arctic expedition) about 30 miles W. of Tromsö, in 650 fms., "on the slope of the banks cold area." It was dredged off Morocco and the Canaries at depths of 50–65 fms., by the 'Talisman' and French expeditions. In all more than fifty examples of the European representative of this well-marked Rhynchonelloid have been obtained by Jeffreys, Friele, and the Marquis de Folin.

M. Eugène Deslongchamps, in his 'Etudes Critiques sur des Brachiopodes nouveaux ou peu connus,' p. 242 (Caen, 1884), expresses an opinion that *Atretia gnomon*, Jeffr., is probably only a very young stage of *R. psittacea*, Chemn. But the recent discovery by Mr. Brazier of eleven good specimens of the genus *Atretia* in the Southern Pacific Ocean, off the coast of New South Wales, tends to invalidate that assumption, the only *Rhynchonellæ* in the Australian and Novo-Zelandian region being the deeply ribbed or furrowed *Rh. nigricans* and its variety, *R. pyxidata*, Boog-Watson. To these well-characterized forms *Atretia brazieri*, smooth, flat,

and compressed, bears no resemblance whatever, and exhibits at all ages definite generic characters [1].

ATRETIA BRAZIERI, sp. nov.

Description.—This pretty little Brachiopod presents all the well-marked characteristics of the genus, two short curved slender processes, denticulated at their extremities, descend from the small narrow hinge-plate of the smaller dorsal valve, and an elevated wedge-shaped projection rises abruptly from the central mesial septum of the same valve. The presence of this septum is indicated by a dark line visible from the exterior of the shell. The shell is small, generally longer than wide, triangular in shape, especially in the younger specimens. Dorsal valve rounder and not so large as the ventral one, slightly flexuous towards the centre at the margins of the valves. The ventral valve, owing to the prolongation of the beak area, is longer and more triangular than the dorsal one raised towards the beak, which is slightly produced and incurved, with a triangular foramen commencing beneath its pointed extremity. Two elevated ridges extend from the shoulder of the shell nearly to the margins of the valves, and there seems to be a slight elevation corresponding with the well-marked exterior depression and surrounded by muscular scars (?) in the exteriors of the ventral valves of two specimens I have examined under magnifying-powers. The shell is shallow towards the margins, but rounded and deeper near the beak. Shell-substance imperforate; surface smooth, glossy, and gleaming, marked with fine concentric lines of growth; semitransparent. Horn-coloured or light grey.

Length 2¼ lines; width 1½ line; depth about 1 line. Another specimen measured 2 lines in length by 2¼ in width; this was more flattened and depressed, and the external mesial sinus in the ventral valve was less marked. Other specimens were about 1 line in length.

Station and Depth.—Eleven specimens and odd valves were dredged in twenty-five fathoms in sandy mud off Cabbage-Tree Island, Port Stephens, N.S.W., by Mr. John Brazier, who sent five specimens to Dr. Davidson, with the remark that they differed from all other known Brachiopoda from Australian waters.

Obs.—Dr. Davidson commemorated Mr. Brazier's discovery by naming the species after him, and I have deemed it my duty to my old and valued friend to describe the species under the name he desired to give it, as well as I am able. In so doing I wish to call the attention of qualified conchologists thereto, and to place on record the wide geographical distribution of the genus *Atretia*, which we now know to range in from 25–1750 fathoms, from nearly 70° N.

[1] NOTE.—I communicated the discovery of the Australian *Atretia* to the Norwegian naturalist, Herr Herman Friele, who replied, April 19th, that my description of the skeleton of *A. brazieri* is quite typical of the genus *Atretia*, which he cannot consider to be the young of *Rhynchonella*. He adds the important fact that he obtained some fifty specimens of the *Atretia gnomon*, Jeffr., during the Norwegian North-Atlantic Expedition, but no *Rhynchonella* occurred on the same station or in corresponding depths.—AGNES CRANE, April 26th.

lat., in the Arctic Ocean to the Canaries in the South Atlantic, and as far as lat. 32° south of the Equator in the Southern Pacific Ocean. The specimens will eventually be placed in the Davidson Collection in the British Museum.

P.S.—Since my paper on *Atretia brazieri* was writtten, I have submitted with my friend Mr. J. E. Haselwood, F. R. Micr. Soc., all the specimens of *Atretia* to microscopic examination. Under a ten-inch power the beak-area deltidial plates present some immature features similar to those figured by Morse in his 'Embryology of *Terebratulina*.' The scaly structure of the shell is very apparent; there are no perforations. We observed two long slender narrow muscular scars, with a diamond-shaped central one in the interior of a ventral valve. The marginal borders of the largest specimen seemed raised or swollen. The most puzzling appearance occurs on some brown patches on the shell, consisting of circular and elongated sac-like aggregations. If these bodies are a feature of the *shell-structure*, it seems strange they should be visible in portions of the surface only[1]. I hope further to investigate the matter.

3. Observations on the Disposition of the Cubital Coverts in Birds. By J. G. Goodchild, F.Z.S., F.G.S., H.M. Geological Survey.

[Received March 16, 1886.]

The prominent position occupied by the cubital coverts in most living birds renders their correct delineation a point of so much importance in any figure intended for zoological purposes that it is perhaps hardly necessary to offer any apology for submitting a few observations upon that subject for the consideration of the Fellows of this Society. Both ornithologists and zoological artists have, of course, long been aware of the existence of considerable diversity both in the relative proportions and in the mode of arrangement of these feathers in various groups of birds; but it seems never to have occurred to any one that these variations are of such a nature as to admit of their being reduced to any system of classification. This oversight may be due to the fact that the specimens made use of for scientific purposes have necessarily been either spirit-specimens or else skins flat or mounted. In the case of the skins especially, such specimens cannot, as a rule, be at all depended upon as representing the natural order of the feathers in a living state; and consequently ornithologists have been led to believe that the subject under notice was not worth any serious attention. But a careful

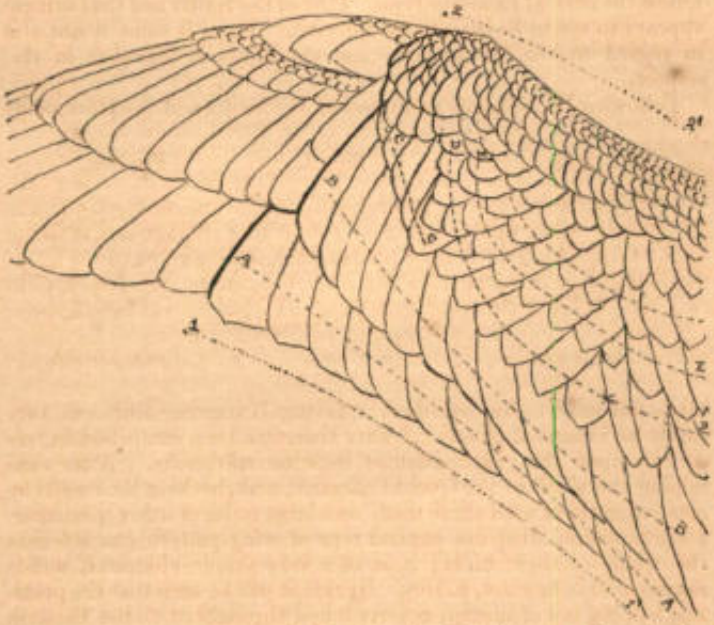
[1] Note.—More prolonged examination by daylight with different powers showed these appearances to result from the partial overlapping of the cycloidal scales of the shell-structure. The presence of parallel rows of spicular projections was clearly revealed in the interior of the valves; these occur at regular distances from each other, running from the beak towards the margins of the valves.—Agnes Crane, April 26th.

comparison of the features presented by a large series of living birds, in good health, or of freshly-killed wild birds, leads to a different conclusion. These show that a particular mode of arrangement, or a particular order of overlap, of the median cubital coverts is practically constant for all the individuals of the same species. More extended observations show that the same general mode of disposition is as a rule characteristic of all the species of a genus, and may even be found throughout all the members of groups larger than that.

A reference to the wing of the Golden Plover, a central type, and one that in itself represents all the leading modifications (see fig. 1, p. 186), may help to make the nomenclature herein used more intelligible. [In drawing up this scheme I have availed myself of several suggestions made to me by Prof. Flower, and by my colleague Mr. E. T. Newton, after the paper was read before the Society.] The terms used refer mainly to the relations of various parts of the wing to each other and to the body axis, when the wing is extended and is viewed from the dorsal or upper surface. The wing-surface is primarily divided into the manual (primary) region and the cubital (secondary) region, this last embracing all the feathers that originate from any part of the forearm or cubitus. Of the manual region I have nothing that need now be discussed. In the cubital region the Remiges, and the Greater Coverts that come on next above them, are uniform in disposition in all Carinate birds. In these feathers the overlap is uniformly distal; that is to say, the several feathers are disposed in such a manner that the outer free edges of those nearer the vertebral axis overlap the inner edges of those originating nearer the distal extremity of the wing. The same observation applies also (but with some minor modifications of detail that will not now be taken into consideration) to the Lesser Coverts, or those feathers that mainly originate in the Patagium, and that extend along the anterior border of the wing from the humeral fold to the carpal joint. The remaining feathers, which are generally comprehended under the term Median Coverts, vary considerably in both their direction of imbrication and in the number of rows that run parallel to the greater coverts in each case. The present paper is devoted to a consideration of the nature and the extent of the variation referred to, without regard to morphological details of any other kind soever. Many of the facts have either not been noticed, or else, if they have been noticed, their significance appears to have been missed. For convenience of description the tract occupied by the Median Coverts may be divided into three areas by lines parallel to the main direction of the cubital quills. The area nearest the vertebral axis will be referred to as the Proximal area, the next the Middle area, and the remaining third, up to the distal border next the manual region, the Distal area. The rows of feathers composing the median coverts range, in a general way, parallel with the greater coverts. The number of rows varies from one to six, or even more, in different forms of birds; and the row nearest the greater coverts is the one most subject to variation in the disposition of the feathers composing it.

In dealing with the various modifications, I propose to take the birds as nearly as possible in the order adopted by Dr. Sclater in the Eighth Edition of the 'List of Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London.'

Fig. 1.



Illustrations of the terms used in the following description, as shown by the feathers of the Cubital Region in the Golden Plover.

1 to 1', Posterior Border. 2 to 2'. Anterior Border. 2' to 1'. Proximal End. 2 to 1. Distal Edge of the Cubital Region (shown by the thicker line). A. Cubital Remiges. B. Greater Wing-coverts. C. Supplementary row of Median Coverts, or Upper Wing-coverts. D. Posterior row of Median Wing-coverts. E. Second row. F. Third row. The Posterior row of Median Coverts from D, near the Carpal joint, shows Proximal Overlap as far as the point marked with a small cross. Distal Overlap is shown by the mode of imbrication of the Greater Wing-coverts.

The Passerine style of imbrication represents one extreme of the range of modification observable, and is well exemplified by the wing of *Turdus merula* (fig. 2). In this the median coverts consist of a single uninterrupted row of feathers, whose free edges are regularly directed backwards along a curve extending from near the carpal joint towards a point near the elbow. The same figure shows also one of the simplest arrangements of the Lesser Cubital Coverts. Such an arrangement as obtains in the Blackbird may be traced, with modifications of only minor importance, through some thousands of

species of Passerine birds, and will probably, on further examination, be found to characterize the whole of the birds that are correctly referred to that Order.

In the Corvidæ an approach towards a somewhat different mode of arrangement is made (fig. 3): another minor modification is seen in the Alaudidæ (fig. 3*a*). The Swallows (fig. 5*a*, p. 188) all appear to follow the normal passerine type. That of the Swifts and the Cotingas appears to me to be essentially different. There is some doubt also in regard to the Bower-birds and the Birds of Paradise in this respect.

Following Dr. Selater's arrangement, the Swifts and the Humming-

Fig. 2. Fig. 3. Fig. 3 *a*.

Turdus merula. *Corvus.* *Alauda arvensis.*

birds fall next to be described. Living Humming-birds can very rarely be examined closely; I have therefore been compelled to rely entirely upon the examination of museum specimens. After examining the whole of the Gould Collection, and checking the results by comparing them with those made on a large series of other specimens, I am convinced that one general type of wing-pattern characterizes the whole of these birds; it is of a very simple character, and is represented in figure 4, p. 188. By this it will be seen that the proximal lapping row of median coverts found throughout all the Passeres is absent entirely in this. The Humming-birds might, indeed, be described as possessing no median coverts at all, the place of these being taken up by feathers having the same mode of imbrication as the Lesser Coverts. All the feathers of each series overlap outwards and backwards from the vertebral axis towards the distal end of the wing in these birds.

Observations on the order of overlap in the wing of freshly-killed specimens of *Cypselus apus*, afterwards extended by an examination of the whole series of Swifts in the National Collection, showed that in these, as in the Humming-birds, no one series of feathers overlaps backwards. In fact the wing-pattern in the genera *Cypselus*, *Acanthylis*, *Chætura*, and *Collocalia* seems to me to differ in no essential respect from that found throughout the Trochilidæ. So far as the disposition of the wing-coverts is concerned, the Swifts and Humming-birds agree amongst themselves, and differ from all of the Passeriform birds, with the possible exception of the Birds of Paradise. Fig. 5, p. 188, taken from a freshly-killed specimen of *Cypselus apus*, will serve to make this point clear. A wing of *Hirundo rustica* is figured alongside for comparison (fig. 5 *a*).

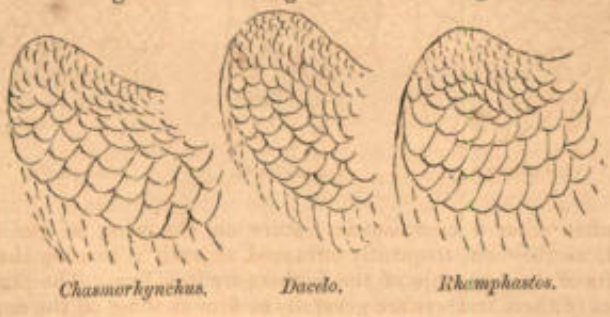
Following the normal Macrochires come the Caprimulgidæ. Of these, in the living state, I have examined only *Caprimulgus europæus* and *Podargus cuvieri*. The disposition of the cubital coverts in these is certainly not at all like that seen in the Swifts; but it closely follows the arrangement seen in the Picarian birds. In these at least two series of the feathers next above the Greater Coverts show proximal overlap. An examination of the specimens

Fig. 5 *a*. Fig. 5. Fig. 4.

Hirundo. *Cypselus.* *Trochilus.*

of *Podargus*, *Batrachostomus*, *Ægotheles*, and *Caprimulgus* in the National Collection, as well as of specimens of the same family elsewhere, confirms this view. The soft and downy nature of the feathers prevents satisfactory observation upon any feathers above the two lower rows of median coverts; but I have satisfied myself in regard to the point in question. While *Caprimulgus* and its allies seem to agree in this particular with *Podargus*, *Steatornis* (so far as one can judge by the unsatisfactory data furnished by skins) presents yet another type, which seems to follow that of the true Cuckoos rather than that of *Podargus* or its allies. In all the remaining

Fig. 6. Fig. 6 *a*. Fig. 6 *b*.



Chasmorhynchus. *Dacelo.* *Rhamphastos.*

Picarian families enumerated in the List (except Cuculidæ, Musophagidæ, and Indicatoridæ), at least the two rows of feathers next

above the greater coverts, and often more, show uniform and uninterrupted proximal overlap. This arrangement can be very conveniently studied in the Toucans (fig. 6 *b*), which are nearly always well represented in the Parrot House in the Society's Gardens. The Cuckoos are associated with the Picarian birds in the List; but as their wing-pattern differs in some essential respects from that of the typical forms, they will be referred to in connection with another series.

The transition from the Picarian type to the Psittacine is gradual; indeed some of the smaller Parrots, especially *Melopsittacus*, might, so far as the wing-pattern is concerned, well stand within the confines of the Picarian group. The chief difference in the case of *Melopsittacus* lies in the further increase in the number of rows of backward-lapping feathers on the cubital area. Fig. 7 shows this form of wing, which can be easily compared with the living form in the case of so common a cage-bird. In the type of wing-pattern prevailing throughout all, or nearly all, the rest of the Psittacidæ, an additional modification may be observed. The row of feathers coming on next above the Greater Coverts, indicated by the letter C in the following diagrams, is seen to consist of a series numbering generally five or six, which are confined to the distal area of the cubital region, and form a distinct and separate series from the feathers that extend across the median area. They correspond in relative position to the Upper Wing-coverts (*tectrices superiores*) in the manual region of the wing; and it might be convenient for the present to refer to those extending over the distal area of the cubital region under the same term, as is done in the specimens illustrative of the structure of birds' wings that Prof. Flower has arranged at the Natural-History Museum. The feathers referred

Fig. 8 *a*.

Psittacus.

Fig. 7.

Melopsittacus.

Fig. 8.

Calopsitta.

to often form a conspicuous feature on the wing of the living bird, as they are frequently arranged in such a manner that the shafts of three or more of the feathers are in a line. The proximal edges of these feathers are generally as firm as those on the opposite side, and, as a consequence, the whole series slides between the feathers next them on the proximal side in much the same way as the

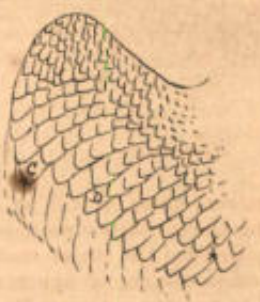
blade of a lancet closes into its sheath. The feature referred to can be better understood by reference to C, figure 8, taken from a living specimen of *Calopsitta novæ-hollandiæ*, which represents the style prevailing throughout probably the whole of the Psittaci.

Essentially the same pattern as is found in the Psittaci prevails also throughout the whole of the Striges, and also throughout the whole of the Accipitres, with the exception of *Pernis*, *Pandion*, *Gypogeranus*, and the Cathartidæ. These exceptional forms will be referred to again in their proper places. Fig. 9, representing the wing

Fig. 9.

Falco.

Fig. 9 *a*.



Phalacrocorax.

of a Merlin, well illustrates the whole of the normal Accipitrine forms. Mr. Wolf's beautiful figures of the Birds of Prey all afford excellent illustrations of the same point, while, from a part of the world where experience has led us to expect minute accuracy of detail, we have the Japanese figure in metal of a species of *Spizaetus*, now amongst the choicest treasures at South Kensington Museum, which affords a correct illustration of the Accipitrine style of cubital coverts. Of the Pelicans, in the present connection, nothing satisfactory can be made out, on account of the lax and drooping condition of their feathers, even in health. But *Phalacrocorax* (fig. 9 *a*) gives us a style hardly distinguishable in any noticeable respect from that of the Accipitrines. On the other hand, *Fregata*, *Sula*, *Plotus*, and some other forms associated with them are widely removed, pterographically, from the Cormorants.

All the Herons and their immediate allies, *Nycticorax* (fig. 10), *Botaurus*, and, I believe, also *Cancroma*, closely follow the Accipitrine mode of imbrication. The principal difference lies in the reduced prominence of the supplementary row of lancet-like feathers (upper wing-coverts) so characteristic of the Birds of Prey and the Parrots. Healthy Night-Herons in immature plumage exhibit the Ardeine style of median cubital coverts remarkably well.

The Ciconiidæ, in regard to the point under notice, will fall to be described in another part of this paper.

The remarks made in connection with the Pelicans apply also to the Odontoglossæ.

Passing over the Palamedeæ for the present, the last group whose style of cubital coverts brings them under notice here is the Anseres. Here, again, we have a group with nearly uniform pterographic

Fig. 10.

Nycticorax.

Fig. 11.

Querquedula.

characters; these, as will be seen by reference to figure 11, representing *Querquedula crecca*, so closely follow the style seen in the Accipitres and the others mentioned as possessing the accessory row of median coverts, or upper wing-coverts (C), that it is difficult to point to any one character that would serve to distinguish them.

It will be noticed that the birds characterized by possessing more than two rows of median cubital coverts with proximal overlap, together with a single supplementary row of upper wing-coverts also with proximal overlap, are further characterized by the Desmognathous palate, are Homalogonate, and possess in addition several other deep-seated points of structure is common.

Fig. 12.

Meleagris.

Near to the Accipitrine birds, and perhaps leading away from them somewhere near the Polyborine birds, a kind of transition may be traced in the direction of the Gallinæ. In the case of *Meleagris* (fig. 12) proximal overlap characterizes nearly all the median cubital coverts, as in the Accipitrines, and in this respect these birds stand

alone amongst the Gallinæ; but neither in *Meleagris* nor in any of the Alectoropods do any traces of the upper wing-coverts exist. In some respects the Peristeropod Gallinæ, represented by *Talegalla* (fig. 13 *a*) and by *Crax* (fig. 13), stand nearest of the Gallinæ to the Accipitres; while *Numida* is hardly more removed.

Fig. 13.

Crax.

Fig. 13 *a*.

Talegalla.

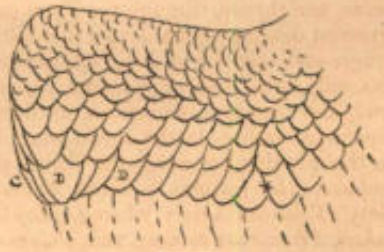
In the Peristeropods we find the commencement of a modification that is carried to a much greater length in other Galline birds, as well as in a large number of forms that have yet to be noticed. This consists in the increased prominence of distal overlap in the proximal third of the cubital area. In *Crax* (fig. 13), for instance, it will be noticed that the distal overlap, whose commencement is indicated by the small cross, extends into the middle area in the case of the lowest row. The distal overlap at C is another noteworthy feature, as it has not yet been observed in any of the Gallinæ except the Peristeropods.

Taking the evidence afforded by the mode of imbrication of the wing-coverts alone, it is near to the Peristeropods, and not near to

Fig. 14 *a*.

Columba

Fig. 14.



Goura.

the Pigeons, that *Goura* should be placed. The pattern is shown in fig. 14, which should be compared with *Crax* on the one hand and

with any conspicuously-marked Pigeon of the normal type (*Columba guinea*, for example, fig. 14 *a*) on the other. The difference, to me, appears both striking and significant. Perhaps I may be allowed to remark that the characteristic differences between *Goura* and the normal Pigeons are represented in the very useful series of coloured illustrations now posted up outside the Western Aviary in the Society's Gardens.

In addition to the difference already noted between the true Pigeons and *Goura*, the following points of agreement and of difference between the two groups may be considered:—

In the normal Pigeons an oil-gland is present; but is absent in *Goura*.

In the normal Pigeons the tail-feathers are 12 in number; while there are 16 in *Goura*.

In the normal Pigeons the pterylosis is columbine; and is galline in *Goura*.

In the normal Pigeons cæca are present; but are absent in *Goura*.

In the normal Pigeons a gall-bladder is present: no gall-bladder in *Goura*.

In the normal Pigeons incubation lasts 16 days; but extends to 28 days in *Goura*.

In addition to these peculiarities reference may be made to the bird's pheasant-like habits, to certain peculiarities of the urosacral and of the caudal vertebræ, to the number of the cervical vertebræ, to the absence of pterygoid processes, and to other features referred to by Prof. Huxley (P. Z. S. 1868, p. 302) and by Prof. Parker (T. Z. S. v. p. 151, 1863). Dr. Sclater (Ibis, 1880, p. 407) refers to certain peculiarities of the tarsus, in addition to the differences just noted, as evidence in favour of separating *Goura* from the Pigeons.

The main differences that distinguish the wing of the Peristeropod Gallinæ from that of the Birds of Prey have already been pointed out. It remains to add that the prominence of distal overlap introduced by *Talegalla*, *Crax* and its allies, becomes more accentuated in *Numida*, and thence, through the Tetraonidæ (fig. 15, p. 194), reaches its greatest development amongst the Gallinæ in the typical Pheasants. A progressive increase of distal imbrication can be traced, in the first stages, only in the first, or posterior, row of median coverts, then in the second, and the third, and so on, until in *Polyplectron* all the more conspicuous feathers in the closed wing of the living bird seem to lap from the proximal towards the distal side of the wing. Excellent examples of the features referred to may be easily observed in the Society's Pheasant Aviary, where *Lophophorus impeyanus*, *Euplocamus swinhoii*, *Phasianus reevesi*, and *Polyplectron chinquis* well display the feature referred to. A reference to the annexed figure of *Euplocamus swinhoii* (fig. 16, p. 194) will serve to make the general disposition clear.

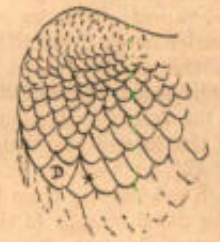
Pavo follows a slightly different pattern; and it is a point worth

notice that there seems a constant difference of small amount between the individuals of *P. cristatus* and *P. nigripennis* now living in the collection. In *P. nigripennis* all the feathers of the posterior row of median coverts appear to lap distally. The Common Peacock is

Fig. 15.

Tetrao.

Fig. 16.



Euplocamus.

well represented in the particular feature under notice by one of the fine pieces of Japanese metal-work at South Kensington already referred to under the head of Accipitres.

In the pterographic characters of both the Hemipodii and the Crypturi, I have hitherto failed to discover any marked characteristic connected with the point under consideration that would serve to distinguish these birds from the Gallinæ. In the case of the Tinamous, especially, the structural characteristics of the palate had led me to expect a wing-pattern of a much lower type.

With the exception of *Goura*, already noticed, the pterographic characters of the Columbæ are remarkably uniform throughout. These characters are well displayed in the case of the Domestic

Fig. 17.

Columba.

Pigeon (fig. 17). Here it will be noticed that the proportion of feathers showing distal overlap, at the proximal end of the median coverts, remains much the same as in the Gallinæ; but that in place of the well-marked, uniform, and uninterrupted proximal overlap of

the posterior, 2nd, and 3rd rows of median coverts in the distal area, which is nearly always seen in the Gallinæ, the corresponding features of the Pigeon show a different and much more complex arrangement. In all the birds previously passed under notice (except the Birds of Paradise amongst the Passeres, and the Macrochires) the feathers of both the middle and the distal area of the median coverts maintain a proximal imbrication from near the carpus backwards, various distances according to the zoological position of the bird under notice. In all the remaining birds, inclusive of the Columbæ, the distal area of the median coverts is composed of feathers arranged in the opposite direction. It is somewhat difficult to reduce the facts to anything like an intelligible description; but a study of the figures may help to make the mode of arrangement clear. It will be seen by this that several feathers on the distal area of each row overlap from behind forwards, or from the proximal towards the distal margin of the wing. The feature referred to can be easily studied in the case of Domestic Pigeons; although the general Columbine pattern can, perhaps, best be studied in the case of such conspicuously-marked exotic Pigeons as *Columba guinea*, *Peristera geoffroii*, *Leucosarcia picata*, and others commonly living in the Western Aviary.

Pterocles arenarius, now (1885) living in the Western Aviary, shows an arrangement of the wing-feathers somewhat like that of the Pigeons, especially so far as the proximal and the distal areas of

Fig. 18.

Pterocles.

the cubital region are concerned. But the distal imbrication of all the feathers next the manual region is, in the Pterocletes, carried to excess. In this respect the Pterocletes stand as far removed from the Pigeons as these are from the Gallinæ. In the stuffed specimens of *Pterocles alchata* in the National Collection this feature is remarkably well displayed (see fig. 18). Another point to be noticed in these birds is that the posterior row of median coverts show distal overlap throughout their entire length—an arrangement of

these feathers that is characteristic of a large number of the birds remaining to be described.

Still following the plan of tracing out the various modifications of wing-pattern without reference to any other characteristics, however important, the place of the Coccyges should be somewhere near the confines of the Columbæ.

Fig. 20.

Carpococcyx.

Fig. 19.

Cuculus.

Fig. 20 *a*.

Coccystes.

In passing in review a number of species belonging to the Coccyges, they seem to be naturally divisible into the Cuckoos proper, well represented by *Cuculus canorus* (fig. 19), and the Centropodinæ, represented by *Carpococcyx radiatus* (fig. 20). The Cuckoos proper somewhat resemble the Pigeons, and where they differ from the Pigeons they seem to approach the Picarian birds. The Ground Cuckoos seem to make some approach to the Peristeropods; in other respects they remind one of the Musophagidæ. Judging from stuffed specimens alone, the wing of *Opisthocomus* closely resembles that of the Cuckoos.

In the living Bustards, so far as I can judge, there seems again to be another variation on the general pattern of the Columbæ; but I have hitherto failed to obtain a satisfactory sketch of the wing-pattern in this bird. Of the remaining families of the Order Alectorides given in the List, I have also, so far, failed to obtain any good evidence, except in the case of the Gruidæ, which will be referred to in more detail presently. It is especially desirable to obtain good observations upon the point specially under notice in the case of the Cariamas; but the lax texture of their wing-feathers renders any such observation a matter of considerable difficulty. So far as I can judge at present, the style of coverts in the Cariamas agrees with that of the Bustards, and differs from that of *Serpentarius*.

The specimens of *Chauna chavaria* living at the Gardens present a style of imbrication that seems to approach the Columbine type very closely. The disposition shown in fig. 21 is practically the same as Wolf has drawn in *Ch. nigricollis* (=*derbiana*), P. Z. S. 1864, pl. xi. Whether the feathers of the distal tract of the cubital region follow exactly the same disposition as do those of the Pigeons

I am at present unable to state definitely, but they appear to do so, judging from stuffed specimens.

The pterographical characters of the Limicolæ, if we start with the Plovers as the representative of the Order, nearly approach those of the Pigeons. The principal difference lies in the fact that the proximal or backward overlap that characterizes the lowest two, or three, rows of median coverts in all the Desmognathæ, and that is so nearly absent in the Pigeons, is again represented more or less perfectly in the majority of the Limicolæ. The distal overlap of all

Fig. 21.

Chauna.

the feathers next the manual region of the wing, that serves to distinguish the Pigeons from the Gallinæ, is a well-marked and constant feature in all the Limicolæ. There is one group of feathers, firm on each edge, that extends backwards from the carpal joint down to the greater wing-coverts; on the distal side of this the median coverts all overlap towards the margin of the wings on that side, up to the alula, while on the proximal side of the same firm-edged feathers the median coverts overlap in the opposite direction as far as the point where they are met by that of the proximal area, which, again, lap forward. It is difficult to convey an exact idea of this somewhat complex arrangement except by means of a diagram, such as that of the wing of *Gallinago cœlestis*, fig. 22, p. 198, which well exemplifies the style current throughout not only all the Limicolæ, but throughout nearly all birds with a Schizognathous palate.

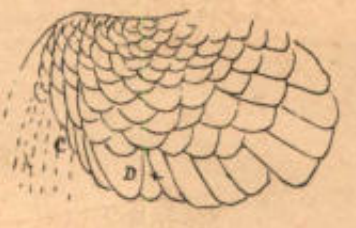
Variations of a minor character occur within the limits of this Order. Even in the case of two birds so closely related as the Common Snipe and the Woodcock (figs. 22, 23), such differences may be detected. The Snipe follows the normal Limicoline style, while that of the Woodcock more resembles aberrant forms such as *Œdicnemus*, which comes nearer to the Bustards. I was so much struck with the difference alluded to, that I sought for evidence of a deeper-seated and more reliable nature, with a view to getting further information upon this point. Such differences do exist, notably in the structure of the skull; but I have not yet had an opportunity of following

the subject far enough to speak with confidence in regard to other differences noticed.

Fig. 22.

Gallinago.

Fig. 23.



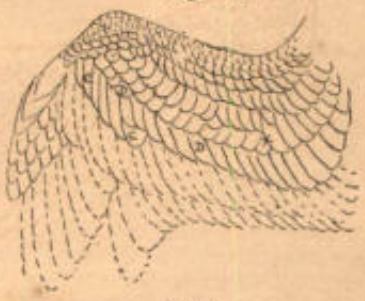
Scolopax.

From the central forms of the Limicolæ nearly all the modifications of style observable in the Carinatæ could be traced without difficulty; and the forms now remaining to be considered join on naturally enough to such types as that represented by the Plovers. In one direction, and at no remote distance from the Plovers, we come to the Rails, represented in fig. 24. In another direction,

Fig. 24.

Rallus.

Fig. 25.



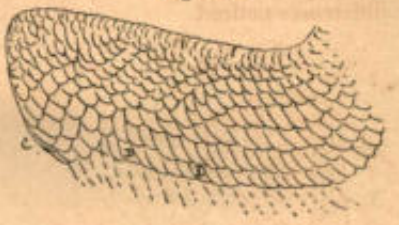
Sterna.

gradations equally gentle conduct us to the Gulls and the Terns (fig. 25). Along another line of modification we arrive at the Cranes. The Storks again stand at no great distance. Each of the forms here mentioned, in turn, leads to others more distantly removed from the central type. Beyond the Gaviæ lie the Pygopods, represented by *Alca* (fig. 26). These in turn graduate easily into the Tubinares, as represented by *Puffinus* and by *Diomedea* (fig. 27). Closely resembling these last in style of wing-coverts follows *Sula* (fig. 28) and *Fregata* (fig. 29), which lead the way to one of the extreme modifications of style observable in this particular, exemplified by *Plotus* (fig. 30). Starting from another point, the

Fig. 26.

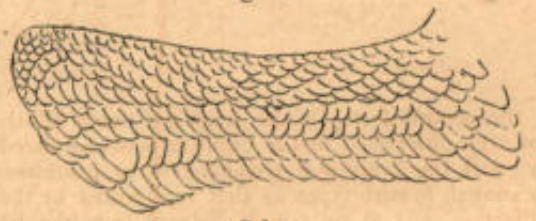
Alca.

Fig. 27.



Diomedea.

Fig. 28.



Sula.

Fig. 29.

Fregata.

Fig. 30.

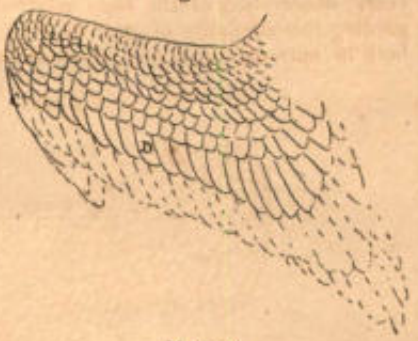
Plotus.

normal Ciconiine pattern, represented by that of *Dissura maguari* (fig. 31), leads the way through *Mycteria* (fig. 32), to *Leptoptilus*

Fig. 31.

Dissura.

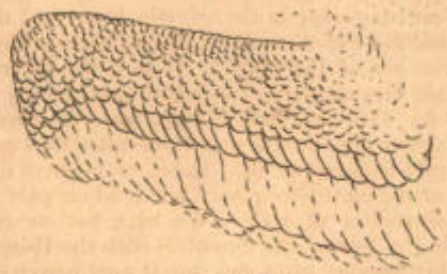
Fig. 32.



Mycteria.

(fig. 33), which, in respect of the feature under consideration, stands midway between the Ciconiine birds and the Tubinares. Between the style of the median cubital coverts in *Leptoptilus* and that of

Fig. 33.

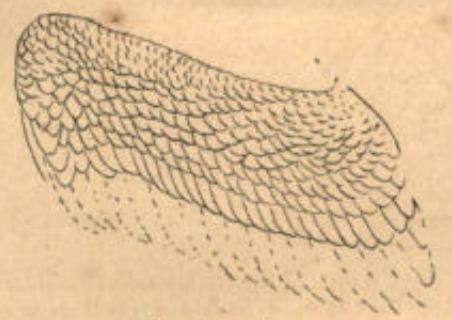


Leptoptilus.

the Cathartidæ (fig. 34), I have hitherto failed to detect any difference of importance in respect of the feature specially under notice. So far as the imbrication of the wing-coverts is concerned, *Leptoptilus* and the Cathartidæ might even stand in the same family. How far the purely superficial feature at present specially under notice can be regarded as affording data of any value in corroborating the view advocated by Messrs. Garrod and Forbes that there is a close genetic affinity between the Storks and Petrels on the one hand and the Cathartidæ on the other, must be left to competent zoologists to judge. After a careful examination of living specimens of *Diomedea*, *Ossifraga*, *Puffinus*, *Fregata*, *Leptoptilus*, *Cathartes*, *Sarcorhamphus*, and

Gypogus, I have been so much impressed with the uniform style of wing-coverts prevailing amongst this group, that it seems to me difficult to believe that their genetic relationship amongst themselves is more remote than Forbes regarded it. I cannot, after many years' observation of the facts referred to in this paper, help regarding this similarity of style of wing-coverts in birds so different, both in outward form and in their mode of life, as presenting us

Fig. 34.



Sarcorhamphus.

with a certain amount of evidence of the transmitted survival, in an unmodified form, of a mode of imbrication of epidermic structures that at some remote period in the genetic history of the common Sauropsidan ancestors of these birds played some really important part in the economy of the wearer. During the differentiation of such parts of the creature's organization as were directly affected by the struggle for existence, other parts, not so affected, either changed at a slower rate, or else were transmitted from generation to generation hardly modified at all. Habit, or mode of life, as birds now live, can at the most have played but a minor part in bringing about these diversities of style. We have but to compare the Swallows with the Swifts, the Sun-birds with the Humming-birds, and many other parallel cases, and we at once perceive that mode of life has had little or nothing to do with the origin of the features in question. The real cause lies deeper than that, and dates back far into the remote history of the Sauropsida.

Reverting to the normal Ciconiine style of coverts, we find *Platalea*, with *Ibis* and its allied genera, differing but little from each other and from *Ciconia*.

Tantalus, in this respect, stands nearer to the Limicolæ.

The Cranes, again (fig. 35, p. 202), present another variation little removed from the central Pluvialine type.

Somewhere near to the Cranes and the Storks, but connected in some way with the Gallinaceous style of coverts, stands the wing of the Secretary Bird (fig. 36, p. 202); it is quite unlike the true Accipitrine type.

Lastly, come two birds whose wings I cannot refer satisfactorily to any one of the groups above described. One is the Osprey

Fig. 35.

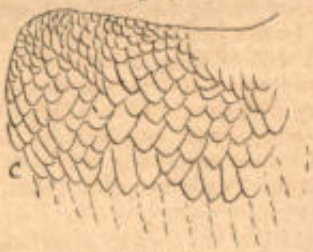
Grus.

Fig. 36.

Gypogeranus.

(fig. 37), whose wing seems to occupy an outlying position somewhere between the style of the Pygopodes and that of the Accipitres. The other is represented by *Pernis apivorus*: several stuffed specimens of this bird showed the posterior row of cubital coverts lapping distally, somewhat as in the Ciconiine birds, and there were in addition some minor differences of less importance. Stuffed birds, at the best, afford data of a very untrustworthy character in this

Fig. 37.



Pandion.

particular; but on laying my difficulty before Mr. Gurney, who had some Honey-Buzzards alive, he courteously replied by sending me from the Norwich collection a skin that showed the feathers disposed as they were in his own living birds. This agreed exactly with the style observable in the stuffed birds, and differed from all the other Accipitrine birds as herein limited. Perhaps the nearest representative style is that presented by some of the Peristeropods, as, for example, *Crax*.

In regard to any conclusions connected with taxonomy that may be drawn from a study of the facts herein referred to there will probably be much difference of opinion. The facts themselves may be, in general, easily verified by a careful study of healthy living

birds, and most of the views admit, I believe, of no reasonable doubt. There can be little doubt, also, that up to a certain point there is a remarkable correlation of particular styles of imbrication of the cubital coverts with certain structural characteristics—osteological, myological, visceral, and pterographical; so that, within certain limits, the disposition of the cubital coverts may be taken as a kind of index to the presence, or the absence, of deeper-seated characters whose importance in relation to taxonomy is generally recognized. Nevertheless, until the facts here called attention to have been independently considered by other observers, I feel sure that it would be premature to press the importance of the bearing that any of these may seem to me to have upon taxonomic questions: for the present it will probably be generally deemed advisable to lay more stress upon the bearing of the facts upon the correct delineation of birds for zoological purposes, than upon their value as furnishing additional data as subordinate factors in any scheme of classification.

4. Second Note on the Melanotic Variety of the South-African Leopard. By Dr. A. Günther, F.Z.S.

[Received March 26, 1886.]

By the last South-African mail I have received from Mr. N. Abraham, President of the Graham's-town Natural History Society, a letter with photograph enclosed, which gives more positive information about the variety of the Leopard of the district of Albany, mentioned by Mr. Trimen in Proc. Zool. Soc. 1883, p. 535, and described by myself, *ibid.* 1885, p. 243, pl. xvi. The skin in Mr. Abraham's possession leaves hardly any doubt that we have before us a case of incipient melanism, which, if the family in which the melanotic tendency showed itself had been left undisturbed, might have been developed into as complete a condition of melanism as is occasionally found in the Asiatic Leopard. Mr. Abraham writes as follows:—

"Graham's-town, S. A.,
March 1st, 1886.

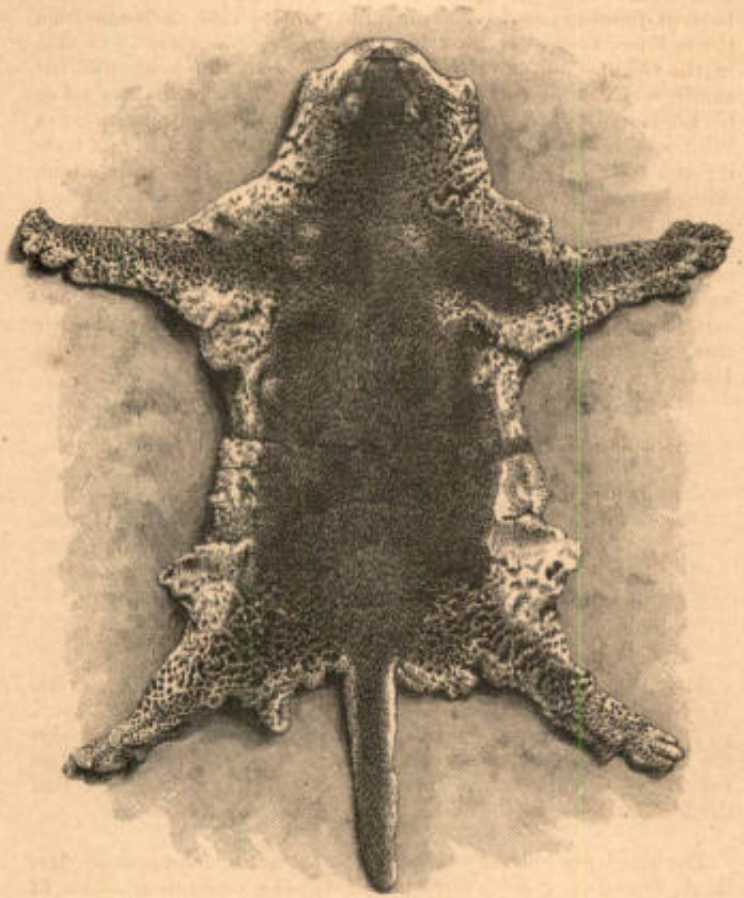
"*To Dr. A. Günther, F.Z.S.*

"Dear Sir,

"Knowing that you are interested in the black variety of Leopard found in the district of Albany, I write to tell you of a beautiful skin which I have in my possession and also to send you a photograph of the same. I had the flat skin photographed on purpose that I might send you a copy, as I thought a photo would convey a good description and save many words. It will, however, be necessary for me to say that the blackness of the skin is more dense than appears in the photo. The gloss upon the skin prevented the photographer from giving a true idea of the beautiful black, which is dense in many parts. There are no rosettes or spots at all on the larger portion of the skin; in this the photograph is quite correct.

The spots do not even show through the black as in the black Leopard of Java. The tail has had its point taken off; this accounts for its shortness.

"The measurements of the flat skin are as follows:—Head and



Flat skin of *Felis leopardus*, var. *melanotica*.

body 4 feet 1 inch; portion of tail 1 foot 4 inches; distance from fore toes to central line of back 2 feet 3 inches. On the black portion of the skin the hair is short with a very thick underfur. The tail is not black, but very dark, and has a somewhat remarkable appearance. The markings on the front legs differ very much from the markings on the hind legs, being very tawny with

scarcely any dense black, while the hind legs are slightly tawny with clear markings of black and white. The whole skin is very handsome and remarkable. The specimen was caught by a native in a trap and then shot. The native took the tip of the tail and the claws for trophies. It was caught about twenty miles from Graham's-town. I have made many inquiries respecting this peculiar variety with the hope of forming some good theory explaining this deviation from the ordinary type. I can only trace four specimens, viz.:—The skin in the Graham's-town Museum (this is a good specimen, but not nearly so black as the one in my possession); another was taken to England by Mr. Bowker, and is in the British Museum; a third was sold some time ago at a Church bazaar, but I cannot trace it; and the fourth I have. I do not know of any other for certain. All these have been shot in, or about the same district. The one I have came from Collingham near to Graham's-town. I am told that there are two living specimens still in the district, and there may be more, but these two have been seen, but not captured. I am still on the trail for more information; at present I cannot give any certain or probable account of the origin of this variety, but I write this to you and shall be glad to forward you further information when I have completed my investigation.

"I remain, dear Sir,
Yours sincerely,
(Signed) NENDICK ABRAHAM,
Pres. Graham's-town Natural History Society."

April 20, 1886.

Prof. Flower, LL.D., F.R.S., President, in the Chair.

Mr. O. Salvin, F.R.S., exhibited a living specimen of an exotic Worm—*Bipalium kewense* (Moseley, Ann. & Mag. N. H. ser. 5, vol. i. p. 238), found at Hawksfold, Fernhurst, April 19, 1886, amongst the broken tiles at the bottom of a pot of *Calceolaria*, which had been in a cold frame the whole winter. This fact suggested that the true home of *B. kewense* was some temperate region.

The following extract was read from a letter addressed by Mr. R. A. Sterndale, F.Z.S., to Sir Victor Brooke, concerning a case of hybridism between *Ovis hodgsoni* and *O. vignei*:—

"In the mountain-range south of the Indus, near Lanskar (the precise locality being for obvious reasons withheld from publication), a herd of *Ovis vignei* were observed for some years to contain a large ram of *Ovis hodgsoni*, who drove out the weaker Shapoo rams and appropriated the ewes of the herd. The ram was ultimately, one winter, killed and eaten by Chankos or Tibetan wolves; but during his stay he produced a family of hybrids possessing greater size of horn and head, with characteristic colouring combining traits

of both animals. In course of time these hybrids were crossed again with *Ovis vignei*, and the third generation shows signs of degeneration from the larger sheep and of reversion to the type of *O. vignei*.

"The skull of the half-bred animals, which the Tartars called Nyan Shapoo, the former being the name of the *Ovis hodgsoni* or Ammon, and the latter that of the *Ovis vignei*, is nearer in size to *Ovis hodgsoni*, which is double that of the other. The horns of these hybrids are rounded in front, resembling what has been figured of *Ovis brookei*, but hollowed out behind like those of *O. vignei*. The horns of the quarter-bred animal are square in front and hollowed behind like the true Shapoo-type, but are more massive than the pure-bred Shapoo.

"Now as regards the colour of the skin, the Nyan or *Ovis hodgsoni* has no black beard or throat-stripe, which *O. vignei* has. The half-bred animal shows no black, but the quarter-bred does in a modified but decided degree. The half-bred turns also in summer to the colour of *O. hodgsoni*, having more of a blue-grey or lavender tint and less of the fawn colour of *O. vignei*; with the white throat of *O. hodgsoni*, it also gets the dark patch at the side of the neck. The skin of a quarter-bred specimen before me is of a bright fawn above, sides and rump white, and a black stripe down the middle of the throat."

Sir Victor Brooke was of opinion that *Ovis brookei*, Ward, P. Z. S. 1874, p. 143, was probably established on a somewhat similar hybrid.

The following papers were read :—

1. On some Specimens of Disease from Mammals in the Society's Gardens. By J. Bland Sutton, F.R.C.S., Erasmus Wilson Lecturer on Pathology, Royal College of Surgeons, Lecturer and Assistant Surgeon to the Middlesex Hospital.

[Received March 30, 1886.]

During the past twelve months several specimens illustrating diseases of mammals in the Society's Gardens have come to hand. Some of them present features of such exceptional interest that it is desirable they should be placed on record. Of the value of the systematic examination of the bodies of wild animals dying in the Society's Gardens there can be no doubt whatever—not in the sense that it will enable us to deal with diseases occurring in them, but in the amount of light likely to accrue to pathological science in general if the investigation be carried on with the diligence and care its importance demands. The specimens to be described in this paper are of value, inasmuch as many of them are somewhat rare in

their nature, whilst others illustrate pathological conditions not before described in wild animals.

In 1877 Mr. Garrod read a short paper before this Society "On the Mechanism of the Intervertebral Substance, and on some Effects of the Erect Position of Man" (P. Z. S. 1877, p. 50) from which the following extract has been taken :—

"The assumption of a vertical attitude by a creature originally differentiated for a horizontal position of its body, has produced but marvellously slight inconvenience. If it had resulted in many, man could scarcely have survived. There are one or two, however, which are most clearly traceable to this cause, including the painful tendency to prolapse, antiflexion, and retroflexion of the uterus in women, as well as crural hernia in both sexes, and inguinal hernia in the male."

At the time the preceding paragraph was written, little was known, and far less recorded, concerning the abnormal conditions referred to by Mr. Garrod. The unusual opportunities which have occurred to me during the past five years of investigating diseases of wild animals will render necessary a reconsideration of this opinion.

In the first place prolapse of the uterus occurs with tolerable frequency, not only in domesticated mammals, but in the lioness, tapir, Cape hunting-dog, the pygmy hog, deer, antelope, and others. These examples are sufficient to show that it is not entirely attributable to the erect position.

With regard to flexions of the uterus, it is a remarkable fact that no fewer than one fourth of all the female Monkeys dying during the past two years presented extreme examples of this abnormal condition of the organ. In many the displacement far exceeded anything that I have seen in the human female. Well marked specimens of flexion of the uterus occur also in Deer. (For a detailed account of these cases and their ætiology consult Path. Soc. Trans. vol. xxxvi. p. 502.) The frequency and severity of the cases show that the flexion is due to causes in addition to the erect position.

Concerning hernia, it has always seemed to me strange that Man, whose inguinal canals are, in the ordinary course of events, more or less obliterated, should be so liable to visceral protrusions at these spots, whilst Monkeys, in whom the inguinal canals in most species remain more or less patent, should escape. It is certain that Horses are liable to inguinal ruptures; and I have long known that the same defect occurs with tolerable frequency in Sheep. During the past two months I have been so fortunate as to meet with two cases of inguinal hernia in Monkeys. In the first, *Macacus cyclopis*, a large plug of omentum occupied the funicular pouch of the left side; the second occurred on the right side in a *Macacus sinicus*. The details of the condition may be gathered from fig. 1, p. 208. This Monkey had also a large varicocele on the left side. These specimens are sufficient to show that such abnormalities are not peculiar to Man.

Probably most individuals among the civilized races of mankind

suffer at some period of their life from those troublesome thickenings of the skin of the feet and toes known as corns. Structurally a corn consists of thickening of the epidermis, due to pressure of an intermittent character, often the result of badly fitting boots. In many cases a small sac containing fluid may be detected between the thickened epidermis and the deeper tissues; this sac is technically termed a bursa. In others the bursa is replaced by loose connective tissue which allows the corn to glide freely over the underlying structures. We find excellent examples of corns in the ischial callosities of the *Cynomorpha* and in the callous pads found on the feet of Carnivora.

Fig. 1.

The right funicular pouch of peritoneum of *Macacus sinicus*, occupied by a plug of omentum, *o*; the testis, *t*.

Of late years the attention of surgeons has been directed to corns, in consequence of a very remarkable affection to which they are liable. Under certain abnormal conditions of the spinal cord and peripheral nerves, such as locomotor ataxy, sclerosis, and peripheral neuritis, the corns ulcerate, and at last the ulceration perforates not merely the corn, but the whole thickness of the foot; hence it is now familiar as the "perforating ulcer."

It was to me a matter of no small interest to find the callous pad on the foot of a Civet Cat the seat of a perforating ulcer; the interest was considerably heightened when, on opening the spinal

canal, the cord was found soft and almost diffluent. By careful hardening and manipulation, sections were obtained from the cord and submitted to the microscope. It exhibited a most marked degree of sclerosis. This was also seen in the nerves of the affected limb. The animal was supposed to be about seven years of age, and had been paralyzed for some time before it died. The specimen was shown to a number of experts, who were unanimous as to the nature of the affection, viz. perforating ulcer, with sclerosis of the cord and nerves. I then ventured the opinion that more cases would come to hand. A few weeks later a second specimen came under my observation, also in a Civet Cat; and, lastly, a most interesting example in the Two-spotted Paradoxure (*Nandinia binotata*). In the case of the Paradoxure the affection of the callous pads is in an early stage, for the ulcers, one on each foot, are as yet shallow (fig. 2).

Fig. 2.

Perforating ulcers (*u*) in an early stage affecting the feet of a Paradoxure, *Nandinia binotata*, secondary to sclerosis of the spinal cord. The ulcers were perfectly symmetrical on the fore and hind feet.

F, the fore, and H, the hind foot.

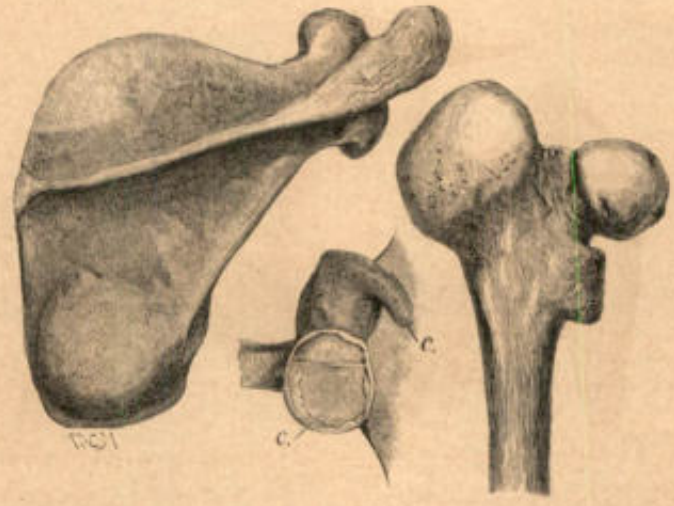
The most remarkable feature in the specimen is the perfect symmetry observed in the ulcers; in each fore foot the position and shape of the sores correspond exactly, and this is also to be observed in the hind feet. In this case only the lumbar and anterior portion of the spinal cord could be examined; for, after the animal died, its companion, much to my annoyance, had eaten the middle portion of its

back. However, an examination of such pieces of the cord as remained showed well-marked and indisputable sclerotic changes.

In 1842 Sir James Paget and Dr. William Budd [1] almost simultaneously directed attention to the frequent symmetry exhibited by disease of the tissues of the body. For example, an eruption on the skin of one leg is occasionally imitated by an eruption on the opposite leg, symmetrical, not only in position, but often in the shape of the patch, in the grouping, and even in the number of spots in each group. This symmetry is not merely confined to skin eruptions, but to diseases of the joints, sense-organs, nerves, bones, tumours, &c. Examples of symmetry occur very frequently in animals as a result of disease; and the following cases will serve as striking instances.

In the accompanying drawings (fig. 3) will be seen the scapula

Fig. 3.



Examples of symmetrical exostoses (*c*) in the skeleton of a Monkey, affecting the scapula, great trochanter, and coracoid process. The tumours on the opposite side were exactly similar in shape and situation, and nearly equal in size.

and femur of a Bonnet-Monkey that died of bronchitis complicating rickets. The inferior angle of the scapula is occupied by an osseous tumour containing tracts of cartilage. The base of the coracoid process presents a rounded projection, which would probably have grown into a tumour had the Monkey lived. The great trochanter of the femur presents also a rounded tumour similar to that of the scapula, but containing less cartilage. Each humerus presented a

[1] Med.-Chir. Trans. vol. xxv.

curious deformity, for at the junction of the upper and middle third the shaft was bent almost at a right angle. The corresponding bones of the opposite side presented precisely similar lesions.

The sebaceous glands of the skin very frqeuently in the human subject suffer obstruction of their excretory duct. The result is that the gland continues to secrete, but the outlet being closed, the sebaceous matter accumulates until at last a definite swelling results, which may remain of insignificant proportions, or attain a diameter of two or three inches in exceptional cases. Technically such swellings form one of a group known as "retention cysts."

The museum of the Royal College of Surgeons possesses some specimens of symmetrical sebaceous cysts growing from the wings of Wood-Pigeons. The specimens were presented by Mr. Tegetmeier. It appears that in certain seasons a large number of birds are found with swellings such as these on the wings, legs, and feet.

Fig. 4.

A Cockateel, *Calopsitta novæ-hollandiæ*, with symmetrical sebaceous cysts on its wings.

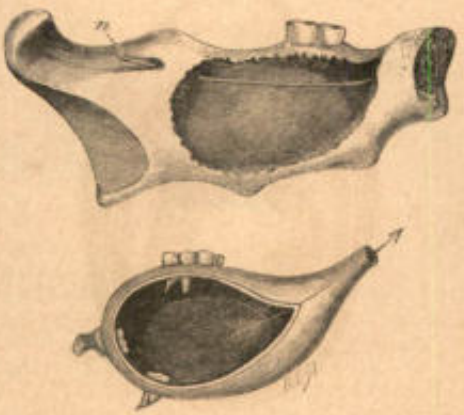
An excellent example of this affection has recently come under my notice in a Cockateel, *Calopsitta novæ-hollandiæ*. In this pretty bird there has developed on the inner surface of each wing a sebaceous cyst. The position, size, and shape of the "swelling" in the two cases exactly correspond, as may be seen on reference to the drawing (fig. 4). The specimen serves as an excellent illustration of symmetrical disease.

Malformations are frequently as symmetrical as tumours and skin eruptions. Mr. Forbes has recorded in the 'Proceedings' of this Society (1882. p. 442) an example of webbed fingers in a *Pithecia satanas*. "The third and fourth digits of the manus on each side were completely connected down to their tips by a fold of nude skin, with their nails closely apposed, though not connected, along their

contiguous margins; the remaining digits were normal." I remember examining the specimen, at the time Mr. Forbes noticed it, in the Prosector's room, and was impressed with the perfect symmetry of the malformation.

Since then one other example of malformation in the manus of a Monkey has occurred. A Gibbon (*Hylobates leuciscus*), which lived in the Gardens a few months, was found to have a supernumerary finger on each hand. In this case the additional fingers possess a metacarpal bone which was attached to the ulnar side of the metacarpal of the fifth digit, and it seems as though the supernumerary bone was formed as a result of bifurcation of the distal end of the fifth one. The carpal bones do not present any abnormality. So few examples of polydactyly in Quadrumana have been noticed that the case before us is worthy of record.

Fig. 5.



A follicular cyst from a Prehensile-tail Porcupine, *Sphingurus prehensilis*. The upper figure represents the jaw after the removal of the cyst.

n, the inferior dental nerve. The lower drawing is the cyst with the teeth projecting into it. The arrow marks the position of the mental foramen.

As an additional illustration of symmetry in disease, the following case is of value. A Prehensile-tailed Porcupine died from the effects of a large abscess on each side of the mouth. These had burst externally, giving rise to deep sinuses. A probe passed into each gave evidence of necrosed bone; and at first sight the case seemed to be one of alveolar abscess consequent upon diseased teeth, a condition of things exceedingly common in animals. On examining the mouth I failed to find the lower incisors; this was very singular, because the bone at the symphysis was quite normal. On tracing one of the sinuses by dissection, it was found to lead into the mental foramen, and thence into a cavity occupying the body of

the inferior maxilla. This cavity was filled with pus, but the abscess was limited by fibrous walls of considerable thickness. Feeling convinced that this was something more than a simple abscess, the bony walls were dissected and the sac removed and examined in detail.

This cyst is represented of natural size in fig. 5. Projecting into its posterior aspect are portions of the fangs of two undeveloped teeth. This is sufficient evidence to show that we have to deal with a follicular cyst—that is, the walls of this sac are constituted by the greatly distended follicle of one of the teeth, probably the incisor. From some cause or other suppuration had occurred, and led to the necrosis of the maxilla and absorption of the fangs of the

Fig. 6.

The tunica vaginalis and testis of a Lamb affected with a congenital parenchymatous hydrocele.

c, cremaster; *d*, tunica albuginea; *e*, epididymis; *t*, secreting-tissue of the testis.

molar teeth: a remnant of one may be seen projecting into the cyst. The inferior dental nerve, as a mere thread, was closely embedded in the walls of the jaw on the outer side of the sac. The opposite maxilla was affected in a precisely similar manner.

The last example of symmetrical disease I shall describe in this communication is a singular affection of the testes of a Lamb, which, so far as my knowledge of testicular disease extends, is unique. The lamb was thought to be ruptured on both sides, but on cutting into the supposed hernial sac a large quantity of fluid escaped, but no gut or omentum were found. The remaining testis was removed entire with its coverings and sent to me. The enormously distended outer covering (fig. 6) is the tunica vaginalis and testis cut off

from its connection with the peritoneal cavity. A few fibres of the cremaster muscle are spread over its upper limits. Inside this, and in close apposition with its walls, is the tunica albuginea, greatly distended, with the epididymis stretched over it like a strap. On cutting into it, a pint of straw-coloured fluid escaped. This liquid was alkaline in reaction (sp. gr. 1020), and contained one half its volume of albumen.

The substance of the testicle presented a very remarkable appearance, for it looked like the roots of a tree in miniature. There was a central main stem, and from it slender rounded rootlets composed of testicular substance, *i. e.* seminiferous tubules and connective tissue, passed outwards to the sac-walls. The appearances were the same in both testes. The condition is best expressed by saying that it resembled a hydrocele, except that the fluid was within the tunica albuginea instead of in the cavity of the tunica vaginalis.

Fig. 7.

The occiput of an Ichneumon, with dislocation of the atlas and subsequent ankylosis of that bone to the occiput.

The specimen has been brought before the notice of the Society, with the hope of inducing others who have opportunities of seeing similar cases to place a description of them on record.

In 1879 Prof. Flower gave an account of a very remarkable condition presented by the occiput of a Beluga. In this Whale the atlas had become dislocated from the occipital condyles, and displaced in such a manner that the passage for the spinal cord at the foramen magnum had become reduced to a very narrow chink, only three quarters of an inch in transverse measurement. The Whale had survived the accident some considerable time, for the displaced

atlas had become firmly ankylosed to the occiput, and it is very curious that the animal could have survived so serious an accident.

A somewhat similar case came under observation in an Ichneumon. In this instance the atlas had been dislocated from its relations to the occiput and axis, so as to occupy the situation shown in the accompanying drawing (fig. 7). In this instance the animal must have survived the injury a long time, because the occiput and atlas are firmly united by new bone.

Concretions formed of insoluble or indigestible matters are of frequent occurrence in the alimentary canal of Horses and Cattle, and at times may attain to very large size without causing any inconvenience. This is more particularly the case when these ægropiles, as they are termed, occur in the cæcum of horses. In this situation they have been known to weigh more than fifty pounds. These heavier masses are composed of magnesium phosphates; the lighter ones consist of hair which the animal licks from its body. This form is fairly frequent in calves, and I have met with a specimen in a Hyæna. Concretions of insoluble substances, such as magnesia, pins, seeds, &c., occur also in the human subject. Recently a Tiger died in the Gardens, and its bowels were found empty until the rectum was reached. Here a large mass of solid material was found about two inches from the anus, measuring six inches in length and eight inches in girth, covered with mucus. The lower end was bluntly pointed, and had caused by its pressure ulceration of the mucous membrane. The rectum was much dilated. On breaking into the mass it was found to be composed entirely of sawdust, which the animal had licked from the floor of the cage. A cast of the abnormal mass was taken at the time by the assistant, Mr. Ockenden.

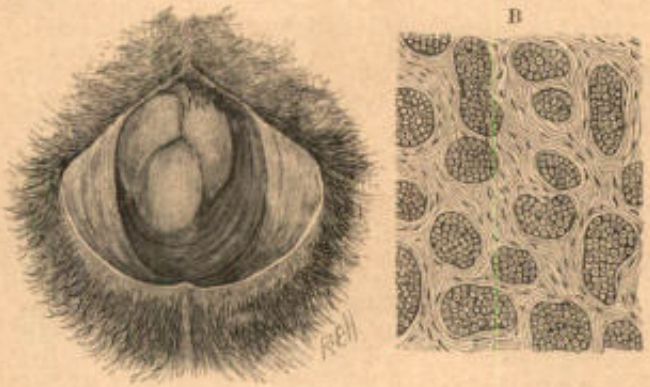
During the past four or five years there is one fact more than any other which has impressed me in the course of my work at the Gardens, and that is the infrequency of neoplasms. In the many hundreds of animals coming under observation, a tumour has been a rarity, and this applies with still greater force to cancers. The only example of this terrible malady I have seen in *wild* animals was a medullary cancer in the viscera of a Python. The infrequency of these growths makes the following case additionally interesting.

A Short-headed Phalanger, *Belideus breviceps*, was found to have a large, hard nodular mass in its marsupium. On slitting open the pouch a tumour presented itself, having the appearance represented in fig. 8, p. 216. Microscopically it presented all the characters peculiar to scirrhous cancer as seen in the human subject—that is, there were alveolar spaces enclosing masses of cells. The alveolar walls were composed of dense fibrous tissue. The structural details of the growth coincided with that of the gland from which it originated, except that the cells, instead of clothing the walls of the alveoli in a regular manner, were tumbled in confusion into the interior. This case is, so far as I know, the first authentic example of cancer in a marsupial.

The last specimen on my list is perhaps as interesting as any. It is an intussusception of the ileum into the cæcum, through, but not

carrying with it, the ileo-cæcal valve (see fig. 9, p. 217). The invaginated portion measures two and a half inches. The portion of gut above the constricted portion was very congested and almost gangrenous. The intussusception was very acute, and probably killed the animal, a Lemur, very quickly. The case is further interesting, for the intussusception occurred at that part of the intestine which

Fig. 8.



The marsupium of a Short-headed Phalanger, *Belideus breviceps*, opened in order to show a scirrhous cancer growing from the mammary gland.

The microscopic characters of the growth are shown in figure B.

is most frequently affected in this way in the human subject; but it is an example of the rarer form that occurs in this situation, viz. the ileo-cæcal variety.

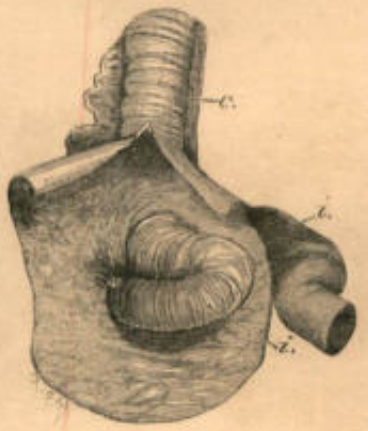
The investigation into disease, structural aberrations, and malformations of animals is of considerable importance apart from its intrinsic interest. Darwin, in his 'Descent of Man,' 2nd ed., 1874, page 6, writes:—"Man is liable to receive from the lower animals, and to communicate to them, certain diseases, as hydrophobia, variola, glanders, syphilis, cholera, herpes, etc.; and this fact proves the close similarity of their tissues and blood, both in minute structure and composition, far more plainly than does their comparison under the best microscope or by the aid of the best chemical analysis." He then quotes Rengger to the effect that the *Cebus azaræ* in its native land is liable to catarrh, apoplexy, inflammation of the bowels, and cataract.

This quotation seems to indicate beyond doubt that, had sufficient evidence been forthcoming regarding diseases of animals, Darwin

would most certainly have taken them into account as arguments in favour of his doctrine of Evolution.

So far as my own observations have extended, and each month adds new facts, there seem to be few forms of disease peculiar to

Fig. 9.



Ileo-cæcal intussusception in a Lemur. *c*, colon; *i*, ileum.

Man. On the other hand, certain affections occur in some animals with much greater frequency than in him, whilst a few diseases are entirely confined to them; many are also modified by peculiarity in structure, mode of life, and environment of the affected animal.

2. On a new Species of Wild Pig from New Guinea. By Dr. O. Finsch, C.M.Z.S. &c.

[Received March 22, 1886.]

The second species of true *Sus* from New Guinea is a very distinct one, and may be separated at once from the well-known *Sus papuensis* by the following characters:—

Sus niger, sp. nov.

Uniform blackish, even when young.

These characters are sufficient, in all ages, to separate the present species from *Sus papuensis*, which is quite different, being in the adult brown, with a very distinct light-coloured mystacal stripe and legs, while the young is rusty brown with light rusty-yellow stripes, as in our Wild Boar.

I was fortunate enough to bring home living examples of both these species, which are now deposited in the Zoological Gardens at Berlin. The specimen of *Sus papuensis* was obtained in the month of May, on the north coast of New Guinea, near the place noted on the charts "Passir Point," a point, however, which does not really exist; it was then striped, but has now changed to the coloration of the adult animal. The Black Pig (*Sus niger*) I purchased at Hihiaura, a village some miles east of Bentley Bay; it was then very young (perhaps six weeks old), and of a uniform black colour, which it still retains.

Sus niger is scarcer than *Sus papuensis*, but lives in the same localities; it is of a more slender figure, higher on its legs and has a much longer head. It grows to a considerable size, and I have seen very huge animals of this species.

I have observed *Sus niger* in a domesticated or semidomesticated state everywhere I have been in New Guinea along the south-east coast, and on the north-east coast from Milne Bay to Humboldt Bay, but always less common than *Sus papuensis*. The natives catch the young ones and feed them; they are pets of the women and often nursed at their breasts, and get very tame. This is the reason why it is so difficult to get them. I have seen some very large specimens in Hood-Bay district (village Kerapuno). Along the north-east coast I saw this species in all the native villages, especially in Chads Bay, in Village Island west of Fortification Point, in Astrolabe Bay, and in Humboldt Bay. It may be mentioned that along this coast I never saw any imported domestic pigs, but such pigs have been introduced into the Port-Moresby district and other places where missionaries have been sent.

The only specimen of *Sus niger* in a Museum that I know of is a young one in the Museum of the Hon. William MacLeay of Sydney.

3. On the Relations of the Mandibular and Hyoid Arches in a Cretaceous Shark (*Hybodus dubrisiensis*, Mackie). By A. Smith Woodward, F.G.S., of the British Museum (Natural History). (Communicated by the Secretary.)

[Received March 23, 1886.]

(Plate XX.)

Exactly as in all other divisions of the Animal Kingdom, the rapid accumulation of morphological facts regarding the Selachian order is providing a sure basis for distinguishing the more archaic from the decidedly modern types. There can be no longer any doubt, for example, that among living Selachians the most primitive and ancient forms are the Notidanidæ, the Cestraciontidæ, and the Chlamydoselachidæ. And of all the characters by which these groups are definitely marked off from the remaining members of the Order, none are of greater interest and importance than those relating

to the cranium and the cartilages of the visceral arches. Employing the terminology of Prof. Huxley, published in this Society's 'Proceedings' for 1876 [1], it may be said that the skull in each of the three families just mentioned exhibits a nearer approach to the primitive amphistylic type than does that of any other adult living vertebrate, the hyomandibular taking very little share in the support of the mandibular arch, and the union of that arch by direct articulation with the cranium being only slight and sometimes almost wanting. The superinduced modifications in the Notidanidæ and Cestraciontidæ are very evidently in the direction of an autostylic arrangement—the former having a postorbital articulation of the pterygo-quadrate, and the latter a more extensive preorbital connection; and in the Chlamydoselachidæ there are somewhat similar tendencies, although the great extension of the pterygo-quadrate cartilage beyond the chondrocranium has apparently rendered the hyomandibular support of some importance. It would seem, in fact, that the oldest representatives of the Selachian order had skulls which were neither hyostylic nor autostylic, though their least altered descendants incline rather to the latter type; and that *Notidanus* and *Cestracion* especially, with *Chlamydoselachus* in a less degree, afford some slight glimpse into the early condition of the mandibular and hyoid arches from which the two later modifications have developed.

Such being the conclusions based upon a study of living Selachians, it becomes of especial interest to determine to what extent they are confirmed or otherwise by the evidence of fossils. The remains of Sharks, Rays, and Chimæroids are abundantly scattered throughout most marine formations, from the Devonian to the latest Tertiary, and the biologist might thus be led to expect considerable information from this field of research. Unfortunately, however, "the imperfection of the geological record" presents its accustomed difficulties, and almost all the facts hitherto discovered relate merely to such hard structures as spines and teeth. There are also a few instances in which the entire fish has been described in a general way; but Prof. Cope's elaborate account [2] of some cranial fossils from the Permian of Texas appears to be the only contribution of importance that has yet been made to the morphology of the skull. Under such circumstances, I venture to offer to the Zoological Society a brief description of a Cretaceous fossil in the British Museum, which is particularly remarkable from the similarity of the archaic features it presents to those of the existing types already mentioned.

The fossil in question (no. 41675 of the B.M. register) was

[1] T. H. Huxley, "On the *Ceratodus forsteri*, with observations on the Classification of Fishes," Proc. Zool. Soc. 1876, pp. 40–45.

[2] E. D. Cope, "On the Structure of the Skull in the Elasmobranch genus *Didymodus*," Proc. Amer. Phil. Soc. vol. xxi. (1884), pp. 572–590, with plate. See also further remarks by S. Garman, "*Chlamydoselachus anguineus*, Garm., a living species of Cladodont Shark," Bull. Mus. Comp. Zool. Harvard Coll. vol. xii. no. 1 (1885), pp. 28, 29.

obtained from the Chalk of Kent, and is in an excellent state of preservation. It agrees in all important respects with a less perfect specimen in the same collection, which forms the type of *Hybodus dubrisiensis*, Mackie[1]—this fossil having been placed with the Hybodonts in the Museum series by Mr. William Davies, and subsequently figured by the editor of the 'Geologist' under the name just quoted. And it may be added that the teeth are undistinguishable in general character from those of the typical species of *Hybodus* of earlier date. The specimen (Plate XX.) exhibits the pterygo-quadrate and Meckelian cartilages of each side, those on the right, however, being broken away for about the hinder third; on the left side, the two elements of the hyoid arch are well shown in their natural position, and less complete remains of the corresponding cartilages are also seen on the right. Teeth and shagreen granules are abundant, and three well-calcified vertebræ appear at the back.

The *pterygo-quadrate* cartilage (figs. 1, 2, *pq*) measures 0·073 m. in length, and varies considerably in depth at different points. At the anterior end it is comparatively low and somewhat folded inwards above, but it soon begins to deepen by the rising of the upper border, which rapidly ascends to form a pterygo-trabecular process (*p*); this is placed at about one third of the distance from the fore to the hinder extremity. The process is almost pointed, and posteriorly the upper contour at once falls again to some extent, though soon re-ascending in the form of a gentle curve to a still higher prominence (*ot*), which exhibits in front a very distinct, relatively broad articular facette. This occurs at about the end of the second third of the cartilage, and thus far the characters are shown on both the left and right sides of the fossil; but the hindermost third is only preserved to the left. A little beyond the summit of the facette, the upper border becomes thickened and turned outwards, and its edge forms a regular gentle curve down to the articulation of the lower jaw. The inferior border of the cartilage is almost straight for its anterior two thirds, the dentigerous portion, and then there follows a curved hollowing; next is a minute process, marking the commencement of the articular portion, which shows two small hollowings and a terminal convex condyle.

The *Meckelian* cartilage, or lower jaw (*mk*), is preserved on both sides of the fossil, but is only perfect on the left. It measures 0·0685 m. in total length, being thus somewhat shorter than the pterygo-quadrate. The upper contour is almost straight from end to end, only a slight hollowing being perceptible immediately beyond the termination of the tooth-bearing portion; and this is succeeded by a short, wavy articular edge, fitting into the corresponding irregularities at the hinder end of the pterygo-quadrate, and finally presenting a distinct concavity for the reception of the upper condyle. The cartilage is deepest just beneath the end of the dentigerous portion, from which point the lower border curves upwards both in front and behind; posteriorly the curve is at first

[1] S. J. Mackie, "On a new Species of *Hybodus* from the Lower Chalk," 'The Geologist,' vol. vi. (1863), pp. 241–246, pl. xiii.

gradual, but then very abrupt, while anteriorly the rise is much more uniform and produces a markedly tapering outline. Quite at the front, the cartilage has the appearance of being more robust than is the case further back; but this is perhaps chiefly due to the infolding of the lower edge for the production of a trough for the membrane bearing the undeveloped teeth.

On comparing this form of mandibular arch with the various modifications observed among living Selachians, it is at once evident that none agrees so closely as that of the two genera of Notidanidæ. *Heptanchus* and *Hexanchus*[1], indeed, exhibit an arrangement that differs in no essential particular from that just described in the Cretaceous Hybodont. In both cases there is not only a well-developed pterygo-trabecular process—homologous (as shown by Prof. Huxley[2]) with the pedicle of the tadpole's suspensorium,—but also a distinct postorbital prominence and articulation, corresponding to the otic process in the tadpole[3]. The mode of articulation of the lower jaw is also nearly identical in each case; and though the fossil is at present much crushed, it requires very little careful study to discover that the hollows for the muscles for raising the mandible were quite as deep in the Cretaceous Shark as they are in the living genera under comparison; the upper border of the quadrate region, however, is much less thickened than in the Notidanidæ and agrees more closely with that of ordinary Selachians.

In the hyoid arch, the upper or *hyomandibular* element (figs. 1, 2, *hm*, and fig. 4) is comparatively small and slender. Its length is 0·037 m., and the cartilage is considerably arched and flattened in what appears to have been an antero-posterior direction. The proximal extremity is imperfect, but was evidently somewhat expanded at its articulation with the cranium; this end is also slightly twisted with respect to the axis of the rest of the element. Just below the bend, the cartilage appears contracted a little when viewed from behind, but soon expands again, forming a blunt tuberosity (*t*) on the side nearest the pterygo-quadrate; and from this point it finally becomes gradually narrowed until its termination in the imperfectly-displayed articulation for the cerato-hyal.

The *cerato-hyal* (figs. 1, 2, *ch*) is 0·048 m. in length, and is completely shown on the left side of the fossil, though somewhat mutilated at the distal end; the lower part, however, is well preserved on the right. The cartilage is considerably arched in the ordinary manner, and is much less robust towards its upper end than in the rest of its length. Compared with the hyomandibular, it is remarkably stout. A little below the proximal end it becomes comparatively large and

[1] See figures by C. Gegenbaur, "Untersuchungen zur vergleichenden Anatomie der Wirbelthiere.—III. Das Kopfskelet der Selachier," pl. x. I am also indebted to the kindness of Mr. Howes and Mr. Martin Woodward for every facility for studying the beautiful preparations of *Heptanchus*, *Centrocion*, &c. in the Biological Laboratory of the Normal School of Science.

[2] T. H. Huxley, *loc. cit.* p. 40.

[3] It is interesting to note that Prof. Cope's Permian Selachian skulls already referred to also exhibit this character.

is much compressed from side to side, the superior edge thus formed being well marked and sharp, but the lower appearing thicker (fig. 2 *a*). About two thirds of the distance from the upper extremity a gradual twist in the cartilage renders the remaining portion compressed almost from above downwards, and it ends distally in a triangular expansion, well shown on the right. The terminal edge was evidently articulated to a basihyal of considerable size, but of this no trace has been preserved.

At one third of its length from the proximal end, the cerato-hyal exhibits a prominent tuberosity on the lower border (fig. 2, *tu*). This appears to be situated opposite a point corresponding to the attachment of the mandibulo-hyoid ligament of living Selachians [1]; but I have failed to discover indications of any similar prominence either in *Heptanchus* or the other specimens and figures to which I have been able to refer. It evidently represents a muscular insertion, and one of no small importance. In Teleostean fishes, the well-developed genio-hyoideus arises from an equivalent point in the hyoid arch, and by its insertion at the symphysis acts as the main depressor of the mandible [2]. In the Selachii, however, the function is undertaken chiefly by the coraco-mandibulares arising from the pectoral arch, and a differentiated genio-hyoid appears to be wanting. The elaborate researches of Vetter [3] in regard to the myology of the jaws and branchial arches in *Heptanchus* and *Acanthias* can leave no doubt that the tuberosity in question is that deep insertion of the great constrictor superficialis muscle which becomes the origin of the genio-hyoid in higher fishes; and its marked character in the Cretaceous Hybodont may perhaps indicate that in this form the differentiation had already taken place to a certain extent.

On the whole, the form of hyoid arch just described bears a greater resemblance to that of the Notidanidæ than to that of any other living family. It agrees in the fact that the hyomandibular and cerato-hyal are most contracted at their point of union, but the elements are somewhat stouter than those both of *Heptanchus* and *Hexanchus*.

The type specimen of *Hybodus dubrisiensis* (B.M. 36908) is of somewhat smaller size than the fossil here described, and as its cartilages are apparently less calcified, it probably represents a younger individual. It is comparatively imperfect, and except in the characters of the teeth and the upper border of the pterygo-quadrate, it does not admit of any detailed comparison with the foregoing descriptive account. There are, however, unmistakable indications of an articular otic process, besides a well-marked pterygo-trabecular eminence; and a small fracture shows the slight thickening of the overturned edge of the quadrate region (fig. 6).

[1] W. K. Parker, "On the Structure and Development of the Skull in Sharks and Skates," Trans. Zool. Soc. vol. x. p. 210, pl. xxviii. fig. 2.

[2] R. Owen, 'Anatomy of Vertebrates,' vol. i. p. 206, fig. 135.

[3] B. Vetter, "Untersuchungen zur vergleichenden Anatomie der Kiemen- und Kiefermusculatur der Fische,—I," Jenaische Zeitschrift, vol. vii. (1874), pp. 403–458, pls. xiv., xv.

A third fossil in the National Collection (no. 49032) also belongs to the same species, and exhibits the remains of the anterior portion of what was evidently a complete fish at the time of its entombment. It agrees in size with the specimen here described, and exhibits traces of the articular facette on the otic process, in addition to part of the left cerato-hyal with its characteristic lower tuberosity. Fragments of the shoulder-girdle are also preserved, and a portion of the base of the chondrocranium; and the vertebral column is shown for a length of 0·16 m., comprising about 33 well-calcified asterospondylic centra. Unfortunately, all indications of dorsal spines are wanting.

As the typical Hybodonts range throughout the whole of the Mesozoic strata, from the Muschelkalk to the Upper Cretaceous inclusive[1], and as it has been found impossible hitherto to recognize more than one generic type—*Hybodus*—on the evidence of spines and teeth, it would be interesting to compare the modifications in the skull of *H. dubrisiensis* with the corresponding structures in earlier species. As yet, however, no information in regard to these has been published, and the only deposits that have yielded satisfactory specimens are the Lower Lias of Lyme Regis and the Wealden of Pevensey Bay, Sussex. Of such fossils the British Museum contains an unrivalled series, and I hope to attempt the elucidation of the more important of these on a future occasion. It must suffice at present to add that, though there are well-preserved pterygo-quadrates from both the formations mentioned, there appears to be none but the most uncertain evidence of an articular facette on the otic process in any; and if this observation can be confirmed it will become of considerable interest when taken in connection with the fact, pointed out by Prof. Huxley[2], that the postorbital articulation in the living *Heptanchus* is only acquired comparatively late in the development of the fœtus. It is also interesting to note that one of the Liassic specimens (Brit. Mus. no. P 340) exhibits traces of a persistent notochord, with the arches alone calcified, whereas in the Cretaceous form it has just been shown that there are well-differentiated centra. The differences between the anterior and posterior teeth are likewise more marked in *H. dubrisiensis* than in any of the earlier species of which satisfactory remains are known. It would appear, indeed, that there is distinct evidence of specialization as the Hybodonts are traced through the Mesozoic period, and it is almost certain that future research in regard to structures other than teeth will lead to the subdivision of the multitudinous forms hitherto grouped under one generic name.

[1] Teeth indistinguishable from *Hybodus*, and originally described under this name, occur in the Carboniferous, but they have been proved to belong to a distinct genus, *Tristychius* (T. Stock, "On the Structure and Affinities of the genus *Tristychius*, Agass.," Ann. & Mag. Nat. Hist. (5) xii. 1883, pp. 177–190, pl. vii.). There are also other Palæozoic Hybodontidæ, e. g. *Ctenacanthus*.

[2] *Loc. cit.* p. 44, fig. 9.

EXPLANATION OF PLATE XX.

Fig. 1. Side view of jaws of *Hybodus dubrisiensis*, Mackie. *pq*, pterygo-quadrate; *mk*, Meckelian cartilage; *p*, pterygo-trabecular process; *ot*, otic process; *hm*, hyomandibular; *ch*, cerato-hyal. (B.M. 41675.)
2. Under view of the same: *tu*, tuberosity on cerato-hyal. 2 *a*, natural transverse section of right cerato-hyal.
3. Teeth of the same, twice nat. size. *a*, anterior tooth; *b*, hinder tooth.
4. Hyomandibular of the same, back view. *t*, tuberosity.
5. Restoration of mandibular and hyoid arches of *Hybodus dubrisiensis*.
6. Section of the upper border of quadrate region of pterygo-quadrate of type specimen of *Hybodus dubrisiensis*, showing thickening.

Figs. 1, 2, 4–6 are of the natural size.

4. On the Hybrid between *Lagopus albus* and *Tetrao tetrix*.

By Robert Collett, C.M.Z.S.

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(Plates XXI., XXII.)

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Introductory Remarks.

The existence in Northern Europe of two kinds of natural hybrids amongst the Tetraonidæ was already known in the last century, and one form of these is rather common in the forests of Norway and Sweden, as well as in some other parts of Europe, being met with annually in many districts, where its hybrid character is, as a rule, well known to the inhabitants. This is the "Rakkelfugl," the cross between the male of *Tetrao tetrix* and the female of *Tetrao urogallus*. The male of this hybrid, which has been known since 1744[1], in colour more nearly resembles the cock of *Tetrao tetrix* than that of *Tetrao urogallus*, whilst the female in this respect is less characteristic and resembles the hens of both species. In shape its hybrid nature is indicated by the form of the tail; in size it is intermediate between both parents, so that both sexes are larger than the father, and the male is even larger than the mother.

The other hybrid, the result of a connection between *Tetrao tetrix* and *Lagopus albus*, which is called in Norway and Sweden "Rype-Orre," is much rarer, and specimens are still desiderata in most museums. The origin of this hybrid, its habits, and its places of resort are as yet partially, if not wholly, obscure. Its winter plumage is the only one which is generally known, whilst the spring or summer plumage is all but unrecorded.

[1] Kgl. Vet.-Akad. Handl. Stockholm, 1744, p. 181.

I will therefore endeavour to recount the most important features which have hitherto been noticed concerning this hybrid, which, on account of its rarity, as well as its pretty and peculiar external appearance, is well suited to attract the attention of naturalists.

The earliest account of this hybrid dates from the year 1788, as Sparrman at that time gave an illustration of it and briefly mentioned it as "*Tetrao tetrix, mas, varietas*" in the third issue of the 'Museum Carlsonianum' (pl. 65), without, apparently, having suspected its hybrid character. In 1795 this was first noticed by Sommerfelt ('Topographisk Journal for Norge,' 14 Hefte, p. 50, Christiania, 1795), who described two specimens from the districts about Mjösen in Southern Norway, which he regarded as a hybrid between *Tetrao tetrix* and *Lagopus albus*. From the description, which is comparatively detailed (see below), it is evident that the specimens were males in winter plumage.

Subsequently a male shot in Wermeland in Sweden in 1808 was mentioned and figured by Thunberg (Vet.-Akad. Handl. Stockholm, 1808, p. 195), and he also recognized its hybrid character.

The first who gave a more detailed and elaborated description of it was Nilsson in his 'Ornithologia Suecica' in 1817, and subsequently in his various editions of his 'Skandinavisk Fauna.' Since then it has been occasionally treated of in different works on the fauna of Scandinavia, and here its winter plumage has also been given on plates, as in Nilsson, 'Illuminerade Figurer till Skandinavisk Fauna' (plate 5); Lindblad, 'Svenska Jägareförbundets nya tidskrift,' vol. xi. plate 4 (1873); Sundevall, 'Svenska Foglarna,' plate 34; and Lloyd, 'Game Birds and Wild Fowl of Sweden and Norway' (London, 1867), &c.[1]

Distribution.

The "Rype-Orre" has hitherto only been found in Northern and North-eastern Europe, and is known from Norway, Sweden, and Northern Russia.

According to a report which I have just received from Dr. Pleske (of St. Petersburg), these hybrids in Russia are not very unusual. Most of them are obtained in the game market; therefore no special information can be given concerning the localities in which they were procured. He believes that about eight specimens are at present preserved in the Museum at St. Petersburg, most of which are males in winter plumage. Dr. Meves, of Stockholm, informs me that in 1872 he saw two specimens in winter plumage in the Museum at Moscow, both males; whilst others, said to be females, were only partial albinos of the female *Tetrao tetrix*. Dr. Kolthoff, of Upsala, has also seen two male and one female Russian specimens.

It is remarkable enough that as yet there is no proof of their occurrence in Finland; for Mela says, "It has not been recognized

[1] In the 'Zeitschr. für die gesammte Ornithologie,' 2 Jahrg. 1885, p. 47, tab. iii. (Budapest, 1885), Herr Henke has figured and treated of a specimen from Archangel under the name of *Tetrao albo-tetrix hybridus*, fem. This specimen is clearly only a partial albino of *T. tetrix*, fem.

with certainty in our land, but it must surely be found if more carefully sought after" ('Vertebrata Fennica,' p. 164, Helsingfors, 1882).

In Sweden several specimens have been captured, most of them in the northern counties (Helsingland, Jemtland, Norr- and Westerbotten), but a few as far south as Dalarne and Wermeland—as a rule amongst the mountain-ridges of the districts adjoining Norway. Dr. Kolthoff has informed me in a letter, dated Upsala, 7th March 1886, that, according to his knowledge, twelve specimens of this hybrid have been preserved in Sweden, of which the Upsala Museum possesses four (one male, three females). The Museum in Stockholm owns four, of which one is a female. Almost all were found, it may be said, accidentally, amongst the game which is forwarded during the winter from the northern counties to the towns for sale.

Propagation in Norway.

The first specimen preserved in any Norwegian collection was a male in winter plumage, forwarded from Rorös in 1837 to the late Prof. Esmark. Until 1870, hardly more than half a dozen specimens were found or preserved in Norway, all of which were males obtained from the mountain districts in the southern part of the country (the provinces of Christianssand, Bergen, and Hamar); but during the years subsequent to 1870, 15 additional specimens have been obtained.

Thus at least 22 specimens of this hybrid have been preserved in Norway during the last 50 years, among which only two were females. Almost all these have been obtained by the University at Christiania; at present there are eleven specimens mounted (amongst which are the two females), one skeleton, and two skins. A few specimens have been sent abroad, and two are preserved in the museum of Bergen. Of these 22 specimens I have personally examined 13 in the flesh, having myself found some in the game-dealers' shops, while the others have during the last few years been presented to or bought for the museum. All the specimens were found in the southern districts of the country, with the exception of one, which was obtained in Saltdalen near Bodö, thus just within the Arctic Circle (65° N. lat.). The most southern specimen was caught in Saude, near the Christiania fjord (59° 35' N. lat.).

The greater number of the preserved specimens, both in Norway and Sweden, have been in their winter plumage. One reason for this is that the greatest capture of the Tetraonidæ takes place during the winter months, for during the summer they are protected by the game-laws; and another is that the hybrids previous to the assumption of their winter plumage so nearly resemble the young males and the hens of the *Tetrao tetrix* that they are easily passed over unnoticed. In the winter, however, their plumage is so marked and peculiar, that this very seldom happens; but it is very probable that the greater number of individuals do not fall into the hands of naturalists.

In giving the following account of the "Rype-Orre" I have had an opportunity of examining, besides the Norwegian specimens, the four specimens which at present (March 1886) are preserved in the Museum at Upsala, and which, by the kindness of Prof. Tullberg and Dr. Kolthoff, have been forwarded to me for examination. Of these specimens one is a male, namely Thunberg's individual of 1808 (see above), the other three are females.

Besides these I have examined a fine male specimen in winter dress, captured in Wermeland (Sweden) in the middle of January 1886, which I found myself in the game-market at Christiania in February last.

Diagnosis and Configuration.

Tail slightly forked; number of rectrices 18; toes semiclothed, the outermost joints bare; claws long and broad; bill stout; eyebrows covered with warts, and pectinated above.

Colour of male in winter dress: white underneath, with black feathers on the breast and flanks; blackish above, with whitish edges on all the feathers. A white band through the eye, and a blackish beneath it. Tail-feathers black, tipped with white.

The female in winter dress more or less whitish underneath; the back, breast, and flanks (sometimes the entire lower surface) transversely banded with reddish brown and black, all the feathers with whitish edges. Tail black, faintly speckled with brown and whitish.

Bill rather like that of *Tetrao tetrix*, strongly built, but the culmen is not so plainly ridged as in that species; its size in the male is nearly double of that of *Lagopus albus*. The side branch of the mandible strongly developed.

Eyebrows covered with numerous small red warts, and with a fine-toothed ridge above. The height of the eyebrows is about half the diameter of the eye; the comb in winter specimens is not very high.

Claws shaped like those of *Lagopus*, long and broad, and very slightly oblique, the inner edge being a trifle broader than the outer. They are less curved than in *T. tetrix*, and their colour is not so dark as in that species.

Toes semiclothed with hair-like feathers, densely in winter; the innermost joint entirely feathered, the middle one naked above, but clothed on the sides, the outermost quite bare. The bare portions covered with horny rings, on the sides with one or two series of rounded scales; under these there is a toothed comb (as in *Tetrao*, unlike *Lagopus*).

Hind toe short, as in *Lagopus* (proportionally much longer in *Tetrao*).

Tail slightly forked, the outermost feathers very slightly bent outwards at the end, and (in the male) 12 to 24 millim. longer than the central ones. Its length is proportionally longer than in *T. tetrix*, and more like that of *Lagopus*.

Under tail-coverts slightly shorter than the central rectrices (or

about one diameter of the eye). In *Lagopus* they are still shorter, or one diameter and a half, in *T. tetrix* one or two diameters longer than the central rectrices.

Male and Female.—Besides the markings and size the following differences occur between the two sexes—the tail of the female is nearly square, the side branches of the upper mandible are more developed, and the comb-like scales of the toes and the ridge of the eyebrows are considerably longer in the male than in the female.

Measurements.

Male.

	Total length.	Wing.	Outer tail-feather.	Centre tail-feather.	
	mm.	mm.	mm.	mm.	
1....	470	242	142	122	Gudbrandsdalen, 7 Dec. 1870.
2....	480	238	147	117	Saltdalen, Nordland, 30 Dec. 1871.
3....	?	237	138	106	Gudbrandsdalen, 8 Oct. 1872.
4....	508	255	142	125	Österdalen, 5 Nov. 1872.
5....	480	252	140	?	Gudbrandsdalen, (?) Nov. 1872.
6....	499	245	?	130	Gudbrandsdalen, 28 Feb. 1873.
7....	505	232	146	124	Hadeland, 27 Dec. 1879.
8....	480	235	135	115	Tolgen, 3 Nov. 1881.
9....	486	235	140	118	Sande Prgd, 9 Nov. 1881.
10....	530	235	150	125	Röros, 10 Oct. 1882.

Female.

11....	423	205	127	97	Gudbrandsdalen, Jan. 1875.
12....	425	205	118	100	Röros, 7 Oct. 1876.

It will be seen from these measurements that the male has an average length of 490 millim., about equal to that of the female *Tetrao tetrix* (but with slightly longer outer tail-feathers). The total length of the female is about 424 millim., being thus considerably less than the male; it is, however, somewhat larger than the male *Lagopus albus*.

Colouring.

Of the fourteen specimens of this hybrid at present preserved in the Museum at Christiania, one is a young bird of the year, on which the brown plumage almost entirely remains; four are young birds changing to winter plumage, the latter being predominant; finally, are eight in full winter plumage, and amongst these are two females. Besides these there is one specimen (a male in winter plumage) exhibited as a skeleton.

In winter plumage are also the specimens in the Bergen and Upsala Museums. The specimens at Stockholm are likewise, so far as is known, in winter plumage, or in the changing from autumn to winter. A long link in the series is entirely wanting in all these collections, namely—the spring plumage, which is probably unknown; the summer plumage, which is in all cases known from

the description of a single specimen in an old treatise (see below); and finally the young in down, which is also unknown [1].

Winter Plumage.

The winter plumage develops itself in Norway during October, and as a rule is completed by the latter half of the month. Whilst one or two of the males had not moulted the last autumnal feathers in the beginning of November, one of the females was in full winter plumage on the 7th of October. This, however, was not an accidental circumstance, but has its analogy in *Lagopus albus*, in which the change to winter plumage takes place more rapidly in the females, although they begin to change later than the males.

The tarsus and toes are then fully clothed, and the naked outer half of the toes is completely hidden by the overlying hair-like feathers.

The male in winter (Plate XXI. fig. 1) has the upper parts black with greyish-white, finely freckled edges to the feathers; the under surface is white, with an irregular black patch on the breast which may be of greater or less extent, occasionally parted in the middle, or so small that there only remain a few black feathers. On the flanks a few black feathers are always present, but sometimes hidden by the white ones. The wing-coverts are chiefly white, speckled with brown. The wing-feathers are brownish black, finely speckled with grey; the outer web of the primaries is white. A more or less conspicuous white band passes through the eye, and under this a similar black one (including in most cases, but not always, the chin), with narrow white edges to the feathers. The upper tail-coverts are black with broad white edges; under tail-coverts white. The tail-feathers are black with narrow white tips, which almost disappear on the outermost ones. The front of the tarsus is greyish.

The eyebrows are bright red; their height 11 millim., of which the upper toothed ridge is 4½ millim.

Although the winter garb is remarkably similar in its general appearance in the different individuals, a slight variation in some details will always be found. In some the unspotted white parts are more extended than in others, while in others the black feathers are predominant on the flanks and abdomen. One of the specimens in the University Museum (Nov. 1881) was unusually dark, with a very large patch on its breast, nearly black scapulars, and numerous black feathers on the abdomen.

The female in winter (Plate XXI. fig. 2) has the upper parts banded with black and yellowish brown, and whitish freckled edges to the feathers. The ground-colouring of the lower parts is white, each feather blackish at base; the breast and flanks barred with yellowish brown and black, and edged with white. The wing-coverts are speckled with white, greyish brown, and rusty yellow; the wing-

[1] A more detailed account of the different plumages I have given in 'Videnskabs-Selskabets Forhandlinger, Christiania,' 1872 (p. 238); and 'Nyt Magazin for Naturvidenskaberne,' vol. xxiii. 1877, p. 159, and vol. xxvi. 1881, p. 324.

feathers are brownish black, finely speckled with grey. A whitish stripe passes through the eye, under this a brown one. The upper tail-coverts irregularly barred with black, greyish brown, and yellowish brown, with broad white edges. The under tail-coverts white, sometimes a few feathers banded with rusty. The tail-feathers are black, with the outer web speckled brownish grey or whitish, and white-tipped; the centre pair entirely mottled. The front of the tarsus as in the male.

Thus in winter plumage there exists this difference between the sexes, that those parts which in the male are black with white edgings to the feathers, are more or less mottled brown in the female, and instead of the male's black spot on the breast the female has the breast barred with yellowish brown. Of the three females from Sweden which at present are preserved in the Upsala Museum, two (Jemtland, Feb. 1886; Angermanland, Jan. 1861) are normal, and on the whole similar to the before-mentioned Norwegian specimens. The last is, however, rather light-coloured: thus the barred feathers on the flanks are quite covered with white ones, so that these portions seem to be unspotted; the throat likewise is snowy white. Both are young individuals; this is seen by their slender and unworn beaks.

The third female (Jemtland, January 1885) was somewhat different, and very dark in colour, without any part of its abdomen being entirely white. This was an old bird, the beak coarse and well-worn on the edges and point. The ovary was (according to Dr. Kolthoff) plainly visible. On the rump several well-worn autumnal feathers with brown cross lines remained amongst the white winter feathers. Its essential peculiarities were as follows:— On the upper parts, wings, and tail normal, though intermingled with a somewhat stronger reddish-brown colour. The whole of the lower half from the beak to the rump evenly furnished with broad brown and black cross bands; a few feathers quite white, others had white edges. In other respects like the former ones. Size normal.

Although this specimen was decidedly more darkly coloured underneath than the others, its general characteristics in markings and shape were otherwise quite in conformity with them.

Summer Plumage.

The period in the spring at which the individuals begin to change their winter plumage is unknown. All the specimens which I have examined were captured in the months October to February; and on a specimen in the Museum at Bergen, shot in Voss (Bergen Stift) about the 1st March 1868, there is yet no trace of spring plumage visible.

Whilst the spring plumage of the Rype-Orre is as yet unknown, there exists one account of a specimen in its summer garb. In 1823 Mr. Sommerfelt, jun.[1], in 'Magazin for Naturvidenskaberne,'

[1] A son of the Mr. Sommerfelt who is mentioned above (p. 225) as having for the first time brought to notice its hybrid character.

1 Aarg. 2 B. p. 71 (Christiania, 1823), described a specimen in summer plumage which he obtained from Thoten (near the lake Mjösen in Norway). From the size of this specimen it appears to have been a male. The statement is as follows:—

(*Male? in summer* (July)). "*Caput, collum, dorsum, pectus Tetraonis tetricis fœminæ. Remiges primores et secundariæ albæ, plurium tectricum albæ. Rhachis remigis* 1^mo^ *fusca. Rectrices nigræ apicibus albis, duabus mediis nigris ferrugineo-undulatis exceptis. Cauda non forficata. Abdomen et femora ut in T. tetrice fœmina, modo pennis singulis albis ornata. Digiti sublanati. Magnitudo T. tetricis fœminæ.*"

The colouring of the summer plumage thus generally resembles that of the Greyhen, but is distinguished by a few white feathers on the abdomen. The tail-feathers also differ from the winter garb in that the central pair are transversely banded with brown. An inaccuracy has probably been made in describing the wings as white instead of "whitish," as in summer it is not likely that the white colour would be more extended than in winter; (and the description "*digiti sublanati*" contradicts the possibility of the specimen being a partial albino of the female *Tetrao tetrix*).

Young Plumage.

The plumage of the young is, as one might expect, mottled brown like both parents, but the upper parts remind one more of *Lagopus albus*, the lower parts of *Tetrao tetrix*. I found a single specimen, a male, in this garb amongst a parcel of game from Österdalen (South-eastern Norway) in the autumn of 1880; it had been probably shot or captured at the end of September. The plumage of the young on the whole is still retained, but a few winter feathers have already appeared amongst the brown; the wings and the outer tail-feathers are also new, and belong to the winter plumage, and thus present a striking contrast to the other mottled brown feathers.

Young male in autumn (Plate XXII. fig. 1).—The upper parts mottled and banded by rusty yellow and black, almost the same as in the young of *Lagopus albus*, the cross bands being narrower and closer than in the young of *Tetrao tetrix*. In the longer wing-coverts there is a discernible light elongated patch along the quills. The tail-feathers, as in *Lagopus albus*, jun., are transversely banded with black and reddish brown.

On its lower parts the breast and sides, as in the young of the *Tetrao tetrix*, are closely and evenly banded with black and rusty yellow, and both colours are about the same extent. In this respect they more nearly approach the last species than *Lagopus albus*, as the young birds of Willow-Grouse have the rusty brown colour much more developed (so that the breast can be said to be a rusty yellow with irregular black patches or broken cross bands). The under tail-coverts are barred by greyish white and brown as in *Tetrao tetrix*. The throat is barred, but not so manifestly as the breast.

The covering of the feet is still thin and incomplete, and the hair-like feathers have only appeared on the innermost toe-joint; the claws are brown horn-colour, resembling those of the Blackgame, but their form is more like those of the Willow-Grouse.

The change of the young to winter plumage (Pl. XXII. fig. 2) proceeds in about the same manner as in the Willow-Grouse; and, analogously with what takes place in them, the first plumage has not always time for development all over before it is dislodged by the winter garb. As already mentioned, the remiges with their longer coverts, the abdomen, and after them the tail-feathers, are the first parts which moult into the winter garb. In the beginning of October the young plumage of the male is half lost, and the winter plumage completed on the tail and belly, and partially on the back, whilst the head, neck, and upper breast are still mottled brown; one or two brown autumnal feathers are also long retained on the flanks. The covering of the toes is still scanty. The Christiania Museum possesses several such specimens.

Sex.

As previously mentioned, amongst the twenty-two known specimens from Norway there are but two females. This may partly be for the reason that the hens even in winter plumage have on the whole a less attractive plumage than the males, and therefore might be more easily overlooked, or pass for a white-speckled Greyhen. But the main cause may probably be a different one. It is a well-known fact, confirmed by a majority of instances, that amongst hybrids an unusually large percentage of males are produced. If compared with the other and better known hybrid of the Tetraonidæ, the "Rakkel-fugl" (*Tetrao tetrix* male + *Tetrao urogallus* female), it will appear that there are perhaps ten males to one female.

However, it must be remembered that the female Rakkelfugl is even to a greater extent more likely to be overlooked than the hen of the Rype-Orre, as it exactly resembles a small female *Tetrao urogallus*, so that this proportion cannot be computed with accuracy.

In all the males dissected (in winter) the *testes* have been found to be small, although not rudimentary or abnormally formed. Their colour was greyish white; the left was generally larger than the right, and measured in one specimen 5 millim. in length, the breadth about 3 millim. In another, and this towards the spring (28th February), they were unusually small, barely 2 millim. long. In the hens, which were also shot in winter, the ovary was visible on the left side like a small whitish patch; the eggs were hardly discernible.

Supposed Parentage.

Which species contributes the father and which the mother to this peculiar hybrid is as yet unknown. Only exceptionally has it fallen to the lot of an intelligent sportsman to see it in its living state, and then only for the few seconds in which it rises, to fall

again to his gun. The knowledge of its life and habits therefore amounts to almost nothing, and no observations have been made in Norway which can give any information concerning its origin.

The existence of this hybrid arises from the fact that both parents not unfrequently inhabit the same localities. Thus *Tetrao tetrix* in the southern valleys of the land, where most of these hybrids are met with, regularly ascends to the elevated birch-forests on the mountains, and establishes itself in the regions where *Lagopus albus* has its proper home. On the other hand, but more rarely, *Lagopus albus* descends and breeds in the upper portions of the conifer-woods, where the other species is still to be met with in numbers.

In the northern portions of the country, however, where both species live almost at the same elevation above the sea, and still more commonly share the same place of residence, the *Tetrao tetrix* on the whole appears in much lesser numbers than the other species, and the hybrids are here apparently more rare.

It is not easy to understand the true reason for the pairing between two species so different in their habits, appearance, and nature. One of the specimens obtained in Norway was shot at a place (Saltdalen in Nordland) where no want of mates of either species could be observed in the neighbourhood. Connections of this kind are repugnant to nature, and in many cases the only feasible explanation is to be found in imagining a violent and irresistible desire to breed *out* of the species.

Concerning the question of the origin, it is first of all necessary to find out whether one or two sorts of such hybrids exist—the one bred between the male *Lagopus albus* and female *Tetrao tetrix*, the other between the male *Tetrao tetrix* and female *Lagopus albus*[1]. But as it is an established fact that all individuals hitherto found (with us) of the Rype-Orre, if obtained at the same season of the year, are on the whole singularly alike both in size and the colouring of their plumage, their origin cannot be ascribed to more than one of the two possible connections.

When Prof. Nilsson in 1817, in his 'Ornithologia Suecica,' treated of its descent for the first time, he mentions it (p. 303) as "*Hybridus a Tetrice patre et Tetr. subalpino femina*"[2]. This assumption that it is the male of *Tetrao tetrix* which has formed an illegitimate connection with the female of *Lagopus albus* (as it is also the Blackcock that with the female of *Tetrao urogallus* produces the "Rakkelfugl"), has always been and is still generally accepted by most naturalists. Upon this theory it has received the names:—*Tetrao lagopoides*, Nilss. Skand. Fauna, 1st ed. (1828), and *Tetrao lagopides*, 2nd ed. (1835); *Tetrao lagopoditetricides*, Sundev. Svenska Fogl. p. 255 (186–?), (being the descendant of *Tetrao tetrix*, *mas*, it had to bear its generic name); and, finally,

[1] A hybrid between *Lagopus mutus* and *Tetrao tetrix* is rather improbable, on account of the very different haunts of these species.

[2] "*Qui vero videt* (illas) *varietates, non diutius dubitare potest de libidine Tetricis ad furtivos amores cum congeneribus instituendos semper paratissima.*" (Nilss. *l. c.*)

Lagopotetrix lagopoides, Malm, Œfv. Kgl. Vet.-Akad. Förh. 1880, p. 30.

In opposition to this assumption respecting its paternity, in 1872, in a treatise "Remarks on the Ornithology of Northern Norway" (Forhandl. Vidensk. Selskabet i Christiania, 1872, p. 238), I advanced the opinion that the Rype-Orre was an offspring of the male *Lagopus albus* and female *Tetrao tetrix*, a theory which, singularly enough (although without any proof), was started by Sommerfelt so early as 1823 in his descriptions of the specimen in summer plumage [1] (*cf.* above). In support of this theory I certainly could not produce direct observations or positive proofs, but I stated some circumstances which, according to my views, caused the descent from the male *Lagopus albus* to be more probable than from that of the Blackcock. In conclusion, I expressed the hope that intelligent sportsmen or naturalists might soon be fortunate enough to institute observations by which this question might be clearly solved. Although this was written fourteen years ago, nothing has as yet appeared in northern literature to throw a light on the subject.

I shall not here set forth at length the reasons which caused me to advance this hypothesis; they will be found given in Dresser's 'History of the Birds of Europe,' vol. vii. p. 213. They are chiefly derived from a comparison with the second and better-known hybrid, the "Rakkelfugl," concerning which it is an undoubted fact that it is descended from the male *Tetrao tetrix* and the female *Tetrao urogallus*. In this case, too, the father belongs to the smaller, the mother to the larger species; and the offspring is a hybrid in which the male is of about the same size as its mother.

It is also a well-known fact that the male Willow Grouse is often found in the breeding-haunts of the *Tetrao tetrix*, and undoubtedly frequents them more often than is generally known. Every sportsman is aware that amongst the Willow-Grouse (and the Ptarmigan) an excess of males is to be met with, which throughout the summer ramble about on the mountains, and these are probably willing to form connections whenever an opportunity offers. My friend Prof. Friis has witnessed a remarkable proof of the eagerness of the male Willow-Grouse's desire to mate. In the spring of 1857 he observed at one of the most elevated farms in Nordmöre (Bergen stift) a male Willow-Grouse which for several succeeding days kept near the house and endeavoured to form a connection with a white speckled domestic hen.

Finally it is worth recording that two young male Rype-Orre, shot in October 1845, in Hedemora, Sweden, were accompanied by a female bird, apparently their mother, which was supposed to be a Greyhen [2]. This observation would have been of great weight in

[1] "Af denne Slægts (*Tetrao*) hybride Yngel forekom mig paa Toten i Juli Maaneds Begyndelse følgende, som sýgnes at være en Afködning of Aarhönen og Rype-Hannen" [From the hybrid brood of this genus I obtained the following in the beginning of July, which appears to be an offspring of the Greyhen and the male Willow-Grouse] (Nyt Mag. f. Naturv. 1st ser. vol. ii. Christiania, 1823, p. 71).

[2] Œfv. Kgl. Vet.-Akad. Förh. 1847, p. 201.

supporting the theory, if it had only been *clearly proved*, as probably the young hybrids continue to follow their mother for long.

I again remark that for the theory of parentage here advanced there is indeed no positive proof, and that it is an hypothesis which may be wrong, but that it appears to me to have at least as much reason in it as the older one (which is also without proof) of the descent from the male Blackcock. On the whole it is remarkable enough that up to the present not one direct observation has been made (such as an observation of the two species *in copuld* in their wild state, or of the two species pairing in captivity). That such observations will not be wanting hereafter, is a matter of course.

I have just received a fresh contribution to this question in a letter from Dr. Pleske, dated St. Petersburg, 16th March, 1886, in which he directs my attention to a communication from Mr. A. Rasin in 'Journal für Jagd und Pferdezucht' ('Journal Ochoty i Konnosawodstwa), 1869, pp. 340–341, with the title "Eine Sündenfall des Schneehuhnes." From this it would appear to be proved that the *Tetrao tetrix* is the father, *Lagopus albus* the mother. This report, the original of which I cannot peruse, is referred to in the following terms by Dr. Pleske :—

"Im Kreise Nowgorod, auf dem sogenannten Konewschen Moosmoraste, wurde eine Kette Hühner gefunden, die von einem ♀ des *Lagopus albus*, welches erlegt wurde, geführt wurde. Von den zwei erbeuteten Jungen hatte beide einen vollständigen Habitus junger Birkhühner, waren auch grösser als die Mutter, und unterschieden sich von echten Birkhühnern nur dadurch, dass beim einen 4 Steuerfedern und zwei Schwungfedern des rechten Flügels weiss waren, beim anderen der linke Flügel vollständig wie bei *Lagopus albus* gezeichnet war, nicht allein in Betriff der weissen Schwungfedern, sondern auch der rostrothen Deckfedern." If the original communication gives no further information upon the subject than the words cited above, no proof is given, in my opinion, that these two specimens were really hybrids.

In the first place there is no description of the covering of the toes, which is the only feature in its diagnosis that is reliable at every age and in every plumage; and, secondly, the true Rype-Orre has never, so far as I am aware, been known to have white feathers in the wing (even the young *Lagopus albus*, before they assume their autumn dress, have brown wing-feathers), and it is still less likely to have them on the tail. The fact that the two young specimens were not even similarly coloured, speaks also for the probability of their being only partial albinos of *T. tetrix*, which in so many instances have been and still are taken for the Rype-Orre.

It may be open to question whether, upon the whole, it is necessary to designate a hybrid by a scientific appellation, even if, like those of the Tetraonidæ, it arises spontaneously, and, as it were, normally. The "Rakkelfugl" has, as is known, received from Nilsson the name *Tetrao urogalloides* (1828) or *urogallides* (1835), which was altered by Sundevall to *Tetrao urogallo-tetricides* (186–?), and by me to *Tetrao urogallo-tetrix* (1872). In accordance with this, as I have

pointed out in my previously mentioned article of 1872, the "Rype-Orre" should receive the name of *Lagopus tetrici-albus*, assuming that the descent is as above supposed.

Other Hybrids of the Genus Lagopus.

1. *Lagopus scoticus* and *Tetrao tetrix*.—In the spring of 1877 I had the opportunity of examining a specimen in Mr. Dresser's collection in London which was considered to be a hybrid between *Tetrao tetrix* and *Lagopus scoticus*. This specimen was a male, shot in Scotland on the 12th of September, 1876. Its hybrid nature was discernible at first glance from the formation of the tail and the covering of the toes, which were exactly like the northern 'Rype-Orre.' The colour was brownish black, the back was finely mottled with brown on an almost black ground; the breast was black, the head and throat black with fine brown spots; the abdomen had reddish-brown cross lines, the lower tail-coverts white edges, as also had several of the feathers on the sides of the rump.

In conformity with the name which above is given to the North-European Rype-Orre, the Scotch specimen, provided the mother in both instances is *Tetrao tetrix*, has been named *Lagopus tetrici-scoticus* (Nyt Magazin for Naturv., Christiania, 1877, vol. xxiii. p. 163). Another specimen of the same hybrid, also a male, was described by Malm, from Gothenburg, in Sweden. This was found in December 1877, at a spot where *Lagopus scoticus* had been introduced in 1861 and 1862 (Œfv. Kgl. Vetensk.-Akad. Förh. 1880, p. 17). This bird was called by Malm *Lagopotetrix dicksonii*.

2. *Lagopus albus* and *Lagopus mutus*.—As in the previous notes it has been supposed possible that the male *Lagopus albus* may be as desirous of forming an illegitimate connection as the male *Tetrao tetrix*, I shall touch upon another question affecting the same subject. It has probably appeared to be strange that, notwithstanding that *Lagopus albus* and *Lagopus mutus* often appear in considerable numbers in the same districts in Northern Europe, and generally share each other's haunts, no evidence of a cross between them, so far as is known, has ever appeared. It is not probable that the cause of this should have its origin in a true repugnance in the two closely-allied species to form hybrids. Probably these hybrids are less rare than one imagines, as it requires an accustomed eye to discern them in the multitudinous garbs in which these two species appear from spring-time until the approach of winter. Even I myself have but once found one, which is now mounted in the University Museum at Christiania. It was shot at Röros in the middle of September 1883.

This specimen is an old male in autumnal plumage, and is thus at a stage when the contrast between the plumage of the two parents is most marked and striking. At this time the old *Lagopus mutus* obtains its peculiar bluish-grey autumnal dress, in which each feather on a light ashy-grey ground is finely freckled with black, without forming distinct cross lines, whilst in *Lagopus albus* each feather has reddish-brown spots and cross lines on a black

ground. In the hybrid specimen the colour and markings of the feathers are a complete mixture of the two species. The upper plumage most resembles *Lagopus mutus*, as the feathers there and on the flanks are finely speckled with black, but on a somewhat reddish ground, though this is not of so strong a colour as in *Lagopus albus*. The pattern on the feathers is almost similar to *Lagopus mutus*, and the long feathers on the flanks and the upper tail-coverts, which are wanting in distinct cross lines, especially differ from the corresponding parts of *Lagopus albus*. One or two feathers, however, resemble the last species. The cross bands on the head are also much the same as in *Lagopus mutus*, and thus more dense than in *L. albus*, but rather indistinct and irregular. The lores are speckled with traces of the black colour which is peculiar to *Lagopus mutus*.

The under-plumage is borrowed most from *Lagopus albus*, especially in colour. The feathers are transversely barred as in *Lagopus mutus*, but the colour is red, almost similar to that of *Lagopus albus*. The fine cross lines are particularly sharply defined and numerous from the bill to the vent, an unknown feature in *Lagopus albus*.

This hybrid has, on the whole, adopted the pattern of its feathers from *Lagopus mutus*, and the colouring (especially underneath) from *Lagopus albus*. The bill in size was intermediate.

It is naturally impossible to state which of the two species supplies the father and which the mother.

3. *Bonasa bonasia* and *Lagopus albus*.—Amongst the specimens belonging to the Upsala Museum sent to me for examination there was a fifth specimen which appeared to be an example of quite a new combination. It was stated by Dr. Kolthoff to have been captured in Jemtland (Sweden) in November or December 1884. The covering of the toes is just the same as that of the normal Rype-Orre. The colour is lighter than any of them, the whole upper parts, and especially the tail-coverts, having broad white (not whitish) edges. The inner hidden parts of the back-feathers are particularly dark and somewhat mixed with brown. The tail-feathers, especially at the root, are much mottled with whitish grey, and the outer feathers edged with white on their inner halves. The underside is white, with the throat black, and with dark-coloured but not cross-lined feathers on the flanks hidden under the white. The head is unusually white, with small dark edgings on the feathers of the forehead, and greyish ear-coverts. The inner half of the under tail-coverts is blackish.

Although the specimen was a male bird with well-defined *testes*, its size was even less than a female Rype-Orre (wing 181 millim.), and was about the same size as *Lagopus albus*. It is therefore impossible that this specimen could have been the produce of a cross between Willow-Grouse and Blackcock. Neither is its tail forked, but somewhat rounded (the outer tail-feathers 115 millim., the centre ones 118 millim.) and contains but 16 feathers.

It is therefore more reasonable to suppose this individual to be a cross between *Bonasa bonasia* and *Lagopus albus*, even if one must

recognize the fact that these two species but seldom meet; but such is by no means an impossibility.

4. *Lagopus scoticus* and *Lagopus mutus*.—A supposed hybrid between the Red Grouse and the Ptarmigan was exhibited at the meeting of this Society, November 5, 1878, by Prof. Newton. The bird was shot in September, 1878, in Sutherland. "As will be seen, it bears some considerable resemblance, above, to a hen Ptarmigan in summer plumage; but its general appearance is much darker. Beneath, there is a greater resemblance to the young of the Red Grouse; and the primaries are much as in that bird, being, however, partially edged with white to a much greater extent than is commonly found in the latter." (Proc. Zool. Soc. 1878, p. 793.)

Habits.

Concerning the habits of the Rype-Orre very little is known. Almost all the specimens which hitherto have been discovered have been brought to the towns with other game snared or shot in the autumn or winter by peasants, without attracting any notice. The peasants themselves, as a rule, regard them as a peculiar kind of Willow-Grouse. In the following instances only have I heard of its being shot by true sportsmen who well knew what it was they had brought down.

On the 30th of November, 1871, a male bird was shot by my friend Herr Berbom, Inspector of Forests, in Saltdalen (within the Arctic Circle), the most northern spot in which this hybrid is known. The locality was a low hill covered with birch-woods, some tarns and marshes; it was occupied by both Blackgame and Willow-Grouse. Mr. Berbom has just informed me, in reply to my inquiries, that this specimen appeared to be solitary, keeping company with neither one nor the other species.

The other case does not either throw any particular light on its habits. On the 7th of October, 1876, another friend, Engineer Oxaal, while shooting "Li-Rype" (Willow-Grouse) at Röros, shot one (a female) in the usual haunts of the "Rype," about 2700 to 3000 feet above the sea. It was on the ground, and ran forward from behind a tuft of grass after the dog had pointed. It was therefore shot whilst running, and in this respect it appeared to Mr. Oxaal to differ from a Willow-Grouse, which at such a time would in all probability not have exposed itself. It was alone, and no Willow-Grouse or Blackgame were met with in the neighbourhood. Notwithstanding that the season was but little advanced, this bird had completely adopted its winter dress, and scarcely a feather remained of its summer plumage.

An older account from Sweden gives a little more information concerning its habits. In October 1846 two young birds were shot in Dalarne which were accompanied by a hen, supposed to be their mother, and which appeared to be a female *Tetrao tetrix*. On this occasion one of the two young birds perched in the trees (unlike a Willow-Grouse, but like a Blackcock). They had a harsh cackling

cry, "which resembled that of the Capercailzie." (Levin, Œfv. Kgl. Vet.-Akad. Förh. Stockholm, 1847, p. 201.)

Most of the specimens which have come into my hands in a fresh state had no gun-shot wounds, and probably had been snared; but whether these were taken in snares together with Rype in districts frequented by the latter, namely in the *regio alpina* (the upper limits of the birch-region on the mountains), or with *Tetrao urogallus* and *T. tetrix* in the forest-regions, cannot be stated with any certainty. If remains of their food are examined it will probably be found that they more usually share the quarters of the Willow-Grouse than those of the other species.

One of the specimens sent to the University Museum (from Sande Sogn, Nov. 9, 1881) was shot not far from the Christiania Fjord, in a district where the *Lagopus albus* certainly breeds, but in very few numbers, and this is hardly an annual occurrence, the locality being comparatively low. The sender of this bird, who regularly received game from that place, deemed it certain that it had been captured along with Blackgame, as it was forwarded to him in a bunch of these birds, and he never received Willow-Grouse from there.

Food.

In some of the individuals opened by me the food was still partially or wholly entire, and consisted of the following:—

1. Male, Dec. 7, 1870: a number of fragments of a *Salix* (15 millim. in length), fragments and numerous berries of *Myrtillus nigra*, tops of *Calluna vulgaris* (about 30 millim. in length), and a few leaves of *Arctostaphylos alpina*.

2. Male, Dec. 6, 1872: tops and seeds of *Carex stellulata*, a few berries of *Oxycoccus palustris* and *Juniperus communis*, some of the latter in an unripe state.

3. Male, Feb. 28, 1873: leaves of *Vaccinium vitis idæa*, fragments and buds of a *Salix* and of *Myrtillus nigra*.

4. Female, Jan. 1875: a number of ripe and unripe berries of *Juniperus*, also a number of the peculiar bunchy leaves of that bush, in which *Cecidomyia juniperina* had formed their capsules; a large number of stalks of the *Myrtillus nigra* (about 12 millim. in length), some leaves of *Vaccinium vitis idæa*, some old female and many young male catkins of *Betula glutinosa* (the mountain form, *alpigena*), and, lastly, the twigs of a haired *Salix* (*S. glauca*?).

5. Female, Oct. 7, 1876: some berries of *Empetrum nigrum*, also stalks of *Myrtillus nigra*.

6. Male, Dec. 27, 1879: leaves and berries of *Oxycoccus palustris*.

7. Young male, autumn, 1880: berries of *Oxycoccus palustris*, also the top of a *Carex*.

From these examples it will be seen that this hybrid both in winter and summer derives nourishment from about the same sources as the Willow-Grouse, namely stalks of willows and bilberries,

also leaves and twigs of different plants, procured principally on the marshes, and occasionally (like *Arctostaphylos alpina*) from the true alpine district; likewise from various berries, and occasionally from birch-catkins. Several of these articles of nourishment form the food of Blackgame; nevertheless it is certain that most of them come from marshy places, from which it must be assumed that its diet most resembles that of the Willow-Grouse.

Skeleton.

In a skeleton of a male from Saltdalen (Nordland) the measurements are as follows:—

	millim.
Length of the skull (bill included)	63
Greatest breadth of the skull	28
Length of scapula	78
Length of humerus	73
Length of radius	65
Length of ulna	71
Length of os coracoideum	55
Length of metacarpus II.	39
Length of the two phalanges of digitus II.	31
Length of furcula (to the edge of the plate)	66
Length of sternum	120
Greatest height of crista sterni	34
Length of pelvis (to the first caudal vertebra)	73
Greatest breadth of pelvis (across ossa ischii)	57
Length of femur	76
Length of tibia	21
Length of tarsus	45
Length of middle toe (claw not included)	45

As the skeletons of the two parents, *Lagopus albus* and *Tetrao tetrix*, resemble each other so nearly that, apart from their difference of size, it would be difficult to find out the most trifling characteristic, this hybrid hardly has one distinctive feature in the structure of its skeleton beyond its difference in size.

Christiania, March 1886.

EXPLANATION OF THE PLATES.

Plate XXI.

Hybrid between *Lagopus albus* and *Tetrao tetrix*.

Fig. 1. Male in winter dress.
Fig. 2. Female in winter dress.

Plate XXII.

Hybrid between *Lagopus albus* and *Tetrao tetrix*.

Fig. 1. Young male in early autumn dress.
Fig. 2. Young male in late autumn dress.

6. Remarks on Specimens of *Rana arvalis* exhibited in the Society's Menagerie. By G. A. Boulenger, F.Z.S.

[Received April 14, 1886.]

(Plate XXIV.)

An interesting addition has recently been made to the series of Batrachians in the Society's menagerie—the Oxyrrhine Frog, *Rana arvalis*, Nilsson, so often described and its specific validity discussed. It is, with the exception of *Rana iberica*, Blgr., the only European Batrachian as yet never figured. The accompanying illustration (Plate XXIV.) is intended to supply this desideratum. My friend Professor Born, of Breslau, favoured me this spring with about 50 breeding specimens of the Frog in question, some of which have been presented to the Society. Two years ago, I also received a number of these Frogs from the same gentleman, which have afforded me an opportunity of verifying the additional observations on the characters of the species recently made by Pflüger and Smith[1]. These authors have shown that some of the characters hitherto regarded as diagnostic comparatively to *R. temporaria* are not constant. Thus the shape of the snout, often given as the principal distinctive character of the two species, is not absolutely constant; and specimens of *R. arvalis* may be found with the snout less pointed than certain specimens of *R. temporaria*. Also breeding males of the former species possess black rugosities on the thumb in every respect similar to those of *R. temporaria*. This statement I have been able to verify not only on the Breslau specimens, but on a Swedish one, for which I am indebted to Dr. Westerlund. However, the breeding specimens from Copenhagen, in M. Lataste's collection, which I described in my monograph of the *Ranæ temporariæ*, have grey, not black, asperities. It is therefore a question whether the colour of the copulatory asperities does not vary according to localities. Besides, the web between the toes is longer in the Copenhagen specimens. The character derived from the vomerine dentition has also been shown by these authors to be an unreliable one. I may add that the remark is not only true in this case, but applies to European species of *Rana* generally; among the hundreds of specimens of *Rana esculenta* which have been examined by me, not a few have the vomerine teeth inserted *behind* the line of the choanæ, and would as regards this character fall in the section *R. temporariæ*! Differences in the dentition exist which may often assist in the discrimination of species, but are not sufficiently constant to be regarded as good characters. The criterion for the easy distinction of *R. arvalis* from *R. temporaria* is the metatarsal tubercle; this character is an infallible one, and will remove any hesitation in the determination. Of greater importance still, but less easily ascertainable, is the character of the spermatozoa. Should any one still entertain doubts as to the specific validity of

[1] Arch. f. ges. Physiol. xxxii. 1883, p. 525.

R. arvalis, let him read Pflüger's account of experiments on the crossing of the German frogs. Dissidents from the modern views on the specific distinctions of the forms of *R. temporaria* have of late become very few. That there should be at the present day a naturalist to express the opinion that *R. arvalis* is the male and *R. temporaria* the female of the same species, and a herpetologist, who professes to know European Frogs, to reproduce such nonsense with the remark "*should this discovery be confirmed it will afford an unexpected solution to the controversy*," may appear incredible, but is unfortunately true.

APPENDIX.

The following paper, originally intended for the 'Transactions,' has been ordered by the Committee of Publications (at the request of the Author) to be printed in this part of the 'Proceedings':—

On the External Characters of Rudolphi's Rorqual (*Balænoptera borealis*). By Robert Collett, C.M.Z.S.*

[Received January 4, 1886: read February 2, 1886.]

(Plates XXV., XXVI.)

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I. *Introductory Remarks.*

Although our knowledge of *Balænoptera borealis* has been considerably increased during the last few years, still almost all researches have been confined to its anatomical structure, and no complete description has hitherto been given of its external characters. Even up to the year 1882 the species was only known from a small number of stranded specimens, the skeletons of which had found their way into different museums; but of the external characters of

* [Mr. A. Heneage Cocks, F.Z.S., has kindly added some footnotes, which are designated by his initials.—Ed.]

these examples either no particulars were obtained, or at most a few scanty remarks by casual observers [1].

In 1882 a whaling-factory was established at Sörvær near Hammerfest (West Finmark) for the purpose of catching the Blue-Whale (*B. sibbaldi*), under the management of Capt. Bull. It was soon seen that the greater number of the whales caught here were the so-called "Sejhval," a species with which Capt. Bull was acquainted through his former whaling-expeditions in the Varangerfjord, but in this Fjord, as well as along the whole of the East Finmarken coast, it had only appeared casually. Eight specimens of this "Sejhval" were caught at Sörvær the first year, 1882, and in the ensuing years it was also taken, though in varying numbers. In 1883 40 specimens [2] were caught, in 1884 only 3, this year (1885) 44. By gradually collecting together the scattered accounts respecting this whale it soon became evident that it was a species distinct from the three other *Balænopteræ*; and both Prof. Sars and I soon came to the conclusion that it might be "*B. laticeps*," Gray=*B. borealis*, Lesson, or the same species to which the skeletons just referred to belonged, two or three of which (among the few hitherto known) had been brought from precisely the same region.

Last year (1884) Dr. Guldberg, in a paper published in Bull. Acad. Roy. de Belg. [1], finally proved by the researches he had been able to make, at Sörvær, upon some parts of the skeleton (now

[1] These specimens are as follows:—

1811. One stranded in the Zuyder-Zee, Aug. 1811 (Eschricht, Kgl. D. Vid. Selsk. Skr. 5 R. 1 B.). Length 32'. The skeleton is preserved in the Leyden Museum.

1819. One stranded on the coast of Holstein in Feb. 1819, and described by Rudolphi as *B. rostrata* (Abh. königl. Acad. Wiss. Berl. 1820–21, p. 27). Length 32½'. The skeleton is preserved in the Berlin Museum.

1861. A skeleton sent to the museum at Brussels from East Finmarken (Norway) through Eschricht (V. Beneden et Gervais, Ostéographie des Cét. viv. et foss. p. 201). Length 32'.

1861. One stranded, June 1861, in Altenfjord, West Finmarken (Norway). Length of the skeleton 30' 1" (Swed.) [about 29 feet 3½ in. English.—A. H. C.]. Described by Lilljeborg (Ups. Univ. Aarsskr. 1862, p. 25, Sver. och Norg. Ryggr.-djür, B. ii. p. 943, 1874). The skeleton is in the Bergen Museum.

1863. One stranded in Skogsvaag, near Bergen (Norway), July 1863. The skeleton not preserved. (Dr. Koren in a letter to Prof. Lilljeborg, dated Bergen, Jan. 24, 1864.)

1872. One caught in the Firth of Forth, September 1872, described by Turner (Journ. Anat. Phys. April 1882, p. 471). Length 38' (English). The skeleton is in the Anatomical Museum at Edinburgh.

1874. One stranded in July 1874, at Biarritz (Basses Pyrénées). Length 7890 mm. (25' Rhen.), and described by Fischer (Compt. Rend. 1876, tom. 83, p. 1298, &c.). The skeleton is in the Bayonne Museum.

1883. One caught on the coast of Essex, England; described by Flower (Proc. Zool. Soc. Lond. 1883, p. 513). Length about 29' (Engl.). Skeleton prepared for the Sydney Museum.

1884. One taken at Goole, Lincolnshire. Skeleton in British Museum.

[2] [I fancy there is some mistake about this number, and that 15 was the total of this species taken by Capt. Bull in 1883, and that 40 was his total take of all species during that season.—A. H. C.]

preserved in the University Museum at Christiania), and a fœtus from the same locality, that the Finmark "Sejhval" is identical with *B. borealis*.

Thus, whilst *B. borealis*, as has been stated, is a constant summer visitor on the coasts of West Finmark, where it has annually, although in varying numbers, occurred off Söröen, near Hammerfest, probably to gorge upon the "Aate," or the shoals of Crustacea which constitute its food, it has, as mentioned above, only exceptionally visited East Finmark, and on the coast east of the North Cape only a few specimens had been caught, and not every year.

It does not, however, appear to have been altogether unknown even on this part of the coast. During a stay in Finmark in 1878 I received information that a shoal of 13 whales, of about 40 feet in length, had stranded in a bay of the Porsangerfjord to the east of the North Cape. I did not have an opportunity of visiting the place; but as the baleen-plates of these Whales were described as being black, it seems very probable that they belonged to this species[2].

In the same month 5 similar small whales were stranded at Sörvær, near Hammerfest (where the above-mentioned factory had not then been established). Moreover, several whalers have informed me that this species visited the Varangerfjord in 1879 and 1880, but was not caught; they also noticed that whenever this species came in, *B. sibbaldi* left the coast and went out to sea[3].

During the past summer, 1885, the Sejhval (*B. borealis*) came quite unexpectedly under land along the whole coast of Finmark, not singly or solitarily, but in such large numbers that, during the whole summer, most of the whales caught both in West and East Finmark consisted of this species. Of the other species, *B. sibbaldi*, *B. musculus*, and *Megaptera boops*, which in former years had formed the majority, only a comparatively small number were caught[4].

Of *B. borealis* 724 specimens were caught by 18 companies stationed in Finmark, and 47 specimens by 3 companies, on the Murman coast, making together a total of 771 specimens.

In fact they were caught by all the companies along the whole

[1] "Sur l'existence d'une 4me espèce du genre *Balænoptera* dans les mers septentrionales de l'Europe" (Bull. Acad. Roy. Belg. 3e sér. tome vii. no. 4, Avril 1884). This paper is translated (with a few additions) in Journ. of Anat. and Phys. 1885, p. 283.

[2] Nyt Mag. f. Naturv. 27 B. p. 260 (1885).

[3] It was therefore said this year in Finmark that as *B. borealis* was under land, *B. sibbaldi* would not come, and this presumption proved to a great extent correct. *B. sibbaldi* was this year almost absent from the Norwegian coast as compared with the preceding years; but it was more common further east, as 5 whalers on the Murman coast killed almost exactly the same number of that species as all the 31 Norwegian whalers did together.

[4] [Of *Megaptera boops* rather more examples were caught than in any previous year; this does not necessarily show that they were more numerous than in other years, but, in the absence of the two larger species, they were hunted in preference to *B. borealis*, as yielding three times the quantity of oil.—A. H. C.]

coast from Söröen, near Hammerfest, to Jarfjord in Syd Varanger, and on the Murman coast at least to Kildin.

When, during a stay in the Varangerfjord in the month of July, I ascertained that specimens of *B. borealis* were daily brought into the factories at Vardö, I at once proceeded to that place, and in the course of a couple of days I had an opportunity of examining the external characters of six specimens, three males and three females, whilst I saw double that number towed in, but want of time prevented my examining them.

Two drawings of this species have previously been produced. According to Van Beneden and Gervais (Ostéogr. des Cét. p. 201) the first known specimen of this whale (Zuyder-Zee, 1811) was figured, but these authors are unable to explain the fate of this figure, which never seems to have been published.

Another figure was given of Rudolphi's specimen (Holstein, 1819) in a lithograph published in Hamburg, 1819; this figure is copied in Brandt and Ratzeburg's 'Medicinische Zoologie' (B. I. tab. xv. fig. 3); it is, however, very imperfect and confusing [1].

As our knowledge of this species is thus still very meagre, I have thought it right to give the principal results of my researches at the factories at Vardö and Mehavn this year, although I am well aware that my observations, based as they are upon only two days' studies on the spot, are very incomplete. I am also indebted to Messrs. Castberg, Bull, Bruun, Bryde, Ellevsen, and Sörensen, all managers of the different factories, for communications chiefly relating to their life-history as observed during their "fishing" this year [2].

II. *General Characters.*

Compared with the three other northern Rorquals, *B. borealis* belongs to the smaller group, its length being somewhere between that of *B. rostrata* and *B. musculus*, or about 44 feet.

Its body is less robust than *B. rostrata*, more like *B. sibbaldi*, and much better proportioned than *B. musculus*.

The colour on the upper part of the body is dark grey-blue, something like *B. sibbaldi*. The belly is more or less white as far as the genitalia, but the remainder of the undersurface and also the flippers are of the same colour as the back.

The flippers are small, smaller relatively than in the other species; the dorsal fin is large, curved, and situated far forward.

The baleen-plates are black; the bristles are white and much curled, and comparatively long. In the sea the *B. borealis* may be recognized at the first glance by its large, high, dorsal fin, which most nearly resembles that of *B. rostrata*, also by its head being more slender, and its snout more rounded than are those of the other Arctic species.

[1] The colour is especially wrong, which is easily explained, as the animal was probably drawn a long time after death.

[2] I have to offer my best thanks to my friend Mr. Alfred Heneage Cocks for the kind assistance he has rendered me by looking over the paper before it was printed.

Measurements.

	No. 1. ♀.	No. 2. ♀.	No. 3. ♀.	No. 4. ♂.	No. 5. ♂.	No. 6. ♂.
Total length	43′ (13⅛ m.)	43⅜′ (13⅜ m.)	47′ (14⅜ m.)	44⅛′ (14 m.)	45⅓′ (14⅛ m.)	49′ (15⅛ m.)
Snout to dorsal fin	28′ (8½ m.)	.....	32′ (10 m.)	29′ (9 m.)	30′ (9⅜ m.)	31′ (9⅝ m.)
Snout to flipper	.....	.....	15½′ (4⅞ m.)	.....	14′ (4⅜ m.)	
End of flipper to flukes	.....	.....	26½′ (8⅛ m.)	.....	26′ (8⅛ m.)	
Point of upper jaw to angle of mouth	.....	7⅞′ (2445 mm.)	.....	8′ (2509 mm.)		
Point of lower jaw to angle of mouth	.....	9½′ (2979 mm.)	10⅓′ (3215 mm.)	9½′ (2979 mm.)	9½′ (2979 mm.)	
Point of lower jaw to end of flipper.	.....	17½′ (5489 mm.)	.....	.....	19⅓′ (6⅛ m.)	
Front of dorsal fin to flukes	.....	.....	15′ (4706 mm.)			
Eye to axilla	.....	.....	5⅞′ (1803 mm.)	5½′ (1724 mm.)	.....	1850 mm.
Point of upper jaw to nostrils	2100 mm.	.....				
Eye to ear	.....	660 mm.	.....	690 mm.		
Vent to anterior end of vulva	.....	780 mm.				
Length of base of dorsal fin	840 mm.	800 mm.	.....	.....	.....	1230 mm.
Height of dorsal fin	570 mm.	510 mm.	500 mm.	670 mm.		
Flipper (from axilla)	.....	1290 mm.	.....	.....	.....	1330 mm.
Greatest breadth of flipper	350–350mm.	350 mm.	350 (L.)–370 mm. (R.)	370 mm.	350 (L.)–380 mm. (R.)	380 mm.
Height of body opposite middle of flippers	.....	7′ (2192 mm.)	7⅞′ (2445 mm.)	.....	7½′ (2348 mm.)	8′ (2509 mm.)
Height of body from base of dorsal fin	.....	5½′ (1724 mm.)	5½′ (1724 mm.)	5½′ (1724 mm.)	5⅞′ (1803 mm.)	6¼′ (1960 mm.)
Height of body at the middle of tail.	.....	4½′ (1411 mm.)	.....	.....	.....	4⅝′ (1490 mm.)
Height at the root of tail	.....	.....	860 mm.	.....	710 mm.	.....
Each fluke of tail	.....	.....	1803 mm.	.....	.....	1820 mm.
Breadth of each fluke	.....	.....	.....	.....	.....	1110 mm.
Diameter of lens	13&19 mm.					

III. *Measurements.*

Most of the examples caught were between 40 and 50 feet in length. The usual length was 44–45 feet or thereabouts. The largest specimens measured 52 feet[1] (16·3 metres). The 6 specimens which I examined thoroughly were 43 to 49½ feet in length (see p. 247). The last of these (a male) was considered to be one of the largest caught; so that it may be laid down as a rule that they rarely exceed 50 feet (15·6 metres).

The smallest specimens this summer that I know of were 35–37 feet, but these were exceptional. A single specimen was caught in July at Mehavn (by Foyn), the length of which was said at the place to be 32½ feet (10·1 metres).

Both sexes seem to attain about the same size; the largest female specimen that I examined was 47 feet long (14·7 metres). One of the managers stated that if there were any difference, the female was the largest and fattest, at any rate during the whaling-season.

The size appeared the same throughout the season, and it was remarkable to notice how uniform it was, and how evidently the whales were all of about the same age.

IV. *Structure of the Body.*

The Structure of the body seems to correspond with that of *B. sibbaldi*, which it on the whole resembles in its mode of living.

The body is highest across the middle of the flippers, where, in the case of the living animal, the height is to the total length about as 1 to 5½ (as in the case of *B. sibbaldi*). In the stranded animal, when the belly is compressed by the ground, the proportion is as about 1 to 6. The height of the body is thus not so great as in *B. rostrata*, which is at that point relatively the largest of all the four species.

The form of the hinder part of the body does not differ essentially from that of the other species. Immediately under the dorsal fin the height is one eighth of the total length, and halfway between the dorsal fin and the root of the tail one tenth. From these proportions it will be seen that in this respect it also corresponds most nearly with *B. sibbaldi*, and is neither of the exceedingly slender "emaciated" form of *B. musculus*, nor of the comparatively stout form of *B. rostrata*.

The breadth of the body can only be given approximately, and would seem across the flippers to be not very different from the height. From the vent to the root of the tail the body is strongly compressed, and the caudal part forms, as in the other species of *Balænoptera*, a thin ridge above and below, which is particularly sharp along the dorsal line. The breadth at the root of the tail at

[1] [About 54 feet English, and so with the other measurements; the Norwegian foot almost = 12½ inches English.—A. H. C.]

the narrowest point (just where the flukes commence) was in the largest specimen 390 mm., or about 15 inches.

V. *Colour.*

The colour of the back is bluish black or occasionally somewhat brown, much resembling the colour in *B. sibbaldi*, although the blue colour as a rule is less pronounced than in that species. The colour after death is darker than in the living animal. On the side of the body the colour becomes somewhat lighter; the belly is dark steel-grey with a white area running along the centre; the white colour begins at the symphysis of the lower jaw, and terminates at the genitalia, but occasionally it is interrupted or imperceptible on the middle portion of the belly.

Considerable variations occur in the breadth, size, and form of this white part of the belly. The throat is always white, occasionally throughout its entire breadth, sometimes only for a couple of feet. On the breast the white becomes narrower, and in many individuals is completely cut off by the bluish-grey colour of the sides, but it then reappears on the belly, and continues in a somewhat irregular width to the genitalia. Behind the vent the whole underside of the tail is light bluish grey, about the same as the back.

The white colour is not always symmetrical, but is occasionally broader on one side of the middle line than on the other; also the extent of it on the belly may be rather irregular. On the throat similarly the white colour is sometimes broader on one side than on the other.

The white patch on the belly was never absent in any of the specimens examined; and this observation is confirmed by all the managers of the whaling companies, who state that it is always to be found, though it is sometimes only slightly developed.

The white colour, especially on the throat, is pure and sharply defined. On the belly and in front of the genitalia there are, on the contrary, a large number of very fine bluish-grey lines, which are quite short and run parallel to each other; these lines, which can only be distinguished when you are near to the animal, sometimes, when they are very numerous and closely set, detract from the whiteness of these portions.

The flippers are coloured on the outer side like the back; on the inner side they are a trifle lighter, especially along the lower edge: a few individuals (such as No. 2 of the specimens examined) have large whitish spots on the inner side; these are never, however, absolutely white. The flukes of the tail are also bluish grey underneath; the dorsal fin is exactly the colour of the back.

Distributed over the dark parts of all the specimens examined were a greater or less number of whitish oblong spots of peculiar form and colour, their length being about 100 mm., and breadth about 30 (Plate XXVI. fig. 2). Their outer edges are not always sharply defined; their colour is in general whitish grey, occasionally almost white, and more rarely dark grey. Along the centre of the

long axis there runs a dark line, from which to both sides and both ends run fine radii of similar lines [1].

These patches are most frequent on the sides of the body somewhat below the middle, and occur also on the tail, but may be found, when they occur to any great extent, distributed singly right up the centre of the back, and extending as far as the end of the lower jaw. They occur on all examples, although they may not be equally apparent in all. They evidently are due to a peculiar matter in the skin, as they become more perceptible after the animal has dried for a time. Single small white spots of a normal form occur less frequently in the black portion of the sides, especially up towards the back.

Among the markings of less constant occurrence may be noticed:—On one of the specimens examined there was a slightly lighter patch behind the ear-opening, which began just at its posterior margin, and extended backwards in a pyramidal form for about a foot.

In order to show the variations of the white colour on the belly, I shall briefly explain its extent in the individuals examined by myself.

No. 1. *A female.*—Throat entirely white; on the breast the white area became narrower, though without being completely broken off. A larger white patch occurred at the end of the furrows, forming here an extension of the central stripe. On the belly the white colour was partly covered over by the fine light bluish-grey lines, which terminated as single white stains at the mammæ.

No. 2. *A female.*—The white area symmetrical and ample; throat white, about ten furrows on each side being included, though the upper ones were spotted with black.

The patch became narrower backwards, so that between the flippers only three furrows on each side were included, while behind the flippers it spread out in an anchor-like form, the arms of which extended rather high up on the sides (and to about half a flipper's length from the end of the flipper).

Behind the furrows the white area was almost interrupted by the grey colour of the sides, but widened out again in front of the mammæ, where it was whitish and not sharply defined. The fine bluish-grey lines were most frequent towards the dark portions of the sides.

In this specimen the oblong whitish marks on the sides were comparatively few and indistinct, although some of them were perfectly white.

No. 3. *A female.*—Throat white, the white commencing just behind the symphysis of the jaw, and including the eight furrows on each side of the central line; this white portion diminished as it passed backwards. Almost exactly under the distal end of the flipper, when lying parallel to the body, it was broken off by the colour of the sides, but it recommenced at the navel, and thence extended unbroken to the mammæ.

[1] The general form and design reminds one of the septa in a *Fungia* or *Herpetolithus*.

The oblong whitish marks occurred all over the animal, from the beginning of the flippers to the root of the tail, but did not, generally speaking, extend much higher than the middle of the sides; several small spots, however, of normal form occurred up towards the back.

In this specimen the underside of the flippers had large whitish spots.

No. 4. *A male.*—Unusually dark. The white colour was comparatively little extended, as in front it embraced only four furrows on each side, and even here was mixed with black. Backwards the white colour widened somewhat, so that six furrows on either side were included, though with black stripes from the sides extending obliquely into them. Behind the furrows the central patch was terminated by the colour of the sides, and there was but little white in the portion in front of the genitalia.

In this specimen were noticed a large number of the peculiar oblong marks, some quite white, most of them, however, darker in hue, spread over all the dark parts of the belly, extending both downwards to the white stripe and upwards on to the back. They were most numerous about the middle of the sides and on the posterior portion of the body.

No. 5. *A male.*—Throat white, extending over eight furrows on each side, from the front to between the ends of the flippers. Above these, six furrows on each side were mottled with white.

Further back the white part was interrupted, so that the belly behind the furrows was, for a short distance, of a uniform blue-grey tint like the sides, but again became whitish, sprinkled over with the narrow bluish lines as far as the genitalia. The oblong whitish marks were present, especially on the sides.

No. 6. *A male.*—Colour almost similar to that of No. 2, the white having almost exactly the same extent. Here also the white patch between the flippers extended in a somewhat irregular anchor-like form. Behind the furrows the white was almost terminated by the bluish-grey colour of the sides; it recommenced at the navel and extended to the genitalia, but was pencilled over evenly by fine short grey lineolæ. The oblong whitish marks were numerous, tolerably light-coloured, but none quite white, and extended almost to the end of the lower jaw.

In a 7th specimen, which lay secured in the water with the belly exposed, the white colour was more decidedly asymmetrical than in any of the others. On the breast the white included six furrows on the right side, whilst the whole of its left side was black [1].

The white area extended as usual to behind the end of the flippers, where it became narrow or disappeared, but extended again backwards to the genitals, and at this point it was symmetrical on the two sides.

[1] A similar asymmetry of colour (left side dark, right side white) has been noted on two occasions by Professor Sars as pervading the lower jaws in *B. musculus* (Forh. Vid.-Selsk. Christiania, 1878, no. 15, p. 9; 1880, no. 12, p. 3). [A similar specimen was recorded by me in the 'Zoologist,' April 1885, p. 138.—A. H. C.]

VI. *Flippers and other External Characters.*

The Flippers are relatively shorter than in any of the other species, somewhat slender and pointed. Their length, measured from the axilla, is about one eleventh of the total length, occasionally a little over and sometimes under this measurement. In form they do not differ materially from those of the other species. A little beyond the middle they present on the ulnar side a slight extension, an indication of the commencement of the manus. At this point the flippers have their greatest breadth, which is, compared to their length (reckoned to the axilla), as 1 to 3·5 or 3·6 (or to *caput humeri* as 1 to 4·7). Thus in its small flippers *B. borealis* differs essentially from *B. sibbaldi*, which it otherwise resembles in so many points, and approaches nearer to *B. musculus*. Their colour, as previously mentioned, is essentially the same on the outer and inner sides, and in this respect they differ from all the other species, in which the inner side is more or less white.

The Dorsal Fin is situated far forward and is high. The front margin is convex, with a slightly curved apex; its hinder margin is deeply concave. In form and position it is quite unlike that of *B. sibbaldi* and *B. musculus*, and is most like that of *B. rostrata*, but it lies further forward than in any of them. The following are the proportions between the total length of the body and the distance from the end of the snout to the beginning of the dorsal fin in five of the specimens examined by me:—

No. 1. . As 1 to 0·65.
No. 3. . As 1 to 0·68.
No. 4. . As 1 to 0·65.
No. 5 . As 1 to 0·65.
No. 6. . As 1 to 0·61.

The dorsal fin is thus constantly placed anterior to the commencement of the last third of the body, whilst that of *B. rostrata* (according to Sars) is placed at the beginning of this third; it is even further back in *B. musculus*, and furthest back in *B. sibbaldi*.

Its height and size is on the whole considerable, especially in comparison with the length of the flippers. The height is in fact more than $1\frac{1}{2}$ times the greatest breadth of the flippers, and is to their length as 1 to barely $2\frac{1}{2}$. The dorsal fin is possibly higher in the male than in the female, although the difference cannot be great.

The length of the anterior margin is about the same as that of the base.

The Flukes, in a couple of specimens examined by me, were, compared to the total length of the body, as 1 to 4·2.

Thus they were relatively somewhat smaller than in *B. rostrata* (3·4), but larger than in *B. musculus* (4·1–5·1).

Their colour is, as in *B. sibbaldi*, about the same on the upper and lower sides.

The Anus is situated directly under the apex and posterior margin

of the dorsal fin. The genital opening lies almost immediately in front of the anterior edge.

The Inferior Maxilla.—The length of the lower jaw-bones (measured to the angle of the mouth in the non-skeletonized animal) is, compared to the total length, as 1 to $4\frac{1}{2}$, viz :—

No. 2..4·5.
No. 3..4·5.
No. 5..4·7.
No. 6..4·4.

In this last specimen the lower jaw-bones, probably on account of their weight, were displaced, which is often the case. The jaws have the same relative length as *B. sibbaldi*, and are longer than in the other two species. In these three species the proportions (according to Sars) are as follows :—

B. sibbaldi, 4·5.
B. musculus, 5·0.
B. rostrata, 5·5.

Their greatest breadth (measured between the eyes) is, compared to their length, as 1 to 1·7. This was somewhat less in a skeleton in the Bergen Museum (total length $30\frac{1}{10}$ feet), where the breadth across the temporal bones (according to Lilljeborg) was, compared to the length of the skull, as 1 to 2·0.

VII. *Baleen.*

The colour of the baleen is usually black and the bristles white; in some individuals, however, a small number of the foremost rows were white, or mottled with white, but not symmetrically in each ramus. Besides the baleen in the six specially examined specimens, I examined a considerable quantity of whalebone which lay heaped up on the beach at the different establishments. Amongst all this, I only found two specimens which differed from the others in having some white mottled plates; in all the others it was entirely black. Of these two individuals, one had on the right side 58, and on the left 53 of the foremost baleen-plates mottled [1].

The second specimen had on the right side 52 white plates, on the left only 5 [2].

The number of the plates was about 330 in each jaw, in some

[1] Namely in the following manner:—On the right side the foremost 27 were white in their outer half, and the next 15 quite white, after which came 3 grey plates. Then came 10 completely black, and finally 3 which were white with black edges. Total 58. The remainder were black.

On the left side the colouring was somewhat similar. The first 31 were semi-white, and the next 9 quite white, then followed 3 blackish grey, after which came 3 white, then 2 greyish black, and finally 5 white. Total 53. The rest were black.

[2] In this specimen on the left side the 5 foremost ones were white, all the others black; on the right side the first 36 plates were mottled with white, after which came 16 quite white, the remainder being black.

individuals 320, in others as many as 340. No. 2 for instance had on its right side only 318, on its left 328. The number appears to be rarely the same in the two jaws of the same individual.

The front plates were small, almost rudimentary, and formed double rows; these were difficult to count. The greatest length was attained at the commencement of the latter third of the series, where as a rule they measured 550 to 600 millim.[1]

From these measurements it appears that the length and number of the plates are not constantly greater in the right than in the left jaw, also that there is no constant difference between the plates in the two sexes.

The hair-like bristles in which each plate terminates, and which form the most effective part of the straining-apparatus, are in this species unusually fine, somewhat resembling silky wool, and white

[1] I give here the measurements of the baleen-plates of 4 examples, viz. those of specimens Nos. 1, 3, and 5, and those of a fourth individual, the jaw of which lay on the beach. They are reckoned from behind forwards, so that No. 50 lies near the angle of the mouth, No. 250 nearest the symphysis of the jaw. They are measured from their base (in the freshly killed specimen) to the outermost point where the plates terminate and the bristles commence.

No. 1. Female. Left all black; on the right side, the first slightly lighter colour.

Left side 328 plates.	millim.	Right side 324 plates.	millim.
Length of no. 50	460	No. 50	430
" no. 100	590	" 100	560
" no. 150	520	" 150	510
" no. 200	420	" 200	420
" no. 250	240	" 250	240

No. 3. Female. All black.

Left side 334 plates.	millim.	Right side 328 plates.	millim.
Length of no. 50	430	No. 50	450
" no. 100	520	" 100	540
" no. 150	490	" 150	470
" no. 200	380	" 200	370
" no. 250	180	" 250	210

No. 5. Male. All black.

Left side 318 plates.	millim.	Right side 321 plates.	millim.
Length of no. 50	490	No. 50	480
" no. 100	640	" 100	630
" no. 150	590	" 150	590
" no. 200	420	" 200	440
" no. 250	250	" 250	250

Another example (sex unknown). All black.

Left side 333 plates.	millim.	Right side 339 plates.	millim.
No. 50	450	No. 50	500
" 100	570	" 100	600
" 150	520	" 150	560
" 200	400	" 200	470
" 250	250	" 250	240

in colour. They form on the inner edges of the baleen-plates a dense, rather curly covering, which appears to indicate that the food of this species consists of only very small animals.

VIII. *Blowholes and Furrows.*

The Blowholes lie in two long furrows somewhat converging anteriorly; their distance from the end of the snout, in a specimen having a total length of 43 feet, was somewhat over 6½ feet (2100 millim.). The length of the furrows was from 370 to 410 millim., between these ran a shorter central furrow.

The Furrows.—These run, as in the other species, along the whole length of the lower jaw, from the symphysis to the angle of the mouth, and extend to the middle of the belly. The upper 8 to 10 are short and terminate in the axilla, and are about 2 feet in length. The others, about 20 in number (from 15 to 34) on each side, are long and extend backwards to the centre of the belly about one foot beyond the end of the flippers. One or more short furrows wedge themselves in between the long ones.

The total number of long furrows is thus from 30 to 44, to which must be added the 8–10 shorter upper ones; altogether 38 to 58.

In addition, the eye is surrounded by two very short horizontal furrows, and in some examples there were also found (as in No. 4) traces of from 20 to 30 short, oblique furrows anterior to the dorsal fin. The furrows permit the body to expand to nearly double its normal girth.

IX. *Hairy Covering.*

This consisted in an adult female of 11 hairs on each side of the lower jaw, each about 10 millim. long, and two other hairs on each side, situated somewhat behind these; altogether 26 hairs.

In the fœtus the covering of hair was more plentiful. On the smallest of the fœtuses described further on (No. 1), the total length of which was 1½ metres, the hairs were visible, but quite short. In fœtus No. 3, the total length of which was not quite 2½ metres, they were arranged on the lower jaw in three rows, comprising 3 hairs in the upper and lower rows respectively and 11 in the central row; altogether on each side 17 hairs.

On the upper jaw there were only 7 hairs situated in a single row, the two first rather further from each other than the rest. Altogether this specimen was provided with 34 hairs on the lower and 14 hairs on the upper jaw.

X. *Parasites.*

Parasites of three different sorts have been up to the present time found living upon or in *B. borealis*; one of these (not yet examined nor preserved) is a true ecto-parasite, one (*Balænophilus unisetus*) is an epizoon, and two *Echinorhynchi* are ento-parasites.

I could find no trace of ecto-parasites on the specimens examined

by myself; and upon inquiry amongst the whalers, I was informed that only Capt. Bryde has noticed such parasites on a single individual captured off Vardö in July. As no specimen has been preserved, it cannot be stated whether they were Crustaceans (Pennellidæ?), *Discophora*, or other forms. They were worm-like animals, about 50 millim. long, and were attached to the edges of both flukes (caudal lobes), where they formed a row of free hanging threads. Some were also attached to the upper surface of the flukes.

In a set of baleen-plates belonging to one specimen, and brought to the University Museum in Christiania from Sörvær (Hammerfest) in 1883 by Dr. Guldberg, most of the plates are infested on both sides with innumerable specimens of *Balænophilus unisetus* (figs. A, B, C, D), a Copepodous crustacean of the subfamily Harpacticinæ, described by Aurivillius in a pamphlet published in Stockholm in 1879, and discovered by him on the baleen-plates of a specimen of *Balænoptera sibbaldi* caught at Vadsö in July 1877. In 1884, Mr. A. Heneage Cocks found this parasite on a specimen of the same whale at Sörvær, near Hammerfest ('Zoologist,' 1885, p. 135). So far as I know, it has never been found by other observers. Its occurrence on *Balænoptera borealis* is therefore of interest[1]. The fully developed specimens (figs. A, B) can only with difficulty be recognized in their dry state; but the larvæ in their *Nauplius*-stage (figs. C, D), which are attached to the plates in myriads, still retain most of their original form and appearance.

These two parasites appear therefore to be of very rare occurrence. However, the intestines of all the specimens that I examined, including those which I found on the beach, were, without exception, filled with thousands of *Echinorhynchi*, belonging to two different species.

One of these, which was very much less numerous than the other, seemed to resemble very closely *E. porrigens*, Rud. Its length was 100 millim. The rostellum was unarmed, the neck long, and the body formed an even continuation of the neck. As I unfortunately only brought one perfect specimen away with me, and as this has the proboscis half retracted, it cannot be decided with certainty whether the species is actually identical with *E. porrigens*.

The other species appeared in all the specimens examined, and in such vast numbers that in some places there were three or four upon each square inch, and they moreover thickly covered the inner coating of the intestines wherever an incision was made. The smallest specimens were thin, semi-transparent, and immature; their length was about 10 millim., the breadth 2 millim. From these up to the full-grown specimens, the length of which was about 25 millim., there were all gradations of size. While the majority of the specimens were of a white colour, the fully adult were of an intense red, as if their integument were impregnated with the colour of the red Crustaceans, which are the principal food of their hosts. The species to which it approaches nearest is *E. brevicollis*, described by Malm in 1867,

[1] I sent some of the specimens to Dr. Aurivillius, and he has confirmed their identification with the species found on the Blue Whale (*B. sibbaldi*).

Fig. A.

Fig. B.

Fig. C.

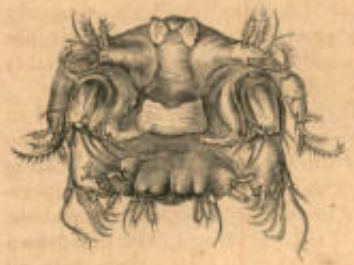


Fig. D.

Balænopterus uniseta.

Fig. A. Female (nat. size 3·5 mm.).
B. Abdominal segment of female, seen from above.
C, D. Nauplius of female, second stage (nat. size 0·25 mm.).

from *B. sibbaldi*[1]; but as it differs in several respects (thus the neck is reduced to a short and quite thin peduncle, from which the body expands rather abruptly to its full size without any gradual transition), I think that the species has not been previously described, and I propose for it the name *E. ruber* (figs. E, E').

E. ruber has on its proboscis about four rows of very thin, pointed, and quite transparent spines.

The rostellum, the length of which (including the proboscis) is 2 millim., is pointed in front, and has, as a rule, a more or less distinct constriction a little in front of its centre, whence the anterior part narrows regularly towards the proboscis. The rostellum has about

Fig. E'.

Fig. E.

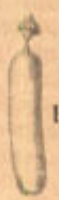


Fig. E. *Echinorhynchus ruber*, sp. nov. (nat. size 25 mm.).
E'. Front part, magnified.

10 rows of spines, the concentric arrangement of which is not always plain.

The collum is thick anteriorly, and still somewhat narrower than the rostellum, but rapidly narrows off to a thread-like peduncle; the neck is, however, quite short, and the total length from the rostellum to corpus is only 3 millim., and is thus even shorter than the breadth of the body.

[1] "Monogr. illustr. Balænopt. . . . . côte occ. de Suède" (fol. Stockholm, 1867), p. 95.

The corpus emerges almost without any transition from the neck, and has a length of about 19 millim., making the animal's total length about 25 millim. It is perfectly cylindrical, and has a regular breadth of about 3½ to 4½ millim., which is thus to the total length as 1 to about 6½.

Males and females were intermixed and seemed to be present in equal numbers. The two sexes do not appear to differ in length, colour, or general appearance; though the males were at the first glance distinguishable on account of the two projecting folds in the skin encircling the outer orifice of the genitalia.

The females were all full of myriads of eggs: these were of normal structure, and measured about 0·135 millim. in length; no trace of the row of spines which appears on the head of the embryo of the other species could be found when magnified 600 times. Neither were spiral threads to be seen, as described in *Echinorhynchus proteus* (Zeitschr. f. wiss. Zool., Bd. xiii. p. 418).

It cannot of course at present be stated whence *B. borealis* obtains the larvæ of *E. ruber*. As the species is decidedly different from *E. brevicollis*, described by Malm from *B. sibbaldi*, it is not probable that both species get their parasites from the same crustacean. We know that *Euphausia inermis* (a Thysanopod) is the species from which *B. sibbaldi* probably exclusively obtains its food in the summer months, and it is therefore not improbable that *Echinorhynchus brevicollis* passes through its first stages with this species.

Whether *Calanus finmarchicus* is the first host of *E. ruber* can only be conjectured as a possibility. It seems, however, more probable that a somewhat larger crustacean, which perhaps constitutes the food of this Whale at other seasons of the year, is the true transporter of this parasite.

Its diagnosis will be as follows:—

E. RUBER, n. sp. Total length 25 millim.; proboscis with about 4 rows of spines, rostellum with 10–12 rows. Neck shorter than the transverse diameter of the body, thread-like. Corpus short, emerging abruptly from the neck. Colour in adult brick-red.

XI. *Time of Capture.*

It has been previously stated, that in 1882 *B. borealis* first became the object of general capture, especially at the newly founded establishment at Sörøen, near Hammerfest, and it appears to "close the land" about there every year, although in varying numbers. In previous years the first specimen, according to Capt. Bull, was captured in the beginning of June. The 24th of June was about the best period for catching them, while after the 8th July they gradually disappeared, when other species generally appeared (*B. musculus* and *B. sibbaldi*).

This year (1885) *B. borealis* coasted the land along the whole of Finmark, and formed such a considerable portion of the "Fishery," that it surpassed the number of all other species combined.

The first specimens observed in shore in 1885 were captured near the establishments on Söröen, near Hammerfest, on the west coast of Finmark, the first on the 14th May, by one of the steamers belonging to Böle (Capt. Foyn); the second on the 18th by one of the Sörvær steamers (Capt. Bull). These two factories together obtained during May five specimens. Whales were under the land the whole time, but the fishery was hindered by bad weather. In the previous year this whale had never approached land so early.

The first one captured by the whalers in East Finmark was killed on the 18th June off Nordkyn.

Many were seen the same day, and they proceeded in an E.S.E. direction, keeping at about 4 Norwegian (over 28 English) miles from land. It was, however, some time before they appeared in any considerable numbers. First, towards the end of June, they began to be captured by several of the whalers, and even then only in small numbers. In the beginning of July, however, the numbers were greater; and during an entire month some were caught daily along the whole coast of Finmark by all the companies; and occasionally several individuals were captured in a day by the same company. The best period was the latter half of July. In the course of August their numbers diminished, but even towards the end of the month several were caught, but the "schools" appeared then to be more under the Murman coast or further out at sea. The last one obtained was by Capt. Sörensen on the 28th August[1], but others were seen during the first week in September (the last time being the 8th September).

XII. *Fœtus.*

All the managers agree that about an equal number of each sex were captured. The six specimens examined by me were three males and three females. One of the whalers believes from his observations that at the beginning of the fishing-season most of those captured were females.

Most of the females were gravid. At the commencement of the season (in the beginning of July) most of the fœtuses were 3 or 4 feet long, in the middle of the month they were often 6 or 7 feet (1·8–2·2 m.), and towards the end of the season, in August, some were seen of from 8 to 10 or 12 feet in length. Although there was thus a somewhat regular increase in the size of the fœtus as summer advanced, their growth increased apparently but slowly, and there were several instances of irregularities. Thus a fœtus taken out at one of the factories at Vardö, on the 15th July, had a length of 8 feet (2½ m.); whilst at the same place, on the 18th July, one was obtained which measured only 2 feet (0·6 m). Some whalers consider it difficult to lay down any fixed rule for the size, having often

[1] [The last specimen of this species killed during the season of 1885 was brought in to Capt. Sörensen's factory early on the morning of August 25. It was a male measuring 45 feet (English) along the curves, and was taken off Kildin Island on the Murman coast.—A. H. C.]

obtained on the same day both large and small fœtuses. So far as my knowledge goes, a fœtus has never been met with under 2 feet in length.

The four fœtuses examined by me were taken out between the 16th and 19th July, and were from 5 to 9 feet (1·5 to 2·8 m.) in length, as will be seen by the following measurements:—

	16 July. No. 1, ♀.	18 July. No. 2, ♂.	19 July. No. 3, ♂.	18 July. No. 4, ♂.
	millim.	millim.	millim.	millim.
Total length	1550	1830	2410	2830
Snout to angle of mouth	250	320	410	460
Angle of mouth to flipper	220	250	350	360
Length of the flipper	240	250	370	410
Width of the flipper	50	54	—	—
Snout to the dorsal fin	1030	1180	1550	1810
Dorsal fin to end of the tail	520	650	860	1020
Snout to the navel	760	940	1230	1340
Greatest height of the body	240	300	330	390
Height at the beginning of the dorsal fin	170	230	310	320
Height at the middle of the tail	140	160	220	270
The least height of the tail	100	120	—	170
Length of each fluke	200	250	—	340

The colour of these fœtuses was homogeneous, a reddish-brown on the upper and under sides, without any appearance of white on the belly. It was only in the largest ones that there was any indication of the baleen. Their covering of hair, on the contrary, as previously stated, was considerable.

Twins.—On the 27th July, Capt. Bruun captured at the entrance to the Varangerfjord a female 43 feet long, which contained two young ones, each six feet seven inches long. So far as I know, twins have never been observed by others.

XIII. *Food.*

In all the examples I examined in the middle of July the stomach and intestines were filled with a fine gritty mass, which consisted entirely of *Calanus finmarchicus*[1] (figs. F, G, p. 262). These were half digested, but among the hairs of the baleen-plates they occurred in great numbers and in a tolerable state of preservation. The fæces had the same intensely red colour as the contents of the intestines and stomach. *Calanus finmarchicus* is known to occur in two forms, one large, the other small. The form here met with was the latter. How far this Copepod formed the only nourishment of this species during the time they remained under the Finmark coast is doubtful. In East Finmark it probably formed their only

[1] *Monoculus finmarchicus*, Gunnerius, 1765; *Cyclops finmarchicus*, Müll. (ex Gunn.) Zool. Dan. Prodr. p. 201 (1776).

Fig. F.

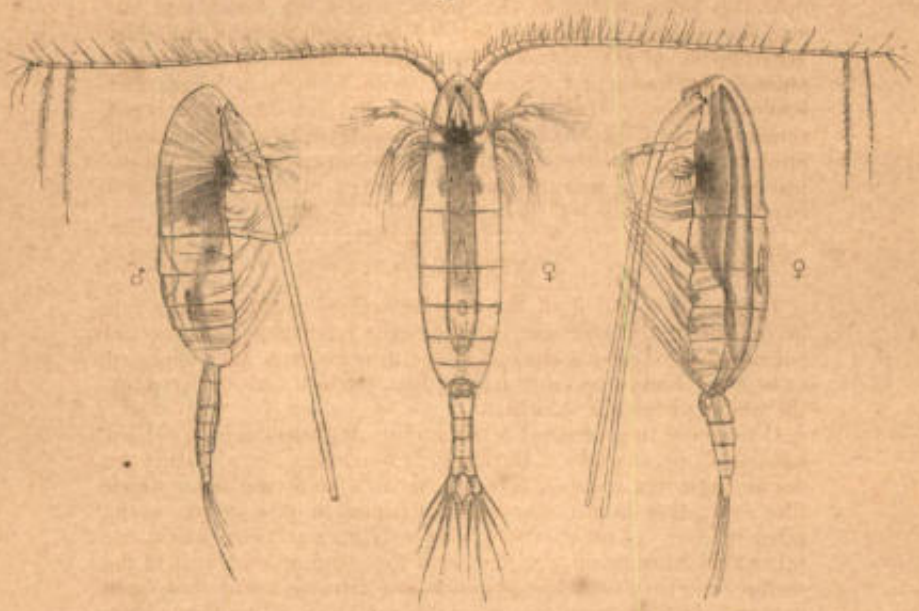


Fig. G.

Calanus finmarchicus.

food; but Capt. Bull, from West Finmark, asserts that not only this summer, but in the previous ones, he found that the stomach contained the so-called "Kril," which forms the chief nourishment of the *B. sibbaldi*. This "Kril" is *Euphausia inermis*, a Thysanopod Crustacean, about 1½ inch in length and semi-transparent. It is therefore certain that the *B. borealis* is not confined to the Copepoda for its nourishment, although the unusually fine and curly, almost woolly bristles on the inner side of the baleen-plates clearly show that their food consists of minute animals, and hardly ever of fish.

XIV. *Habits.*

B. borealis appeared off the coast sometimes singly, but as a rule in schools of different size, which might number as many as 50 individuals. Towards the end of the fishing-season they appeared to be more broken up, after having been terrified and scattered by the whaling-boats for months.

Concerning their method of swimming, the whalers have noticed some small peculiarities. During their wanderings, or when they are not amongst the "Aate" (*i. e.* the shoals of crustaceans on which they feed), they swim fast, and do not require to blow so often as the other species. As a rule they blow only once or twice, whilst the other kinds blow as often as five or six times during each visit to the surface, and they swim for a considerable distance before they again appear. Their course under the water can be traced by the bubbles of air which appear on the surface. When in amongst a shoal of *Calanus finmarchicus*, and on the feed, they swim quite slowly, with their snout and half of their back above water. The *B. musculus* and the *B. sibbaldi* under such circumstances often turn on their side whilst swimming, with their mouths open to take the crustaceans.

In its temper *B. borealis* is inoffensive and avoids the boats. But it has sometimes happened that in its death-agonies it has struck the boats, and on several occasions has injured their sides or propellers. Such conduct has, however, probably been unintentional, or committed in its agony, and cannot be considered, as it has often been called, natural ferocity.

All the whalers are unanimous in opinion that *B. borealis* (as well as *B. musculus* and *B. sibbaldi*) can remain under water for a far greater time than is generally supposed. The duration of this time is estimated to be from 8 to 12 hours. Such periods of rest often occur at particular hours of the day. These animals are never heard to make any sound.

XV. *Value.*

The quantity of blubber as a rule is but little in this species. An average-sized individual yields from 15 to 20 Norw. barrels (17 to 23 hectolitres) of oil; they appear this year to have been as a rule

thinner than usual. Capt. Bull told me that during the previous year at Sörvær he got 25 to 30 barrels off each example (30 to 35 hectolitres). The blubber is thickest about the flippers and on the back, where it is from 3 to 6 inches thick (80 to 130 millim.).

The value is estimated by the whalers as being about half that of *B. musculus*, and averages about 500 to 600 kroners (£27 to £33). The baleen is considered more valuable than that of the other kinds.

Finally, it may be mentioned that it is from this species, and from none of the others, that the flesh is prepared on a large scale for human consumption. A factory has been at work during the past year at Sörvær, near Hammerfest, hermetically preserving the flesh of this species, the flesh of the other species of the Balænopteridæ not being considered fit for such a purpose.

XVI. *Monstrosities.*

During my stay at Capt. Castberg's factory at Vardö I was shown an individual which lay moored to the shore, caught on the 16th July. It wanted both "flippers" from the shoulder-joints. As this deficiency appeared to be symmetrical, it is probable that the specimen was born without flippers (however I could not be sure of this, as I could not stop until the blubber was removed).

XVII. *Synopsis of the four Northern Species of* Balænoptera.

I conclude my remarks by giving a brief summary of the external characters of the four northern species of *Balænoptera* :—

Balænoptera rostrata (Fabr. 1780). Norwegian *Vaagehval* ("Bay Whale").—Length 25 to 30 feet, seldom exceeding 33 feet. Form of the body rather robust or plump; the greatest height is to the total length as 1 to 5. Colour greyish black above; the underside white, including the whole of the lower side of the tail; the flippers with a broad band of white across the outer side; the inner side quite white. Dorsal fin high, evenly curved, and deeply emarginated behind; it is placed somewhat far forward, at the commencement of the last third of the body. Vent placed just under (or a trifle beyond) the hindermost edge of the dorsal fin. Flippers moderately long, measuring about one eighth of the total length of the body. Baleen with the bristles of a yellowish-white colour. The number of plates about 325; their greatest length about 200 millim., not including the bristles. Jaws short, being to the total length to 1 to $5\frac{1}{2}$.

Balænoptera borealis, Less. 1828. Norwegian *Sejhval* ("Coal-fish Whale").—Length 40 to 48 feet, rarely as much as 52 feet. Form of the body less robust; the greatest height is to the total length nearly as 1 to $5\frac{1}{2}$. Colour bluish black above, with oblong light-coloured spots; the underside as far as the genitalia more or less white. The whole of the tail, with the flukes and the flippers on both sides, is exactly similar to the back in colour. Dorsal fin high, evenly curved and deeply emarginated behind; it is placed far forward,

as a rule a little in advance of the last third of the body. Vent placed exactly under hindermost edge of the dorsal fin. Flippers unusually small, measuring about $\frac{1}{17}$ of the total length of the body. Baleen black; the bristles fine, white, and curling. The number of plates about 330; their greatest length 650 millim., not including the bristles. Jaws long, being to the total length about as 1 to $4\frac{1}{2}$.

Balænoptera musculus, Comp. 1828. Norwegian *Finhval* ("Finner Whale").—Length 60 to 65 feet, seldom exceeding 70 feet. Form of the body very elongate; the greatest height is to the total length as 1 to $6\frac{1}{2}$ or $6\frac{3}{4}$. Colour greyish slate above, also the left lower jaw; the whole underside, the right lower jaw, the inner side of the flippers, and the underside of the flukes white. Dorsal fin rather low, with almost straight margins; it is placed somewhat forward, or very slightly in front of the last fourth of the body. Vent placed just beneath the anterior edge of the dorsal fin. Flippers rather small, measuring about $\frac{1}{9}$ of the total length of the body. Baleen with the bristles dark bluish black or slate-colour; on the right side, the first rows are white or whitish. The number of the plates between 350 and 370; their greatest length about 950 millim., not including the bristles. Jaws of moderate length, being to the total length as 1 to 5.

Balænoptera sibbaldi, Gray, 1847. Norwegian *Blaahval* ("Blue Whale").—Length about 70 to 80 feet, seldom exceeding 85 feet. Form of the body more robust than the last species, the greatest height is to the total length as 1 to $5\frac{1}{2}$. Colour dark bluish grey, with small whitish spots on the breast; the lower edge of the flippers and their inner sides white. Dorsal fin particularly low and small, with straight margins; it is placed far back, close to the commencement of the last quarter of the body. Vent placed in front of the vertical line from the anterior edge of the dorsal fin. Flippers large, measuring about $\frac{1}{4}$ of the total length of the body. Baleen with the bristles black. The number of the plates up to 400 (according to Dr. Guldberg); their greatest length (according to Dr. Nansen) 930 millim., not including the bristles. Jaws long, being to the total length as 1 to $4\frac{1}{2}$.

EXPLANATION OF THE PLATES.

PLATE XXV.

Fig. 1. Side view of *Balænoptera borealis*, male.
2. Lower surface of ditto.

PLATE XXVI.

Fig. 1. Lower surface of *Balænoptera borealis*, female.
2. One of the whitish spots on the skin; enlarged.

May 4, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during April 1886:—

The total number of registered additions to the Society's Menagerie during the month of April was 170, of which 83 were by presentation, 23 by purchase, 11 by birth, 11 were received in exchange, and 42 on deposit. The total number of departures during the same period, by death and removals, was 119.

Amongst these special attention was called to:—

1. A fine example of a Lizard belonging to a new species of the genus *Ctenosaura*, which Mr. Boulenger described at the last meeting of the Society as *Ctenosaura erythromelas* (see above, p. 241), obtained by purchase April 3rd.

The exact locality of the specimen, which was purchased of a dealer at Liverpool, could not unfortunately be ascertained; but it is believed to be from some part of Central America.

2. A fine male example of the Lesser Koodoo, *Strepsiceros imberbis*, received in exchange from M. Cornély, of Tours, on April 7th.

Having lost the female, M. Cornély was good enough to part with the male of this rare Antelope in our favour. The specimen in question was originally obtained by one of Mr. Hagenbeck's collectors in Somali-land (see P. Z. S. 1884, pp. 45, 539).

3. A young male two-horned Rhinoceros, received in exchange from the Zoological Gardens, Calcutta, April 27th, and apparently referable to *R. lasiotis*, if this species is really distinct from *R. sumatrensis*. Dr. John Anderson, F.Z.S., has kindly favoured me with the subjoined note upon this interesting acquisition:—

"The young male Rhinoceros, lately received from the Calcutta Zoological Gardens, was brought into Rangoon on the 27th of March, 1884, while I happened to be there on my way to Japan. The animal had been captured a day or two before in the Bassein district, close to the sea, and, when first seen by its captors, it was in the company of its mother. The mother, however, escaped, I was told, by plunging into the sea and swimming away, leaving her young one behind. I at once secured it for the Calcutta Zoological Gardens. When I saw it in Rangoon it was only about 2 feet high at the shoulder, and was evidently quite a baby. Its skin was smooth and pinkish, and thickly covered with pale yellowish-grey hairs, somewhat curly, and as soft as wool, except on the front of the legs, where it was blackish-brown and much coarser than elsewhere. The positions of the two horns were well-defined, although these structures were only feebly developed. From its general appearance I concluded at the time that it was *R. lasiotis*."

Mr. E. L. Layard, F.Z.S., exhibited a rare Beetle of the family Cerambycidæ (*Macrotoma heros*), obtained in one of the islands of the Fiji group.

This species was originally described and figured by Graeffe (Reis. Ins. Viti, 1868, p. 47, Taf. i.; see also the Stettin. entom. Zeitung, 1868, Taf. ii.). It was said to live in hollow trees. The specimen was intended for the National Museum.

Mr. Layard also exhibited a series of specimens of the genus *Bulimus* from New Caledonia and the adjacent islands, and some other interesting shells.

The following letter, addressed to the Secretary by Mr. F. W. Styan, F.Z.S., relating to some Chinese animals, was read:—

"Shanghai,
"12th March, 1886.

"I have lately procured from Ningpo the skin of a Hairy-fronted Muntjac, *Cervulus crinifrons*, the species described by you before the Society on the 20th January last. My specimen is a female, and as I believe the male in the Gardens of the Society is the only individual of the species that has yet been met with, a description of the skin may be interesting.

"The following are the measurements of the dry skin:—

	inches.
"From nose to root of tail	46 (apparently stretched)
Tail to end of bone	6½
Tail to tip of hair	8¼
Heel to base of hoof	11
Shoulder to base of hoof	15
Nose to forehead between base of ears	9
Ears	4

"Upper parts rich dark glossy brown, mixed with black, darkest along the middle of the back. Belly and inner sides of thighs pure white, the line of demarcation very distinct except in the lower part of the thighs, where it merges gradually into dark brown. Tail above black, below pure white; a pale patch under the forearm; rest of the underparts dark brown. The brown of the neck gradually pales into reddish brown on the sides of the head; the nose-ridge dark brown; the longitudinal slits form a black V, the colour between them is a bright reddish brown, which turns into a fiery orange-brown in the tuft of bristly hair, rather more than two inches long, which rises from the tip of the forehead. On each side of this is a very small bony pedicle surmounted by short tufts of hair of the same colour. Ears at the base of the same hue, but not quite so bright, and fading into brown on the upper parts.

"In general appearance it much resembles both *Elaphodus michianus* and *Cervulus lacrymans*, having the dark-coloured body, tufted

forehead, and slender build of the former, and the yellow head and black slits along the face of the latter. It is, however, much larger than either, and apparently longer in the legs, compared with the size of body. Its fur is of a similar hard texture to that of *Elaphodus michianus*, but the colour is much richer and more glossy. The skull is attached to the skin, but I have not taken it out to examine. This species appears to be very rare; ever since the description of it first appeared, the man I employed to hunt has been specially looking for it, but has only procured this single specimen. When I first gave him a description of it he was quite incredulous, and said no such animal was known, nor would he believe in it until he actually came across this one.

"Last summer he procured for me two young of the *Elaphodus*, which I am not aware have been described before. They are apparently not more than two or three weeks old, but are almost exact miniatures of the adult, similar in colour, with a very pronounced frontal tuft, but no pale eyebrow, ears marked with white as in adult. On each side of the back is a row of not very distinctly marked white spots, and outside that again just the faintest suspicion of another row.

"I have also to record an interesting addition to the avifauna of China in the shape of *Hirundo savignyi*. Two birds, which I believe to be of this species, were killed at Pekin last October, one of which is now in the Shanghai Museum. David records having seen Swallows with reddish-yellow underparts in Upper Mongolia, which doubtless were of the same species, but no record of its occurrence in China exists. Both are males, one an immature bird, and measure respectively 7½ and 7 inches—the tail in the former being 4 inches, in the latter 3½, not fully developed. In the adult the forehead and throat are deep chestnut, the lower parts uniform rich chestnut-buff; the nuchal collar is broad and complete, but a little mixed with chestnut. In the younger bird the colour of the forehead and throat is similar to that of the lower parts in the adult, while its lower parts are again paler, a bright buff, and the nuchal collar is broken in the centre.

"Whether *H. savignyi* is now admitted as a distinct species or is regarded as only a variety of *H. rustica* I do not know; but if the latter, its range is remarkably wide, and it is strange to find it where the parent form is unknown and replaced by a distinct species, *H. gutturalis*.

"I am, Sir,

"Yours faithfully,

"F. W. Styan, F.Z.S.

"P.S.—A friend tells me that when in Pekin in 1883 he saw Swallows with uniform brick-red underparts, but did not obtain specimens. It is probable the species is not uncommon there."

The following papers were read:—

1. Remarks on four rare Species of Moths of the Family *Sphingidæ*. By W. F. Kirby, Assistant in Zoological Department, British Museum (S. Kensington).

[Received April 16, 1886.]

(Plate XXVII.)

I am indebted to Prof. V. Ball and Mr. Nichols, of the Dublin Museum of Science and Art, in which most of the species noticed in this paper are contained, for an opportunity of carefully examining and figuring some of the more interesting *Sphingidæ* in the collection under their charge.

1. Chærocampa maculator, Boisd. Lép. Hét. i. p. 274 (1874).

C. moschleri, Ersch. Trudy Russk. Ent. x. p. 64, t. i. f. 1 (1876).

The identity of these supposed species has been suggested from the first. There is a specimen in the Dublin Museum which agrees with Erschoff's figure, except that it is not quite so dark, and the pale band of the hind wings is rather broader and has a slight pinkish tinge. This specimen was, I believe, received from Herr Möschler, labelled "*C. maculator*, Boisd., Colombia." Boisduval's type was from "Venezuela," and Erschoff's from "Colombia," the latter having been also received from Möschler. Boisduval's description agrees well with the Dublin specimen, except that he calls the pale band of the hind wings "jaune terreux," and seems to imply that the dark blotch on the fore wings is nearer the centre than is actually the case. But I am not disposed to attach too much importance to these trifling discrepancies.

2. Ambulyx eos, Burm. (Plate XXVII. fig. 1.)

Philampelus eos, Burm. Desc. Rep. Arg. v. p. 350 (1878), Atlas, pl. 10. fig. 1 (1880).

The British Museum possesses a male from Buenos Ayres, presented by Walter de Rothschild, Esq., which differs so much from Burmeister's figure of the female that I have thought it worth while to figure it. The vertex, thorax, and fore wings are of a dull green, slightly inclining to olive above; the face and under surface of the thorax are greenish yellow, the base of the labrum and the knees being narrowly white. The antennæ are white behind, and reddish in front. The sides of the thorax above are of a much darker green than the centre, and are marked behind with a small white triangular spot; the first segment of the abdomen is also of a dark green, somewhat yellowish, the remainder being of a yellowish grey. The

fore wings are whitish at the base, this colour being narrowest at the costa; and rather below the costa is a small dark green spot near the base. On the inner margin, a dark green oblong mark curves upwards from the base, ceasing at one third of the distance from the costa, and rather beyond it is an oblong white spot with a dark-green centre. Below this, and beyond the oblong mark, the wing is obscurely marked with blackish, and from the upper curve of the oblong a dark obsolete mark curves towards the anal angle, before which it becomes more distinct, and is bounded outside by some whitish markings in the form of a W. In the middle of the wing are three obsolete transverse lines, ceasing at the subcostal nervure—the basal one dull green, the second obscurely blackish, and having an oblong black spot within its upper portion, and the outer one much waved, marked rather broadly with blackish above; beyond it, just below the subcostal nervure, is another blackish mark, like a broad V. The hind wings are reddish tawny, the hind margin being olive-yellow, most broadly so at the anal angle, above which it is surmounted by an irregular blackish blotch enclosing two white dots. Wings beneath yellowish green or greenish yellow, the fore wings being pale orange-yellow at the base to beyond the cell, and brighter orange along the costa; at the extremity of the cell is a blackish spot. The outer portions of the fore wings are marked with three obsolete green lines, converging towards a blackish spot at the anal angle, and the hind wings with three similar lines, which do not quite meet; the outer ones terminate in blackish blotches, between which stand two white dots.

The obscure shades and markings of the fore wings of this and the next species render them difficult to describe satisfactorily.

The fore wings are strongly falcate, and the anal angle is very strongly marked. The hind margin of the hind wings is bidentate beyond the anal angle.

3. AMBULYX TITHONUS, sp. n. (Plate XXVII. fig. 2.)

Very similar to *A. eos*, but the upper surface is of a much duller olive-brown; markings of the head and thorax nearly similar. Fore wings hardly white at the base and with a yellowish-olive band, slightly edged with white, running less obliquely from the inner margin just beyond the base to the median nervure, at which point it is broader than in *A. eos*; its outline is also more sinuous. Above the median nervure, and beyond it, is an obscure olive-green spot, flecked with white; at the end of the cell is a black spot, beyond which is a sinuous black line (double above) curving down to the inner margin; beyond it are two more waved blackish lines (the first double) running from the subcostal nervure half across the wing; the hind margin and anal angle are shaded into olive. Hind wings orange-tawny, paler at the anal angle, above which is a black blotch marked with two white dots, from which runs an ill-defined submarginal blackish stripe; the hind margin is also narrowly blackish. Wings beneath of a more uniform yellowish green than

in *A. eos* and the fore wings paler yellow at the base; the black discoidal spot is less strongly marked, and is followed by three short dusky lines on the costa; the hind margin is grey in the middle, bordered by a suffused blackish line running from the tip to the anal angle; on the inner margin, within the anal angle, is a short curved blackish line; nearer the base the inner margin is reddish. Hind wings beneath with a black spot at the end of the cell, and three obsolete greenish lines beyond (the middle most obscure), terminating in a black blotch, on which stands a yellowish-white spot, the two seen above having become united beneath.

The wings are rather less falcate than in *A. eos*, and the hind wings have only one tooth within the anal angle.

The example of this species was received by the Dublin Museum as "*Ambulyx lycidas*, Brazil;" but M. C. Oberthür of Rennes, who has kindly compared the figure with the type of that species (described by Boisduval, Lép. Hét. i. p. 191) from Brazil, informs me that the outline of the wings (which I have reproduced here from his sketch, Plate XXVII. fig. A) is very different.

4. PROTOPARCE ABADONNA. (Plate XXVII. fig. 3.)

Sphinx abadonna, Fabr. Ent. Syst. Suppl. p. 435 (1798).
Protoparce abadonna, Kirby, Trans. Ent. Soc. Lond. 1877, p. 238.
Sphinx godarti, Macl. King's Survey of Coasts of Australia, ii. p. 463 (1827).

I am glad to have an opportunity of figuring this species, from a specimen from Queensland in the Dublin Museum; it is singular that it has not yet been obtained for the British Museum. It is quite distinct from the common Australian *P. distans*, Butl. Macleay's description is so good as to render it unnecessary to redescribe the species here. I believe it to be *P. abadonna*, described by Fabricius from the East Indies, and I therefore retain his name provisionally, though I do not feel quite so certain of the correctness of this identification.

EXPLANATION OF PLATE XXVII.

Fig. 1. *Ambulyx eos*, ♂, p. 269.
2. —— *tithonus*, sp. n., p. 270.
3. *Protoparce abadonna*, p. 271.
A. Outline of wing of *Ambulyx lycidas*, p. 271.

2. Observations on the Ovarian Ovum of *Lepidosiren* (*Protopterus*). By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society.

[Received May 3, 1886.]

(Plates XXVIII. & XXIX.)

I. Introduction, p. 272.
II. Egg-membranes, p. 273.
III. Germinal Vesicle, p. 276.
IV. Follicular Epithelium and Development of Yolk, p. 279.
V. Postembryonic Origin of Ova, p. 288.
VI. Résumé, p. 291.

I. *Introduction.*

A recent memoir on the anatomy of the Dipnoi by Howard Ayers [1] contains some account of the ovaries and the ova in *Lepidosiren* [2], illustrated by several figures. The description of these organs is, however, mainly anatomical; and though in the figures some histological details of the ovary and the contained ova are to be found, their structure is not described. The author contents himself with remarking upon the similarity to the Amphibia, and all that I can find in his paper about the minute structure of the ovaries and ova is the following paragraph [3]:—"Die Structur der Eierstöcke ist direkt vergleichbar mit der der Urodelen. Die verschiedenen Stadien in der Entwickelung der Eier aus dem Keimepithel sind, soweit bei dem in Alcohol konservirten Material festgestellt werden konnte, wesentlich dieselben, wie sie für niedere Wirbelthiere constatirt sind. Wenn die Eier völlig entwickelt sind, so ist eine Hälfte ihrer Oberfläche pigmentirt (diejenige, welche gegen die freie Hälfte des Eierstockes gerichtet ist), während die andere Hälfte farblos bleibt" [4]. Furthermore, in describing the anatomical relations of the different parts of the genital system, Dr. Ayers takes occasion to remark that the sexual cells (both ovaries and testes) are inclosed in two delicate sacs—an outer peritoneal, and an inner formed by the connective-tissue stroma.

I shall refer more particularly to the appearances depicted in Ayers's figures in considering the structure of the ovaries and ova as I interpret them from my own preparations.

[1] "Beiträge zur Anatomie und Physiologie der Dipnoër," Jenaische Zeitschr. vol. xviii. (1885), pp. 479–527, 3 plates.

[2] The specimen studied by myself is from the Nile, and would therefore, according to some authors, be more properly termed *Protopterus*. Dr. Ayers shows reasons for assuming that there is really no generic distinction between the American *Lepidosiren* and the African *Protopterus*; the former name should therefore, on grounds of priority, be retained.

[3] *Loc. cit.* p. 508.

[4] This is a curious point of similarity to the ova of the Frog (see Balfour, Comp. Embr. vol. ii. p. 99; Pflüger, Arch. f. d. ges. Physiol. Bd. xxxi. 1883), not remarked upon by Ayers in his paper.

membrane shows signs of its subsequent reabsorption into the ovum, the lower margin being rather less distinct than in the earlier stage. At no time is the zona radiata so distinctly "membranous" as the vitelline membrane; it always has a granular appearance, and if it were not for the fine vertical striæ, which are presumably the expression of pores, would be regarded as merely a superficial layer of the protoplasm appearing more deeply stained because of its firmer texture. If the vertical striation be really due to protoplasmic processes traversing the zona radiata, this latter must be regarded as a distinct metamorphosis of the superficial layer of the ovum; otherwise, if it really has retained its protoplasmic character, there would be no necessity for special protoplasmic filaments to pass through its substance: the whole layer would serve equally well as a conductor of nutritive material. The disappearance of this membrane, which commences with the commencing formation of yolk, is complete in the later stages of the maturation of the ovum; and the disappearance is easier to understand on the assumption that the zona radiata is only but little changed from its original protoplasmic condition, its reabsorption being therefore a kind of solution. On the other hand, the thinning of the vitelline membrane in the later stages of egg-development is possibly purely mechanical, being due to the extension of an elastic membrane through the increasing bulk of the egg-contents.

The pores in the zona radiata are very generally believed to admit processes of the follicular epithelium, and where no imperforate membrane exists between the zona radiata and the follicular epithelium, as in Mammals, it has been actually demonstrated that such is the case.

In Elasmobranchs Balfour[1] has described an enlargement of some of the follicular cells as the ovum approaches maturity; these are doubtless concerned with the nutrition of the ovum, but they cannot (?) come into actual contact with it because the vitelline membrane divides them. It is a significant fact, however, that at this period the vitelline membrane becomes extremely thin, so that it would evidently favour osmosis. In this case the perforations of the zona radiata may still be the expression of pores which contain prolongations, not of the follicular cells, but of the egg-protoplasm, which thus takes an active part in its own nutrition, as in the lower forms, and is not merely passively fed by the follicular epithelium.

This may well be the case with *Lepidosiren*, though I have been unable actually to demonstrate the protoplasmic contents of the pores in the zona.

During this second stage of the egg-development, while the yolk is in process of formation, and there is therefore a special need of extra nutrition, not merely are these pores in the zona radiata, but in the more highly refracting membrane outside of this (Plate XXIX. fig. 5), which I believe to be the thickened vitelline membrane of earlier stages.

These pores are very obvious indeed, and impossible to be over-

[1] Quart. Journ. Micr. Sci. 1878, p. 405.

looked in good sections. The vitelline membrane in earlier stages is so thin that I have found it impossible to detect any pores; it may be that they are present, or that the nutrition of the ovum in the earlier stages is carried on, as suggested above, by osmosis, while during the later stages, when the formation of yolk is going on and the need for nutrition increased, direct contact between the follicular cells and the ovum is necessary to convey adequate nourishment.

In the stage represented in Plate XXVIII. fig. 3, which is characterized by the extraordinary proliferation of the follicular cells and their migration into the interior of the ovum, there was no trace whatever of any membrane. The ovum lies within the follicular epithelium, and in actual contact with its cells. Indeed the very migration of the follicular cells into the ovum would necessitate the absence of such a membrane, and there were, at any rate, no traces of it except in the well-marked limiting membranes (see Plate XXIX. fig. 7) of the follicular cells, which, however, I never observed to be separated from the cells themselves, and were continuous all round them. The absence of any such membrane round the ova of this stage is one of the strongest arguments against regarding them as a stage intercalated between the last and the next to be described. Into this question I shall enter later.

In the latest stages, in which the ovum is entirely occupied by yolk, the follicular epithelium is separated from the contents of the ova by an extremely fine and delicate homogeneous membrane (Plate XXIX. fig. 6); this membrane probably corresponds, in some ova at least, to the vitelline membrane which has persisted after the disappearance of the internal zona radiata. In some ova belonging to this stage, the occurrence of a few scattered cells through the substance of the yolk appears to indicate that they have been derived from ova belonging to the stage just referred to; in these also a thin delicate membrane lay between the ovum and the surrounding follicular epithelium. In this case the membrane must be regarded as a new formation, though perhaps still homologous with the vitelline membrane.

In the number and structure of its membranes the ovum of *Lepidosiren* appears to be related much more nearly to the Elasmobranchs than to the Amphibia, with which group the general anatomical structure of the reproductive organs more closely corresponds. In the Amphibia in fact, according to Waldeyer and Kolessnikow, there is only a single delicate membrane, developed comparatively late, and showing a radial striation. Götte's observations on *Bombinator*[1] point to the existence of a single membrane, clear and structureless, which arises by a metamorphosis of the external layer of the ovum. In *Triton* Iwakawa[2] describes and figures a single structureless membrane surrounding the ovum. In these cases the single membrane evidently represents the membrane in *Lepidosiren* which I have termed vitelline. The discrepancies in the observations of these authors on the structure of the membrane,

[1] Entwickelungsgeschichte der Unke, p. 19.

[2] Quart. Journ. Micr. Sci. vol. xxii. (1882), p. 274, pl. xxiv. figs. 2, 4–26.

whether it is really structureless or radiately striate, are possibly to be explained by supposing that, as in *Lepidosiren*, it is structureless at one time and striate at another.

So also with the observations of Brock upon the Teleostean ovum. This anatomist figures (*loc. cit.* pl. xxviii. fig. 7 *f*, pl. xxix. fig. 6 B *e*) two ova, both of which are provided with two egg-membranes: in the one the outer egg-membrane is striate, while in the other it is unstriate; in the latter case it is considerably thinner than in the former, and the processes of the follicular cells, whether by accident or design, are drawn as if stopping short at the outside of the membrane. Brock's figures seem to me to point to the conclusion that the outer egg-membrane (vitelline membrane) arises, as in *Lepidosiren*, as a differentiation of the outer layer of the egg-protoplasm, and is subsequently perforated by processes of the follicular cells as the ovum approaches maturity. On the other hand, the perforations in the zona radiata would seem in this case to be caused, as suggested above, by protoplasmic strands radiating outwards from the ovum. The observations of Owsiannikow appear to contradict this explanation. Owsiannikow has figured (*loc. cit.* pl. i. fig. 3) the branching of the processes of the follicular cells after they have passed through the outer membrane, in which the pores are wider apart, to fit into the more closely arranged pores of the inner membrane.

III. *History of the Germinal Vesicle.*

My observations on the development of the germinal vesicle are unfortunately rather meagre. I have been unable to trace it continuously from the youngest to the most mature ova. The principal lacuna in the history of the germinal vesicle is the very interesting stage characterized by the immigration of the follicular cells into the substance of the ovum. In this stage I could observe no appearance whatever of a germinal vesicle, which is much to be regretted, as it would be interesting to know what are its relations to the immigrating follicular cells [1].

I observed two distinct stages in the development of the germinal vesicle which will now be described. The first stage is found in young ova, in which the yolk-formation has not yet begun. The germinal vesicle is of an oval form, and lies excentrically within the ovum; it is bounded externally by a very fine membrane in *Ceratodus*, according to Ayers's figure (*loc. cit.* pl. xviii. fig. 76). In my own preparations (Plate XXIX. figs. 3, 4) the limiting

[1] Dr. Balbiani has described in the egg of *Geophilus* (Zool. Anzeig. Nos. 155, 156) a formation of cells from the germinal vesicle which pass through the substance of the ovum, and ultimately range themselves round its periphery to form a follicular epithelium. These stages are depicted in a series of woodcuts, some of which bear not a little resemblance to the stage in the maturation of the ovum of *Lepidosiren* described above. It is possible that the appearances described by Balbiani may ultimately be reconciled with those described by myself in the present paper. Balbiani's observations have not, however, been confirmed by the recent researches of Heathcote (Quart. Journ. Micr. Sci. 1886), though in many insects' ova other observers have noted similar processes.

membrane of the germinal vesicle is not always very obvious; but as there is a sharp contrast between the protoplasm of the germinal vesicle and the surrounding substance of the ovum (indicated by the much deeper staining of the former by borax carmine), there comes to be an appearance of a delicate membrane surrounding the germinal vesicle; this membrane has not a double contour.

In younger ova there is a very distinct membrane bounding the germinal vesicle externally; this membrane is more easily to be distinguished in my preparations from the fact that it is very deeply stained.

Although the boundaries of the germinal vesicle are distinct enough, there is no cavity dividing it from the egg-protoplasm; the granules of the latter are everywhere in contact with the germinal vesicle. In several preparations the germinal vesicle had shrunk; but in every case observed by me the wall of the germinal vesicle was covered with egg-protoplasm granules, thus showing that the spaces surrounding the germinal vesicle in that figure are not natural, but due to alterations caused by the contraction of the germinal vesicle.

The interior of the germinal vesicle is occupied by a finely-granular matter, which is almost homogeneous throughout. In certain tracts, however, the granules are more deeply stained and often larger; these granules form a reticulum (Plate XXIX. fig. 3). In the ovum of *Triton*, Iwakawa illustrates (*loc. cit.* pl. xxiv. fig. 27) a very similar condition of the nucleoplasm. The germinal spots are very numerous, and form a layer surrounding the germinal vesicle; the latter is shown on a superficial view in fig. 3, and in transverse section in Plate XXIX. fig. 4. The germinal spots are of very varying size, and usually oval or circular in form; borax carmine stains them more deeply than the surrounding nucleoplasm; they are evidently not homogeneous, but appear to consist of an outer sheath of stout consistency, and very deeply stained by the reagent, and within this an apparently more fluid core which is not deeply stained.

The presence of numerous germinal spots is figured by Ayers for both *Ceratodus* (plate xviii. fig. 76) and *Lepidosiren* (plate xvii. fig. 27).

It is also characteristic of the Teleostean ovum [1], and is mentioned by Messrs. Balfour and Parker [2] in *Lepidosteus*. Among Amphibia *Triton* shows the same condition of the germinal spots. In ova of the stage represented in Plate XXVIII. fig. 2, the substance of the ovum which immediately surrounds the germinal vesicle differs from the rest in being more loosely compacted.

In ova which are distinguished by the enormously increased functional activity of the follicular epithelium, the germinal vesicle could not be found. In all probability, however, my failure to find the germinal vesicle is not due to its absence.

[1] Broek, "Beiträge z. Anatomie und Histologie der Geschlechtsorgane der Knochenfische," Morphol. Jahrb. Bd. iv. (1878) p. 505, pl. xxviii. figs. 8, 11.

[2] "On the Anatomy and Development of *Lepidosteus*," Phil. Trans. 1884.

In older ova the germinal vesicle has altered somewhat from the characters which it presents in the earlier stages of the maturation of the ovum. In Plate XXIX. fig. 1, I have sketched a germinal vesicle precisely as it appeared in transverse section. It will be noticed, in the first place, that the germinal vesicle is very sharply marked off from the surrounding substance of the ovum, and in the section figured has become separated from it throughout a considerable area; this separation is no doubt due to shrinkage, but serves to show the very trenchant line of division which separates germinal vesicle and ovum, since no yolk-spherules were found to remain adherent to the germinal vesicle.

The substance of the germinal vesicle in ova of this stage of development has become specialized into an outer peripheral portion and a central core. These two areas of the germinal vesicle are almost as sharply marked off from each other as is the outer layer of the germinal vesicle from the surrounding egg-protoplasm and yolk. This is clearly shown in the same figure (Plate XXIX. fig. 1), and, as in the first case, is probably due to shrinking of the germinal vesicle when plunged into the preservative reagent. Along the upper side of the preparation illustrated in the figure already referred to, the central core of the germinal vesicle has shrunk away from the external sheath; along the lower margin of the germinal vesicle the contraction has not caused a separation of the two constituents, but a split in the outer layer, which I have not indicated in the figure.

The outer coat of the germinal vesicle is very easily distinguishable from the inner core; it is much more finely granular in structure, appearing occasionally almost homogeneous, and has become stained a pale pink. The inner core is more coarsely granular, and has a yellowish tinge, hardly owing to the non-penetration of the staining reagent, since the imbedded nucleoli were deeply stained.

The substance of the internal core contained elliptical spaces here and there, which are possibly themselves due to contraction. The boundary line between the central core and the peripheral layer is also marked by the nucleoli, which are for the most part situated in a single layer at the extreme periphery of the central core. A few, however, as indicated in the figure, are to be found in the more central regions of the core. The nucleoli were extremely conspicuous owing to their vivid staining with the reagent, and appeared to be solid, being uniformly stained throughout. In the earlier stages of the germinal vesicle mention has already been made of the annular appearance of the germinal spots. The germinal spots were very unevenly distributed and of varying size, but were never found in the peripheral layer of the germinal vesicle.

In *Triton*, Iwakawa has described what appear to be very similar changes in the germinal vesicle, though there is some little difference in detail; as the egg approaches maturity the germinal spots move in towards the centre of the germinal vesicle, leaving a homogeneous, more deeply stained peripheral area.

IV. *The Follicular Epithelium and the Formation of Yolk.*

In the youngest ova (Plate XXIX. fig. 8) the protoplasm is dense and solid, staining deeply with borax carmine; the uniform appearance of the egg-contents indicates that no formation of yolk has at present commenced.

In the next stage, where the zona radiata is well developed (Plate XXVIII. fig. 1), the protoplasm of the ovum is less dense and has acquired here and there a reticulate arrangement, which is well shown in the figure referred to.

In ova slightly more mature (Plate XVIII. fig. 2) the formation of the yolk is in active progress, though for the present confined to limited areas of the egg-protoplasm. None of my sections display any ova which show the first beginning of yolk-formation. In Plate XXVIII. fig. 2, it will be noted that the yolk appears in patches usually spherical in shape and larger or smaller; the yolk has the form of minute spherules and aggregations of spherules, which are easily distinguishable from the surrounding protoplasm, which is also granular, by their more coarsely granular appearance. They have also been stained much more darkly by the borax carmine.

The yolk-spherules invariably make their appearance in the interspaces between the reticulations of the egg-protoplasm. There is thus no doubt that the yolk is actually formed in the interior of the ovum at the expense of the egg-protoplasm; the reticulation of the egg-protoplasm, invisible in earlier stages, but completed before the appearance of yolk, is probably a preparation for the formation of the latter, which is received when formed into the interspaces between the protoplasmic strands.

Ova of the next stage (Plate XXVIII. fig. 4) show the yolk-spherules well developed and filling up the entire ovum; the spherules themselves are small and of varying size; occasionally numbers of yolk-spherules had run together to form irregular shaped masses; these yolk-masses, owing to their size and impenetrability, were invariably left unstained.

The yolk at this period entirely fills the ovum, and is spread throughout it in a perfectly uniform fashion; there was no indication of any peripheral layer free, or nearly free, from yolk.

The ovum displayed in Plate XXVIII. fig. 4 is remarkable for the fact that the yolk is distinctly differentiated into two layers—a thin peripheral layer, and a central mass; the boundary between the two was perfectly distinct, there being an absolute break, a narrow line perfectly free from yolk-spherules; the outer layer was also rendered more conspicuous by the lighter staining of the reagent. I have noticed several ova among my sections which displayed this curious differentiation.

Throughout its whole development the ovum is surrounded by a single layer of follicular epithelium-cells; these cells are flattened as in the Amphibia, and have a large deeply staining nucleus. In most cases a *membrana propria folliculi* could be detected outside these cells.

It seems to me to be fairly certain that the ova represented in Plate XXVIII. figs. 1, 2, 4, are progressive stages in egg-development: there is a gradual increase of size accompanied by various changes in the egg-contents, the germinal vesicle, and the egg-membranes, which all tend to prove the truth of this supposition. All these different stages were frequently to be observed in a single section. In the same sections were a number of very peculiar ova, displayed in Plate XXVIII. fig. 3; these were for the most part intermediate in size between ova of the third stage (fig. 2) and the more mature ova (fig. 4); in a few cases, however, they were distinctly smaller than ova of the third stage. This last fact would be hardly sufficient of itself to prove that these ova do not form a stage intercalated between Stages 3 and 4, because there is often some irregularity in size; larger ova, particularly if they are not much larger, could not be positively regarded as more mature than smaller ova. In the first place, however, the structure of these ova and the conditions of the follicular epithelium are so markedly different from ova of any other stage, that it seems difficult to assign them to the same series; and, in the second place, I have been able to observe no transitional stages between these ova and those belonging to Stages 2 or 3. On the other hand, these ova eventually acquire the same appearance as ova that have evidently passed through Stages 2 and 3; to this point I shall return later. I must for the present leave it an open question as to whether these ova form part of the same series as those displayed in Plate XXVIII. figs. 1, 2, 4, or whether the ovary of *Protopterus* contains ova of two kinds which follow a different course of development though they ultimately come to be identical in appearance.

These ova (Plate XXVIII. fig. 3) are surrounded by a follicular epithelium which, like that of the other ova, consists of a single layer of cells; these cells are long and somewhat columnar in form (Plate XXIX. fig. 7); they are limited by a distinct membrane and contain a darkly stained nucleus as well as a number of *highly refracting round particles which resemble in every respect the yolk-spherules of the contained ovum*. These follicular cells rest upon the surface of the ovum, and there is no trace whatever of any membrane separating them from the ovum.

The connective-tissue sheath of the follicle was very distinctly marked off from the surrounding ovarian stroma; near to the periphery of the ovum were an immense number of blood-capillaries of large size and gorged with blood. These capillaries, although probably belonging to the stroma-sheath, were in many cases pressed down among the epithelial cells of the follicle, appearing as if they were actually lying between the cells; this remarkable appearance of the blood-vessels is illustrated in Plate XXIX. fig. 7, which represents a portion of the periphery of such an ovum very highly magnified. The interior of the ovum contained abundant yolk; but in no case did I succeed in finding any trace of a germinal vesicle. The yolk consisted of highly refracting spherules which were for the most part of small size, but here and there were very much larger spherules.

The structure of these ova and the surrounding follicle is extremely remarkable, and quite unlike any other ova that I have seen in transverse sections of the ovary of *Protopterus*. But the peculiarities of these ova do not end here.

Scattered throughout the substance of the yolk are an immense number of cells more or less spherical in form (Plate XXVIII. fig. 3, *c*).

These cells were limited in most cases by a very distinct external membrane; *their contents are a mass of rounded bodies which are quite indistinguishable from the yolk-spherules of the ovum*, and strands of granular protoplasmic substance; furthermore there is a distinct and large nucleus deeply stained by borax carmine, and within this a number of nucleoli and granules.

These cells appeared to be in a condition of active multiplication, the various stages of which are indicated in Plate XXIX. figs. 9–20. In fig. 10 the nucleus is constricted in the middle; in fig. 11 the nucleus has divided; in fig. 12 the two cells have become distinct but lie close together; in fig. 18 cell-division has evidently gone on very rapidly, as there is a nest of four cells pressed closely together and occupying a common cavity in the yolk. In some cells the amount of yolk-granules present was considerably less than in others. Occasionally (figs. 19, 20) the yolk-particles had run together to form a single large droplet.

In a few cases I observed (fig. 15) the nucleus to be thrust altogether without the cells; and here and there within the substance of the ovum were apparently nuclei without any cells. I am not inclined, however, to lay too much stress upon the last mentioned fact, because it would be rather difficult in any case to detect the boundaries of one of these cells if it were packed quite full of yolk-spherules.

In other cases (fig. 13) the nucleus had become paler in colour (less acted upon by the staining reagent) as well as more homogeneous. Nuclei of this kind might easily be mistaken for larger yolk-spherules; indeed my only reasons for believing them to be altered nuclei are their similiarity in size and shape to the more normal nuclei, their occurrence in cells that have become emptied of their contents, and the fact that they are rather more deeply stained than the surrounding yolk.

Concerning the nature of these bodies there appears to me to be three possibilities:—either (1) they are similar to the white yolk-spherules of the Fowl's egg; or (2) they are follicular cells which have migrated into the interior of the ovum; or (3) they are cells which have been formed anew within the substance of the ovum.

The first alternative, that the structures in question correspond to the white yolk-spheres of birds, seems at first sight to be a likely explanation of their occurrence, especially since they are only to be seen in comparatively young ova. The white yolk-spheres of birds[1] are rounded bodies containing one or more highly refractive nucleus-like bodies in their interior; but these apparent nuclei are really

[1] Foster and Balfour's 'Elements of Embryology,' p. 16.

very dissimilar to true nuclei, and the sphere has no limiting membrane. It is doubtful therefore whether they can be regarded as cells, though it is probable that, as the segmentation of the ovum advances, the white yolk is directly converted into cells. Now in the cell-like bodies which I have described in the immature ovum of *Lepidosiren* there is a very distinct and obvious nucleus (figs. 9–20), which is in fact entirely similar to a nucleus of one of the follicular cells; it is deeply stained by borax carmine and unevenly stained, so that it has the appearance of being formed of a meshwork of condensed protoplasm, the interspaces of which are filled by a homogeneous substance which is less acted upon by the reagent. In some instances there was more than a single nucleus to each of these cells, but it is quite impossible to confound these nuclei with the surrounding particles of yolk. Furthermore, in many cases the limiting membrane of the cells was distinctly visible (figs. 9 &c.); and the fact that the cell-contents were hardly acted upon by the staining fluid rendered the perception of this membrane easier. There seems to be but little doubt that these structures are veritable cells, and are not in any way comparable to the white yolk-spheres. The question then arises, What is the origin of these cells? Are they formed anew within the substance of the ovum, or have they migrated from the follicle into the interior of the ovum?

The former supposition is supported by no facts that I have been able to note, and it is distinctly negatived by other facts.

In the first place, these cells are very closely similar to the cells of the follicular epithelium; like them they are bounded by a distinct limiting membrane; the contents of both consist of protoplasmic strands and numerous highly refractive particles similar to the yolk-particles; the nucleus is identical in shape and size; and the behaviour of both to the staining reagent is precisely the same. This series of facts would, however, be hardly regarded as proof that these cells have originated from the follicular epithelium; it might be supposed that the cells have arisen within the ovum, and that some of them have migrated to the periphery to form the follicle, as has been stated by various observers to be the case in certain other ova (see p. 276); but the immense vascular development round the follicular epithelium that has been already mentioned seems to indicate that the main activity is centered in these latter cells; and this fact, coupled with the additional fact that in certain instances there were masses of migrating cells evidently in course of being budded off (Plate XXVIII. figs. 5, 6) from the follicular epithelium, seems to indicate that the second supposition as to the origin of these cells is correct, viz. that they are formed by the proliferation of the follicular cells and migrate into the interior of the ovary.

The migration of these cells also explains the absence of a limiting membrane to the ovum. A "formed" membrane, however thin, would evidently prevent such a migration.

It appears to me possible to make another statement as a deduction from the facts just detailed: *that the follicular epithelium-cells secrete the yolk which is conveyed to the interior of the ovum by*

means of the proliferating follicular cells. I do not mean to assert that these ova do not also form yolk endogenously, as I have observed in other cases (Plate XXVIII. fig. 2); but the similarity between the contents of the follicular cells and their derivatives which migrate into the interior of the ovum, on the one hand, with the yolk-spherules of the ovum, on the other hand, coupled with the fact of the subsequent disintegration and disappearance of the immigrated cells, seems to me to necessitate the conclusion that at least part of the yolk is so formed.

Unfortunately I am quite unable to record any observations as to the earlier stages of these ova; they may be a stage intercalated between Stages 3 and 4, as already suggested. In favour of this supposition are the following facts:—(1) that for the most part these ova are intermediate in size between the presumed earlier and later stages; (2) that there is no proof of their independent origin; (3) the unlikelihood (?) of there being two kinds of ova with a different process of growth.

Against such a supposition I may adduce the following arguments:—(1) the absence of any transitional stages between these ova and the presumed younger stages; (2) the disappearance of the vitelline membrane during this stage and its subsequent reappearance, or at least the appearance of a similar membrane.

Whatever may be the origin of these ova, they come ultimately to resemble in every particular the ordinary mature ova. I have fortunately succeeded in obtaining sections of an ovum considerably larger than that just described, which presented the following characters:—The follicular epithelium was considerably reduced in importance, as was also the accompanying network of blood-capillaries. Between the follicular epithelium and the ovum was a distinct membrane excessively thin; there were hardly any traces left of the immigrating follicular cells present in such great numbers in the earlier stages; I noted perhaps one or two in as many sections.

It is interesting to observe that if these ova, characterized by the formation of the yolk from the follicular cells, are really different from the other ova, they are in certain respects more Amphibian like than the other ova; not in the immigration of follicular cells, but in the late appearance of a single thin membrane shutting off the ovum from the follicular epithelium with which it was previously in contact. Götte, in his 'Entwickelungsgeschichte der Unke,' makes the following statement (p. 16):—"Ferner kann man bei der Anwendung des Wassers nachweisen dass der Follikelinhalt noch unmittelbar die Zellen berührt, dass aber die Grenze zwischen beiden Theilen eine sehr scharfe ist und sie durchaus nicht continuirlich zusammenhängen." It is only later that a membrane surrounding the ovum and separating it from the follicular cells appears.

Similarly Iwakawa's observations upon *Triton*[1] show that in the young stages the follicular cells are in contact with the body of the ovum. In more mature ova a membrane comes to surround the

[1] Quart. Journ. Micr. Sci. vol. xxii. p. 270.

body of the ovum; this membrane does not appear until after the yolk has begun to be formed.

Leaving the question as to the origin of these ova undecided for the present, the penetration of the follicular epithelium into the interior of the ovum and the formation of yolk by the follicular cells are in my opinion strongly supported by the facts that I have been able to bring forward. I will now compare these facts with similar observations on other ova.

A migration of follicular cells into the ovum has been recorded by several writers, but other writers have thrown doubts upon the accuracy of these observations.

In Elasmobranchs and Amphibia nothing of the kind has been recorded; Balfour, in studying the ovarian ova of *Scyllium*, particularly directed his attention to this point, but was unable to find any trace whatsoever of cells such as have been described by His in the Teleostean ovum; he suggests indeed that His may have mistaken the white yolk-spherules for such cells; the resemblance of white yolk-spherules to cells is not a little striking, and may easily have led to mistakes.

With regard to the Teleosteans, however, there is some variety of opinion as to this point. His [1] has described a migration of the follicular cells through the pores of the zona radiata into the interior of the ovum; but Brock (*loc. cit.* p. 558) doubts the truth of this observation, not merely because he did not himself succeed in seeing any such migration, but because it appeared to him inexplicable that if there were so general an immigration the follicular epithelium should yet maintain its continuity.

The most recent writer on the subject whose memoir is known to me is Owsjannikow [2]. This author describes in detail a number of facts relative to the structure of the Teleostean ovum which are often somewhat difficult to understand. With regard to the supposed immigration of cells (leucocytes) into the interior of the ovum, believed by His to occur, this author states that it has not been observed by him, and that further the necessity for such a process of nutrition does not exist, since nutritive material is supplied to the ovum through the processes of the follicular cells, which are so universally admitted to pass through the egg-membrane. At the same time Owsjannikow describes in *Osmerus* and *Acerina* a peculiar condition of the yolk, also referred to by His, but denied by others, which in a certain degree is similar to the condition which I have described in the present paper in *Lepidosiren*. The yolk-bodies ("Dotter-Kugeln") contained in many cases nuclei often difficult to show and needing most complicated processes for their demonstration; in these structures, which the author calls cells, the oil-drops take their origin. Without additional investigations it does not seem to me permissible to regard these bodies as true cells; their appearance in Owsjannikow's figures (pl. ii. figs. 22, 23) is very

[1] 'Eierstock der Knochenfische,' p. 22, &c.

[2] "Studien über das Ei, hauptsächlich bei Knochenfischen," Mém. d. l'Acad. d. St. Pétersb. t. xxxiii. no. 4.

much like that of the white yolk-spheres of Sauropsida. In any case these bodies are not supposed to have an extrinsic origin, but to arise within the ovum. On the other hand, a penetration of follicular cells through the micropyle (*loc. cit.* pl. i. fig. 6) appears really to occur in many osseous fish and to be comparable to the proliferation into the ovum of the follicular cells in *Lepidosiren*.

Kolessnikow [1] confirms the accuracy of His's results as to the entrance of leucocytes into the ovum, but does not think this process to have much functional importance.

In Mammals a number of observations have been published which tend to show that there is a migration of cells, which is evidently comparable to the facts which I have detailed above in *Lepidosiren*. Lindgren [2] has described such a migration of follicular cells, and figures an ovum which is half filled with unaltered follicular cells. Von Sehlen [3] and H. Virchow [4] have confirmed the accuracy of Lindgren's observations. More recently Schäfer [5] has described a remarkable series of changes in the Rabbit's ovum which do not altogether tend to the same conclusion. In young ova, which are as yet surrounded by a follicle consisting of only a single layer of cells, peculiar cells make their appearance in the peripheral regions, and ultimately form a single layer of cells which surround the ovum, lying beneath the follicular layer. Schäfer believes that these cells are not derived from the follicular layer, but they originate in the ovum. He compares very justly his own observations with those of Kuppfer on *Ascidia canina*. Kuppfer [6] had shown that cells appear in the interior of the ovum and range themselves round its periphery. Kuppfer, however, believed that these cells originate in the ovum itself, and are not, as Kowalevsky supposed, a product of the follicular epithelium. His statements therefore are in complete accord with those of Schäfer; while Lindgren, von Sehlen, and H. Virchow describe a process in the maturation of the mammalian ovum which is more comparable to that described by Kowalevsky in the case of the Ascidians. The latest writer on the mammalian ovum, Mr. Heape, did not find any such migration of follicular cells, and concludes that the observations put on record by Lindgren, von Sehlen, and Virchow are based upon abnormal processes. It is to be noted, however, that the type studied by Heape [7] (Mole) was not studied by any one of these naturalists, and this fact may possibly account for the discrepancies in their statements. In the latest edition of Quain's 'Anatomy' it is suggested that the entrance of follicular cells into the ovum described by Lindgren, von Sehlen, and H. Virchow may be an abnormal process and not a regular

[1] Archiv f. mikr. Anat. vol. xv. (1878) p. 399.
[2] Arch. f. Anat. u. Phys. 1877.
[3] Arch. f. Anat. u. Phys. 1882.
[4] Arch. f. mikr. Anat. Bd. xxiv. (1884).
[5] Proc. Roy. Soc. vol. xxx. (1880) p. 243.
[6] Arch. f. mikr. Anat. Bd. viii. See also the papers of many others (Sabatier, Roule, Fol) on the Ascidian ovum, and the facts referred to in footnote on p. 276, *supra*. These have been lately summed up in Quart. Journ. Micr. Sci., June 1886, by Mr. Arthur Thomson.
[7] Quart. Journ. Micr. Sci., Feb. 1886.

occurrence. I would suggest myself that this migration of follicular cells in the Mammalia is a record of what occurred in their Dipnoan ancestors[1], where the migration of follicular cells into the interior of the ovum was an important process in connection with the formation of yolk.

It is, however, among the Invertebrata that the most striking resemblances to the immigration of follicular cells in *Lepidosiren* are to be found, and more particularly in the Cephalopoda.

Some remarkable facts with respect to the nutrition of the ova of *Sepia* have been discovered by Lankester, which are analogous to the facts recorded by myself in *Lepidosiren*. In *Sepia*[2] the ova are surrounded by a single layer of follicular cells which are supplied externally with an abundant vascular network. The epithelial layer becomes folded in a complicated fashion, and the folds project into the interior of the ovum (*loc. cit.* pl. 12. fig. 23); the cells of the epithelium take on a character resembling that of the goblet-cells, and pour out their contents into the ovum; moreover the cells also proliferate and pass off into the interior of the ovary (*loc. cit.* pl. 12. fig. 25), becoming gradually absorbed.

Kowalevsky[3] has described a proliferation of the follicular cells of Ascidians which migrate into the interior of the ovum, and eventually form (*loc. cit.* pl. 10. figs. 2–4) a complete layer round it, so that the follicle comes to be two layers deep; the outer layer, which is made up of very much larger cells, represents the original follicular epithelium, while the inner layer consists of very much smaller cells.

In many of the lower Invertebrata the ovum is largely nourished at the expense of the surrounding cells. In the Platyhelminthes a peculiar organ, the vitellarium, elaborates yolk-particles which are subsequently absorbed by the ovum; analogous processes take place in many Insects. In all these cases the ovum retains the capacity, inherited from its Protozoan ancestor, of feeding by the intussusception of solid particles.

All these facts seem to me to be directly comparable to what has been described above in *Lepidosiren*. The secretion of yolk by the follicular cells in the Platyhelminth and the absorption of this yolk by the ovum only differs in degree from the proliferation of the follicular cells in *Sepia* and *Lepidosiren* and their subsequent absorption by the ovum.

I may say a few words with regard to the special fact that the yolk is largely elaborated with follicular cells and conveyed to the ovum by the proliferation of these cells and their subsequent disintegration in the interior of the ovum. Such a formation of yolk in the Vertebrate ovum has not been put beyond a doubt; indeed most observations on the subject seem to show that the yolk is generally

[1] I imagine that few will dispute Prof. Huxley's opinion that the Mammalia in the course of their evolution have passed through a Dipnoid stage (see P. Z. S. 1880, p. 661).

[2] "On the Developmental History of Mollusca," Phil. Trans. 1875, p. 43.

[3] "Weitere Studien über d. Entwickelung d. Ascidien," Archiv f. mikr. Anat. Bd. vii. (1871) p. 101.

formed in the interior of the ovum itself and has not an extrinsic origin.

Kolessnikow [1], however, concludes his paper on the Teleostean and Amphibian ovum with the statement that the yolk is chiefly a product of the follicular epithelium, which behaves in this respect like a gland. Apart from this fact, the follicular cells do, however, play an important part in supplying the ovum with nutriment in most Vertebrata; but this is not in the form of yolk, which is subsequently elaborated in the ovum itself. In Elasmobranchs Balfour has noted [2] that certain of the cells become larger than the others, and apparently communicate within the substance of the ovum into which they pour their contents. Heape [3] has described something very similar in the ovarian ova of the Mole, as also have Lindgren [4], von Sehlen [5], and Virchow [6]. The part which the enlarged follicular cells of Elasmobranchs play in the nutrition of the ovum is not the direct formation of yolk. Balfour has shown that the yolk originates within the protoplasm of the ovum, and is not transferred thither from the follicular cells. The reasons for this statement are :—(1) that the yolk-spherules first of all appear in the deeper portions of the yolk and not in the more superficial layers, as they would naturally do if they were passed into the interior of the ovum; (2) that there is no trace of yolk-particles in the follicular cells themselves.

Iwakawa's observations on the yolk in the egg of *Triton* lead to a similar conclusion. Götte states that in *Bombinator* the yolk-spherules first make their appearance in the peripheral layers of the ovum, but is inclined to think that they are formed within the substance of the ovum, and that they are not extrinsic in origin. Brock (*loc. cit.* p. 560) quotes and confirms Gegenbaur [7] to the effect that the yolk-spherules in Teleosteans originate by the fusion of minute yolk-particles, and that this formation takes place in the peripheral layers of the ovum; only exceptionally was the neighbourhood of the germinal vesicle the seat of yolk-formation. In Mammalia, according to Balfour the yolk is formed in the peripheral layer of the ovum.

Lepidosiren therefore appears to be remarkable in that the yolk is often formed in the follicular cells and transferred thence to the ovum. Seeing that this is the rule in many of the lower Invertebrata, the occurrence of this method of yolk-formation in *Lepidosiren* would appear to be the retention of an ancestral character.

[1] *Loc. cit.*
[2] Quart. Journ. Micr. Sci. 1878.
[3] Quart. Journ. Micr. Sci. Feb. 1886.
[4] Arch. f. Anat. u. Phys., Anat. Abtheil. 1877.
[5] Arch. f. Anat. u. Phys., Anat. Abtheil. 1882.
[6] Arch. f. mikr. Anat. vol. xxiv. (1884).
[7] "Ueber den Bau und die Entwickelung der Wirbelthiereier mit partieller Dottertheilung," Müller's Arch. 1861, p. 495. Gegenbaur describes (p. 524) a peculiar fatty degeneration of the follicular cells which serves to loosen them from the ovum when the latter is ready for extrusion. Possibly this is to be referred to a trace of yolk-formation comparable to that described in this paper.

V. *Postembryonic Origin of Ova.*

This section has been added after the rest of the paper was in type; it deals with the results of some further observations which tend to confirm the supposition hinted at above, that the ovary of *Lepidosiren* contains ova of two kinds which have a different mode of development.

It should have been mentioned that the general surface of the ovary is, for the most part, devoid of any germinal epithelium, a condition which is often met with in adult ovaries; in places, however, the germinal epithelium is very conspicuously present and in a condition of active multiplication. These patches of germinal epithelium are only occasional, as has also been noticed by Spengel[1] in the case of the Frog's ovary; I have only succeeded in discovering them after this paper was communicated to the Society. I have been able, however, to insert a figure into Plate XXVIII. (fig. 7), which illustrates the fact that the germinal epithelium has not entirely disappeared in the mature ovary.

In every case that I observed, the germinal epithelium, where it was left, was in a state of very active cell-division; the cells on the surface of the ovary were closely crowded together, and had given rise to a mass of cells three or four deep, surrounding a cavity partly filled by another mass of cells of a somewhat different appearance. The central mass of cells was invariably connected at one side only with the surrounding sphere, as shown in the figure (Plate XXVIII. fig. 7), and, at this point, its cells gradually alter in appearance until they become indistinguishable from those of the surrounding hollow sphere, which is the future follicular epithelium. The investing mass of cells (*f*) is connected by a pedicle with the germinal epithelium (*e*) on the outside of the ovary, and is clearly formed by a proliferation and inward growth of its cells. The arrangement of these, as shown in the figure, gives a strong impression of motion; the cells look as if they had been arrested in the act of rapid proliferation inwards. The cells of the germinal epithelium, both those on the surface of the ovary and those which form the investing mass of the central cells, are small, but with large, deeply-stained nuclei. On the other hand the cells which occupy the interior of the sphere are much larger, and of a somewhat irregular, angular contour, and often containing more than one nucleus. As already stated, these cells pass by gradations into the follicular mass at one side only, but this may be due to shrinkage. On the outside of the central mass of cells, and forming generally a complete peripheral layer round them, is an amorphous mass (*x*) deeply stained by the reagent; here and there nuclei, with or without some surrounding protoplasm, were imbedded in this amorphous mass, which thus has the appearance of being formed by the fusion of the peripheral layer of the central cells. I have no observations to offer as to the origin of the central mass of cells; but their position and attachment to the peripheral layer, more particularly at one point, would seem to suggest that they arise, like

[1] Semper's 'Arbeiten,' Ed. iii.

the peripheral cells, from the germinal epithelium, but that they are first invaginated and subsequently surrounded by the peripheral layer.

In a later stage the formation of yolk has commenced, and the cells of the central mass are in places separated from each other by aggregations of yolk-particles, though for the most part the cells remain closely adherent; these latter, however, contain yolk-particles in their interior, and the follicular cells, which still form two or three layers, are also filled with yolk. The later stages have been already referred to (p. 283).

It is clear, therefore, that in *Lepidosiren* there are two kinds of ova; those which arise in the way just described may possibly be confined to the postembryonic period.

The mass of central cells with the surrounding follicular layers is clearly comparable to the "Ureiernester," described by Balfour and others, in many Vertebrates, *e.g.* Elasmobranchs. But although there is this general similarity between the ovary of *Lepidosiren* and that of *Scyllium*, there is evidently a very great difference in detail.

In the Elasmobranch-ovary the nest of primitive germinal cells is imbedded in a mass which consists of the general undifferentiated cells of the germinal epithelium; there is no definite follicular layer at this period. The protoplasm of the primitive germinal cells fuse together, and the nuclei multiply; some of the nuclei degenerate, while others undergo further development, and are eventually separated off from the rest, together with a certain amount of protoplasm, to form ova; the degenerating nuclei are absorbed and aid in the nutrition of the ova. When the ovum is formed, some of the undifferentiated germinal cells range themselves round it and form the follicular layer. A nest gives rise to a variable number of ova. The yolk is formed much later.

In *Lepidosiren* the nest is imbedded in a mass of cells which are definitely marked off from the surrounding cells of the ovary, and can be recognized as the future follicular epithelium; the protoplasm of at least some of the primitive germinal cells fuse together, and the nuclei appear also to multiply, if not the cells themselves in many cases; some of the nuclei degenerate (show a paler colour under the influence of borax carmine) and become irregular in shape; the formation of yolk commences extraordinarily early (as compared with the Elasmobranch) in the mass resulting from the fusion of the peripheral cells, in the remaining cells, and in the follicular layers; the nest gives rise to but a single ovum.

It seems to me impossible to deny that the whole structure (Plate XXVIII. fig. 7), which I have compared to the "nest" of the Elasmobranch ovary, eventually becomes a single ovum; the question that must first be answered is, does the ovum in this case represent a single cell or is it produced by the fusion of a number of cells? The only answer to this question that the facts at my disposal enable me to give is that *these ova are formed by a coalescence of a number of cells out of the nest, the remainder serving as pabulum.* This opinion is so far confirmatory of Götte's observations on the deve-

lopment of *Bombinator*[1]; but there are certain facts adduced by Götte which require to be recorded in *Lepidosiren* before my opinion can be expressed without hesitation. Götte observed a fusion of the nuclei as well as of the protoplasm of the primitive germinal cells; I have not been able to detect any such fusion in *Lepidosiren*; on the other hand it is difficult to interpret my results so as to regard these ova as equivalent in each case to a single cell. As already mentioned, the series of ova between the earliest stage where a mass of follicular cells contained a nest of primitive germinal cells, and the latest stage when the ovum was surrounded by a single layer of follicular cells and separated from them by a delicate membrane, is fairly complete; there seems to be no doubt that somehow or other the numerous primitive germinal cells of the nest result in the formation of one ovum. There were no signs of the separation of any of these cells to form a number of different ova, as Balfour has described in *Scyllium*; none of the central cells became larger than the rest, and the follicular epithelium, which was specialized as such in the earliest stage observed, showed no breaks in its continuity at any time; if the ovum really represents one of the primitive germinal cells, the rest serving as pabulum, it is remarkable to find that this cell shows no difference in size or structure from the rest as development proceeds.

The appearance of a fusion of some of the cells, which strongly supports my view of the case, is illustrated in Plate XXVIII. fig. 7, *x*; the homogeneous mass depicted in that figure contains a few nuclei, and occasionally a certain amount of the cell-protoplasm still unaltered centrally, but peripherally shading off into the supposed protoplasmic mass. It might perhaps be supposed that this peripheral darkly-staining mass is really due to the coagulation of some fluid substance; but in that case the appearance of nuclei, without any cell-protoplasm in its interior, would have to be explained, and more particularly the presence of yolk-particles which seem to be formed by its metamorphosis.

For the present I am unable to say any more about the development and maturation of these ova; the most important matter that requires further investigation is the mode of origin of the germinal vesicle; but there are obviously other points that remain to be discovered before the whole history of these ova can be cleared up.

It might be supposed that the facts described in this section do away with the necessity of any immigration of follicular cells; the yolk has been shown to originate largely in the primitive germinal cells, and many of the free cells remaining in the interior of the ovum during later stages are no doubt derived directly from the primitive germinal cells. In the earlier stages the follicular cells, although forming a distinct layer, are not individually very different from the central cells of the nest; hence their proliferation and migration inwards is not surprising. It has been already mentioned that the yolk commences to be formed very early in the follicular cells as well as in the central cells, so that the former evidently takes a

[1] 'Entwickelungsgeschichte der Unke.'

large share in the building up of the ovum; in later stages, but before the follicular cells have dwindled down to a single layer, there is a considerable proliferation and migration inwards of these cells (Plate XXVIII. figs. 5, 6); finally, when the ovum is surrounded by only a single layer of follicular cells, there is still here and there a proliferation of these cells.

VI. *Résumé.*

The observations recorded in the present paper may be briefly summed up as follows.

The ovum is in the earliest stages observed composed of a mass of deeply staining granular protoplasm; it contains a germinal vesicle limited by a distinct membrane, inside of which is a peripheral layer of germinal spots; the ovum is separated from the surrounding follicular epithelium by a thin structureless membrane. The follicular epithelium is composed of a single layer of cells, each with a large deeply staining nucleus, which retains the same character throughout the whole development of the ovum. In the second stage the protoplasm of the ovum is arranged in a reticulate fashion; the germinal vesicle is not defined by a limiting membrane; within the vitelline membrane, which is still delicate and structureless, is a well-defined zona radiata with closely arranged vertical pores.

In the third stage the external vitelline membrane is much thicker and shows a radial striation, the pores being further apart than those of the external zona radiata; the latter is commencing to disappear. The formation of yolk is in active progress and takes place within the ovum, though not necessarily in its peripheral layers.

In the more mature ova the yolk occupies the whole extent of the ovum; occasionally a peripheral layer is to be distinguished from a central mass; the vitelline membrane alone is present, and is excessively thin and apparently homogeneous, with no trace of radial striation. The germinal vesicle has undergone certain changes, chiefly in the centripetal movement of the germinal spots.

A single section frequently contained ova of all the above mentioned stages; besides these there were present in the ovary a vast number of ova which undergo a different development; in size these ova were generally larger than those of Stages 2 and 3. The follicular epithelium of the ova is composed of a single layer of large, more or less columnar cells filled with granules exactly like the yolk-particles; these cells proliferate and migrate into the interior of the ovum; eventually they disappear: the yolk of these ova appears to be, at least in a great measure, formed by these cells, whose contents are round granules quite indistinguishable from the yolk. The follicular epithelium rests directly upon the ovum and is separated from it by no membrane. The earlier stages of these ova seem to indicate that they are formed by the fusion of a number of germinal cells.

At a later stage these ova were indistinguishable from other mature ova; the follicular epithelium decreases in importance, and a delicate membrane is formed between it and the ovum.

EXPLANATION OF THE PLATES.

PLATE XXVIII.

Explanation of lettering: *f*, follicular epithelium; *v.m*, vitelline membrane; *z.r*, zona radiata; *g.v*, germinal vesicle; *b.v*, blood-vessels; *g.c*, germinal cells; *e*, superficial germinal epithelium; *c*, cells in interior of ovum; *y*, yolk-masses.

Fig. 1. Ovum of *Lepidosiren* (*Protopterus*) before commencing formation of yolk.
2. Ovum of *Lepidosiren* (*Protopterus*), to show the commencing formation of yolk.
3. Ovum, with cells in interior.
4. Nearly mature ovum, to show differentiation of yolk into a peripheral and central portion and modification of germinal vesicle.
5, 6. Two ova, belonging to the same series as fig. 3, to show the proliferating follicular cells.
7. Early stage in development of ovum, represented in figs. 3, 5, 6, to show the central mass of germinal cells which, at *x*, have commenced to fuse, and the invaginated mass of cells which form the follicular layer: *e*, immature ovum belonging to series represented in figs. 1, 2, 4.

PLATE XXIX.

Fig. 1. Germinal vesicle of ovum (Plate XXVIII. fig. 4), more highly magnified, to show its specialization into an outer and inner layer: *n*, germinal spots.
2. A portion of ovum (Plate XXVIII. fig. 1), more highly magnified.
3. Germinal vesicle of same ovum, highly magnified, superficial view: *n*, germinal spots.
4. The same, in section; lettering as before.
5. Portion of ovum a little more mature than that shown in Plate XXVIII. fig. 2.
6. Nearly mature ovum.
7. Less mature ovum of same series as last, to show the follicular epithelium resting directly upon the contents of the ovum; *y*, yolk-particles in follicular cells.
8. Very young ovum.
9–20. Cells from interior of ovum (Plate XXVIII. fig. 3), showing various conditions of division and degeneration: *y'*, yolk-particles in interior of cell; *n*, their nucleus; *y*, yolk of ovum.

3. On the Mode of Attachment of the Ovum of *Osmerus eperlanus*. By J. T. CUNNINGHAM, B.A., F.R.S.E., Fellow of University College, Oxford, and Superintendent of the Scottish Marine Station. (Communicated by Mr. F. E. BEDDARD.)

[Received April 20, 1886.]

(Plate XXX.)

In several works on Ichthyology and Pisciculture it is stated that the ovum of the Smelt is adhesive. The mode of attachment is described as differing from that which occurs in the Herring-ovum in the following manner:—In the Herring-ovum the whole of the outer surface of the egg-membrane at the moment of deposition is glutinous, and the ovum becomes attached at any part of the surface

which comes into contact with a solid object. The ovum of the Smelt is not fixed by the surface of the egg-membrane, but suspended by a short filament, the distal end of which alone adheres.

No detailed account seems to have been given of the nature and development of the suspending filament. Alex. Agassiz ignores altogether the assertions which have been published concerning the attachment of the Smelt-ovum. In his beautiful memoir on Pelagic Teleostean Ova, he describes a certain well-characterized pelagic ovum, and identifies it as that of *Osmerus mordax*, Gill. The ovum in question, or one exactly similar, has been described by Victor Hensen in the 'Vierte Bericht der Commission zur Untersuchung der Deutschen Meere.' The most conspicuous characteristic of this ovum, a feature which is unique among the Teleostean ova hitherto described, is the segregation of the yolk into polyhedral masses. Agassiz refers to this character as the segmentation of the yolk, as if he considered the ovum to be holoblastic; but in all probability the subdivision of the yolk in this case is similar in nature to the more usual subdivision into yolk-spherules, and the polyhedral masses are not cells or segmentation-spheres. The same ovum was taken by myself in the Firth of Forth in June 1884, and formed the subject of a short communication which I made to the Royal Society of Edinburgh. If it be true that the ova of *Osmerus eperlanus* are, during development, fixed to solid objects, it is in the highest degree improbable that the ova of *Osmerus mordax* are pelagic; and as the adhesive nature of the eggs of the British Smelt is beyond all question, the correct identification of the peculiar pelagic ovum studied by Hensen, myself, and Agassiz is a task for the future. The latest examination of the egg of *Osmerus eperlanus*, before my own work, was made by Owsjannikow[1], whose results appeared only last year. Owsjannikow describes the condition of the ovum when taken from the parent a short time before complete maturity has been reached. He makes no mention of the attached condition of the deposited ovum, nor of the adaptation of the structure of the ripening ovum to the future process of adhesion.

My interest in the ovum of *Osmerus* having been strongly excited by the confusion concerning it, indicated by the literature thus summarized, I obtained some living specimens of the fish from the neighbourhood of Alloa, in the Forth, and conveyed them to my aquarium. I also attempted to fertilize some ova artificially. This experiment was made at the riverside with the fish just taken from the seine. As the weather was very cold and the water very muddy, little could be made out concerning the ova at the time of the experiment. It was seen that very few of the ova became attached to the stones on which they were allowed to fall. The greater number sank to the bottom of the water, and remained quite free; they became opaque white shortly after expulsion from the fish; at first they are of a translucent yellow colour. On examining them next day in the laboratory, I found they

[1] "Studien über das Ei, hauptsachlich der Knochenfische," Mémoires de l'Académie Impériale de St. Pétersbourg, 1885.

had not been fertilized and were all dead. But they all possessed a kind of membranous appendage, and there were two or three which were suspended from the surface of the stones by means of this membrane, the distal end of which had become attached at the moment of extrusion. In the free eggs no power of adhesion any longer existed. It was obvious enough that the membranous appendage was the so-called suspensory filament mentioned in the existing literature. But the word filament is a very inappropriate term. The membrane is flexible, and in the form of a hollow truncated cone, the sides of which are thrown into irregular folds; the narrow end of the cone is continuous with the envelope of the egg; the attachment between the enveloping and the suspensory membrane thus forms a ring on the surface of the former. Examination of the eggs in this condition does not afford evidence of the origin of the suspensory membrane. All that could be seen was that the suspensory membrane was dotted all over with pores of considerable size, and that the enveloping membrane was perforated everywhere by finer pores more closely crowded. The enveloping membrane is thus a zona radiata.

Examination of the eggs freshly pressed from the female gave the complete explanation of all the facts. These eggs were nearly, and some of them quite, mature. They are enclosed in a thick zona radiata, which is differentiated into two layers, the outer of which is somewhat thinner than the internal. In the zona radiata externa the pores are larger and farther apart than in the interna. But the important fact, which I believe no one has previously observed, is that the external zona separates very readily from the internal, and, rupturing at one portion of the ovum, peels off, becoming turned inside out in the process, and, remaining attached over a small circular area, forms the suspensory membrane which I have already described. Slight pressure and rolling of the eggs by means of a cover-glass was sufficient to cause the rupture of the external zona, and the two membranes were examined in all stages of separation. Owsjannikow has described the presence of the two layers of the zona radiata in the ovum of *Osmerus*, and his description agrees with mine; but the eggs he examined were less mature than those I had to deal with, and it is this fact which prevented him discovering the curious function which the external zona performs. Owsjannikow has also described the micropyle in the unripe ova he studied. I was unable to detect the micropyle, but I am inclined to think it exists in the centre of the area over which the suspensory membrane is attached.

A comparison between the adhesive ova of *Osmerus* and other adhesive ova can now easily be made. In all adhesive ova the exterior surface of the zona radiata is glutinous; it adheres to solid objects, and, setting hard after attachment, securely fixes the eggs to one another and to surrounding solids. In some adhesive eggs the external layer of the zona is different in structure from the inner. In the Herring-ovum there is no distinct differentiation into two layers; in *Perca fluviatilis*, as described by Owsjannikow, there are

two layers, the external of which has pores, which are larger and less numerous than those of the inner layer. The egg adheres by the surface of the external layer, but no separation of the two layers takes place. In *Osmerus eperlanus* the same differentiation occurs, and the external layer, after becoming attached by one point or other, detaches itself from the inner layer except at one circular area, thus forming a membrane by which the ovum is suspended from its attachment.

It remains to be mentioned that in the unripe ova, which are forcibly expressed from the parent, there is a delicate structureless membrane external to the zona radiata. This is doubtless derived from the ovary; it is perhaps the connective-tissue layer of the follicle, which becomes reduced in thickness as the egg attains its mature size; it is certain that the perfectly ripe ovum is enveloped only in its double zona radiata.

EXPLANATION OF PLATE XXX.

Fig. 1. Nearly ripe ovum of *Osmerus eperlanus*, taken from female, and examined in fresh condition. *a*. Thin membrane derived from the ovary, not present in the naturally deposited mature ovum. *z.r.* Zona radiata; its division into two layers is not shown. *g.v.* Germinal vesicle. (Zeiss A, Oc. 2.)

2. Outline of attached ovum of *Osmerus*. *s.m.* The suspensory membrane formed by the zona radiata externa. *z.r.i.* The zona radiata interna. (Zeiss A, Oc. 2.)

3. The membranes of an almost mature ovum of *Osmerus*, as seen in the fresh state after rupture of the zona radiata externa by pressure of the cover-glass. *z.r.i.* Zona radiata interna. *z.r.e.* Zona radiata externa. (Zeiss A, Oc. 2.)

4. The zona radiata of egg of *Osmerus*, as seen in fresh condition in optical section, in process of separation of the two layers. *z.r.e.*, *z.r.i.*, as before. (Zeiss E, Oc. 2.)

May 18, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

Mr. C. W. Rosset exhibited and made remarks on a series of photographs taken during a recent visit to the Maldive Islands, and gave the following account of his collections in these islands:—

"On my return from an eighteen months' stay among the Veddas of Ceylon, I undertook a journey to the Maldives, in October 1885, in the course of which I passed seventy-five days on the Málé Atol. The principal object of my journey was to make a complete Ethnographical collection, as also to take a series of photographs of the people, objects and places of interest, and so on, and obtain full particulars about habits and customs, manufactures, trade, &c. I was also able to make a zoological collection.

"I was not able to carry out my original plan, as the Sultan absolutely refused to allow me to quit Málé Atol, so that I was unable to visit the southern islands of the group. It will therefore

be necessary for me to revisit the islands, when I shall commence at the southernmost Atoll, and hope to gradually work my way north. I hope to leave next September on my second journey. The Ethnographical collection which I was able to bring back is now exhibited in the Ceylon Court of the Colonial and Indian Exhibition, and this has taken up so much of my time that I have so far been unable to classify and arrange my zoological specimens. A short paper descriptive of my stay on Málé Atoll will shortly be read before the Royal Geographical Society.

"The zoology of the Maldives is not of importance so far as animals are concerned. Domestic animals have been imported from India; and there are at present bullocks, cows, sheep, and goats on the islands; the first named, however, are few in number, and all belong to the Sultan; but the last are reared by the Maldivians, and there are about five hundred of them on Málé Atoll. There are a few cats, and former writers on the Maldives mention the presence of the Mongoose; but I saw none on Málé Atoll, and all the natives with whom I came in contact told me they had never seen any. Flying-foxes are numerous and very destructive, but their ravages are eclipsed by those of the cocoa-nut rats, who destroy thousands of nuts yearly. I found a kind of musk-rat, with black-and-white fur and a pointed tail, in large numbers.

"I brought with me a large number of lizards, ground-snakes, beetles, butterflies, fish, sea-animals, and corals, of which I am only able to show a small number to-night.

"The fauna of the Maldives, *i. e.* of the Northern Atolls, is very similar to that of India and Ceylon; I have been given to understand, on the other hand, that on the Southern Atolls it resembles that of Mauritius, the Seychelles, and Madagascar. Birds and butterflies are only seen at certain seasons; the north-east monsoon brings these from India and Ceylon, which are then to be found on most islands of the Northern Atolls, whilst during the south-west monsoon species from Mauritius &c. are brought to the Southern Atolls.

"The Maldive Islands are nearly all of coral-formation. I found several pieces of lava and pumice-stone on the sea-shore; but these evidently came from Java at the time of the great eruption and earthquake there, as the natives assured me they had only been seen for the last two or three years."

Mr. Philip Crowley, F.Z.S., exhibited some pupæ of Nocturnal Lepidoptera from Natal, and made the following observations:—

"Some few months since, when Mr. Thomson exhibited some large specimens of Saturniidæ hatched in the Gardens from pupæ received from South Africa, I asked if any one present could tell me whether these species were subterranean in their pupa state, and I could get no satisfactory answer; one or two said they believed they spun up in the leaves of the food-plant. My Natal correspondent was therefore asked to send me some cocoons. I received his reply some six weeks since, and a consignment of pupæ on Monday the 18th, some of which I now exhibit. In his letter he says:—'The larvæ of all our big

Moths burrow into the soil to a depth of 2 or 3 inches, and there they remain, some for six months, some for ten. The way in which I manage is this: first I search in due season for the caterpillars, which having found I remove to bushes and trees as near my residence as possible. I then watch them carefully day by day, until I consider them large enough to remove into my breeding-cages, all of which have at least six inches of good soil at the bottom. When full-fed they burrow, as I have said before, and exactly six weeks after the disappearance of the last one, I dig up all the pupæ and lay them carefully side by side upon moss which is from time to time moistened.'

"I may add I received last year pupæ of the following species from this source, all of which hatched out well with the exception of six or eight:—

Cyanissa maia.
Bunea caffraria.
Antherea tyrrhea.
—— *menippe.*
—— *wahlbergii.*
Cirina forda.

"The pupæ which I now exhibit will, I think, by their general appearance, bear out the statement of my correspondent."

Mr. Joseph Whitaker, F.Z.S., exhibited a specimen of Wilson's Phalarope, *Steganopus wilsoni* (Sabine), believed to have been shot some years ago at Sutton Ambion, near Market Bosworth in Leicestershire. Mr. Whitaker had found the bird stuffed in a case of local species of birds which had belonged to a Mr. Richard Bradfield, who stated that he shot the specimen in question on a small pond, into which the manure ran from his farm-yard, and the breast of the bird showed a stain which might have been so produced. The owner was quite unaware of the rarity of the species, looking upon it merely as a curiosity; and unless there should have been some accidental exchange at the bird-stuffer's, the evidence as to its genuineness seemed entitled to credence.

The following papers were read:—

1. On a fourth Male Specimen of King William the Third's Paradise-bird. By A. B. Meyer, M.D., Director Royal Zoological Museum of Dresden, C.M.Z.S., &c.

[Received April 28, 1886.]

In the year 1875 I described and figured (Mitth. Zool. Mus. Dresden, i. p. 3, pl. i.) *Rhipidornis gulielmi-tertii*, after a male and female specimen forwarded to me by my friend the late S. C. S. W. van Musschenbroek from Ternate, and a short time afterwards Gould figured a second male specimen ('Birds of New

Guinea,' pt. ii. pl. 2, 1876), which belonged to the Museum of Warsaw.

Since then only one specimen has been obtained (see Proc. Zool. Soc. 1883, p. 252), which is now in the British Museum, but nothing trustworthy has been made out as to the supposed habitat of the species—Waigiou (*cf.* Salvadori, Orn. Pap. ii. p. 646, 1881).

Quite recently I have procured for the Dresden Museum a male example of this rare species, therefore the fourth, offered by a merchant from Amsterdam together with other Papuan birds. This specimen resembles exactly those figured by Gould and myself, but its origin is quite as obscure as that of the other specimens. The accompanying birds being apparently of species found in New Guinea, and not in Waigiou, perhaps Beccari's supposition (Ann. Mus. Civ. Gen. vii. p. 710, 1875), that this Paradise-bird occurs on N.W. New Guinea and Salawati, may be right.

As it is of importance to know where type specimens are preserved, I add the history of those of *Rhipidornis gulielmi-tertii* described by myself. Having kept them in the Dresden Museum since the year 1875, I one day in the year 1877 received a telegram from van Musschenbroek, who had returned home in 1876, telling me that he wished to show the birds to King William III. I sent the specimens to him, and never saw them again. They remained in the hands of the king, and we never succeeded in recovering these types for science, though supported by the late Prof. Schlegel of Leyden; but after van Musschenbroek's death in the year 1883, the King of the Netherlands delivered the specimens to the Museum of the Zoological Society (Natura artis magistra) of Amsterdam, where they probably will remain.

2. Descriptions of some new or little-known Earthworms, together with an Account of the Variations in Structure exhibited by *Perionyx excavatus*, E. P. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society.

[Received May 18, 1886.]

Contents.

1. Note on *Perichæta indica*, Horst, p. 298.
2. *Perichæta horsti*, n. sp., p. 300.
3. A new Species of *Eudrilus*, p. 302.
4. Additional note on *Microchæta rappii*, p. 306.
5. Remarks on the Variation of *Perionyx excavatus*, p. 308.

1. Note on Perichæta indica, Horst.

Perichæta, sp., Horst, Nederl. Arch. f. Zool. Bd. iv. 1879.

Megascolex indicus, Horst, Notes from Leyden Museum, vol. v. p. 186.

With the exception of *Lumbricus* and other forms affined to it, which ought perhaps to be regarded as subgenera (*Allolobophora*

Dendrobæna, &c.), there have been described more species of *Perichæta* than of any other genus. Rather more than thirty have been named, but several of these, as Dr. Horst[1] has pointed out, are merely synonyms, while a large number have evidently been too imperfectly characterized to admit of recognition. In the majority of cases the number of the spermathecæ and the absence or presence of variously formed diverticula have proved useful as specific characters; but species have been distinguished on other grounds which happen to agree in the number and form of the spermathecæ. The presence of genital papillæ is almost universal in the genus *Perichæta*, and these are placed either in the neighbourhood of the spermathecæ or of the reproductive apertures; this character serves to differentiate *P. indica* from *P. affinis*, which otherwise agree pretty closely in structure. I have had the opportunity of examining a number of specimens of both these species as well as of an apparently new species which is closely allied to both. A few notes therefore, which will perhaps serve more clearly to define these species, may be worth adding to what is known about them.

Of *Perichæta indica* I have received about half a dozen specimens from New Caledonia though the kindness of Mr. E. L. Layard, C.M.G. The specimens were of varying size, the largest individuals reaching a length of some 6 inches. Their colour (in alcohol) was a very dark brown, with an indistinct whitish line in the middle of each segment, marking the insertion of the setæ. The latter are remarkable for the fact that one or more on either side of the ventral median line are very much larger than the rest: this fact has already been noted by Horst (Nederl. Arch. &c. *loc. cit.*), and a similar variation in the size of the setæ occurs in Perrier's species *P. luzonica* and *P. biserialis*[2]. The two last-mentioned *Perichætæ* have up to the present been but briefly described; but the description is sufficient to show that they cannot be confounded with *P. indica*. *P. biserialis* has only two pairs of spermathecæ and several pairs of genital papillæ in the segments following the 18th, while there are four pairs of spermathecæ in *P. indica*. In *P. luzonica* the clitellum occupies four segments. Dr. Horst mentions two pairs of genital papillæ placed respectively upon segments 7 and 8; in one of my specimens there were three pairs, the third pair being upon segment 6. Another important variation is in the number of segments which compose the clitellum: in most of the individuals where the clitellum was developed, it was found to occupy segments 14–16 inclusive, as described by Horst for this species and as commonly found in the genus. In one specimen, however, the clitellum was a segment short, being developed only upon the 14th and 15th rings; the clitellum was fully developed upon these segments and sharply defined, as it usually is in this genus. It is of some importance to note this fact, since a species of *Perichæta*, *P. bicincta*, has been characterized mainly on account of the restriction of the clitellum to two segments.

[1] Notes from the Leyden Museum, vol. v. p. 186.
[2] Comptes Rendus, t. lxxxi. (1875) p. 2044.

there are three or four pairs of genital papillæ, one to each of a corresponding number of segments following the 18th. There was, however, no indication of an additional median papilla on each of the segments as in *P. horsti*, nor does Perrier mention anything of the kind.

The clitellum is not, as is so generally the case, restricted to three segments; but, at least in one specimen, extended from segment 14 to 17 inclusive; on the 17th segment, however, it was only developed on the dorsal region of the body.

The orifice of the oviducts occupies the usual position on the ventral median line of the 14th segment[1]. The spermathecal orifices are between the 7th and 8th and 8th and 9th segments.

The setæ are continuous all round the body and are everywhere of uniform size.

With regard to internal structure, there are one or two features in which this species is peculiar.

In the first place, the spermathecæ are separated from each other by very stout mesenteries, which are also found between segments 8–7, 7–6, 6–5; in front of the fifth segment the mesenteries are more or less indistinguishable, forming a mass of muscles which bind the pharynx to the parietes; behind the 9th segment the mesenteries are comparatively thin and delicate. The gizzard is situated in the 8th segment, that which contains the anterior pair of spermathecæ; it does not, as is so commonly the case (*e. g.* in *P. affinis*) occupy two segments, the intermediate mesentery having disappeared. The spermathecæ consist of an oval or sometimes cylindrical pouch communicating with the exterior by a narrow duct, to which is attached a short diverticulum of much the same shape as the pouch. The diverticulum appears never to lie in a different segment from the spermatheca.

The ovaries and oviducts were very distinct, and appear to occupy the normal position.

The vasa deferentia open on to the exterior in common with the duct of a compact prostate.

The testes are to the number of two pairs and in the usual position. The œsophagus widens into the intestine at about the 20th segment;

[1] The extension of the clitellum over four segments, combined with the regularity and uniform size of the setæ, makes it difficult, in the absence of additional information, to distinguish this species from *P. cærulea*, E. P.; it is stated, however, that in *P. cærulea* the female generative orifices are paired. Nevertheless this latter difference is not perhaps of very fundamental value; it must at any rate be discounted by my own observations with regard to *Megascolex* (Ann. & Mag. Nat. Hist., Oct. 1883), where the female pore is sometimes single and sometimes double. *Perichæta taitensis* of Grube (Reise der Novara, Anneliden, p. 36, pl. iv. fig. 2) is a very doubtful species, agreeing with *P. horsti* in having only two pairs of spermathecæ situated in the 8th and 9th segments. It may possibly be identical with it. I may take this opportunity of remarking that several other species described by Grube (MB. Akad. Berlin, 1877, p. 553) are in need of revision. *Lumbricus kerguelarum* appears to me from his description to be undoubtedly referable to the genus *Acanthodrilus*, and perhaps to Lankester's species *A. kerguelenensis*; *L. tongaensis* is certainly not a *Lumbricus*, and perhaps belongs to the same genus as the last.

about five or six segments from its commencement, the intestine undergoes a remarkable change in its structure; in three or four segments the walls of the intestine are greatly thickened, but these specially thickened regions are separated by intervals where the intestinal walls have preserved their normal delicacy of structure; these intervals are on either side of the septa. These appearances, which recall the moniliform structure of the œsophagus in *Moniligaster*, can hardly have been brought about by the effects of the alcohol in which the specimens were preserved. There were no cæca present, unless these local thickenings represent the cæca morphologically; in other *Perichætæ* the cæca generally contrast with the intestine by their greater thickness.

On several of the anterior mesenteries were bunches of glandular tubules similar to those found in other *Perichætæ*, and which may represent the nephridia.

The foregoing brief description is, I think, enough to distinguish this species from any that is at all sufficiently known.

3. A new Species of Eudrilus (Eudrilus boyeri).

Among some Earthworms kindly sent to me from New Caledonia by Mr. Layard were about a dozen individuals which I refer to Perrier's genus *Eudrilus*[1]. This genus is already known to inhabit South America and the West Indies, but has not been recorded from anywhere else. I am inclined myself to suspect that the New-Caledonian specimens may have been accidently imported, and may not be indigenous to that island. I name the species after M. Boyer of New Caledonia, who collected the specimens for Mr. Layard. At the same time I am not convinced that the species really is new. It appears to differ from all the three species described by Perrier in the long coiled oviduct, and in the termination of the vasa deferentia at the middle of the prostate gland. With regard to the first mentioned point of difference, I have elsewhere[2] expressed the opinion that M. Perrier has mistaken the relation of the ovary to the spermatheca. The oviduct in my specimens so unmistakably corresponds to what Perrier has described as a diverticulum of the spermatheca, that I cannot but think that they are really identical even if the species are distinct. M. Perrier did not make use of the method of section-cutting, which is so infinitely better than dissection for deciding an anatomical relation like that of the ovary and its duct. Still the difference between my species and his in respect of the vasa deferentia makes me hesitate in asserting that his conclusions are mistaken. With regard to the vasa deferentia, M. Perrier states that in his species they open directly into the bursa copulatrix, and not indirectly by way of the prostate gland as in *Eudrilus boyeri*. With M. Perrier's figure before me it appeared to me that in one instance, at any rate, *Eudrilus boyeri* agreed with *Eudrilus decipiens*; but in two or three other specimens which I dissected the vasa

[1] Nouv. Arch. d. Muséum, t. viii. (1872) p. 71.

[2] Proc. Roy. Soc. Edinb. (forthcoming paper); Zool. Anzeig. Bd. ix. (1886) p. 342.

deferentia, although passing over the bursa copulatrix, did not open into it but into the prostate gland, as I have indicated in the drawing (fig. 1). The anterior section of the vasa deferentia (*v.d*) as far as the bursa copulatrix was very conspicuous, owing to the white colour of the tubes (white from the contained spermatozoa): the distal region of the vasa deferentia was far less conspicuous, and I mistook them at first for a mere ligament uniting the prostate with the surface of the

Fig. 1.

Generative organs of *Eudrilus*.
a, glandular appendix; *b*, bursa copulatrix; *v.d*, vasa deferentia; *pr*, prostate.

bursa copulatrix; a more careful examination has shown that the supposed ligament is really a continuation of the vasa deferentia. These tubes, although lying upon the bursa, are in no way adherent to it, and can be readily lifted up with a dissecting-needle; they are then seen to be continuous with the prostate (*pr.*).

In all the species described by Perrier there appears to be but a single vasa deferens on either side of the body, which opens directly into the bursa copulatrix and not, as in my species, into the prostatic glands. The single vas deferens of either side is figured by Perrier (*loc. cit.* pl. ii. fig. 26). In all the specimens of *Eudrilus boyeri* dissected by me there were unmistakably two vasa deferentia on each side of the body, which after came to be separated by a considerable interval, owing perhaps to the contraction of the body-walls, though more usually lying side by side and in close juxta-position. The only other genus in which there are two vasa deferentia on each side of the body is *Acanthodrilus*, and this is in correspondence with the two generative orifices of each side; where there is only a single pair of male generative pores, the vasa deferentia become fused directly behind the posterior funnel and pass down the body as a single tube. In *Microchæta*, however, Benham[1] has described the two vasa deferentia of each side continuing separate for several segments, though they ultimately become fused some way in front of the male generative pore.

The condition of the vasa deferentia in *Eudrilus boyeri* forms another intermediate term in the series which connects *Acanthodrilus* with *Lumbricus*; in *Acanthodrilus* the two vasa deferentia are separate throughout their whole extent and their external apertures are each furnished with a prostate gland[2]. In *Eudrilus boyeri* there is only a single generative opening, but the vasa deferentia remain distinct. In *Microchæta*, where there is also a single male generative pore, the vasa deferentia of each side are partially fused. Finally, in *Lumbricus* and other genera the vasa deferentia unite immediately behind the posterior internal funnel.

The *nephridia* of this species are well developed, and open in every case in front of the dorsal setæ. The organs themselves are remarkable for the very large muscular duct.

The *alimentary tract* presents certain features of interest. The œsophagus is furnished with three pairs of thick-walled whitish-coloured glands disposed in pairs in consecutive segments, viz. 11, 12, and 13; the posterior pair was smaller than the two anterior pairs. These glands appeared to have a lamellar structure, and the interior was filled with irregularly-shaped calcareous masses: there seems to me to be no doubt that these structures correspond to the calcigerous glands of *Lumbricus*. Along the intestine are another series of glands, about 40–50 pairs, commencing in the 90th segment. There is a single pair of these glands to each segment, which become larger towards the middle of the series, and

[1] Quart. Journ. Micr. Sci. vol. xxvi.

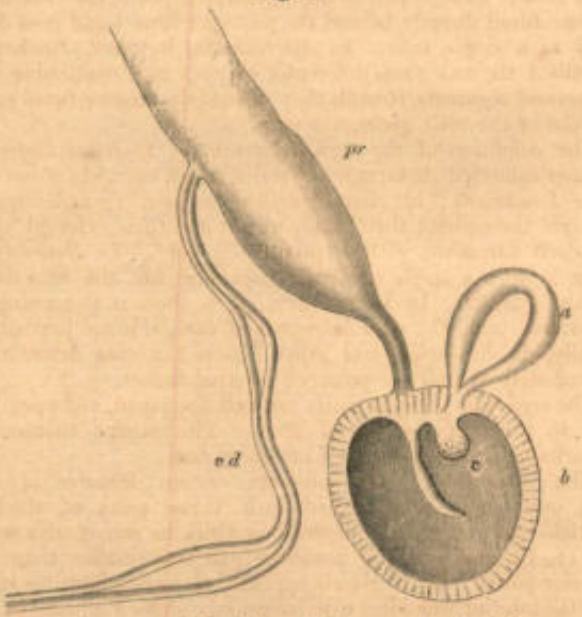
[2] In a species of *Perichæta* recently described by myself (Ann. & Mag. Nat. Hist. 1886, xvii. p. 89) there are two prostates on either side, whose apertures are, however, situated in the same segment, and not in different segments as in *Acanthodrilus*. The condition of the specimen was such that I could not detect the connection of these with the vasa deferentia. It seems very possible that each prostate may correspond to a single vas deferens, in which case the male generative organs of this worm will be in certain respects intermediate between those of *Acanthodrilus* and *Eudrilus boyeri*.

diminish in size towards either extreme. These glands are situated on the dorsal wall of the intestine, close to and on either side of the dorsal vessel; each is supplied with a rich plexus of blood-vessels derived from the most anterior of the two vessels which arise from the dorsal trunk in each segment.

These glands are probably of the same nature as those described by myself in a similar position in *Megascolex*[1] and *Typhœus*[2], and by Dr. Horst[3] in *Acanthodrilus*.

The female reproductive organs I have already described; they are quite unique in that the ovary is directly continuous with its efferent duct, which opens on to the exterior in common with the

Fig. 2.



Generative organs of *Eudrilus*, with bursa copulatrix laid open.
p, penial process; *c*, pad-like process connected with glandular appendix. Other lettering as in fig. 1.

spermatheca. The male reproductive organs are also remarkable; they have been described by M. Perrier in all the three species of the genus; my own dissections do not altogether bear out his statements, but of course the differences may be specific; they are hardly individual, inasmuch as three or four specimens agreed perfectly.

In most cases there were three pairs of vesiculæ seminales, situated in segments 10, 11, 12; with these are connected a pair of vasa

[1] Trans. Roy. Soc. Edinb. vol. xxx. pt. ii. p. 493.
[2] Ann. & Mag. Nat. Hist. 1883, xii. p. 222.
[3] Notes from Leyden Museum, vol. vi. p. 103.

deferentia on each side, which were invariably extremely conspicuous; the two vasa deferentia of each side remained perfectly distinct, and could readily be traced as far as the prostatic gland, into which they open. The latter structure is a tubular organ of a nacreous appearance, lying behind the generative orifice, and occupying some five or six segments; it communicates with a large rounded pouch-like structure (figs. 1, 2, *b*), which overlies the generative pores on either side, by a narrow duct. The prostatic gland is constricted at about the middle of its extent, and it is at this point that the vasa deferentia open into it. M. Perrier has accurately figured the appearance presented by the 'bursa copulatrix' when its upper wall has been removed (*loc. cit.* pl. ii. figs. 27, 28). I find that the duct of the prostatic gland is continuous with the curved penis (woodcut fig. 2), while the rounded pad (*c*) which lies behind the penis receives the duct of a peculiar glandular body (*a*), which is either horseshoe-shaped as in fig. 2 or Y-shaped as in fig. 1. This glandular appendix has been referred to by Perrier, who did not, however, succeed in making out its relations with the bursa copulatrix; neither has M. Perrier figured or described the termination of the prostatic duct in the penis.

4. Additional Note on Microchæta rappii, F. E. B.

Since my paper on the structure of this Worm was communicated to the Society, Mr. Benham has published a careful and detailed account of its anatomy.

The description of the female generative apparatus which Mr. Benham gives[1] agrees in the main with my own description, which I have left unaltered in the paper. A structure which I identified with the oviduct—a pair of ciliated funnels on the posterior wall of segment 12—has appeared to Mr. Benham not to be really an oviduct but to be related to a glandular structure on the anterior septum of segment 12, possibly serving as the excretory duct of its products. On the other hand, the structure described by myself as an ovary, lying in the segment behind that which contains the presumed oviduct (Trans. Zool. Soc. vol. xii. pt. 3, pl. xv. fig. 4, *o*), is also identified as such by Mr. Benham.

I am now inclined to think that both Mr. Benham and myself were wrong in that identification, and that the supposed ovary really corresponds to what has been termed by Bergh[2] the *receptaculum ovorum*. In the first place, Mr. Benham remarks that the ova which completely filled this supposed ovary exhibited no gradation in size among themselves such as is to be seen in the ova of *Lumbricus*; in the second place, I have observed this structure in another example of the worm, recently received at the Gardens from the Rev. G. H. R. Fisk, *where it was entirely devoid of ova*. I cut a careful series of sections through the 'ovary' and oviduct, and could

[1] Quart. Journ. Micr. Sci. 1886, p. 279, pl. xvi. figs. 7, 8, 14.
[2] Zool. Anzeiger, no. 220, p. 232.

find no traces whatever of ova in the former body, and its walls were comparatively thick and composed of muscular or perhaps connective-tissue fibres. These two series of facts are very decidedly opposed to the view that this body is really the ovary, and I have no doubt whatever that it corresponds to the receptaculum ovorum. In *Lumbricus* the receptaculum ovorum was correctly described by Hering, as Bergh has pointed out. More recently the structure has been figured by Dr. Horst[1], who also quotes Hering's observations. I have myself observed an evidently similar structure attached to the oviduct of *Acanthodrilus dissimilis*. Dr. Bergh describes the origin of these bodies as being similar to that of the receptacula seminis; they arise on the anterior wall of segment 13, and are at first independent of the oviducal funnels but subsequently unite with them. In *Microchæta* these receptacula ovorum appear therefore more completely to retain their primitive position. It was obvious, however, from my sections that there was a communication through the mesentery between the receptacula and the oviduct. The identification of the supposed ovaries with the receptacula ovorum confirms so far the accuracy of my own determination of the oviducal funnel. I am bound to say, however, that a most searching examination of my sections failed to bring to light any traces of the oviducal canal. I see that Mr. Benham has also failed to detect any connection between the funnel and the exterior. Assuming, at least for the present, that the supposed ovary is nothing more than a receptaculum ovorum, the true ovary remains to be identified. This I believe to be a glandular-looking body in segment 12, noted by Mr. Benham but overlooked by myself at the time when my paper was written. Mr. Benham describes and figures (*loc. cit.* pl. xvi. fig. 8) this gland as consisting of a "mass of rounded cells arranged in a band which is bent upon itself several times, the folds being close to one another." It is attached to the anterior septum of somite 12. In the specimen of this worm more recently dissected by myself, I have found a structure which must correspond to that described by Mr. Benham, though it occupies a slightly different position and is somewhat different in structure. This gland in my specimen was elongated and composed of a mass of rounded indifferent cells; the anterior end of the gland was wider than the posterior extremity, which tapered gradually, and was attached to the anterior mesentery of segment 12; the main part of the gland lay along the ventral body-wall close to the nerve-cord.

The reasons which lead me to suppose that this cellular mass represents an ovary in a state of functional inactivity are—first, that it occupies the right position; secondly, that it corresponds exactly in structure to certain glandular bodies in *Acanthodrilus dissimilis*[2], in which I have observed the occasional development of ova.

[1] Tijdschr. d. Nederl. Dierk. Vereen. Deel iii. afl. i. p. 28.
[2] P. Z. S. 1885, p. 828, pl. lii. fig. 9.

5. Remarks on the Variation of Perionyx excavatus, E. Perrier.

Hardly anything is at present known with respect to the variations in structure which may occur in a given species of Earthworm; and in order clearly to define the limits of different species it is evidently a matter of some importance to ascertain how far variation may take place. The description of by far the majority of exotic forms of Lumbricidæ has depended upon the dissection of a very few examples, so that many of these descriptions must be qualified by admitting the possibility that they relate only to what may be termed for convenience' sake the normal conditions of structure. Such a criticism, however, can only be applied to those instances in which a species or genus has been created for the reception of a single individual, which may show well-marked divergencies in structure from its immediate allies; if a number of individuals agree to differ from a second series of individuals in certain well-marked characters, it would be obviously necessary to separate the two groups either generically or specifically as the case demands.

The Lumbricidæ are a group which exhibit a most remarkable variability in internal structure, more especially of the generative system; in accordance with this variability they have been divided into a considerable number of species and genera. It might well be expected that this group, which is apparently universally distributed and is at present no doubt as abundant, or even more abundant[1], in individuals as well as in species as it ever was, is still in course of differentiation into new forms; any accidental variation may be the first term of a series which will ultimately lead to the formation of a new species.

I have had the opportunity of examining, through the kindness of my friend Mr. Herbert Barwell, rather more than 400 individuals of a Philippine Earthworm belonging to the genus *Perionyx*; this worm exhibits a number of variations which appear to me to be really variations, and not marks of specific distinctness. The reasons for this belief will be stated after the facts have been detailed.

The Earthworm in question appears to be identical in every respect with *Perionyx excavatus*: it differs in no point from M. Perrier's[2] description of that species. I need hardly therefore describe in detail its specific characters, as it would be merely repeating what Perrier has already said; it will be necessary, however, briefly to indicate the main features of its organization in order to render clear what follows.

The setæ are disposed in a continuous row round the middle of each segment; they are not disposed upon a ridge as in *Perichæta*,

[1] There seems to be a certain relation between the abundance of Earthworms and the cultivation of the soil; this fact is noted in a short article on Earthworms in the 'Field' of March 27, 1886. My friend Mr. James Cavan informs me that in California fishermen know well that if worms are required for bait they must be sought for in cultivated land.

[2] Nouv. Arch. d. Mus. t. viii. (1872) p. 126.

and this character serves to distinguish the genus from *Perichæta* in addition to those mentioned by Perrier.

Between the 7th and 8th and the 8th and 9th segments are the orifices of the spermathecæ, which lie in the 8th and 9th segments respectively; the orifices are near to the ventral median line. On the 12th segment anterior to the circle of setæ is the single median aperture of the oviducts.

On the 18th segment are the paired apertures of the vasa deferentia, which lie close together upon two slightly raised papillæ[1] situated in an oval depressed area (see fig. 5, p. 310).

Among rather more than 400 individuals I observed the following varieties:—

(1) The spermathecæ were situated in segments 7 and 8; the female generative pore was upon segment 11; the male generative pores upon segment 16. The clitellum occupied segments 12–15 inclusive (fig. 3).

(2) The female generative pores were two, one upon each of the two segments 13 and 14; they were unpaired and median; the male generative pores occupied the normal position upon segment 18.

(3) The spermathecæ were normal, viz. two pairs in 8 and 9. The female generative pores were paired as in the last variety, and occupied the same segments (viz. 13 and 14); the male pores were upon segment 17. The clitellum extended from segments 13–17.

(4) The female generative pores occupy segments 15 and 16; the male pores are upon segment 20.

(5) Of this variety there were two examples. In one the spermathecæ are normal, in segments 8 and 9. In both the female pores are paired, but situated close to each other on the 14th segment; the male pores occupy the normal position upon the 18th segment. In one specimen the clitellum extended from 13–17.

(6) The spermathecæ are present to the number of two pairs, but are situated in segments 6 and 7; the single female generative pore is upon segment 10. There are apparently three pairs of male generative pores upon segments 14, 15, and 16; only the two first pairs were furnished with prostate glands; the hinder pair therefore are probably to be compared to genital papillæ (fig. 4).

(7) The female pores are upon segments 15 and 16; the male pores occupy the normal position upon segment 18.

(8) The female pores are upon segments 14 and 15; the male pores upon segment 18.

(9) In this variety there are three pairs of spermathecæ, occupying

[1] In a description of a new species of *Perionyx* (*P. macintoshii*, Ann. & Mag. Nat. Hist. 1883, xii. p. 217) I have described the openings of the vasa deferentia as differing from those of *P. excavatus* in being placed in an area which is not depressed below the level of the surrounding integument. I find by an examination of a large series of *P. excavatus* that this supposed specific distinction is probably due to the immaturity of the single specimen of *P. macintoshii*; in immature examples of *P. excavatus* the male genital apertures are precisely as I have described them in *P. macintoshii*. The latter species, however, seems to me to be distinct on account of the structure of the prostate glands and the thickened mesenteries of segments 6–9.

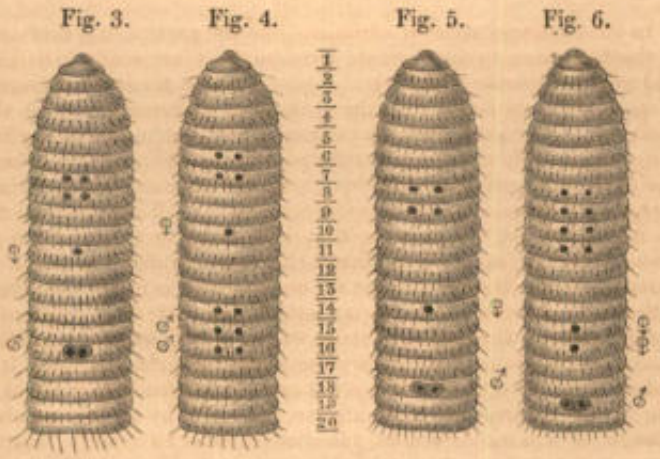
segments 7, 8, and 9. The female pore is single and upon segment 14; the male pores are upon segment 17.

(10) There are four pairs of spermathecæ occupying segments 8, 9, 10, and 11. The oviducal pores are two, upon segments 15 and 16. The male generative pores are upon segment 19. The clitellum extends from segments 15–18 inclusive (fig. 6).

(11) There are three pairs of spermathecæ in segments 6, 7, and 8. The female generative pores are upon segments 13 and 14; the male generative pores are upon segment 16.

(12) Of this variety I noted two specimens. The female and the male pores were perfectly normal, but the 18th and 19th segments were only separated from each other on the right side of the body; on the left side they were fused.

(13) There were also two specimens of this variety. The female pores were upon segments 14 and 15; the male pores occupied the normal position upon segment 18.



Figs. 3, 4, 6. Varieties of *Perionyx excavatus*. Fig. 5. Normal individual.

(14) There were two pairs of spermathecæ, occupying the ordinary position in segments 8 and 9. The female generative pores were upon segments 15 and 17; the male pores upon segment 21. Segments 11, 12, and 18, 19 were only divided from each other on the left side of the body. Viewed from the right side, the female pores were upon segments 14 and 15, the male pores upon segment 18.

(15) The female generative pores were upon segments 15 and 16; the male pores upon segment 18.

These different varieties may be tabulated as follows:—

	Spermathecæ.	♀ pores.	♂ pores.	Clitellum.
Normal	8, 9	14	18	14–17
Var. 1	7, 8	11	16	12–15
„ 2	.....	13, 14	18	
„ 3	8, 9	13, 14	17	13–17
„ 4	.....	15, 16	20	
„ 5 (2) ...	8, 9	14, 14	18	13–17
„ 6	6, 7	10	14, 15	
„ 7	7, 8, 9, 10	15, 16	18	
„ 8	.....	14, 15	18	
„ 9	7, 8, 9	14	17	
„ 10	8, 9, 10, 11	15, 16	19	15–18
„ 11	6, 7, 8	13, 14	16	
„ 12 (2) ...	8, 9 (right); 9, 10 (left)	14	18	
„ 13 (2) ..	8, 9 (right); 9, 10 (left)	14, 15	18	
„ 14	8, 9	15, 17	21	
„ 15	.....	15, 16	18	

In considering a series of variations like the present, it is necessary in the first place to discriminate between what are really variations and what are specific characters. I have stated at the commencement of this paper my belief that the anatomical differences between the individuals described here are variations, and not marks of specific difference. This opinion is based upon the following facts:—*First*, the exact correspondence in colour, size, and all anatomical characters, except those liable to variation, between the different individuals. It may, perhaps, be objected that it is begging the question to assume that it is precisely those characters which are liable to variation in this "species" that are unimportant as marks of specific difference; especially when it is remembered that these differences mainly concern the genital system, which is well known to exhibit constant and regular variation, serving as a basis of classification. It is indeed perfectly true that this is the case; but then the variations in the genital system are constantly accompanied by equally regular, though perhaps inconspicuous, variations in other characters; so that a naturalist acquainted with this group could probably easily determine any species known to him by external characters only. It is not meant to imply by this statement that external characters are sufficient to decide the systematic position of an Earthworm, but merely to emphasize the fact that when, after dissection, the relations of internal structure to external form are known, the latter characters will serve as a guide to recognize the species.

Secondly, the fact that the supposed variations are never represented by many specimens. Out of some 430 individuals I have recorded 15 variations, 12 of which are exhibited in as many specimens, while 3 are represented by two specimens apiece. The importance of this argument is in exact proportion to the number of specimens examined; in the present instance it appears to me to be fairly sound.

Thirdly, Earthworms are known to vary somewhat in structure,

though there has never, to my knowledge, been described so great a number of variations as I have been able to record in the present communication. Dr. Horst[1] has recorded a variation in the form of the spermathecæ of *Perichæta indica* and in the cœca of *Perichæta musica*, and Perrier[2] in the spermathecæ of *Perichæta affinis*.

Fourthly, and lastly, the probability, suggested above, of the occurrence of variations must not be left out of sight.

Assuming it to be proved that an actual variation does occur in the present species, it will be necessary in the next place to eliminate those variations that are mere monstrosities, and that can hardly be considered to have any importance. Such are the occasional doubling of segments on one side of the body, as the variations Nos. 4, 12, and 14; these are comparable to such monstrosities among Vertebrata as two-headed lambs, calves with five limbs, and so forth, which are not in any sense reversions to an ancestral type, but are owing to some accidental cause, such as defective or excessive nutrition. On the other hand, the remaining variations are to my mind of some importance. These will now be considered in some detail.

It must be noted first of all that the variations occur in the generative system, and it is precisely the modifications of this system which have enabled systematists to classify the group.

These variations affect all the parts of the generative system—the clitellum, the ovaries and their ducts, the spermathecæ, and the male organs.

I will commence with the clitellum. This organ and the relations which it bears to the male generative apertures has enabled M. Perrier to classify the whole group, after a fashion which is in the main satisfactory, though open to objections in certain cases. I have elsewhere urged that, in so far as it separates the Anticlitellians, *i. e. Lumbricus* and its allies, from the remaining genera of Earthworms, M. Perrier's system is by no means artificial, but bears out other anatomical differences. To distinguish the Intra- and Postclitellians from each other is not so easy a task: in the first place, we have genera like *Megascolex*, whose affinities are clearly with *Perichæta*, and which yet possess Intraclitellian generative apertures; in the second place, we find that within the limits of a single genus, i. e. *Acanthodrilus*, the male generative orifices vary in position, and may be either intra- or post-clitellian.

If the relations of the clitellum to the male generative apertures be used for classificatory purposes, it appears to me necessary somewhat to alter Perrier's definition, and to divide Earthworms into two groups, according as to whether the clitellum is placed far forward, and commences *in front* of the male generative orifices, or whether it is placed further back and commences *behind* the male generative orifices.

That there is really a connection between the clitellum and the

[1] Notes from the Leyden Museum, vol. v. p. 182.

[2] Nouvelles Arch. &c. *loc. cit.* p. 106. These facts are of course liable to the same criticism as my own.

generative orifices is certainly shown by the series of variations in *Perionyx* described in the present paper. When the male generative pores, as in var. no. 1, are placed very far forward, the clitellum also moves forward; on the other hand, when the male generative pores are situated further back, *e. g.* in segment 19, the clitellum likewise changes its position and occupies segments 15–18.

In both these instances it will be noted that the relations of the male pore to the clitellum remain the same, although both structures have shifted their position; in both cases, as in the normal condition, the male generative pore occupies the first segment *after* the clitellum. This fact would at first sight appear to be a strong argument in favour of Perrier's scheme of classification; but in the first place the clitellum extends in var. No. 1 on to the left half of segment 16, and in the second place one variety (No. 3) was distinctly 'intraclitellian,' through the shifting forward of the generative pores on to the 17th segment.

Ovaries and Oviducts.—I have been able to prove by dissection that the presence of two pairs of oviducts in consecutive segments is a reality; the two oviducts of each side were quite obvious and were each furnished with their own ovary. Moreover in var. No. 11 there was an additional (third) ovary in segment 11, on the right-hand side. In var. No. 10 I also noted three pairs of ovaries.

The occasional occurrence of more than a single pair of ovaries in this Earthworm lends additional support to my identification in *Acanthodrilus* of certain glandular structures with rudimentary ovaries, and also to Prof. Lankester's description in *Chætogaster* of two pairs of ovaries, which has been recently doubted by Vejdovsky[1]. In the present instance there can be no doubt of the presence occasionally of two or three pairs of ovaries, since they were extremely conspicuous on account of their large size, and contained abundant mature ova.

In two varieties (No. 5) there were only a single pair of ovaries present, but with separate openings on to the exterior. I have already in the present paper (p. 301, note) referred to the fact that this variation also occurs in *Megascolex*.

Spermathecæ.—The number and position of the spermathecæ have been so constantly made use of as a systematic character, that it is well to emphasize their variations in the present species. They vary from two to four pairs, and may be placed in any of segments 6–11. In most cases they get to be placed further forward when the male generative pores shift their positions forward, but this relation is by no means constant. The occasional symmetry of these organs (*e. g.* in var. No. 12 and 13) cannot be a matter of any importance; it was only observed in two of the four specimens.

Male Generative Pores.—The position of these pores varies from segment 14–21, but they were invariably behind the female generative pores; there was particular relation between the positions of the male and female pores, except that the latter were *always* in front of the former.

[1] System u. Morph. d. Oligochaten, p. 145.

The variation in position of these apertures is of importance, because certain genera (e. g. *Urochæta*, *Eudrilus*, *Rhinodrilus*) are characterized by the different position of the male pores, which are almost always (*Perichæta*, *Perionyx*, *Megascolex*, *Anteus*, and *Microchæta*) upon the 18th segment. In one instance (No. 6) there were two pairs of male generative orifices on following segments (14, 15), and on segment 16 a pair of orifices which appear to be papillæ, since they are not furnished with the prostates of the anterior orifices. The presence of two pairs of male orifices, each with their own prostate, is of importance, since a genus (*Acanthodrilus*) is mainly distinguished on account of this very peculiarity. The normal individuals of *Perionyx excavatus* have no genital papillæ, which are so characteristic of many species of *Perichæta*; in the variety just mentioned, as well as in No. 8, there were a pair of similar papillæ.

Nephridia.—In one instance I observed an alternation in the position of the nephridial pores, confined, however, to a single pore, which was placed considerably nearer to the dorsal median line than the pores on the preceding and ensuing segments.

In conclusion I would again point out that the variations recorded in this paper mainly affect the generative system, which is known to exhibit such characteristic differences in various genera and species. I have not noticed any prominent variations in other organs.

3. Remarks on the various Species of Wild Goats. By P. L. Sclater, M.A., Ph.D., F.R.S., Secretary to the Society.

[Received May 17, 1886.]

(Plates XXXI. & XXXII.)

The male Sinaitic Ibex which we received as a present from Mrs. Laing in December 1884[1] has now become a fine animal. As the first of the species that has reached the Society's Gardens, I have thought that a portrait of it would not be inappropriate to the Society's 'Proceedings;' and I have accordingly had the accompanying sketch (Plate XXXII.) prepared by Mr. Smit, which will give a good idea of the original.

The animal stands about 31 inches high, and is generally of a dark rusty brown colour, with black dorsal stripe and limbs, the latter being white on the inner sides and on the knees.

I take this opportunity of offering a few remarks on the known species of Wild Goats and their distribution. I will mention them in geographical order, commencing with the westernmost species, and proceeding eastwards, alluding especially to those of which we have received living specimens.

[1] See P. Z. S. 1885, p. 2.

1. Capra pyrenaica.

Capra pyrenaica, Schinz, Neue Denkschr. d. allg. Schweiz. Ges. Nat. ii. p. 9, t. ii., iii. (1838).

Capra hispanica, Schimper, Compt. Rend. xxvi. p. 318 (1848).

The Spanish Ibex is now well known to occur not only in the Pyrenees but, under a slightly altered phase, in Central Spain and in the higher ranges of Andalusia and Portugal. It is curious that it is more nearly allied to the Caucasian Ibex than to the Ibex of the Alps.

The only specimens of this species we have yet received alive are those presented by Major Howard Irby in 1868 and 1869[1]. They were obtained in the Sierra Hermosura, north of Marbella, in the province of Malaga.

2. Capra ibex, Linn.

Capra ibex, Linn. Syst. Nat. i. p. 95.

So far as I know the Steinbok, or Bouquetin, is confined to the Alps of Switzerland, Savoy, and Tyrol, where it is now become nearly extinct, except in one or two places in which it has been specially cared for and artificially preserved for sporting purposes. Whether the pair of this species presented to us by the late King of Italy in 1862 were really perfectly pure was, I have always thought, a little doubtful; at all events it is well known that the Alpine Ibex breeds freely with the Domestic Goat, and I have seen many such hybrids.

3. Capra ægagrus, Gm.[2] (Plate XXXI.)

The Wild Goat, which was so abundant over the Grecian Archipelago in the time of Homer, seems now only to exist in Crete and some of the smaller Cyclades[3].

It appears, however, to be found throughout the mountains of Asia Minor and Persia, and to extend into Sind and Baluchistan[4]. There can be no question, I suppose, that the Domestic Goat is a derivative principally of this species, but with a probable mixture of other species in different localities. Mr. T. B. Sandwith, H.B.M. Consul for Crete, has sent us several examples of Wild Goats which must be referred to this species.

Mr. Smit's drawing (Plate XXXI.) represents a fine male of this animal, presented by Mr. Sandwith in March 1884.

4. Capra caucasica[5].

Capra caucasica, Güld. Act. Petrop. 1779, pt. 2, p. 273 (1783).

Ægoceros ammon, Pallas, Zoograph. i. p. 229.

[1] See 'List of Vertebrate Animals,' ed. 8, p. 153.

[2] For synonymy, see Blanford, J. A. S. B. xliv. pt. ii. p. 15.

[3] Antimelos and Joura. See Erhard, 'Fauna der Cykladen' (Leipzig, 1858), p. 32, where this species is described as *Ægoceros pictus*.

[4] Blanford, 'Eastern Persia,' vol. ii. p. 89.

[5] The specimens called *Capra caucasica* in the British Museum belong either to *Capra ægagrus* or to a closely allied species, with the horns compressed and angular in front.

Ægoceros pallasi, Bouill. Bull. Soc. Imp. Nat. Mosc. xiv. p. 908, t. xi. (1841).

This species is restricted to the Caucasian range. I have never seen living examples of it, but there are two fine stuffed male specimens in the British Museum which are labelled *Ægoceros pallasi*. It is a very distinct form, of a generally dark brown colour, with the thick horns curving backwards and outwards, the tips finally turning upwards and inwards. It seems to be most nearly allied to *Capra pyrenaica*.

5. Capra sinaitica. (Plate XXXII.)

Capra nubiana, Geoffr. St.-Hil. et Cuv. Mamm. vii. t. 397 (1825).
Capra sinaitica, Hempr. et Ehr. Symb. Phys. Zool. i. t. xviii. (1828).
Capra arabica, Rüpp. Neue Wirbelth. p. 17 (1835).
Ægoceros beden, Wagner, Schreb. Säugeth. v. p. 1303 (1836).
Capra beden, Tristram, Fauna of Palestine, p. 6, pl. ii.

The Sinaitic Ibex is stated upon the best authority to be found only in the mountains of Upper Egypt and in the ranges of the Sinaitic Peninsula and Palestine[1]. It would be therefore perhaps better to drop the name *nubiana*, under which it was first described by F. Cuvier, and to employ instead "*sinaitica*" of Hemprich and Ehrenberg. These authors give Gebel Garab as one of its exact localities in Egypt, and Rüppell states most positively that it does not occur south of 24° N. latitude in that country.

Our specimen was, I believe, procured at Suakim, on the western coast of the Red Sea, and was, no doubt, brought from the mountains lying to the north of that port.

The Sinaitic Ibex belongs strictly to the same group as *C. ibex* and *C. sibirica*, but has the horns rather more compressed and strongly knotted in front.

6. Capra walie.

Capra walie, Rüpp. Neue Wirbelth., Säugeth. i. p. 16, t. vi.

This, it appears to me, is a very well-marked species, both as regards the shape of its horns and the curious bony protuberance in the middle of the forehead, pointed out by Rüppell, by whom it was discovered in the highest ranges of Abyssinia. I am not aware that any specimens of this animal have been obtained except those of Rüppell, which are in the Senckenberg Museum at Frankfort.

7. Capra sibirica.

Ibex alpium sibiricarum, Pallas, Spicil. Zool. xi. p. 31, t. iii.
Capra sibirica, Meyer, Zool. Ann. i. p. 397 (1794); Jerdon, Mamm. Ind. p. 292; Kinloch, Large Game Shooting, i. p. 145 (1885).
Capra himalayana, Schinz, Mamm. ii. p. 463 (1845).

It seems to be now generally agreed that the Ibex of the Altai

[1] Hempr. et Ehr. Symb. Phys. *l. s. c.*; Rüpp. Neue Wirbelth. i. p. 17; Tristram, Fauna of Palestine, p. 6.

Mountains and the Ibex of the Himalayas (which is found throughout that range from Cashmere to Nepaul) should be referred to one species; but I am not aware that any one has made an exact comparison of specimens from these two localities. The animal certainly belongs to the same group as the Ibex of the Alps and that of the Sinaitic peninsula. We have never yet succeeded in obtaining living examples of it.

In Siberia, Radde tells us, this Ibex is found only in the Altai and Sagan Mountains.

8. CAPRA FALCONERI.

Ægoceros falconeri, Wagn. Münch. Gel. Anz. ix. p. 430 (1839).
Capra megaceros, Hatton, Calcutta Journ. N. H. ii. p. 535, pl. xx. (1842); Sclater and Wolf, Zool. Sketches, ser. ii. pl. xx.
Capra falconeri, Hügel, Kaschmir u. d. Reich. d. Siek, iv. p. 579 (1848); Blanford, J. A. S. B. xliv. pt. i. p. 17 (1875).

The Markhoor, although regarded by Blyth (at one time) and by Gray altogether as merely a variety of the Domestic Goat, is now universally recognized as a most distinct species, distinguished at once by its long massive spirally-twisted horns, which readily separate it from every other known member of the genus.

It is not found in the Himalayas proper, but extends from the Pir-panjal range, south of Cashmere, into Afghanistan and Gilgit on the one side, and the Sulemani range on the other. Colonel Kinloch, the most recent writer on the larger game of India, states that four well-marked varieties of the Markhoor are easily recognizable. To two of these—in one of which the horns have a more open spiral (*Capra megaceros*), and in the other a closer spiral (*Capra jerdoni*)—he assigns distinct specific names[1]. The living specimens we have received have belonged, I believe, to the latter variety. A pair of this species, presented by Major Pollock in 1866, bred for several years in the Gardens; but we are now, I regret to say, without any representative of this fine animal.

9. CAPRA JEMLANICA.

Capra jemlanica, Ham.-Smith, Griff. An. King. iv. p. 308.
Capra jemlaica, Sclater and Wolf, Zool. Sketch. ser. i. pl. xxv.

This species and the following have been separated from the true Goats by Dr. Gray as having "a moist naked muffle." But this is, I think, a question of degree, as there is certainly a small moist muffle, although not so well developed, present in some species of true *Capra*, for example in *Capra sinaitica*. These forms, however, differ from the Goats in their short, thick, and much compressed horns.

The "Tahr," as this species is usually called by Indian sportsmen, is found on suitable ground along the whole range of the Himalayas, from Cashmere to Bootan.

We received our first specimen of this fine and most distinct species in 1852, from Capt. Townley Parker. It was a male, and

[1] Kinloch, 'Large Game Shooting,' 1885, pp. 136, 142.

lived many years in the Society's Gardens, where its portrait was taken by Mr. Wolf. In 1880 the Prince of Wales presented us with two female examples, mother and young, the latter of which is still living, and has paired with a male of the same species presented to us by Colonel Kinloch in 1883.

I am happy to be able to add that there is every appearance of the female Tahr being likely to increase her species in a short time.

10. CAPRA HYLOCRIUS.

Kemas hylocrius, Ogilby, P. Z. S. 1837, p. 81.

Capra (*Ibex*) *warryato*, Gray, Ann. & Mag. N. H. x. p. 267 (1842).

The "Neilgherry Ibex," as this Goat is usually called by Indian sportsmen, has never, so far as I know, been imported alive into Europe. Although I have received many letters promising living specimens for the Society, these animals have always died in India after a short period spent in captivity.

Although the horns of this species differ somewhat materially from those of *Capra jemlanica* in having the external angle in front much rounded off, I believe the two animals to be nearly allied.

This species is found only in the Neilgherries, Anamallays, and other adjoining ranges of Southern India.

June 1, 1886.

Dr. A. Günther, F.R.S., Vice-President, in the Chair.

The Secretary made the following report on the additions to the Society's Menagerie during May 1886:—

The total number of registered additions to the Society's Menagerie during the month of May was 190, of which 123 were by presentation, 31 by purchase, 18 by birth, 4 received in exchange, and 14 received on deposit. The total number of departures during the same period, by death and removals, was 139.

The most noticeable additions during the month were:—

1. An Orange-thighed Falcon (*Falco fusco-cærulescens*), presented by Captain W. M. F. Castle, R.N., May 5th, and stated to have been obtained in Chili. This is the first example of this elegant species which has been obtained by the Society.

2. Five Senegal Parrots (*Pœocephalus senegalus*), presented by R. B. Sheridan, Esq., May 5th. Four of these are young birds bred in a large aviary at Frampton Court, Dorchester, under the management and care of the late Mrs. Sheridan. This is of interest, as these Parrots are rarely known to breed in captivity.

Dr. Günther, F.R.S., exhibited a specimen of a small fish of the genus *Fierasfer* imbedded in a Pearl-Oyster, and made the following remarks:—

The specimen, which is represented in the accompanying woodcut of the natural size, has been in my possession for many years. It is an old shell of *Margarita margaritifera*, in which there is imbedded, behind the impression of the attractor muscle, a perfect

individual of a fish belonging to the genus *Fierasfer*. The fish is covered by a thin layer of pearl-substance, through which not only the general outlines of the body but even the eye and the mouth can be seen. The parasitic habits of *Fierasfer* are well known, and Putnam describes, in the 'Proceedings of the Boston Society of Natural History,' vol. xvi. 1874, p. 344, a species, *Fierasfer dubius*, which is found on both coasts of Central America, but inhabits Holothurians on the Atlantic, and Pearl-Oysters on the Pacific side; and he further mentions, in a footnote, an example belonging to the

Museum of Comparative Zoology at Cambridge, in which also a *Fierasfer* has been imbedded in the substance of the shell. In this case, as well as in ours, the fish, instead of introducing itself into the cavity between the two halves of the mantle, penetrated between the mantle and the shell, causing irritation to the mollusk, which the latter resented by immediately secreting the substance with which the intruder is now covered. It is remarkable to note that the secretion must have taken place in a very short time, at any rate before the fish could be destroyed by decomposition.

Mr. Sclater made some remarks on the most interesting objects noticed in the Zoological Gardens of Rotterdam, Amsterdam, Cologne, Antwerp, and Ghent, which he had lately visited.

In Rotterdam a pair of Bar-headed Geese (*Anser indicus*) had nested and the female was sitting; and a pair of Black-footed Penguins (*Spheniscus demersus*) had twice laid eggs. Mr. Sclater had never known either of these species breed in captivity before, but believed that the former had bred at Antwerp. Specimens of a *Leucopternis* (sp. inc.), *Epimachus albus*, and *Carpophaga goliath* were seen in the aviaries.

In Amsterdam the series of Cranes, Herons, and Storks were, as usual, very complete and the specimens in fine condition, particularly those of *Ardea sumatrana* and *A. herodias*. The Spoonbill was breeding in one of the aviaries. Other rare birds noticed were examples of *Conurus luciani*, *Alauda tatarica*, and *Cacatua gymnopis*.

At Cologne a fine young male Burchell's Zebra, born in the Gardens 19 months ago, had been much admired, and would, it was hoped, be secured for the Society's Gardens.

The Gardens at Antwerp were in their usual excellent condition and very fully stocked. The flock of Barbary Sheep (*Ovis tragelaphus*) and herds of Lamas, Guanacos, Alpacas, and Vicunas were much admired. Amongst other noticeable objects were a pair of Isabelline Antelopes (*Cervicapra isabellina*), three young examples of *Casuarius uniappendiculatus*, and several specimens of *Ara glauca*, one of which had been obtained for the Society's collection.

At the small but well-kept Garden of the Société Royale d'Histoire Naturelle at Ghent was observed a fine male example of the Ostrich of Somali-land (*Struthio molybdophanes*), distinguishable when alive by its naked bluish skin, and the large red plaque in front of the tarsus.

A letter was read from Mr. J. M. Cornély, of Tours, C.M.Z.S., stating that his pair of Michie's Deer (*Elophodus michianus*) had bred, and that a young one had been born on the 15th May. The young one was stated to be nearly of the same colour as the mother, showing only a few indistinct spots.

The following papers were read:—

1. Notes on the Convoluted Trachea of a Curassow (*Nothocrax urumutum*), and on the Syrinx in certain Storks. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society.

[Received June 1, 1886.]

My predecessor in the office of Prosector to this Society, Mr. W. A. Forbes, has summed up all the facts that are known with respect to the convoluted trachea of Birds in a communication published in the 'Proceedings' for 1882 (p. 347)[1]. The present note is a supplement to that paper, and deals with the convoluted trachea of the male *Nothocrax urumutum*. Among the Cracidæ it is the rule for the males to have a convoluted trachea, while it is very unusual for the female to resemble the male in this respect; in every case when present the trachea makes a single loop on the right side of the carina sterni—sometimes very short, as in *Crax globicera*; sometimes of great length, as in *Pauxis galeata*, where the loop bends up on the right side of the carina, terminating near to its upper margin. In *Nothocrax urumutum* the male has a trachea which makes a single loop extending to the end of the carina sterni, as shown in the accompanying drawing (fig. 1, p. 322); the female, as Mr. Forbes has already pointed out, has a simple trachea.

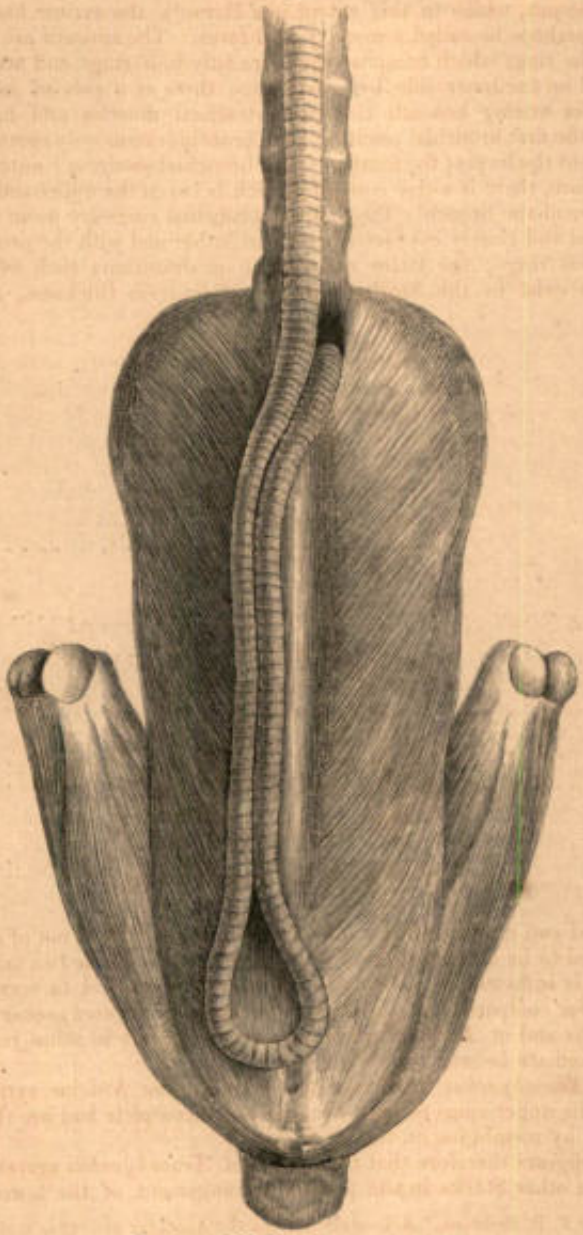
On a Peculiarity in the Syrinx of Xenorhynchus *and* Abdimia.

The Order Herodiones appears to be separable into two very distinct families—the Ardeidæ and the Ciconiidæ, which differ from each other in certain anatomical peculiarities; thus the ambiens is always absent in the former, and generally, though not always, present in the latter; the pectoral muscle is separable into two distinct portions in the Storks, while in the Herons it is only incompletely separated by a tendinous band. Another well-marked difference is to be found in the structure of the syrinx.

In the Storks[2] there are no intrinsic muscles; the lowest rings of the trachea are very slender and cartilaginous, often incomplete; and the occasional presence of an upwardly projecting bony piece from the lateral portions of the last three tracheal rings gives to the syrinx an appearance not at all unlike that of the Tracheophonine Passeres. The bronchi are particularly long, "the bifurcation of the trachea occurring at, or even a little above, the superior aperture of the thorax"[3]; the membrane which unites the two bronchi—which was termed by Garrod the *bronchidesmus*[4]—is complete in the Storks, that is to say, it commences from the very point where the bronchi diverge; the rings which make up the bronchi themselves are quite continuous, as in the Cathartidæ, Ostrich, &c.

[1] Forbes's Collected Papers, p. 338.
[2] Garrod's Collected Papers, p. 669.
[3] *Loc. cit.* p. 284. [4] *Loc. cit.* p. 479.

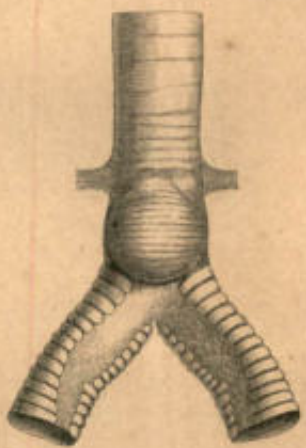
Fig. 1.



Trachea of *Nothocrax urumutum*, ♂.

In the Ardeidæ, on the other hand (including the Herons, Bitterns, and *Scopus*, which to this extent is a Heron[1]), the syrinx has what may perhaps be called a more typical form. The bronchi are short, and the rings which compose them are only half-rings, and are completed on the inner side by membrane; there is a pair of intrinsic muscles arising beneath the sterno-tracheal muscles and inserted on to the first bronchial semiring; the bronchidesmus only commences at about the level of the fourth or fifth bronchial semiring; anteriorly, therefore, there is a free communication between the upper and lower surface of the bronchi: the first two bronchial rings are more or less ossified and closely connected with each other and with the preceding tracheal rings; the latter undergo no modifications such as those which exist in the Storks, but are of uniform thickness, closely

Fig. 2.



Syrinx of *Abdimia sphenorhyncha*.

applied and often ossified. The foregoing account does not of course pretend to be a detailed description of the syrinx in the two families, but it is sufficient to indicate the main differences and to serve as a basis for comparison of them with the syrinx of *Xenorhynchus senegalensis* and of *Abdimia sphenorhyncha*, which are in some respects intermediate between the two types.

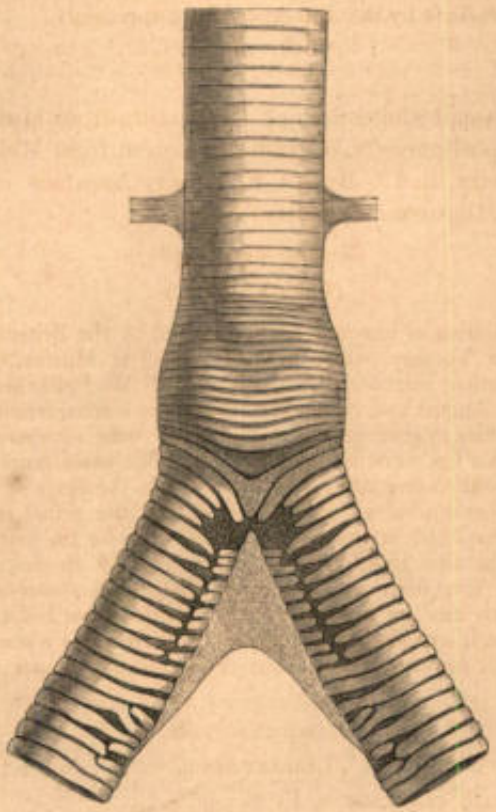
In *Xenorhynchus* there is a transition to the Ardeine syrinx in that the upper rings of both bronchi are incomplete and are (fig. 3) closed by membrane on the inner side.

It appears therefore that the syrinx of *Xenorhynchus* agrees with that of other Storks in the peculiar arrangement of the lowermost

[1] See F. E. Beddard, "A Contribution to the Anatomy of *Scopus umbretta*," P. Z. S. 1884, p. 543.

part of the trachea, while the presence of a membranous wall completing internally the upper bronchial half-rings recalls the Ardeine syrinx. *Mycteria americana* has a syrinx which is again intermediate between that of *Xenorhynchus* and the typical Storks; the bronchial

Fig. 3.



Syrinx of Xenorhynchus senegalensis.

rings are complete internally as in the latter, but the rings, instead of being of uniform width, are considerably narrower on the inner side of the bronchus, which therefore becomes largely membranous.

Abdimia sphenorhyncha (fig. 2) is another Stork which presents even a closer resemblance to the Herons in the form of its syrinx; the membranous inner wall of the bronchi is more largely developed than in *Xenorhynchus*, indeed quite as much as in the Ardeidæ; but there

are no intrinsic muscles, and the bronchidesmus is complete as in other Storks.

In no other Stork that I have had the opportunity of examining does the syrinx depart from the type of structure characteristic of the *Ciconiæ* as in the two above-mentioned genera.

Prof. Garrod has already mentioned that *Abdimia* and *Xenorhynchus* also approach the Herons in the absence of the ambiens muscle; I have been able to confirm Garrod's statement that this muscle is absent in *Abdimia* by the dissection of two specimens.

2. On a small Collection of Dragonflies from Murree and Campbellpore (N.W. India), received from Major J. W. Yerbury, R.A. By W. F. Kirby, Assistant in Zoological Department, British Museum.

[Received May 17, 1886.]

(Plate XXXIII.)

In a collection of insects recently received by the British Museum from Major Yerbury, which he had formed at Murree, Campbellpore, and other neighbouring localities in N.W. India, between the months of August and November 1885, were a considerable number of Dragonflies in good preservation. They were numbered from 1 to 15; but a few were not ticketed. In some cases more than one species bore the same number, while in others the sexes of a species bore different numbers. Allowing for this, the actual number of species exemplified in the collection proved to be 19, four of which appear to be new to science. Among these 19 species, the most interesting are, first, the European *Sympetrum fonscolombei*, De Selys, which has not been previously recorded from India, so far as I know; and, secondly, a new species of *Micromerus* resembling the common *M. lineatus*, Burm., but really forming a new section in the genus.

Libellulidæ.

Libellulinæ.

1. Pantala flavescens, Fabr.

(No number or locality.)

2. Palpopleura sexmaculata, Fabr. (no. 11).

Hassan Abdal and Campbellpore, Oct. 14 and Nov. 14, 1885 (♂ ♀).

3. Lepthemis sabina, Dru. (no. 8).

Hassan Abdal and Campbellpore, Oct. 14 and 28, 1885.

Two males. One bears a memorandum, "lavender abdomen"; but there is now no gloss over the black ground-colour.

4. Sympetrum fonscolombei, De Selys (no. 1).

Murree, over water, Sept. 5 (♂).

Undistinguishable from European examples. Major Yerbury remarks, "♂ (?) dull crimson; ♀ (?) yellowish"; but the only ♀ specimens of *Sympetrum* in the collection are unlabelled, and appear to belong to an undescribed species.

5. Sympetrum subpruinosum, sp. n. (Plate XXXIII. fig. 7.)

Exp. al. 60–62 millim.; long. corp. 20–21 millim.

Face olive-green, shading into dull orange above; underparts varied with yellow; occiput with black and yellow markings, nearly as in *S. fonscolombei*; thorax dull olive-green above, and black (more or less pruinose) below; pleuræ with two wide bright yellow bands, beneath the front band is a round yellow spot, beneath the second one or two, and behind, on each side of the median line, two more subtriangular yellow spots, coalescing in one specimen. Abdomen black beneath and at the sides, and yellowish tawny above; the first six or seven segments are marked behind with a series of black lines, gradually coalescing with the more extended black markings on the hinder segments; below these the markings on the first three segments are paler yellow, and there is sometimes an additional yellow spot on each side on the under surface of the first segment; the median crest is also narrowly black, expanding into spots on the two penultimate segments; upper appendages black, rather pointed; lower appendage convex, hairy. Legs black; tibiæ sometimes lined with yellow. Wings with black reticulation, very slightly yellow at the base; membranule white; 7 antecubital and 6 postcubital nervures on the fore wings; pterostigma reddish brown, between black nervures, 3 millim. in length.

Three females, without locality or date of capture.

The black neuration, unusually dark legs, and the pattern of the thorax are quite sufficient to separate this species at a glance from *S. fonscolombei*, De Selys, and *striolata*, Charp.

6. Orthetrum hyalinum, sp. n. (nos. 6, 7). (Plate XXXIII. figs. 5, 6.)

Exp. al. 55 millim.; long. corp. 33–35 millim.

Male. Head pale straw-yellow, shading into greenish above; occiput yellow, with three black spots on each side; thorax and abdomen pulverulent blue, with a yellow spot at base of abdomen; in less adult specimens the thorax is marked nearly as in the female (*vide infrà*), but darker; legs striped with black, yellow, and reddish; wings clear hyaline beyond the basal membranes; membranule long and narrow, white edged with black; 11–12 antecubital and 8 postcubital nervures; pterostigma narrowly yellow, bordered by black nervures; upper appendages moderate, smooth, curving downwards, and recurved and pointed at the tip; lower appendage curved upwards, about two thirds as long as the others; appendages of the second segment prominent, hairy, with the anterior lobe sloping backwards.

Female. Head yellow, the upper part greener; occiput obscurely spotted; thorax reddish brown, with two yellow lateral stripes edged externally with black, and two yellow pleural stripes edged in front by the black sutural lines; legs varied with black, yellow, and reddish; between the wings runs a row of yellow markings similar to those found in many female *Libellulinæ*; abdomen dull reddish tawny, with black lateral carinæ and a black dorsal stripe, commencing on the second segment and narrowed at all the sutures. Wings nearly as in the male; one specimen has thirteen antecubital nervures.

Campbellpore, Nov. 14 (♂ ♀); Murree (♀), no date; upper slope of Nian Jani, above Kalabagh, about 9000 ft., Sept. 16 (♀).

Allied to the European *O. cærulescens*, Fabr., and *O. ramburii*, De Selys.

7. Orthetrum triangulare, De Selys (nos. 3 and 4).

Murree, Aug. 10 and 16 (♂), Aug. 16 and 18 (♀).

The male much resembles the inky-black *O. carnaticum*, Fabr., which we have from Nepal. The females differ considerably in the intensity of colouring of the thorax and abdomen. As in some allied species, the particoloured eyes are remarkable in both sexes, the upper portion being reddish and the lower parts dark brown.

8. Orthetrum neglectum, Ramb. (no. 3).

Hassan Abdal and Campbellpore, Oct. 14 (♂ ♀) and Nov. 14 (♀).

The female is very similar to that of *O. triangulare*, but it is lighter in colour; the wings are clear hyaline (rarely the case in *P. triangulare*); and the pleuræ are uniform yellowish, with a small black ocellus on the mesopleura.

9. Trithemis aurora, Burm. (Plate XXXIII. fig. 3.)

A somewhat undercoloured male, without date or locality.

The species, which I take to be *T. aurora*, has only 10–11 antecubital and 6–8 postcubital nervures on the fore wings, placed rather widely apart. Like the next species it occurs both in India and Ceylon, but seems to be rarer. We have no specimens from the Philippines, the locality given by Burmeister.

10. Trithemis intermedia, Ramb. (no. 13). (Plate XXXIII. fig. 4.)

Hassan Abdal, Oct. 14 (♂).

May be distinguished from *T. aurora* by the more numerous and crowded nervures—14–15 antecubital and 8–9 postcubital; the markings of the thorax beneath resemble those of *T. rubrinervis*, De Selys.

11. Trithemis festiva, Ramb. (no. 12).

Hassan Abdal, Oct. 14 (♂); Campbellpore, Nov. 14 (♂).

12. Crocothemis reticulata, sp. n. (no. 13). (Plate XXXIII. figs. 8, 9.)

Campbellpore, Nov. 21 (♂).

Exp. al. 5·8 millim.; long. corp. 36 millim.

Head red, lower mouth-parts yellowish; occiput reddish yellow, obscurely spotted; thorax and abdomen ochreous-yellow (perhaps reddish when living); thorax with a hexagonal figure bisected by the median line; and from the three angles on each side, formed by the boundary lines, run similar narrow black lines, which are crossed by the narrow black sutural lines; abdomen with obscure blackish submarginal lines on its hinder portion; appendages moderate, recurved, and rather acutely pointed; legs black and ochreous; wings hyaline, slightly yellow at the base; neuration inclining to reddish; pterostigma rather large, reddish, edged with black lines; 11–12 antecubitals, 10 subcubitals.

Allied to *C. soror*, Ramb. A somewhat similar reticulation is indistinctly visible in some females of *Orthetrum triangulare*.

13. Crocothemis soror, Ramb. (nos. 5, 13).

Murree, Aug. 18 (♂ ♀); Campbellpore, Nov. 14 (♂ ♀).

The Indian form of *C. erythræa*, Brullé.

Corduliinæ.

14. Macromia moorei, De Selys (no. 10). (Plate XXXIII. fig. 2.)

Chittar, Oct. 9 (♂).

This species is remarkably similar to the N.-American *M. cingulata*, Ramb.

Æschniinæ.

15. Anax immaculifrons, Ramb. (no. 10).

Campbellpore, Nov. 21, 1885 (♂).

Agrionidæ.

Calopteryginæ.

16. Neurobasis chinensis, Linn. (no. 9).

Hassan Abdal. Taken over running water, Nov. 14, 1885 (♂ ♀).

17. Micromerus obscurus, sp. n. (no. 14). (Plate XXXIII. fig. 1.)

Hassan Abdal, Nov. 14 (♂).

Exp. al. 36 millim.; long. corp. 19 millim.

Resembles *M. lineatus*, Burm., but will form a new section in the genus, as there is neither pterostigma nor dark apical spot on the fore wings.

Head black, behind much varied with dull yellow; upper part of the eyes marked within with two large pale spots on each side, the

hindermost yellower and more distinct; between the hindermost pair runs a yellow stripe, nearly divided into three; between the front pair runs a series of four spots, of which the middle pair are the smallest and placed most forward; in front of these are two more yellow spots, edged with black; the rest of the head is yellow, except the edges of the nasus; a Y-shaped mark running from between the two last-mentioned pair of yellow spots, and a short stripe running forward from their outer edges; prothorax black in front, with a triangle of three yellow spots in the middle, and yellow at the sides, beneath, and behind; mesothorax black above, with a V-spot and two yellow longitudinal lines; sides yellow, with two black sutural stripes, the upper one divided in front by a brighter yellow spot; abdomen dull reddish brown, the sutures darker, preceded by a yellow median spot, edged in front by two short dark lines; anal appendages rather large, approximating, those of the second segment somewhat less prominent than in *M. lineatus*; legs yellowish, darker above.

Wings hyaline, yellowish towards the base; five antecubital nervures, the first two interstitial on all the wings; hind wings with a yellow rhomboidal pterostigma, surmounting about $2\frac{1}{2}$ cells; the extreme base black.

It is not unlikely that in more brightly coloured or better preserved specimens the back of the abdomen may be marked with yellow, nearly as in *M. lineatus*.

AGRIONINÆ.

18. MEGALESTES MAJOR, De Selys (no. 2).

♂. Captured at Murree, over water, Aug. 7, 1885.
♀. At Kali Pani, Sept. 22, 1885.

19. ISCHNURA SENEGALENSIS, Ramb. (no. 15).

Hassan Abdal and Campbellpore, Oct. 14.

EXPLANATION OF PLATE XXXIII.

Fig. 1. *Micromerus obscurus*, sp. n., p. 328.
2. *Macromia moorei*, De Selys, p. 328.
3. *Trithemis aurora*, Burm., var., p. 327.
4. —— *intermedia*, Ramb., p. 327.
5. *Orthetrum hyalinum*, sp. n., p. 326.
6. —— ——, ♀.
7. *Sympetrum subpruinosum*, sp. n., p. 326.
8. *Crocothemis reticulata*, sp. n., p. 328.
9. —— ——, side view.

June 29, 1886.

Osbert Salvin, Esq., F.R.S., Vice-President, in the Chair.

The Secretary exhibited, on behalf of Mr. John Brazier, of Sydney, N.S.W., C.M.Z.S., a series of 55 eggs of the Pacific Porphyrio (*Porphyrio vitiensis*), and read a note forwarded by Mr. Brazier showing the extraordinary fecundity of the individual of this species which had laid them.

The bird in question was obtained at Maré, Loyalty Islands, in May 1873, and had been kept in captivity in Sydney until December 1882, when she was accidentally killed by poison. She had laid eggs as follows:—

1876. June–December	36
1877. June–December	44
1878. June–December	68
1879. January, February, and May–December	83
1880. January, and March–December	93
1881. January, February, and April–December	101
1882. January, February, and April–October	66
Total in 7 years	491

The Secretary read the following letter, addressed to him by Captain J. A. M. Vipan, F.Z.S., on the nesting of a South-American Siluroid fish (*Callichthys littoralis*[1]) in this country:—

"Stibbington Hall, Wansford.
June 25th, 1886.

"Dear Dr. Sclater,

"Two Cascaduras (*Callichthys littoralis*), from Trinidad, that I have in my aquarium, commenced making a nest on June 6th; but that, and the one they made on June 9th, they soon pulled to pieces. On the night of the 11th they began a new one; it consisted of pieces of *Valisneria*, all the leaves of the *Nymphæa* that were growing in the tank, which they bit off close to the roots of the plants, and a great quantity of river-moss (*Fontinalis antipyretica*), each piece being two or three times the size of the fish, so that they must have had hard work to bring them to the surface. They worked these materials together by some mucous substance until the outside was hard, the whole being under a quarter of an inch thick; they next buoyed up the structure with a quantity of mucous foam until it was raised three and a half inches above the water. The whole nest was nine inches long and seven inches wide, and somewhat resembled a finger-glass turned upside down on the top of the water, with the interior filled with froth. The fish kept swimming close under it all the time on their backs and filling it with foam. When finished, on the 12th, the female

[1] Günther, Cat. Fishes, v. p. 227; Sclater, P. Z. S. 1885, p. 717.

Peronia; and, by searching among the holes in the reef-rock, tolerably large specimens of *Octopus* may be found. Small Scaroids and File-fishes of great beauty swim rapidly away from the approach of the observer, and Murænoids of various sizes, chiefly of the genus *Ophichthys*, are to be found lurking under the scattered boulders of the reef. A small species of *Periophthalmus* is very abundant, but is very difficult to capture, even in the pools which have been left by the retreating tide, for it escapes by leaping from pool to pool with great agility. This species of *Periophthalmus* appears to differ in habit from the Pacific species, in that its paired fins are not so well adapted for progression on land; it leaves the water but rarely, and is unable to sustain life in the air for a longer period than half an hour. The boulders at the edge of the sea are occupied by swarms of crabs of the genus *Grapsus*; and the strip of dazzling white sand that borders the shore is often covered with small white or grey crabs of the genus *Ocypus*.

The outer edge of the land is always composed of a heap of coral-boulders, many of them of considerable size, which have been heaped up by the waves. This heap of boulders forms a sort of rampart all round the outer edge of the island, which slopes down to the lower-lying land, raised only two or three feet above the level of the lagoon at high tide. The whole island is densely covered with vegetation, the bushes known by the native names of "Manioc" (*Scævola kœnigii*), "Velouté" (*Tournefortia argentea*), and "Bois de feu" (*Guettarda speciosa*) forming impenetrable thickets near the shores. The central and interior parts of the strip of land are covered with cocoa-nut palms, beneath which, from the continual decay of the fallen leaves, a rich peaty mould has become established. The imported animals of the island are donkeys, hogs, fowls, and rats; the last-named swarm on the main island and do great destruction among the cocoa-nuts, but, curiously enough, they have not yet found their way to the islets in the mouth of the lagoon. Cattle do not thrive, but sheep have been imported and appear to do well on the herbage which covers the more open spaces; the first consignment was unfortunately destroyed by the donkeys, to whom sheep were utter strangers.

When I arrived at Diego Garcia on September 15th, 1885, Terns were breeding in countless numbers on some of the less frequented parts of the island. The dark grey Terns build rough nests, composed of a heap of sticks and leaves piled up in the forks of trees and bushes; in each of these a single egg is laid, on which the female sits. The black-and-white Terns lay a single egg on the bare ground, which is apparently hatched by the heat of the sun, for I never saw one of these birds sitting. But it was difficult to make observations, for the negroes soon took all the eggs, and wantonly destroyed hundreds of the birds, which could easily be knocked down with a stick as they flew screaming round one's head. As soon as the breeding-season was over, the number of Terns diminished very considerably; it seems that they assemble in these remote islands for breeding, and fly off to continents and larger islands for the remainder of the year.

Gannets and Frigate-birds breed at the southern end of the island; and although they are well known to be enemies on the wing, the Frigate-bird pursuing the Gannets and compelling them to disgorge the fish they have caught, yet they nest close together without molesting one another. The Gannets were hatching out on my arrival, but the Frigate-birds did not breed during my stay. The snow-white Tern, *Gygis candida*, breeds in considerable numbers; the peculiar situation in which this bird lays its egg has been described by Mr. Forbes in his recent work ('Wanderings of a Naturalist in the Malay Archipelago'), and I have nothing to add to his account. Although Whimbrels, small Plovers, Herons, and Sandpipers are numerous on the island, they do not appear to breed there. I was assured by the negroes that their eggs were never found; and M. Spurs, a former resident on the island and a naturalist of no mean order, tried during a stay of fifteen years to obtain the eggs or young of these birds, but without success.

There are no indigenous Mammalia or Amphibia. A species of Gecko (*Platydactylus mauritanicus*?) is common, and a Mud-Tortoise is abundant in some of the marshy pools. The former of these reptiles has probably come across in ships from Mauritius; but I cannot account for the presence of the latter, which is unlikely to have been brought over as a pet, for it is abundantly provided with stink-glands and emits a most unpleasant odour; it cannot have been brought over to serve any useful purpose, nor is it likely to have been accidentally imported. Yet, unless it was brought over by man, it is difficult to imagine how this animal can have found its way over the sea to so distant a spot as Diego Garcia. The insect life is not varied; huge cockroaches, mosquitoes, flies, and ants swarm everywhere and are a great pest. I found a few nests of Termites or White Ants in decayed cocoa-nut stems, but they are rare. Of Orthoptera there are two species of *Locusta*, one of *Acridium*, a *Forficula*, and a *Gryllotalpa*. Of Lepidoptera I found three species of Nocturnal and one of Diurnal Moths, and I noticed a few individuals of *Vanessa bolini*, and one individual of *Œnone*. Three species of *Æschna* were abundant in the marshes. Of Coleoptera I only found four species. Of Myriapods I found a *Scolopendra*, a luminous species of *Geophilus*, and an *Iulus*.

The most remarkable inhabitants of the land are the Crabs. Hundreds of Land-Crabs of the genus *Gecarcinus* are to be found in any part of the island, and are a great annoyance to the inhabitants, for they do great destruction in gardens, and prevent the cultivation of the potato or vegetables. There are several species of these crabs, one of which attains to a large size and gives a formidable nip with its large claws; it is so conscious of its power that it attacks any person who is walking through the grass in which it lurks, and is able to give the naked foot of a negro a severe wound. Large Hermit-Crabs of the genus *Cœnobita* are found, some of them hiding their abdomens in broken cocoa-nut shells in lieu of the shells of mollusks, there being but few of the latter that are large enough. The close relative of these *Cœnobitæ*,

Birgus latro, is also found and attains to a great size. I was never able to watch a *Birgus* opening a cocoa-nut, though I several times shut one up in a tub with a cocoa-nut for the purpose, but they will not feed in captivity. Being nocturnal in their habits, these animals are difficult to observe; the account of them given by the negroes agrees in all respects with that of Forbes in the work above quoted. Many people have doubted that these "crabs" are able to climb palm-trees; but I have seen them do so myself, and I have also seen one mount the slender stem of a "Bois de fer" till it arrived at a projecting branch, along which it then proceeded to climb, clinging underneath it like a sloth. *Birgus*, however, does not mount the palms in order to rob them of the cocoa-nuts, but to obtain shelter among the thick tuft of leaves at the summit.

The large lagoon of Diego Garcia affords an excellent harbour, in spite of the coral patches which rise to the surface in many places, the courses for ships having been carefully buoyed out. The lagoon abounds with fish, which are all eaten; the most common sorts caught by hook and line are the well-known Surgeon Fishes, "Vielles" (*Novaecula*), and some species of Percoids. Large Hammer-headed Sharks (*Zygæna malleus*) are found in some parts of the harbour, and specimens of the common Blue Shark (*Carcharias glaucus*) are very common. On one occasion we captured twenty-three young specimens of this species in a single haul of the net.

The climate is very damp and oppressive; the thermometer rarely exceeds 86° F. by day, or falls below 78° F. at night; but although the heat is not excessive, the heavy moisture-laden atmosphere is very trying to European constitutions.

An incredible amount of rain fell during my four months' stay on the island; it was only during the last three weeks of my visit that we had anything like fine brilliant weather. On such days the bright green foliage illuminated by the tropical sun, the dazzling white sand bordering the lagoon, and the clear blue or, in the shallower parts, green waters of the lagoon afford a striking picture of peculiar beauty which is well worth seeing.

I have to express my thanks to the authorities of the Orient Steam Navigation Company, who facilitated my voyage in every way, and kindly permitted me to reside at their coaling-station during a large part of my visit; and to M. Jules Leconte, the kind and hospitable manager of the oil-stations on the main island, whose guest I was for a long time, and who spared no trouble in assisting me in my researches.

2. On the Birds obtained by Mr. G. C. Bourne on the Island of Diego Garcia, Chagos Group. By Howard Saunders, F.L.S., F.Z.S., &c.

[Received June 14, 1886.]

I have had much pleasure in examining the small collection of birds obtained by Mr. Bourne on his visit, described in the preceding paper, to this little-known island or group of islets. As will be seen by the following list, the species are but few in number, and some of them are of either a pelagic or a regularly migratory nature; the general character of the avifauna is, however, Indian rather than Ethiopian, with the exception of one (doubtless introduced) Madagascar bird.

Mr. Bourne's remarks are added in square brackets.

1. Foudia madagascariensis (Linn.). "Cardinal."

This species was no doubt introduced from Mauritius.

[No. 4. ♂. Eye brown. Sept. 30th, 1885. One specimen in spirits.

Common. They were building during my stay, but though I examined several nests I never found an egg. The negroes said that they could find me the eggs, but never did. The nest, loosely constructed of grass, is dome-shaped, with a circular entrance at the side.]

2. Fregata aquila (Linn.). "Frigate."

[No. 2. ♂. Sept. 29th, 1885. Eye dark brown. Naked skin on the throat lavender-coloured.

Common, and may often be seen chasing Terns and Boobies till they make them disgorge their fish, as described by Mr. H. O. Forbes in his recent work. I have never seen Frigate-birds fishing for themselves; they are said to do so sometimes, but very rarely. Their flight is magnificent; I have seen one wheeling round and round in circles for at least five minutes without once flapping its wings, during which time it must have covered a mile of ground.]

A bird in immature plumage, passing into the adult stage. A very similar example in this state is described in P. Z. S. 1880, p. 63.

3. Sula piscator (Linn.).

[No. 15. ♂ adult. Common at the south end of the island.]

4. Ardea coromanda (Bodd.). "Macaque blanc."

[No. 11. ♂. Eye lemon-yellow. Skin at base of beak yellow. Very rare on these islands, and appears only during the N.W. monsoons. It is supposed to come over from the Maldives.]

This specimen presents some difficulty, as it is in winter plumage, but I think it is the Indian species and not the African *Ardea bubulcus*. The latter is found in Madagascar, and is believed to breed there in September, so that the African species would be in

nuptial dress at the date of Mr. Bourne's visit, whereas this example is not so.

5. BUTORIDES JAVANICA (Horsf.). "Macaque."

[No. 1. ♂. Sept. 22nd, 1885. Eye light golden-yellow. Skin at base of beak yellow.

No. 10. ♀. East islet, 28th October, 1885.

These birds are common, and may be seen any evening standing by the rock-pools, or on the beach at low water, on the look-out for fish. They are rather shy, and when alarmed fly off with a shrill cry like *kae-kae kae-kae kae*.]

6. TRINGA SUBARQUATA (Güldenst.).

[No. 14. ♂. Eye black.

Tolerably common, frequenting spots where slimy mud is left bare at low water.]

7. NUMENIUS PHÆOPUS (Linn.). "Corbijeu."

[No. 13. ♂. Eye black.

Common, but very shy and difficult to approach. I only got one shot during my stay.]

8. STREPSILAS INTERPRES (Linn.). "Alouette-de-Mer."

[No. 6. ♀. October 22nd, 1885. Eye dark brown.

Common on soft marshy ground. They usually fly in flocks of twenty to thirty.]

9. DROMAS ARDEOLA.

[No. 12. ♂. Eye black.

Common along the outer shores and in marshy places. Wary and difficult to approach.]

The fact that the Crab-Plover breeds in burrows and lays a single white egg, similar to that of a Shearwater, has been known for some years. (See P. Z. S. 1881, p. 259.)

10. STERNA BERNSTEINI, Schlegel. "Goeland."

[No. 9. ♂. October 9th, 1885. Eye black. Not common.]

An immature specimen of this very rare Tern, the adult breeding-dress of which is still unknown. It is nearly of the size of *Sterna bergii*, from which it may be distinguished by the very light colour of the mantle and by the white tail-coverts. We have yet to learn whether the adult in nuptial dress has a white frontal band at the base of the bill, as in *S. bergii*, or whether the black of the forehead comes down to the bill as in most other Terns. The present species is known from Halmaheira on the one side, and the Rodriguez waters on the other, and that is about all that can be said. The type from the first-named locality is in the Leyden Museum; there are two examples from Round Island and Ile de la Baleine, near Mauritius, in the collection of Messrs. A. and E. Newton; two more from the island of Rodriguez are in the British Museum of Natural History; the present is the sixth example I have examined.

11. Sterna melanauchen, Temm.

[No. 8. ♂. October 9th, 1885. Eye black.
Common. I have seen this bird pursued by the Noddy Tern, just as they themselves are pursued by the Frigate-bird.]

It would be interesting to know if this species breeds in Diego Garcia, because, if so, the locality would be the furthest S.W. as yet recorded.

12. Sterna fuliginosa, Linn.

[No. 7. ♀. October 8th, 1885. Eye black. Very common.
These birds were laying when I arrived on Sept. 15, and single eggs were scattered on the bare ground. The negroes soon took all the eggs, and I could not make observations on the breeding.]

13. Gygis candida (Gm.).

[No. 3. ♂. Sept. 25th, 1885.
Very common, perching in the cocoa-nut trees, and laying a single egg in the axils of the leaves, as described by Darwin in his 'Journal of Researches.']

14. Anous stolidus (Linn.).

[No. 5. ♀. October 2nd, 1885. Eye black.
Common on the island. It constructs a large rough nest of a heap of sticks and leaves, in the fork of a tree or bush, and on this it lays one egg, upon which it sits.]

[A bird called by the inhabitants the "Mangeur des Poules" was said to visit the island frequently during the N.W. monsoons, but I never saw one. Perhaps it may be *Tinnunculus punctatus*, which goes by the same name in Mauritius; but if so it is not easy to see why it should visit Diego Garcia only in the N.W. monsoons.
"Fouquets" are abundant on the Ile des Vaches marines at Peros Banhos, and are said to have been seen on the Ile des Oiseaux, Diego Garcia, but I never saw one. From the descriptions given me they seem to be a species of burrowing Petrel.]

3. On the Intervertebral Disk between the Odontoid Process and the Centrum of the Axis in Man. By J. Bland Sutton, F.R.C.S., Lecturer on Comparative Anatomy, Middlesex Hospital Medical School.

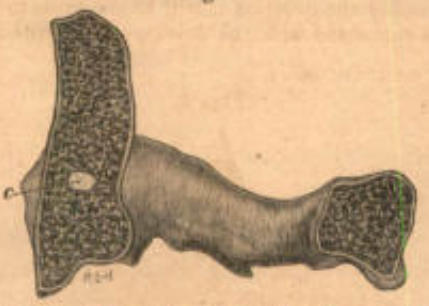
[Received May 29, 1886.]

There are few bones in the human skeleton which can boast a more extensive literature than the atlas and axis. Indeed so many investigations have been made concerning their nature, and so much has been written regarding the morphology of the first two vertebræ, that most anatomists have abandoned them for more fertile regions of the skeleton. Yet, in spite of this attention, a new fact in connection with the axis has recently been disclosed by Prof. Cunningham

in a paper published in the 'Journal of Anatomy and Physiology' for January of the present year. The object of this paper was to draw attention to the circumstance that if a section be carried vertically through the long axis of the second vertebra in an adult there will be found in the majority of cases a small strip of cartilage occupying the position indicated in the drawing (fig. 1).

Prof. Cunningham states that whilst engaged in an investigation into the curves of the spinal column in Man and the Apes he made mesial sections of a large number of frozen human spines. His

Fig. 1.



A vertical section through the body of the axis to show the lenticular-shaped piece of cartilage, *c*.

attention was attracted to a small lenticular-shaped plate of cartilage, which seemed in almost every case to be interposed between the os odontoideum and the body of the axis vertebra; on all sides it was surrounded by bone, so that it could only be brought into view by means of sections.

The observations were made on eighteen axis vertebræ, but three were eliminated on account of difficulty in ascertaining the age of the subjects. The fifteen remaining specimens were divided into three groups according to their age.

The first group comprised six axes, two from females and four from males, varying in age from twenty-four to fifty. In all the cartilage was present, measuring 4 mm. in length and 2 mm. in thickness.

The second set comprised three specimens from females, varying in age from fifty to sixty years. The cartilage was present, and of the same dimensions as in the younger bones in the previous set.

The third group consisted of six examples, two males and four females, the limits of age being from sixty to seventy. In four of the axes the lenticular disk was present, and measured in length 3 mm. and in width 1½ mm. In the two oldest examples the disk was absent.

The cartilage in the youngest specimen, a girl aged twenty-four years, was found to be of the hyaline type, with evidence in some of the sections of a sluggish ossific process around the margin; but remains of the notochord could not be detected.

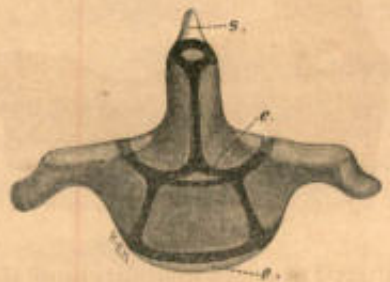
On becoming acquainted with these observations of Prof. Cunningham, I lost no time in testing the statements by independent observation, and am able to confirm them in every particular.

As in so many other instances, it is not remarkable that this piece of cartilage should exist, but that it has remained so long undetected.

My intention in bringing the subject under the notice of the Society is not merely to confirm Cunningham's statement, but to show that the presence of this piece of cartilage, in the midst of the axis, merely harmonizes with the condition of things found in situations where other vertebræ normally fuse together, as for example in the sacrum.

Before discussing the question it will be desirable to briefly review the chief facts connected with the development of the axis.

Fig. 2.



A diagram of the axis vertebra to show the various nuclei. The dotted portions represent cartilage. *s*, the suspensory ligament, marking the former position of the notochord; *e*, *e*, epiphyses.

In common with the majority of the vertebræ, the axis ossifies from three primary centres—one for the centrum, and two lateral for the laminæ and processes.

Subsequently two nuclei appear for the odontoid process, arranged side by side as represented in fig. 2. After birth these centres fuse, and an additional nucleus, detected by Prof. Humphry, is deposited for the tip of the odontoid process, usually visible about the second year. Finally two epiphysial plates appear to complete the ossification of the true centrum of the axis, as shown in the figure. As growth proceeds the various nuclei fuse, the cartilage becomes replaced by bone, except the piece referred to at the commencement of the paper, and the growth of the bone is complete. The band of fibrous tissue passing from the summit of the odontoid process represents the thickened sheath of the notochord, and is known as the suspensory ligament.

Turning our attention to the sacrum, we shall find in that bone an explanation of the persistence of the piece of cartilage which remains unossified in the axis. The sacrum in man is composed of five fused vertebræ. The body of each of the segments has its centre for the

body and two additional centres for the epiphysial plates, as in other regions of the spine. When the segments of the sacrum commence to ankylose, the adjacent epiphysial plates fuse with each other before they join the bodies of the vertebræ to which they belong. This fusion of epiphyses is of a deceptive character, for it does not occur throughout the whole width of these bony menisci, but only around their circumferences. Hence if a section be carried through the sacrum, a piece of cartilage may be detected situated in a central cavity, the boundaries of which are constituted by the epiphysial plates; this piece of cartilage persists long after the various segments of the sacrum have, from all external evidence, become

Fig. 3.

A section through the human sacrum, showing the epiphysial plates uniting with each other peripherally before fusing with their centra.

firmly united. This remarkable arrangement of the epiphysial plates is represented in fig. 3.

It is quite possible that this mode of fusion is applicable to the cervical vertebræ of Whales; for an examination of this region of the column in a young Porpoise shows well-marked indications of peripheral union of the epiphysial plates, whilst they are still separate from the bodies of the vertebræ to which they respectively belong. My attention was first drawn to this question when examining the sacral vertebræ of a young skeleton of the Great Anteater, *Myrmecophaga jubata*. After the skeleton had been macerated, the sacrum broke up into its component elements, the epiphysial plates separated from the vertebræ, but the contiguous plates were firmly united in pairs.

So far as my observations on other mammals have extended, this mode of fusion appears to be general.

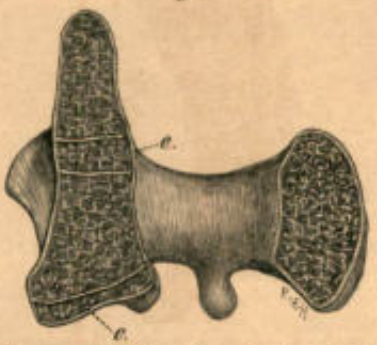
There are other points in the axis which demand some notice. I was unaware, until reading Prof. Cunningham's paper, that any

modern anatomist doubted the existence of two lateral nuclei for the main portion of the odontoid process; but if any one examine the axis of a human fœtus at the eighth month of intra-uterine life, he will have all doubts as to the duplicity of this centre removed (see fig. 2).

Another matter of considerable interest is the existence or non-existence of an epiphysial plate for the upper surface of the *true* centrum of the axis. Cunningham considers it to be absent; but it is certainly present, and may be detected in section of the axis at the time the epiphysial plates make their appearance in other parts of the spine. In Cunningham's paper reference is made to Macalister's observation that the two epiphysial plates are present in the axis vertebra of *Balænoptera rostrata*, and that it can be detected in some cases in Man. Prof. Humphry has described and figured the upper plate in a Rabbit.

On the other hand, Prof. Flower[1] figures the axis of a man with

Fig. 4.



Axis vertebra of a young Seal in section, showing the epiphysial plates of the true centrum of the axis, *e*, *e*.

these plates present, as though it were an accepted fact, but describes the upper one as being represented by irregular ossifications.

In order to test this point I have secured the axis vertebra from many young animals. As a result of the investigation, I find two epiphysial plates for the axis present in the following:—

Primates.... Man. Spider-Monkey, *Ateles paniscus*; Bonnet-Monkey, *Macacus sinicus*.
Ungulata .. Horse. Axis Deer. Giraffe. Sheep.
Carnivora .. The Leopard. The Domestic Cat. Seal.

Other anatomists have reported it in:—

Ungulata .. Fœtal Horse (Macalister[2]).
Cetacea .... *Balænoptera rostrata* (Macalister[2]).
Rodentia.... Rabbit (Humphry[3]).

[1] 'Osteology of the Mammalia.'
[2] Journal of Anat. and Physiology, vol. iii. p. 54; and Phil. Trans. 1868.
[3] 'The Human Skeleton,' p. 129.

As the upper epiphysis of the axis exists in forms so widely different as a Cat and a Whale, or a Monkey and a Horse, there can be very little doubt that it is a very general condition which has been overlooked simply because it has not been sought.

The reason why I have been able to give an account of the axis in the specimens enumerated in the preceding list is explained by the fact that for some time past I have been collecting immature axes for another purpose; thus, having a goodly stock, I utilized them for the purpose of this paper.

As a matter of convenience the following list of probable dates in the appearance of the individual nuclei of the axis is appended:—

Centres for laminæ, 8th week.
Centres for body, 12th to 16th week.
Nuclei for os odontoideum, 5th month.
Centre for tip of odontoid process, 2nd year.
Epiphysial plates, about 16th year.

By the twentieth year all parts of the bone are consolidated, except the lenticular portion between the axis and the odontoid process.

The interest of the question centres itself around the additional evidence afforded to the view that the odontoid process is the body of the atlas united with the axis, as was hinted by Cuvier, but first clearly made out by the admirable researches of Rathke[1], and subsequently confirmed by many competent observers.

P.S. (July 30th, 1886).—In the discussion which followed the reading of this paper, Mr. J. W. Hulke drew attention to the importance of the above observations in so far as they independently confirmed Prof. Albrecht's recent view expressed in a paper entitled, "Über die Wirbelkörperepiphysen und Wirbelkörpergelenke zwischen dem Epistropheus, Atlas und Occipitale der Säugethiere." (See 'Die Comptes Rendus der achten Sitzung des internationalen medicinischen Kongresses, Kopenhagen,' 1884.)

At the time my paper was read I was ignorant of Albrecht's research in this particular direction. However, a careful perusal of the paper in question convinces me that the epiphysis in the midst of the axis really represents, as Albrecht insists, two epiphyses, viz., that belonging to the cranial end of the axis and that appertaining to the caudal end of the atlas (odontoid process). Regarding the "centroidal" masses more observations are required, and the subject is one of great interest.

[1] 'Entwickelung der Schildkröten.'

4. Note on an Ectoparasite of the Menobranch.

By Prof. R. Ramsay Wright, F.Z.S.

[Received June 24, 1886.]

The specimens of *Menobranchus* recently brought by me from Toronto and presented to the Society's Collection were infested by an ectoparasitic Trematode, *Sphyranuria osleri*, mihi, which I first described in the 'Proceedings of the Canadian Institute,' Toronto, 1878. The preserved specimens on which I founded my description enabled me to determine the zoological position of this parasite, which turned out to be an interesting form intermediate between *Gyrodactylus* and *Polystomum*; but I was obliged to postpone any closer investigation into its anatomy till I had access to fresh specimens. I have recently had abundant opportunity of securing these, and I propose shortly to publish elsewhere the results of my studies.

In view of the interest attaching to a certain parallelism between the phylogeny of the Polystomidæ and that of their hosts, I take the present opportunity of referring to the desirability of examining any Urodela which may die in the Reptile House, in case of possible additions to this interesting family of Trematoda.

5. Descriptions of some new Species of Rhopalocera from the Solomon Islands.

By Gervase F. Mathew, Staff-Paymaster Royal Navy, F.L.S., F.Z.S., &c.

[Received June 11, 1886.]

(Plate XXXIV.)

During nearly a four years' Commission on the Australian Station, H.M.S. 'Espiègle' was employed for a greater part of her time among the islands of the Western Pacific, and, upon two occasions, paid brief visits to the Solomon Islands. It is to be regretted that she did not prolong her stay at this charming group, for, from the little seen of them, they appeared to be, entomologically speaking, a perfect paradise, being clothed from water's edge to mountain's peak with the most luxuriant and varied tropical vegetation.

But a serious drawback to collecting was the hostility and treachery of the natives. At many places they were cannibals, and extreme caution had to be exercised when landing—indeed at some places collecting was quite out of the question, as it would have been almost certain death to have ventured into the forest alone. When the natives have had more intercourse with white men it is to be hoped that they will become more civilized, and discontinue their, at present, unpleasant customs. Now they look upon all white men

as their natural enemies, though it is a well-known fact that this state of feeling has to a great extent been created by the white men themselves, who have committed the gravest excesses, and often deliberate murders, while engaged in obtaining recruits for the labour vessels. Until this abominable traffic is abolished it would be unsafe to land at any of the larger islands, except under the escort of a strong and well-armed party. The natives are extremely revengeful, and recollect and treasure up an injury. Their notion of justice is blood for blood, a head for a head, so that in several instances in which white men have been murdered the innocent have suffered for the guilty.

The first place we called at was Ugi, one of the smallest and easternmost islands of the group. Here, fortunately, the natives were all friendly, and an English trader (Mr. Stephens) had resided there for several years, being employed as an agent buying and collecting "copra" for some Sydney firm. There is also a small depôt for coal at this island, and our men-of-war occasionally call, and no labour traffic is permitted, so that the natives at this island were beginning to trust white men.

Ugi is about twenty miles in circumference, for the most part hilly, and covered with dense forest. In the immediate vicinity of the villages there are small clearings where yams, taro (*Caladium esculentum*), and a little sugar is cultivated. Cocoa-nut palms grow all over the island, but especially near the beach, where, in some places, their waving crests form a graceful fringe. Bread-fruit trees are also plentiful near the villages.

We anchored just off Mr. Stephens's hut, at the back of which there was about a couple of acres of ground which had been cleared a year before, but which, at the time of our visit, was overgrown with a dense mass of weeds. Here Butterflies were numerous, especially *Danais archippus* and a species of *Precis* allied to *P. ida*, *Hypolimnas bolina*, *H. alimena*, &c. A very interesting case of mimicry occurred here. A dark-brown *Euploea* with broad white outer margins (*E. brenchleyi*, Butl.), and *Danais insolata*, Butl., with markings almost identical, were fairly plentiful; but, to add to the confusion of things, a *Hypolimnas*, which on the wing might have been mistaken for either, was flying with them! Which mimicked which it was difficult to say, or the reason of the mimicry, as all three genera are avoided by birds both in the larva and perfect states.

We remained at Ugi for three days, one of which was devoted to an expedition across the island to a large village on the other side. We breakfasted early and landed at 7 o'clock—a party of five of us, some being armed. On the beach we found a couple of natives, whom we had engaged the previous evening, waiting to show us the way. After leaving Mr. Stephens's hut the trail led through the dense forest, and was so narrow that we were seldom able to walk more than one abreast. Everything at this early hour was reeking with moisture, and in some places the trees were so thick overhead that the path below was enshrouded in gloom. At first no Butterflies were seen, but as the sun gained strength the heavy dew

disappeared, and a few were noticed flying high among the branches and quite out of reach. This was very tantalizing, and we must have walked nearly two miles before the first was captured. This was *Drusilla phorcas*, Westw., a low-flying but most conspicuous black-and-white species. Species of *Danais* and *Euplæa* were the next to appear; and then, whenever we passed any open spots, Lycenidæ of various kinds became rather numerous; but altogether Butterflies could not be called abundant in this shady forest. A great many more were seen than captured, for every now and then a large *Papilio* dashed across the path, and was lost in the forest before one had time to make a stroke at it. Overhead cockatoos and parrots were screaming, and pigeons and doves cooing among the branches; but the trees were so lofty, and the leaves so thick, that it was almost impossible to see them, and only one of the latter was obtained.

Upon nearing the village, about noon, our guides set up a great shouting to apprise the inhabitants of our approach, and upon entering it we were surrounded by a crowd of naked savages, who seemed to be very pleased to see us. We walked through the village and examined the various huts, which were very well constructed, and were much better built than those we had previously met with at the New Hebrides. After seeing all there was to be seen, we sat down in the shade of one of the huts and discussed our lunch, the natives boiling our solitary pigeon and some yams which they gave us, and very good they were.

After lunch I strolled about the clearings near the village, followed by a crowd of natives, who were much interested in my proceedings, and soon began to take an active part in the sport, and it was amusing to see them running madly after Butterflies with small bushes in their hands, with which they made frantic efforts to knock them down. Of course they very often succeeded, for they were extremely nimble, and then the broken fragments were brought to me in triumph, and I had to pretend to be much pleased. Butterflies were fairly numerous in these clearings, and I captured among others several of the fine *Papilio erskinei* described further on. After the others had had an hour's rest, we started back and got on board again about six o'clock, pretty tired with our day's excursion, for in some places it was most fatiguing, especially up-hill, where the path frequently took us over slippery soap-stones, which made walking very difficult and unpleasant.

We left Ugi the following day, and after stopping for a few hours off Tesemboko in the island of Guadalcanar, proceeded to the Duke of York Islands.

Our next visit to the Solomon Islands was in September 1883, when we stayed for three days in Blanche Harbour, Treasury Island, at the entrance of the Bougainville Straits. The harbour is a very beautiful one, being almost landlocked by other small islands, all of which are hilly and densely wooded. Unfortunately it rained nearly the whole time we were there; but during the intervals of fine weather, when I was able to get on shore, I could not go very far, as I was only just recovering from a severe attack of fever, and was too

weak for much exertion. My hunting-ground was therefore confined to a slope on the hillside at the back of the native village, which had recently been cleared for yam-planting. Here Butterflies were more numerous than at Ugi; and if the weather had been more favourable, and I had been able to get about more, I believe I should have taken a large number. As it was I secured examples of several new species, *Papilio bridgei* being among them. The most plentiful were a *Precis* near *P. ada*, but very different to the Ugi form, *Hypolimnas alimena*, very fine, and several species of *Euploea*. *Danais archippus* was not seen at all in this place, although it was so common at Ugi; perhaps its migration had not yet extended so far in a north-westerly direction.

From the little I have seen of the Solomon Islands, I feel quite convinced that when they are properly worked they will yield a large number of new and interesting Rhopalocera, and I hope on a future occasion to be able to describe some more new species.

Argyronympha, n. gen.

Head moderately large, hairy between the eyes; eyes rather prominent, smooth; antennæ long, slender, extending to beyond two thirds of costa, with a long, gradually-thickened club; palpi conspicuous, pea-green, porrect, ascendant, clothed outwardly at their base with fine short white hairs, the hairs less numerous towards the tip and dark grey; tip black, finely pointed: thorax rather short: abdomen almost as long as hind wings, slender, pinched in at base, and with a brush-like tuft of hairs at base of genital organs in male. Fore wings rather long and narrow in male, broader in female; costa moderately arched, convex at base; apex somewhat acute in male, truncated in female; hind margin entire, oblique; inner margin straight, hairy to beyond the middle; anal angle slightly obtuse; nervures of fore wings dilated at base; cell narrow, rather long; first subcostal nervule emitted just before end of cell; discocellular nervules pointing outwards; median nervure and first discocellular nervule forming a moderately acute angle. Hind wings: costa elbowed at base, very slightly concave at one third, and rounded off at apex; hind margin very moderately sinuate; inner margin slightly grooved. First pair of legs imperfect, rather pubescent, pale green; second and third pairs long, slender, smooth.

This interesting genus does not appear to come very near any yet described, but bears some relationship to *Hypocysta*, Westw., and *Nissanga*, Moore.

These beautiful little Butterflies were local in their habits and of retiring disposition, frequenting shady spots in the dense forest. When disturbed, they flew but a short distance and settled upon the leaf of some low shrub, always on its upper surface. They were rather restless, and generally walked several times round the margin of the leaf, and then flitted off to the next. While so engaged their wings were kept erect, and the bright metallic spots and stripes made them very conspicuous.

ARGYRONYMPHA UGIENSIS, n. sp. (Plate XXXIV. fig. 3.)

Male and female.—Upperside orange-red: *primaries* with a black marginal border extending on costa from end of cell to rather beyond middle of inner margin; border very broad at apex, constricted and narrowest at second median nervule, widening out again at first median nervule: *secondaries*, costa blackish brown, base and margins broadly clouded with dusky, and with some indistinct dusky markings across disk; a black and rather indistinct submarginal line widening out between subcostal nervules into a linear-shaped blotch; all the nervures dusky. *Underside*: *primaries* orange-red, not quite so bright as upperside; a submarginal silvery stripe bordered outwardly by a narrow very dark fuscous line; a short oblique silver stripe extends from inner margin near hinder angle to halfway between first and second median nervules, and with its apex almost touching the submarginal stripe: *secondaries*, basal half greyish ochreous, thickly irrorated with minute black dots; an oblique reddish-brown stripe from near costa crosses the wing, and encloses upper part of cell and terminates near anal angle; this is bordered outwardly by a curved or double crescent-shaped silvery band, which is again bordered by a pale ochreous-yellow band; a narrow submarginal line of silver bordered outwardly by reddish ochreous, and inwardly, from submedian nervure to discoidal nervule, by reddish brown; between the discoidal nervule and first subcostal nervule there are four jet-black and somewhat square-shaped spots, with their bases resting on the submarginal line; between first and second subcostal nervules are two additional black spots, above the others, the space between them, which is ochreous, forming a complete St. George's Cross, and the whole inwardly bordered by a silvery band; between submedian nervure and two median nervules a silvery horseshoe-mark bordered outwardly and inwardly by reddish brown; all the wings margined by a line of dark reddish brown. The silvery markings have opalescent tints in various lights.

Exp. 42 millim.

Hab. Ugi, Solomon Islands.

ARGYRONYMPHA PULCHRA, n. sp. (Plate XXXIV. fig. 4.)

Male and female.—Upperside dark brown; basal third of fore wings reddish brown. *Underside*: *primaries*, basal portion, including cell and a little beyond on costa and inner margin, grey, thickly irrorated with minute black dots; a silvery submarginal band from rather before apex on costa to hinder angle, where it forms an elbow and turns back and runs parallel to itself as far as third median nervule, this is bordered inwardly by dark chestnut; a pale yellowish stripe from near apex to first median nervule, its lower half between the silver bands; beyond this to grey part of wing a broad band of chestnut: *secondaries*, basal part, including half of cell to near anal angle, grey, thickly irrorated with minute black dots; beyond this a band of chestnut from inner margin two thirds across wing towards anal angle; this is bordered outwardly by an elbowed stripe of silver

which is continued round by anal angle, forming a submarginal stripe, to apex, whence it forms a curve as far as discoidal nervure; a silver Λ-shaped mark between second median and discoidal nervule, the bases nearly resting on submarginal stripe; a subcrescent-shaped silver stripe near anal angle divided by first median nervule; four small square black confluent spots just above submarginal stripe, between discoidal and second subcostal nervules; above these, two ochreous lunules bordered above, as far as outer edge of silvery curved band, by a large black irregularly-shaped blotch; space between arms of Λ-shaped mark, and inner edge of submarginal stripe between second median nervule and submedian nervure, deep chestnut; a large black lunular spot between first and second median nervules, its inner edge touching the subcrescent-shaped silver stripe. Thorax reddish brown; some bluish-green hairs on collar and between eyes; eyes dark reddish brown, bright red when the insect is alive.

Exp. 39 millim.

Hab. Treasury Island, Solomon Islands.

PAPILIO XENOPHILUS, n. sp.

Male.—Upperside dark brown: *primaries*—a straw-coloured transverse marginal band slightly curved inwards towards the apex, straight on the outer edge and nearly parallel with hind margin, rather clouded on inner edge; nervures crossing band dark brown and clouded at their edges: *secondaries* tailed, scolloped; a straw-coloured transverse and somewhat outwardly dentated band from costa, near apex, to inner margin just above anal spot; anal spot indistinct, composed above of blue and below of pinkish-yellow atoms; indentations whitish. *Underside*: *primaries*, same as above but band paler: *secondaries*, no band, but instead a series of seven whitish-yellow spots, the three near anal angle and one at apex near costa small and indistinct, the other three large and oblong-oval; beyond these spots patches of bluish atoms; a marginal row of indistinct orange-yellow spots, above each of which is a cloudy pyriform blotch; an orange-yellow spot at anal angle, bordered above by a few blue atoms.

Exp. 110 millim.

Hab. Ugi, Solomon Islands.

This species comes near *P. capaneus*, Westw., but differs in having the bands right across the wings, and in the markings of the underside.

PAPILIO ERSKINEI, n. sp. (Plate XXXIV. fig. 1.)

Male.—Upperside greenish black: *primaries* with a marginal band of eight large creamy-yellow spots curved inwards at the apex, extending from subcostal to submedian nervure, and with indications of another spot between submedian nervure and inner margin, and a short dash of the same colour between the subcostal nervure and costa, and just above the subcostal spot; base of cell dusted with a

few minute yellowish atoms: *secondaries* not tailed, margins scolloped; a broad transverse outwardly-sinuated greenish creamy-white fascia, its inner margin touching, but not extending into, discoidal cell; a conspicuous orange-red oval spot at anal angle. *Underside* black: *primaries* with four white apical spots, and a whitish streak at base of cell: *secondaries* with a row of seven orange-red marginal spots, the one at anal angle being much the largest, and above these a series of six lunules composed of pale-bluish atoms; indentations pale yellowish.

Exp. 144 millim.

Hab. Ugi, Solomon Islands.

This fine Butterfly belongs to the *Erectheus* group. It was tolerably common at Ugi in June 1883, but difficult to catch on account of its powerful flight, and its habit of keeping in the thick forest, where it could not be easily followed. I saw several of what I believe were the females of this insect; they were much larger than the males, of a dark brown, and with more white across the wings.

I have named this species in honour of Admiral James E. Erskine, who commanded the Australian Squadron at the time I was on the Station.

PAPILIO BRIDGEI, n. sp. (Plate XXXIV. fig. 2.)

Male.—Upperside deep black, appearing greenish black in certain lights: *primaries*, a marginal band of eight somewhat square-shaped pale greenish-white spots curved inwards at the apex, the apical spots being small and indistinct; base of cell and apex dusted with a few whitish atoms: *secondaries* not tailed, scolloped; a broad transverse outwardly-dentated pale greenish-white fascia, its inner margin enclosing lower part of cell, and its upper portion running between costa and subcostal nervure nearly to base. *Underside* black: *primaries*, subcostal nervure inwardly bordered by a narrow whitish streak from base to near middle of cell; a few whitish atoms at apex: *secondaries*, a marginal row of seven pale pinkish-orange spots, the three nearest the apex small and obscure, the one at anal angle large and nearly square-shaped; above these a row of seven ill-defined lunules of pale-bluish atoms, the one at apex nearly obsolete; indentations conspicuous, white, crescent-shaped.

Exp. 118 millim.

Hab. Treasury Island, Solomon Islands.

This is another fine species, and also belongs to the *Erectheus* group. It was not uncommon, but, like *P. erskinei*, frequented the thick forest and was difficult to capture. I only obtained one, a very perfect example. I saw a larger insect, of a dark brownish-black hue and with larger spots and fascia, which was probably the female of this.

I have named this species in honour of Captain Cyprian A. G. Bridge, who commanded H.M. ship 'Espiègle' during her long and interesting Commission of nearly four years, a great portion of which time was spent among the islands of the Western Pacific.

PAPILIO HICETAON, n. sp.

Male.—Upperside deep olive-brown: *primaries*, an oblique row of nine spots from apex to inner margin, the spot contiguous to inner margin greenish yellow, the remainder paler; a submarginal row of five small pale-yellow spots between subcostal, discoidal, and first and second median nervules; two small spots outside upper end of cell, and another larger spot beyond, near the apex; the cell contains six spots and streaks, at the base a long oblique streak pointing towards the apex, next a minute perpendicular dash, this is followed by two narrow subcrescent-shaped spots near subcostal nervure, and at end of cell two spots, the upper irregular in shape, the lower oval, all these spots yellow with the exception of basal streak which is pale green: *secondaries*, basal half light brown, dotted with golden-brown atoms, the rest deep velvety brown, the nervules paler; a small suboval and slightly raised patch of scales at upper end of cell; inner margin and base thickly clothed with fine golden-brown hairs. *Underside*: *primaries*, same as above, but spots paler, and row of submarginal spots extends to inner margin; a small crimson streak at base: *secondaries*, a large and somewhat square-shaped pale-green spot at base, bisected by subcostal nervure and bordered outwardly by black and crimson; an opalescent lunule with dusky pupil at upper end of cell; a discal band of dusky lunules, bordered below with some metallic-blue atoms, the lunule at anal angle edged above with crimson atoms; apex with marginal patches of opalescent atoms; fringes reddish.

The primaries are narrow, and the costa is much arched.

Exp. 100 millim.

Hab. Ugi, Solomon Islands.

Near *P. browni*, but quite distinct.

EXPLANATION OF PLATE XXXIV.

Fig. 1. *Papilio erskinei*, ♀, p. 348.
2. —— *bridgei*, ♀, p. 349.
3. *Argyronympha ugiensis*, ♂, p. 347.
4. —— *pulchra*, ♀, p. 347.

6. Notes on some Birds from Perak. By R. BOWDLER SHARPE, F.L.S., F.Z.S., &c., Zoological Department, British Museum.

[Received June 15, 1886.]

Thanks to the exertions of Mr. Davison, who explored the western side of the Malayan peninsula, we have a tolerably complete list of the birds of this portion of the Indian Region, and a list of his collections has been given by Mr. Hume ('Stray Feathers,' 1879, pp. 37, 151). The series of Malayan birds in the Hume Collection, now in the British Museum, is an extremely valuable one, and it is

to be regretted that Mr. Davison was never able, through political obstacles, to reach the mountains on the eastern side of the peninsula and explore the high ridge or "backbone" which runs down its entire length. Considerable speculation has been excited respecting the fauna of these Malayan mountains, because all the collections hitherto made in Malacca have proved that, as regards the birds, there are very few species which are not common to Borneo, Sumatra, and the Malayan peninsula. Sumatra, however, has always enjoyed a certain distinction from possessing at least one genus, *Psilopogon*, peculiar to itself; and, again, in the mountains several Himalayan genera have been found with species identical with, or only slightly differing from, those which occur in the Eastern Himalayas and extend down the mountains of Tenasserim. Many Malayan species range into the southern portions of the last-named province; but as regards the Himalayan genera, such as *Niltava*, *Liothrix*, *Pnoepyga*, *Sibia*, &c., all traces of them are lost after leaving Tenasserim until they turn up again in Sumatra.

Many prognostications have been made that when the mountains of the Malayan peninsula were explored, the above-named genera and many others common to the mountains of Tenasserim and Sumatra would be found to extend along the eastern side of Malacca; but of this the first actual proof has been furnished by Mr. L. Wray, who has sent a small parcel of birds from the mountains of Perak to the British Museum. Although so few in number, the revelations which they disclose are of the greatest value, for they show that in Perak, at least, and probably throughout the mountain-range, there is a curious mixture of Himalayan and high-Sumatran forms. Thus the *Psilopogon*, hitherto supposed to be a peculiar Sumatran genus, is accompanied by *Rhinocichla mitrata* (*Ianthocincla mitrata*, auct.), another species hitherto believed to be confined to Sumatra; and the *Sibia* is also the Sumatran *S. similliina*, and not *S. picata*. The affinities of the Perak species being therefore so markedly Sumatran, it is not a little surprising to find that the *Mesia* is *M. argentauris* of the Himalayas, and not *M. laurinæ* of Sumatra as one would have expected.

The following is a list of the specimens sent by Mr. Wray, who informs us that they were mostly obtained at an elevation of 3000 feet, and that his native collector, after an experience of 30 years' work, had not met with some of the species before.

Fam. Muscicapidæ.

Niltava grandis, Hodgs.; Sharpe, Cat. B. iv. p. 404.

"No. 11. Male. Irides red; legs and feet nearly black; beak black. The female is brown, with a blue spot on each shoulder and a patch of ash under neck; head blackish and slightly glossed with blue. Specimens obtained at 4000 feet."

Compared with males from Sikhim and Tenasserim in the Hume Collection, and apparently identical in every respect.

RHINOCICHLA MITRATA (S. Müll.); Sharpe, Cat. B. vii. p. 452.

Ianthocincla mitrata, Bp. Consp. i. p. 371.

"No. 12. Males. Irides brown; beak orange; legs yellow; skin under eye pure white. Common above 3000 feet."

Two specimens sent, identical with others in the Museum from Sumatra, to which island the species has hitherto been supposed to be confined.

Fam. TIMELIIDÆ.

HYDROCICHLA RUFICAPILLA (Temm.); Sharpe, Cat. B. vii. p. 319.

Henicurus ruficapillus, Temm. Pl. Col. iii. pl. 534.

"No. 17. Female. Irides brown; legs nearly white; beak black; Rocky streams in the jungle on the hills."

Agrees with the females of this species as described by Messrs. Hume and Davison.

SIBIA SIMILLIMA (Salvad.); Sharpe, Cat. B. vol. vii. p. 402.

Heterophasia simillima, Salvad. Ann. Mus. Civic. Genov. xiv. p. 232.

"No. 13. Female. Iris brown; beak black; legs plumbeous. Flies about among the tops of trees in parties of from 20 to 30. Above 3000 feet."

The two specimens sent agree precisely with a Sumatran example in the British Museum collected by Mr. Carl Bock.

MESIA ARGENTAURIS, Hodgs.; Sharpe, Cat. B. vii. p. 642.

"No. 10. Female. Iris brown; feet and beak of same colour as throat of female. Male bird has red under tail-coverts; throat orange. From the hills of Perak over 3000 feet. Flies about in small parties of 10 or 12."

The female sent is absolutely identical with Himalayan specimens, and the note given by Mr. Wray as to the colouring of the male also suits the Himalayan bird and does not agree with the Sumatran *M. laurinæ*, Salvad. (Ann. Mus. Civ. Genov. xiv. p. 231), which is the species one would have expected to find along with *Sibia simillima*.

Fam. CAPITONIDÆ.

PSILOPOGON PYROLOPHUS, S. Müll.; Marshall, Monogr. Capit. p. 133, pl. 53.

"No. 14. Male and female. Iris brown; legs dull green; bare skin under eye green. On the hills over 3000 feet."

This species has only been recorded from Sumatra up to the present time.

Fam. ALCEDINIDÆ.

CARCINEUTES PULCHELLUS (Horsf.); Sharpe, Monogr. Alced. p. 251, pl. 96.

"No. 16. Male. Irides white; bare skin under eye pale brown;

beak crimson-red. Had just caught and partly eaten a large spider."

Fam. TROGONIDÆ.

HARPACTES DUVAUCELI, Temm.; Gould, Monogr. Trogon. 2nd ed. pl. 40.

"No. 15. Male. Irides brown; bill pure cobalt-blue. Hills up to about 2000 feet."

7. Notes on Specimens in the Hume Collection of Birds. By R. BOWDLER SHARPE, F.L.S. &c.

[Received June 18, 1886.]

(Continued from p. 97.)

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No. 2. *On some Rose-Finches.*

In 1881 Colonel Biddulph (Ibis, 1881, p. 156, pl. vi.) noticed the differences between the large Rose-Finches of Yarkand and those of the Gilgit district, in which he had been resident for some time, and named the former bird *Propasser rhodometopus*. Having lately had occasion to examine the series of Rose-Finches in the Hume Collection, I was able to discriminate the *P. rhodometopus* of Biddulph as distinct from *P. rhodochlamys* of Indian authors, from the Himalayas. The two species are very nearly allied, but the Yarkand bird has silvery pointed feathers on the forehead, which the Himalayan bird has not.

At the same time Colonel Biddulph has, I believe, fallen into an error in his identification of the true *P. rhodochlamys* of Brandt, which was described from the Altai Mountains, and appears to me to be identical with the Yarkand bird, but not with *P. rhodochlamys* (so-called) from the Himalayas.

Brandt in his original description (Bull. Phys.-Math. Acad. Sci. St. Pétersb. 1843, p. 363) distinctly says "Pennæ *frontales*, *verticis*, gutturis &c. acuminatæ;" and this seems to point undoubtedly to the species afterwards called *P. rhodometopus* by Biddulph. Consequently the Himalayan species must require a separate designation, which is forthcoming in *Propasser grandis* (Blyth, J. A. S. Beng. xviii. p. 810).

Mr. Seebohm has lent me specimens of *Carpodacus rubicillus* from the Caucasus, and on comparing them with examples of so-called *C. rubicillus* from Turkestan and Yarkand, which have the back almost entirely uniform, and narrow black shaft-streaks on the under tail-coverts, I find that the two species are not identical.

Both races are figured by Gould in the 'Birds of Asia,' but, like other ornithologists, he considered the differences between them to be of insufficient specific value. They are, however, so well marked that I propose the name of *Carpodacus severtzovi* for the Central-Asian bird, and Mr. Seebohm agrees with me that it ought to have a different name from that of the Caucasus form (*C. rubicillus* of Güldenstädt).

No. 3. *On* Lalage melanothorax, *Sharpe*.

In registering and arranging the splendid series of Campophagidæ in the Hume Collection, I naturally looked out for additional specimens of the fine *Lalage* which I described in 1879, from Madras, naming it *Lalage melanothorax* (Cat. B. iv. p. 91).

Not finding any additional specimens in the Hume Collection, I had another look at the type in the British Museum, and at once recognized that it must be an artefact! The body is that of *Lalage sykesi*, but the head and neck are those of *Buchanga atra*. That I should not have noticed this before is as surprising as the fact that I have shown the specimen to many ornithological friends, most of them intimately acquainted with the two species above mentioned, and that none of us have detected the fraud. On re-examining the specimen, as I have done many times before, it is impossible to detect where the birds have been joined together. *Lalage melanothorax*, however, is a name to be suppressed.

No. 4. *On some Flycatchers of the Genus* Siphia.

Seven specimens of *Siphia olivacea* (Hume) are in the Hume Collection, and I find that I had rightly identified the species in the 'Catalogue of Birds,' vol. iv. p. 458.

Cyornis albo-olivacea, Hume, Str. F. 1877, p. 488, is *Setaria pectoralis*, Salvad. Ucc. Born. p. 233, and *Rhinomyias pectoralis* of my 'Catalogue,' vol. iv. p. 368.

Cyornis poliogenys, Brooks, Str. F. 1878, p. 469, seems to be a good species, and is closely allied to *S. olivacea* (Hume), but has a grey head and face, and is orange-rufous on the breast, the throat also being washed with the same colour and not white as in *C. olivacea*. This species will have the following synonymy:—

SIPHIA POLIOGENYS.

Cyornis poliogenys, Brooks, Str. F. 1879, p. 469.

Siphia cacharensis, Madarász, Zeitschr. ges. Orn. i. p. 52, Taf. 1. fig. 2 (1884).

Hab. Sikhim Terai (*W. E. Brooks*); Bhootan Dooars (*Mandelli*); Dibrughur, Assam (*J. R. Cripps*); Shillong; Cachar (*A. O. Hume*); Manipur (*A. O. Hume*); Tippera.

The plate of *Siphia cacharensis* does not agree with the description. The latter, however, is very good, and leaves no doubt as to the identity of the species.

8. On Lepidoptera collected by Major Yerbury in Western India. By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Received June 25, 1886.]

(Plate XXXV.)

Major Yerbury has recently presented to the Museum a fine series of Lepidoptera collected by himself at Campbellpore; along with the specimens he has forwarded numerous notes of considerable interest; therefore it is the more desirable that an account of the collection should be published. Unfortunately some of the specimens were pinned, and amongst these were several specimens of *Caligula simla*; the usual result naturally followed—the abdomen of one of these large Saturniids broke off, and not only more or less damaged the other specimens of this species, but made such havoc amongst some of the smaller Moths as to render their identification hopeless.

Major Yerbury has sent the following notes on the various localities mentioned by him:—

"*Campbellpore*. A military station about 40 miles from Rawal Pindee. Height above sea-level, 1200 ft.; situated on a cultivated sandy plain. The river Haro flows past the cantonment at a distance of about 2 miles to the southward and eastward; the country across the river is very much broken up by water-courses and with rocky spurs running down to the river.

"*Attock*. A military station to the N.W. of Campbellpore and 12 miles off; situated among barren hills on the banks of the Indus.

"*Khairabad*. Railway-station across the Indus, opposite Attock; barren hills all round.

"*Lawrencepore*. An abandoned military station 9 miles from Campbellpore, on the banks of the Haro.

"*Chittar Pahar*. A range of hills running east and west; the nearest point to Campbellpore about 7 miles across Haro. The highest peak of this range is about 3600 ft., but Kala Dilli, Lumbahdun, and other places mentioned are probably only from 1500 to 1800 feet above sea-level. Limestone, thickly covered with vegetation to the north; barren, with scattered bushes of baubul and jinnetta, on the south side.

"*Thundiani*. Hill-station near Abbottabad (8700 feet?).

"*Kala Pani*. Stage between Thundiani and Abbottabad (6000 feet?).

"*Bugnoter*. First stage from Abbottabad on the Abbottabad and Murree road (6000 feet?).

"Murree and Rawal Pindee road.—*Tret*, 5000 feet?, first stage from Murree; *Chittar*, 3000 feet?; *Barracoo*, 2500 feet, second stage; *Rawal Pindee*, 1800 feet?

"*Dewal*, 6000 feet; first stage on Murree and Cashmere road.

"*Hassan Abdal*, 1600 feet?; midway between Rawal Pindee and Campbellpore.

"*Nisan Jani*. Mountain near Kalabagh, Abbottabad and Murree road; highest point nearly 10,000 feet."

The collection contains examples of 178 species, many of them represented by a fair series of specimens, mostly identified for the collector (but frequently erroneously) by Mr. de Nicéville. Six of the Butterflies and nineteen of the Moths are described as new, and several other species probably new to science, but in bad condition, are indicated in order to show that there is still much to be done in that part of India by any one who will take the trouble to collect Lepidoptera.

Nymphalidæ.

Euploeinæ.

1. Limnas chrysippus.

Papilio chrysippus, Linnæus, Syst. Nat. 1758, p. 471.

♂, Campbellpore, 19th and 26th July, 1885; ♀, 20th June and 26th July, 1885; Dewal near Murree, 24th August.

One of the females has a tawny subapical patch beyond the white band on primaries, exhibiting a slight tendency to modification in the direction of *L. klugii*.

1 a. Limnas alcippoides.

Limnas alcippoides, Moore, P. Z. S. 1883, p. 238, pl. xxxi. fig. 1.

♀, Campbellpore, 17th and 21st June and 18th July, 1885.

The specimens of this form obtained by Major Yerbury tend to confirm my expressed opinion that it is a reversional sport of *L. chrysippus*; the three specimens differ as follows:—

a. Primaries as in *L. alcippus*; secondaries with the veins, internal area, and centre of median interspaces snow-white.

b. Primaries as in *L. chrysippus*; secondaries with the veins, internal area, and centre of median interspaces whitish.

c. Primaries as in *L. chrysippus*; secondaries above pale, below white.

Major Yerbury says of *L. chrysippus*:—"Very common, May, June, July, October, November, December. Caterpillar common in July, feeds on *Calotropis gigantea*; agrees with the description given in 'The Butterflies of India,' and appears to be the same as that reared at Aden, where it fed on either this or some closely allied plant." Of *L. alcippoides* he says:—"Some eight specimens taken in all during May and June 1885; varies greatly in the amount of white on the hind wing."

2. Limnas klugii.

Limnas klugii, Butler, P. Z. S. 1885, p. 758. n. 2.

Euploea dorippus, var., Klug, Symb. Phys. pl. 48. fig. 5.

♀, Campbellpore, 11th June, 1885.

"Not so common as *L. alcippoides*; only four specimens taken during May and 2nd to 11th June, 1885. All these specimens have curious leprous-like spots on their wings."—*J. W. Y.*

I am surprised to find that this species extends so far to the east as Campbellpore; that it is rare (where *L. chrysippus* is common) is only natural, if this is the limit of its range eastward from Afghanistan. I cannot agree at all with Col. Swinhoe's statement that typical *L. dorippus* is variable; I never saw a doubtful specimen.

Satyrinæ.

3. Aulocera saraswati.

Satyrus saraswati, Kollar in Hüg. Kaschm. iv. 2, p. 445, pl. 14. figs. 3, 4 (1848).

♀, Dewal, 26th August; ♂ ♀, Murree, 5th September, 1885.

"Common at Murree in August. Some of those obtained towards Thundiani, though under this number (42) were noted by De Nicéville as *A. padma*."—*J. W. Y.*

The four examples sent to us by Major Yerbury are all typical *A. saraswati*. *A. padma* is so perfectly distinct from that species, that Mr. de Nicéville can hardly have mistaken one for the other; at the same time I cannot include it without proof.

4. Aulocera swaha.

Satyrus swaha, Kollar in Hüg. Kaschm. iv. 2, p. 444, pl. 14. figs. 1, 2 (1848).

♂, Murree, 8th and 28th August and 8th September; Atabul, 9000 feet, 16th September; Thundiani, 24th September.

"Common at Murree in August and September; found higher up the hill than *A. saraswati*."—*J. W. Y.*

The six specimens received are all males.

5. Hipparchia parisatis.

Satyrus parisatis, Kollar, Denkschr. Akad. Wien, math.-nat. Cl. i. p. 52. n. 7 (1850).

♂ ♀, road between Bugnoter and Abbottabad, 4000–5000 feet, 20th September; ♀, between Abbottabad and Kala Pani, 25th September, 1885.

"Common between Bugnoter and Abbottabad; also on the lower slopes of Thundiani; seen near Tret, 8th October, 1885."—*J. W. Y.*

6. Lethe dyrta.

Debis dyrta, Felder, Reise der Nov., Lep. p. 497. n. 860 (1867).

♂, Bugnoter, 19th September, about 4000 to 5000 feet; between Bugnoter and Abbottabad, 20th September; Kala Pani, about 5000 feet, on 24th; Tret, 8th October, 1885. ♀, between Murree and Tret, on same day.

"Two specimens taken at Dewal, 26th August; afterwards found commonly below Bugnoter, 20th September, and between Abbottabad and Kala Pani."—*J. W. Y.*

The specimens sent are all males excepting one dwarfed example.

7. AMECERA SCHAKRA.

Satyrus schakra, Kollar in Hüg. Kaschm. iv. 2, p. 446, pl. 15. figs. 3, 4 (1848).

♂ ♀, Murree, 4th, 5th, and 11th August, and 7th September; ♂, between Abbottabad and Kala Pani, 25th September, 1885.

"Very common in August and September. Found all along the hill as far as Thundiani, and as low as Tret and Bugnoter; probably not above 5000 feet."—*J. W. Y.*

8. CALLEREBIA ANNADA.

Erebia annada, Moore, Cat. Lep. E.I. Co. Mus. i. p. 226. n. 475 (1857).

♂ ♀, between Abbottabad and Kala Pani, 25th September, 1885.

"Not uncommon about Kala Pani; here its habits appeared different from those of *Callerebia* in general, as it was flying about over stones and low bushes, not affecting the shade; near Tret (8th October), however, it affected the shade much like *C. nirmala* and *C. daksha*."—*J. W. Y.*

It is an interesting fact that Major Yerbury sends the above species under the name of "*C. hybrida*;" because his identifications are, to a great extent, derived from Mr. de Nicéville. A short time since I was severely taken to task for having described *C. hybrida* as a species (not that I ever did so, for I distinctly stated my opinion that it was a hybrid and an inconstant one); now if the gentleman who attacked me obtained his identification from the same source, it is clear that what he considered a very bad species is *C. annada*. Who shall decide this point?

9. CALLEREBIA NIRMALA.

Erebia nirmala, Moore, P. Z. S. 1865, p. 501. n. 91.

♂ ♀, Murree, 6th, 9th, and 12th August, 1885.

"*Callerebia daksha* and *nirmala*. These two species appear to me to merge into one another. They were common at Murree in shady places in August 1885."—*J. W. Y.*

Major Yerbury sends seven specimens, some of them rather worn, but all perfectly typical *C. nirmala*; whether the female has been identified for him as *C. daksha* or whether he actually possesses the latter species, I cannot say; but I am much inclined to accept the first as the more probable explanation of his note. I should be glad to obtain specimens of *C. daksha* for our collection, as we only have one male labelled by Mr. Moore and received from him in 1877; from this one specimen it is impossible to decide how far the differential characters of the species can be relied upon; if constant, they are amply sufficient to distinguish it from *C. nirmala*.

10. YPTHIMA ORDINATA.

Ypthima ordinata, Butler, P. Z. S. 1880, p. 148, pl. xv. fig. 3.

♂ ♀, between Abbottabad and Kala Pani, 25th September, 1885. ♀, between Murree and Tret, 1st October.

"Common on the 25th September about Kala Pani and on the road between Abbottabad and Bugnoter."—*J. W. Y.*

The incorrect identification of *Y. avanta* has been given to Major Yerbury for this species; though common in India, it is a very rare species in European collections, as also is *Y. avanta*—a smaller Butterfly, more nearly resembling *Y. newboldi* in form, the under surface of its wings ash-grey, densely striated with brown and distinctly crossed by olive-brown bands; the ocelli of the secondaries small, oval, and with large silver pupils.

The four (unfortunately rather worn) specimens in the present collection, though they differ from one another in minor details, correspond in all their principal features with my type of *Y. ordinata*.

11. YPTHIMA NAREDA.

Satyrus nareda, Kollar in Hüg. Kaschm. iv. 2, p. 451 (1848).

♂, Dewal, 26th August, 1885.

"Common at Murree in August."—*J. W. Y.*

12. YPTHIMA SAKRA.

Ypthima sakra, Moore, Cat. Lep. E.I. Co. Mus. i. p. 286. n. 508 (1857); Hewitson, Trans. Ent. Soc. ser. 3, vol. ii. pl. 18. fig. 18 (1865).

♂, Murree, 12th September; Thundiani, 24th September, 1885.

"*Ypthima nikæa*. Dewal, 26th August. Not uncommon about Murree and towards Thundiani, end of August and beginning of September. The form *Y. sakra* (differing in having no intervening yellow bands to the ocelli) was also obtained."—*J. W. Y.*

The true *Y. nikæa* is unknown to me, but Mr. Moore describes it as having the "underside grey," whereas in this species (*Y. sakra*) it is distinctly yellow; he also says that the apical ocelli of the hind wings are "joined together, though having a yellow band between them," the only part of this description which is to me unintelligible, but to which Major Yerbury evidently refers as the distinctive character between the two named forms. In the Hewitson cabinet there is a series of five *Y. sakra*, the smallest specimen, labelled "*nikæa*, M.," differing in having the two apical ocelli separate though enclosed in an 8-shaped yellow zone: though the under surface is still yellow instead of grey, this may be the typical *Y. nikæa*; if so, it is connected with *Y. sakra*, of Marshall and De Nicéville, by one of the two specimens now sent, in which the ocelli, though not absolutely confluent, touch one another upon the vein as in Hewitson's figure. Hewitson's type of *Y. sakra*, therefore, is clearly one of these intermediate specimens.

NYMPHALINÆ.

13. HYPOLIMNAS MISIPPUS.

Papilio misippus, Linnæus, Mus. Lud. Ulr. p. 264 (1764).

♂, Campbellpore, 9th November, 1885.

"Flew to light at night during R. A. Mess." "Rare: only four specimens in all taken—3 ♂ and 1 ♀. November and December."—*J. W. Y.*

14. Sephisa dichroa.

Limenitis dichroa, Kollar in Hüg. Kaschm. iv. 2, p. 429, pl. 8. figs. 1, 2 (1848).

♀, Muree, 11th August, 1885.

"Not common; some half-dozen specimens, nearly all damaged, taken at Murree (9th and 11th August), all on the trunk of the same tree—a species of willow. Two or three seen on the wing: the flight appears to be particularly rapid."—*J. W. Y.*

15. Athyma opalina.

Limenitis opalina, Kollar in Hüg. Kaschm. iv. 2, p. 427 (1848).

♂, Murree, 5th and 12th August; ♀, 1st October, 1885.

"Fairly common at Murree in August."—*J. W. Y.*

16. Neptis mahendra.

Neptis mahendra, Moore, P. Z. S. 1872, p. 560, pl. 32. fig. 3.

♂, Murree, 13th August; ♀, 8th September, 1885.

"Common at Murree, August and September; seen as far as Thundiani."—*J. W. Y.*

The following species was sent under the same number and name (*N. mahendra*), but is perfectly distinct both in pattern and coloration, being more nearly allied to *N. nandina* of Darjiling and Nepal, which it apparently represents in Western India.

17. Neptis yerburii, sp. n.

♂. Wings above of the size, form, and general aspect of *N. mahendra*, but the discoidal streak and spot beyond it as in *N. duryodana*, which it also resembles in having a pale irregular line across the primaries between the discal and submarginal spots, and a pale submarginal line on the secondaries. It differs from both species in having a complete submarginal series of white spots on the primaries, and a pale line through the centre of the black belt on the secondaries; further, it differs from *N. mahendra* in the greater obliquity of the subapical discal spots of the primaries: on the under surface the markings are very different, corresponding in almost all respects with those of *N. nandina*; the brown colouring, however, is olivaceous instead of rufous, and the brown belt across the secondaries does not taper towards the costa as in the Darjiling insect. Expanse of wings 54 millim.

Murree, 16th August, 1885.

As we possess Moore's types of *N. nandina*, and as this species is certainly confounded with others in at least one large collection, it may be useful to point out that it is more closely allied to *N. soma* (the types of which we also have in the Museum) than to any other named species; in fact it differs from the latter only in its broader and yellower whitish bands and larger spots (of the same colour); the ground-colour below is a shade darker, but of a similar rufous hue. It is a larger, longer-winged species than *N. yerburii*, has narrower bands and spots on the upper surface, and these markings are of a sordid yellowish tint instead of being snow-white.

18. Vanessa charonia.

Papilio charonia, Drury, Ill. Ex. Ent. i. pl. 15. figs. 1, 2 (1773).

Murree, 22nd August and 10th September; Dewal, 26th August.

"Common at Murree in August and September; found along this hill as far as Thundiani, also at Dewal.

"This butterfly is fond of pitching on the trunks of trees, particularly of the ilex when the tree has been wounded and the sap is exuding. I have taken several in company with *Pyrameis indica* and a large greenish beetle (*Cetonia*, sp.?) while thus engaged."—*J. W. Y.*

19. Vanessa kaschmirensis.

Vanessa kaschmirensis, Kollar in Hüg. Kaschm. iv. 2, p. 442, pl. 11. figs. 3, 4 (1848).

♂ ♀, Mir Jani above Kalabagh, about 9000 feet, 16th September; ♂, Thundiani, 23rd September, 1885.

"Rare in Murree, ten specimens taken end of August; very common at the top of Thundiani, 23rd to 24th September."—*J. W. Y.*

Major Yerbury sent us two perfect specimens and one much broken; in their fresh condition I hardly recognized them as conspecific with the dingy series of very old specimens in the Museum, and I much regret that our good friend did not send as long a series of this species as of *Libythea lepita*.

20. Junonia almana.

Papilio almana, Linnæus, Mus. Lud. Ulr. p. 272 (1764).

Hassan Abdal, 14th October; Campbellpore, 17th November, 1885.

"A few in October and November near Campbellpore."—*J. W. Y.*

21. Junonia swinhoei.

Junonia swinhoei, Butler, Ann. & Mag. Nat. Hist., Oct. 1885, p. 308.

♂, Campbellpore, July; ♂ ♀, Murree, 5th August, 1885.

"The commonest Butterfly in Campbellpore; found in May, June, July, October, November, and December. Probably the commonest fly on the Murree hills in August and September."—*J. W. Y.*

22. Pyrameis indica.

Papilio atalanta indica, Herbst, Natur. Schmett. vii. pl. 180. figs. 1, 2 (1794).

Murree, 16th and 26th August and 10th September, 1885.

"Fairly common all over the hills in August and September."—*J. W. Y.*

23. Argynnis niphe.

Papilio niphe, Linnæus, Syst. Nat. i. 2, p. 785. n. 208 (1767).

♂ ♀, Campbellpore, 23rd May; ♂, Murree, 10th September, 1885.

"Common (at Campbellpore) May and June; at Murree in August."—*J. W. Y.*

24. ARGYNNIS KAMALA.

Argynnis kamala, Moore, Cat. Lep. E. I. Co. Mus. i. p. 156. n. 324 (1857).

♀, Thundiani, 23rd September, 1885.

"A few at Murree and along the slope of Thundiani in September."—*J. W. Y.*

25. ARGYNNIS ISSÆA.

Argynnis issæa, Moore, Cat. Lep. E. I. Co. Mus. i. p. 156. n. 323 (1857).

Murree, 5th, 23rd, and 28th August, 3rd September; melanistic var., 1st October, 1885.

"*Argynnis lathonia* apud de Nicéville; *Argynnis issæa* apud Swinhoe. Common at Murree, August and September, and found along the hills as far as Thundiani."—*J. W. Y.*

No lepidopterist familiar with *A. lathonia* of Europe could fail to note the differences which exist between this form and the European one: it is, of course, a local representative of *A. lathonia* as every species of butterfly is of some other, so far as I have been able to ascertain, but it never really corresponds with European specimens.

26. ATELLA PHALANTA.

Papilio phalanta, Drury, Ill. Ex. Ent. i. pl. 21. figs. 1, 2 (1773).

♂, Hassan Abdal, 14th October, 1885.

27. MELITÆA PERSEA.

Melitæa persea, Kollar, Denksch. Akad. Wien, math.-nat. Cl. i. p. 52. n. 6 (1850).

Campbellpore, Khairabad side near Attock Bridge, 1st November, 1885.

"*Melitæa robertsii* apud de Nicéville; *M. didyma* apud Swinhoe. Not uncommon."—*J. W. Y.*

This species may readily be distinguished from *M. robertsii*, apart from other characters, by the black markings on the basal two thirds of secondaries, which do not exist in the Candahar species. After comparing it with our series of thirty-four *M. didyma* and fifteen *M. trivia*, I have not the least hesitation in supporting Mr. Kirby's opinion that it is much more nearly allied to the latter than to the former species.

The two specimens sent by Major Yerbury, though not absolutely agreeing with any of our nine typical examples of *M. persea*, differ only in characters which the series before me proves to be variable, the principal of these characters being the ill-defined submarginal spots on the upper surface of the secondaries and the less perfect row on the under surface of the primaries; no two specimens, however, absolutely correspond in these points.

28. CYRESTIS GANESCHA.

Amathusia ganescha (part.), Kollar in Hüg. Kaschm. iv. 2, p. 430, pl. 7. figs. 3, 4 (1848).

♂, Murree, 9th August, 1885.

"Rare, only three specimens taken; probably not more than four specimens seen in all."—*J. W. Y.*

Kollar apparently regarded *C. thyodamas* as the other sex of this species, and in this error he has been largely followed. If it proves to be a seasonal form or dimorphic representative of that species, it will indicate a similar condition of things as probably existing between *C. lutea* and *C. nivea* of Java, which differ precisely in the same way, although in a more marked degree.

C. thyodamas is a white species compared with *C. ganescha*; the apical area of its primaries is always suffused with blackish, which has the effect of a quadrate apical patch; this character does not appear in Kollar's figure, which is evidently taken from what I (on that account) regard as typical *C. ganescha*—the more or less yellow-tinted form; but in the description—"Vor dem Ausseurande ist das Feld ausserhalb der fünften Linie mehr oder weniger schwarz getrübt"—it is evident that both types are included; and the remark, "between male and female I find no other difference than that in the latter the marking is more lively and intense," shows that *C. thyodamas* was supposed to be the female, whereas this sex seems to be very much rarer than the male in either of the Indian forms.

ERYCINIDÆ.

LIBYTHEINÆ.

29. LIBYTHEA LEPITA.

Libythea lepita, Moore, Cat. Lep. E. I. Co. Mus. i. p. 240. n. 519 (1857).

♂ ♀, 2nd, 12th, 16th, and 23rd August, and 8th September, 1885; ♀, Lumbahdun, 27th November.

♂ var. (without hatchet-like termination to discoidal streak), Thundiani, 24th September.

"Common at Murree in August and September. Only two specimens of this Butterfly were taken in the neighbourhood of Campbellpore—one near Lawrencepore 22nd November, and one at Lumbahdun in the Chittar Pahar, 27th November."—*J. W. Y.*

Major Yerbury appears to think that *L. myrrha* exists in his series of this species; the latter, however, is easily recognized by the unbroken tawny stripe on the primaries, intersected by the median vein and its two first branches, and by the larger, entirely tawny, subapical spots; the direction of the tawny stripe on the secondaries differs a little, and it is longer and not zigzag along its outer edge. No lepidopterist possessing examples of the two species could possibly confound them.

NEMEOBIINÆ.

30. TAXILA EUGENES.

Dodona eugenes, Bates, Journ. Linn. Soc., Zool. ix. p. 371 (1867).

♀, Murree, 10th September, 1885; Thundiani, low down near Kala Pani, 24th September.

"*Dodona dipœa*: uncommon, a few at Murree in August, and two or three below Thundiani in September."—*J. W. Y.*

Although Hewitson, in his collection, associated three examples of *T. eugenes* with his type of *T. dipœa*, the two species are so well marked that there ought to be no difficulty in distinguishing them. Though rare, *T. eugenes* is common compared with *T. dipœa*: it differs most prominently in the pattern of the under surface of the secondaries; these wings in *T. dipœa* are of a dingy grey-brown colour, and the bands across it are very narrow and of a creamy yellowish tint; the short band between the cell and the apex is bounded internally by three dark brown angular spots, and the anal lobe has no tail; in fact, strictly speaking, it is a *Dodona*, whereas *T. eugenes* is a *Taxila* [1].

31. TAXILA DURGA.

Melitæa durga, Kollar in Hüg. Kaschm. iv. 2, p. 441, pl. 13. figs. 3, 4 (1848).

♂ ♀, Murree, 18th, 22nd, and 23rd August; Dewal, 26th August; Bugnoter, 20th September, 1885.

"Common at Murree in August and September; found along the hills to Thundiani; also at Dewal."—*J. W. Y.*

LYCÆNIDÆ.

32. PANCHALA? DODONÆA.

Amblypodia dodonæa, Moore, Cat. Lep. E. I. Co. Mus. p. 43. n. 65, pl. 1*a*. fig. 8 (1857).

♂, Thundiani, 23rd September, 1885.

This species in Mr. Kirby's Catalogue is indicated as female of the following; in our series are both sexes of each species, which are totally different. Major Yerbury's note refers to both.

33. PANCHALA? RAMA.

Thecla rama, Kollar in Hüg. Kaschm. iv. 2, p. 412, pl. 4. figs. 1, 2 (1848).

♀, Dewal near Murree, 26th August, 1885.

[1] Practically, however, the two genera are synonymous, as, in spite of Scudder's oversight of the following important facts, I shall now show:—In Doubleday's List the following species stand under the then undescribed genus *Taxila*—T. fatua, *egeon*, erato, cesonia, *fylla*, drupadi, *orphna*, esther, echerius, tantalus, neophron. This genus was adopted and described by Westwood in the 'Genera of Diurnal Lepidoptera,' the three italicized species being figured in the same order as above; and *T. orphna* (under which name two species are confounded on the plate) is not figured as a *Taxila* at all, though placed with that genus in the letterpress; it, moreover, stands last in Mr. Westwood's notes on the genus; yet Mr. Kirby admits this species alone into the genus *Taxila*, whilst Scudder admits only *T. drupadi*, an insect in no way brought prominently forward as typical.

"Common at Dewal, a few seen near Murree, and several on the lower slopes of Thundiani (*P. dodonæa*?); two taken 24th September. Prefers ilex trees; scarcely ever seen on any other tree."—*J. W. Y.*

34. Polyommatus bæticus.

Papilio bæticus, Linnæus, Syst. Nat. i. 2, p. 789. n. 226 (1767).

♂, Campbellpore, 29th October, 1885.

"Common, May, June, and July."—*J. W. Y.*

35. Catochrysops cnejus.

Hesperia cnejus, Fabricius, Ent. Syst. Suppl. p. 430 (1798).

♂ ♀, Campbellpore, 31st May, 15th July, and 27th October; ♂, Murree, 5th August.

This and the following are mixed up; one of them being identified for Major Yerbury as *C. strabo*, an insect to which they are by no means nearly allied.

36. Catochrysops hapalina.

Catochrysops hapalina, Butler, P. Z. S. 1883, p. 148, pl. 24. figs. 2, 3.

♂, Campbellpore, 27th October; ♀, 21st November, 1885.

"Common on baubul bushes in October."—*J. W. Y.*

The female was numbered as possibly *Zizera putli*; but as it was unset, the difference between the two was not so easily seen as might be supposed from the mounted specimens.

37. Catochrysops ella.

Catochrysops ella, Butler, P. Z. S. 1881, p. 606. n. 17.

♀, Campbellpore, 21st November, 1885.

One beautiful specimen, confounded with the preceding, from which, however, its brighter colouring above and smoky grey under surface at once distinguish it.

38. Everes dipora.

Lycæna dipora, Moore, P. Z. S. 1865, p. 506. n. 108, pl. 31. fig. 8.

♀, Murree, 20th August, 1885.

"*Catochrysops patala*? ♀, rare."—*J. W. Y.*

I cannot understand how any lepidopterist can have given to Major Yerbury an identification so wide of the mark as the above; the very colouring of the under surface at once points out to what group of Lycænidæ the species belongs, apart from all structural distinctions.

39. Azanus zena.

Lycæna zena, Moore, P. Z. S. 1865, p. 505. n. 107, pl. 31. fig. 9.

♂ ♀, Campbellpore, 17th and 21st November, 1885.

"Common on baubul bushes in October."—*J. W. Y.*

40. Azanus uranus, sp. n. (Plate XXXV. fig. 1.)

♂. Allied to *A. zena*, but differing from all specimens in the Museum series, or that of Mr. Moore's collection, in the much brighter and more uniform lilac colour of the upper surface[1], in the brighter blue at the base, the browner tint of the under surface, on which the white-edged markings are consequently less well defined, and in the obsolete character of the black spots, which are either reduced to minute points or wholly absent. Expanse of wings 21–22 millim.

Hassan Abdal, 13th October; Campbellpore, 17th and 29th November, 1885.

41. Azanus ubaldus.

Lycæna ubaldus, Cramer, Pap. Exot. iv. pl. 390. figs. L, M (1782).

♀, near Attock Bridge, Khairabad side, 15th November, 1885.

This species was unidentified, and specimens of *A. uranus* indicated as *A. ubaldus*, whilst others of the same species were simply recorded as "*Lycæna* sp."

42. Tarucus nara.

Lycæna nara, Kollar in Hüg. Kaschm. iv. 2, p. 421 (1848).

♂, Campbellpore, June; id.? (worn), 17th November, 1885.

"*Tarucus theophrastus*, very common May and June; it is probable that *T. nara* was also among some of the captures placed under this number."—*J. W. Y.*

T. theophrastus is an African species; the Butterflies so named by Col. Swinhoe probably represent two or more new species, of which the following is one :—

43. Tarucus extricatus, sp. n. (Plate XXXV. fig. 2.)

Paler than *T. nara* above, varying in size even more than *T. balkanica*; readily distinguished on the under surface by the much greater regularity of the markings, those of the primaries being arranged nearly as in *T. theophrastus* (*i. e.* the central stripe is often unbroken, the subcostal spot beyond sometimes confluent with it so as to form a Γ-shaped marking; the dashes beyond the central stripe placed transversely and always confluent instead of forming an interrupted <-shaped character); the markings of the secondaries vary in colour from rust-red to black, but correspond in character with those of *T. nara*. Expanse of wings, ♂ 15–25 millim., ♀ 28–30 millim.

♂, Campbellpore, 31st May, 1885.

We have two females of this species from Kurrachee, collected by Col. Swinhoe, and a male collected by Sir John Hearsay at Landoor; thirteen other specimens also representing the *T. theophrastus* of Indian lists, but apparently belonging to another unnamed form, are in our collection.

[1] In *A. zena* it is chiefly confined to the centre of the wings, and has almost the appearance of a brand.

44. CYANIRIS VARDHANA.

Polyommatus vardhana, Moore, P. Z. S. 1874, p. 572, pl. 66. fig. 5.

♂ ♀, Murree, 28th August, 3rd and 8th September, 1885.

"Not uncommon at Murree at the end of August; was for a long time passed over as *C. cœlestina*."—*J. W. Y.*

C. vardhana is rather a rare species in collections.

45. CYANIRIS KOLLARI.

Lycæna kollari, Westwood, Gen. Diurn. Lep. p. 491. n. 69 (1852).

Lycæna cœlestina, Kollar (*nec* Eversm.), Hügel's Kaschm. iv. 2, p. 423 (1848).

♂ ♀, Murree, 12th August; ♀, 28th December, 1885.

"Very common, August and September."—*J. W. Y.*

This species being new to the Museum collection, I cannot question the identification, more especially as Kollar's description would do just as well for half a dozen other species; at the same time Kollar's name having been already used by Eversmann, cannot possibly be admitted. *C. kollari* is more like typical *C. pseudargiolus* than any other species known to me, but is smaller; it should probably stand next to *C. levettii* in collections.

46. ZIZERA DILUTA.

♂. *Lycæna diluta*, Felder, Reise der Nov., Lep. ii. p. 280. n. 353, pl. 35. figs. 12, 13.

♀, Campbellpore, 17th June and 23rd July; ♂, 9th October; ♀, Murree, 2nd, 5th, and 6th August, and 20th September.

"*Zizera maha*, De N., *diluta*, Swinh. Common at Murree in August and September."—*J. W. Y.*

In spite of Felder's very poor figure of the upper surface, I have never seen any other than this species that could be identified with *Z. diluta*; it has hardly a feature in common with *Z. maha*, which is much nearer to *Z. chandala*. The specimens of this species were all females, with the exception of two worn ones, and one of these was labelled as probably a Moth; the females stand under the numbers 7, 72, 12 *a*, and 527.

47. ZIZERA KARSANDRA.

Polyommatus karsandra, Moore, P. Z. S. 1865, p. 505. n. 106, pl. 31. fig. 7.

♂ ♀, Campbellpore, 21st May and June; ♀, Murree, 1st October, 1885.

"*Zizera maha* and *Z. sangra* apud de Nicéville; *Z. decreta* and *karsana* apud Swinhoe: very common in the grass and lucerne-fields in May and June; though many of them differed, still they all seemed linked to one another, and I put them all under one number."—*J. W. Y.*

Major Yerbury was perfectly correct in so doing: I find only males

and females perfectly normal in colouring, size, pattern, and everything; amongst those sent to me are no *Z. maha*, *sangra*, or *decreta*. The name "*karsana*" is probably meant for *karsandra*, to which species the whole series belongs.

48. CUPIDO ARIANA.

Polyommatus ariana, Moore, P. Z. S. 1865, p. 504. n. 103, pl. 31. fig. 2.

♂ ♀, Murree, 8th to 11th August, and 3rd September, 1885.

Major Yerbury says that he caught this and the following species flying together at Murree in August.

49. CUPIDO NAZIRA.

Polyommatus nazira, Moore, P. Z. S. 1865, p. 504. n. 102, pl. 31. fig. 4.

♂, Murree, 5th and 11th August, 1885.

50. PLEBEIUS TROCHILUS.

Lycæna trochilus, Freyer, Neuere Beiträge, v. pl. 440. fig. 1 (1840).

♂ ♀, near Attock, Khairabad side, 8th November, 1885.

These are the first Indian examples that I have seen of this species.

"Common in stony nullahs near Attock Bridge."—*J. W. Y.*

51. PLEBEIUS PUTLI.

Lycæna putli, Kollar in Hüg. Kaschm. iv. 2, p. 422 (1848).

♂. Campbellpore, 18th October and 14th November, 1885.

"Common in October and November."—*J. W. Y.*

52. CHRYSOPHANUS TIMEUS.

Papilio timeus, Cramer, Pap. Exot. ii. pl. 186. figs. E, F (1779).

♂, Campbellpore, 4th June; Murree, 9th and 11th August and 24th September, 1885.

The Campbellpore specimen was numbered "527" (referring to *Zizera maha*); doubtless an oversight. Major Yerbury says that the species is "common at Murree and along the hills to Thundiani in August and September." *C. timeus* has been identified for him as "*C. phlæas*"; it appears, however, to be a tolerably constant form, so far as I can judge from our present series; on the upper surface it much resembles *C. stygianus* of Kandahar, but the darker colour and red band on the under surface of the secondaries at once separate it.

53. ILERDA TAMU.

Polyommatus tamu, Kollar in Hüg. Kaschm. iv. 2, p. 417, pl. 5. figs. 7, 8 (1848).

♂ ♀, Murree, 11th, 12th, and 14th August, and 3rd September, 1885.

Common, according to Major Yerbury, but certainly not so in

European collections; it has been named *I. coruscans* for him, but is not even nearly allied to that species, of which we possess the types. Kollar's figure is not good, having been taken from a worn and broken specimen, but the identity of the species is settled by the "sky-blue gloss" of the basal half of the wings[1]; as a matter of fact the colour is ultramarine, but a little inaccuracy in colouring is perhaps admissible in the description of a rubbed insect. Kollar says, "We possess only a single example of this beautiful species, and it has suffered severely in transport, so that in fact only the wings are preserved," and from the description we find that the hind wings, at least, are "badly rubbed."

54. ILERDA SENA.

Polyommatus sena, Kollar in Hüg. Kaschm. iv. 2, p. 415, pl. 5. figs. 3, 4 (1848).

♂, Dewal and Murree, 8th, 16th, and 30th August; Bugnoter, 20th September, 1885.

"Rather rare at Murree, very common on the lower slopes of Thundiani, and as low as Tret and Bugnoter, probably not above 5000 feet."—*J. W. Y.*

55. SPINDASIS HYPARGYROS, sp. n. (Plate XXXV. fig. 3.)

Allied to *S. acamas* and *S. eparyyros*. Larger; the male differing from both in the whitish costal area of primaries and both sexes differing in the darker bands on all the wings; on the under surface the wings are chalky white instead of cream-colour, all the markings are darker and edged with black; the submarginal band of the secondaries is not angulated as in *S. acamas* and the secondaries themselves are longer. Expanse of wings, ♂ 36 millim., ♀ 35–38 millim.

♂ ♀, Campbellpore, 19th, 20th, 25th, 26th, and 28th July, 1885.

This is the representative of *S. acamas* in N.W. India; Col. Swinhoe obtained it at Kurrachee and Chaman; Major Yerbury says that it is common[2]. At the time when I identified it as *S. acamas* we did not possess that species, and I supposed that the differences which existed in Klug's figures were due to inaccuracy of delineation. The Zeller collection has, however, now put us in possession of specimens of the true *S. acamas* and the allied *S. eparyyros*, and I am able to see at a glance that here we have a series of those constant local races which constitute the only existing species in the Order Lepidoptera, but which, for that very reason, are always as thorns

[1] In *I. coruscans* the colour is shining metallic emerald-green.

[2] Another allied species occurs at Suakim; it has recently been presented to the Museum collection by Surgeon Mandest. It may be called *S. bellatrix*. This species is smaller than *S. acamas*, is bright tawny above, with a black marginal stripe and white fringe; the primaries show dusky indications of the ordinary markings upon the costal half; there is also a whitish spot in the cell and a white subapical costal spot; wings below chalky white, with pale sandy-brownish markings edged with black and enclosing the usual silver streaks and spots; all the bands are a little wider than in *S. acamas*, the central band of primaries is abbreviated; the subapical band of secondaries more angular and the submarginal band interrupted. Expanse of wings 30 millim.

in the sides of those who believe that the species of Butterflies are widely distinct.

56. Rapala nissa.

Thecla nissa, Kollar in Hüg. Kaschm. iv. 2, p. 412, pl. 4. figs. 3, 4 (1848).

♂ ♀, Murree, 16th, 18th, and 25th August, 1885.

"Common at Murree."—*J. W. Y.*

Rare in European collections.

57. Deudoryx epijarbas.

Dipsas epijarbas, Moore, Cat. Lep. E.I. Co. Mus. i. p. 32. n. 30 (1857).

♂ ♀, Murree, 11th, 12th, and 22nd August, 1885.

"Common at Murree."—*J. W. Y.*

Papilionidæ.

Pierinæ.

58. Colias edusina.

Colias edusina, Felder, Wien. ent. Mon. iv. p. 100. n. 55 (1860).

♂ ♀, Murree, 2nd, 5th, 11th, 14th, and 18th August; ♂, Campbellpore, 30th May and 17th November; ♀, Chittar Pahar, 1500 feet.

"Common at Murree up to October; found all along the hills at Campbellpore, common May and June; fairly common October, November, and beginning of December."—*J. W. Y.*

This is the normal western type of *C. fieldii*; the latter is represented by a species near to *C. aurorina*, which, though found in the west, extends as far eastward as Assam; whether the two forms are distinct or not can only be decided by breeding. Of course the present form is generally called *C. fieldii* in Indian collections; but if it be that species, it should stand as var. *edusina*.

59. Colias erate.

Colias erate, var. ♀ *pallida*, Staudinger, Cat. Lep. eur. Faun. p. 3. n. 54 (1861).

♂, Murree, 16th August; Dewal, 26th August; ♂ ♀, Campbellpore, 29th October, 20th and 21st November, 1885.

One male of typical *C. erate* was obtained at Murree on the same day as the male of var. *pallida*; Major Yerbury says that it does not appear to be so common at Murree as the latter; a second fragmentary male from Campbellpore was also sent with specimens of *C. pallida*. Both Col. Swinhoe and Mr. de Nicéville seem to have wrongly identified the form, though, as *C. sareptensis* was mixed up with it, I may be mistaken in the case of the former gentleman: Major Yerbury, however, quotes the species as "*Colias hyale* apud de Nicéville, *C. sareptensis* apud Swinhoe"; he says that at Murree it is not common. He further remarks as follows:—"When first I arrived in Campbellpore and began to collect, I had no setting-

boards; so I placed all my captures in envelopes and consequently put all the pale clouded-yellows under one number; it was only when my attention was drawn to it, that I discovered that I had two species under the same number. I then went through all the pale forms I had, but only succeeded in finding three specimens of *C. erate*; so I presume this species is the rarer of the two. I have taken it in May, June, and November."

60. COLIAS SAREPTENSIS.

Colias hyale, var. *sareptensis*, Staudinger, Cat. Lep. eur. Faun. p. 5. n. 48 (1871).

♂, Campbellpore, 14th November; ♀, Murree, 12th August, 1885.

This form again seems to be rare as compared with *C. pallida*, so that not only does my original suggestion that the latter was a hybrid between *C. erate* and *C. sareptensis* seem to be probable, but also that the intermediate form thus produced is supplanting both the parent stocks.

61. TERIAS FIMBRIATA (var. ?).

Terias fimbriata, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 323, n. 16 (1867).

♂ ♀, Attock Bridge, Khairabad side, 15th November, 1885.

"*Terias æsiope* apud de Nicéville, *T. fimbriata* apud Swinhoe; common in October and November."—*J. W. Y.*

This species only differs from typical *T. fimbriata* in the little pronounced subapical brown dash or stria on the under surface of the primaries; and as, in some species, this marking certainly does vary in intensity, it is safer to regard the Campbellpore form as a variety, at any rate until we have proof that the difference of pattern is locally constant.

The following was placed by Major Yerbury under the same number, but with a note of interrogation.

62. TERIAS IRREGULARIS.

Terias irregularis, Moore, P. Z. S. 1882, p. 253.

♂ ♀, Campbellpore, 9th November, 1885; 13th January, 1886.

63. TERIAS SUAVA.

Terias suava, Boisduval, Sp. Gén. Lép. i. p. 670. n. 28 (1836).

♂, Campbellpore, 17th June, 1885.

"*Terias rotundularis* (?), a few in June and July."—*J. W. Y.*

64. TERIAS PURREEA.

Terias purreea, Moore, P. Z. S. 1882, p. 252.

♂, Attock Bridge, 8th November; ♀, Campbellpore, 11th November; Hassan Abdal, 13th October, 1885.

The Campbellpore specimens were mixed up with *T. fimbriata*,

and probably represent the *T. æsiope* of De Nicéville. Major Yerbury says of it, "*Terias rotundularis* not uncommon at Murree and along the hills to Thundiani in September. *T. æsiope* apud Swinhoe."

I think there must be a slight error in the above note, for Col. Swinhoe knows *T. purreea* quite well; at the same time he may have labelled the insect in haste. *T. æsiope* is not known from India.

65. TERIAS HECABE.

Papilio hecabe, Linnæus, Mus. Lud. Ulr. p. 249 (1764).

♀, between Abbottabad and Kala Pani, 25th September, 1885.

With this is a male, taken at Bugnoter on the 20th September, and which I think must be a very abnormal specimen of the same species. It wants the black border, and therefore, on the upper surface, resembles *T. excavata*; certainly, with only one example before me, I do not feel justified in separating it.

66. TERIAS EXCAVATA.

Terias excavata, Moore, P. Z. S. 1882, p. 252.

♂, Campbellpore, 9th November; ♀, Chuttar, 9th October, 1885.

This species was mixed up with *T. purreea* and *T. fimbriata*.

67. TERIAS VAGANS.

Terias vagans, Wallace, P. Z. S. 1866, p. 357. n. 10.

♀, Chuttar, 9th October, 1885.

We previously only possessed males of this species; it has been incorrectly named *T. læta* for Major Yerbury; he says that it is rare, two specimens having been taken at Chuttar on the Murree and Rawal Pindee road. *Terias læta* is a species in which the apical area of the primaries and whole of secondaries on the under surface are of a bright rusty-reddish colour; in the male of *T. vagans* they are lemon-yellow, and in the female of a sericeous creamy-whitish tint; in *T. jægeri* they are flesh-tinted in both sexes.

68. TERACOLUS PROTRACTUS.

Teracolus protractus, Butler, P. Z. S. 1876, p. 137, n. 37.

♂ ♀, Chittar Pahar, Lumbahdun, 2000 feet; 28th November, 1885.

The specimens of this species are not perfectly typical, the colouring of the under surface being of a nearly yellow tint instead of flesh-pink; the third black spot of the primaries, in the male specimens, is expanded so as to reach the inner margin, as in the form from Beloochistan and Kutch; but the female has three isolated spots as in the type form.

"A single specimen, Campbellpore, 29th June, 1885; found commonly in the Chittar Pahar near Lumbahdun, Kala Dilli, &c., at the end of November and beginning of December."—*J. W. Y.*

69. TERACOLUS FAUSTINUS.

Idmais faustina, Felder, Reise der Nov., Lep. ii. p. 190.

♂ ♀, Campbellpore, 17th and 21st November, 13th December; and Chittar Pahar, Lumbahdun, 2000 feet, 28th November, 1885.

With a series of each species before one, it is easy to distinguish this from the Turco-Persian *T. fausta*; it differs in its superior size and more heavily marked primaries on the upperside (which, as Felder says, more nearly resembles the female of *T. fausta* than the male), the much more dusky bases to the wings, blackish body, greyish costa to primaries and interno-basal area to secondaries, altogether duller and darker coloration below, the secondaries being flesh-tinted on basal two fifths and irrorated with grey atoms throughout, the conspicuous clay-coloured spots across the disk, and the white instead of pale sulphur colour of the ventral surface of the abdomen.

70. TERACOLUS FARRINUS.

Teracolus farrinus, Butler, P. Z. S. 1876, p. 159. n. 112, pl. 7. fig. 2 (1876).

♀, between Tret and Barracoo, Murree and Rawal Pindee road, 9th October; Attock Bridge, 8th November; Campbellpore, 14th November, 1885.

This was identified for Major Yerbury as "*T. etrida*?"

71. TERACOLUS BIMBURA.

Teracolus bimbura, Butler, P. Z. S. 1876, p. 161. n. 117, pl. 7. figs. 3, 4.

♀, Campbellpore, 27th October; near Attock Bridge, Khairabad side, 8th November; ♂, Chittar Pahar, Lumbahdun, 2000 feet, 28th November, 1885.

This and the following are confounded together and labelled doubtfully as *Teracolus etrida*. Major Yerbury says of them:—

"Common in June, July, October, and November. There seem to be Butterflies corresponding to the following species under this number, viz.:—*purus*, *etrida*, *pernotatus*, and *bimbura*; but I should be doubtful whether, here at any rate, they do not all belong to *T. etrida*. I have taken these small orange-tips at Hassan Abdal; (single specimen), on the road between Murree and Rawal Pindee near Barracoo (single specimen), near Attock Bridge, Khairabad side (a few), in the Chittar Pahar between Choi and Lumbahdun (very common), neighbourhood of Campbellpore (common)."

Taking specimens in so many localities, it is not surprising that three species should be obtained; as to their being all one, that is a question only to be decided by most careful breeding; they differ far more than our three British White Butterflies *Ganoris brassicæ*, *rapæ*, and *napi*, yet there is not the slightest doubt of the distinctness of the latter.

72. Teracolus purus.

Teracolus purus, Butler, P. Z. S. 1876, p. 160. n. 113, pl. 7. figs. 14, 15 (1876).

♂, Campbellpore, 26th June and 17th July, 1885.

It is interesting to note that whereas this species was obtained in June and July, *T. farrinus* and *T. bimbura* were caught in October and November; at the same time we have a specimen of *T. farrinus* taken by Col. Swinhoe in July; so that they cannot be regarded as seasonal forms, as seems to be the favourite plan now-a-days with many allied species. The brown colouring of the underside in *T. bimbura* sufficiently distinguishes it from any of its allies to prevent confusion.

73. Ixias pygmæa.

Ixias pygmæa, Moore, P. Z. S. 1882, p. 254, pl. xii. fig. 1.

♂ ♀, Campbellpore, 17th November and 13th December; ♀, Chittar Pahar, 1500 feet, 1st December, 1885.

"*Ixias*, n. sp. allied to *dharmsalæ*, apud Swinhoe. This *Ixias* is not uncommon near Campbellpore in November; almost all the males taken were caught in this neighbourhood; whilst at Kala Dilli in the Chittar Pahar the females were very common and there were no males. The females were, almost without exception, taken on the same plant (*Croton* sp.?), a plant with spikes of white labiate flowers and broadish dark green leaves. I have taken this species near Campbellpore in the bed of the Haro; near Attock Bridge, Khairabad side, two females; and at Kala Dilli in the Chittar Pahar, all females, very common."—*J. W. Y.*

The type of this species, from Kangra, is a dwarfed male; a similar one is sent to us by Major Yerbury; the regular size of the species, however, for both sexes is about 59 millim., so that *I. pygmæa* is a misnomer. The species is allied to *I. moulmeinensis*, but differs in the broad inner black border to the orange belt of the male and the bright sulphur-yellow of the female; the absence of the heavy black bordering to the secondaries removes it from the neighbourhood of *I. dharmsalæ*.

74. Belenois auriginea, sp. n.

♀. Allied to *B. taprobana*, but differing in the whiter colour of the primaries on both surfaces, the almost total absence of the grey basal suffusion on these wings, the more oblique and rather narrower discocellular patch, the narrower external border divided by six indistinct pale spots, the abrupt narrowing of this border (so as to leave only a greyish border on the interno-median area); the secondaries, which are either cream-coloured or ochreous, have a much narrower border with zigzag inner edge and enclose four spots of the ground-colour, the grey veins are similar, but the discocellular vein is only partly blackened and the subapical bar uniting the subcostal branches is represented only by greyish scales; on the under surface the whole disk of primaries is white, and the black and brown markings are all much narrower than in *B. taprobana*, but

the basal and apical areas of primaries and the whole surface of the secondaries are bright ochreous, only a little paler than in that species. Expanse of wings 56 millim.

♀, Campbellpore, 29th and 30th May, 1885.

It is evident that this form is regarded by collectors in India as the spring brood of *B. mesentina*; but, so far as I have been able to ascertain, this is not an ascertained fact, whilst the existence of a species representing it in Ceylon is strong evidence to the contrary.

Though apparently commoner in the North-west Provinces, this form does occur in the East; the male, though very like *B. mesentina* on the upper surface, has the apical area of the primaries and whole surface of secondaries on the underside of a deep cream-colour more or less tinged with chrome-yellow.

75. Belenois lordaca.

Pieris lordaca, Walker, Entomologist, v. p. 48.

♂, Campbellpore, 11th June; ♀, Chittar Pahar, 2000 to 3000 feet, 28th November, 1885.

This is the common form of India, of which it is possible that *B. mesentina* may be a variety; the latter, however, differs on the under surface in the great breadth of the brown veins on the apical area of primaries and the whole of secondaries.

"Common in May, June, and July, and again in October and November; a few to be seen in December: the spring brood is much the darkest. The caterpillar feeds on a caper with dark red blossom (*Capparis horrida*?)."—*J. W. Y.*

It is a significant fact that the only male sent to us in this collection should not belong to the dark form supposed to be the spring brood.

76. Synchloë daplidice.

Papilio daplidice, Linnæus, Syst. Nat. i. 2, p. 760. n. 77 (1767).

Campbellpore, 11th and 12th June and 11th July, 1885.

77. Ganoris ajaka.

Pieris ajaka, Moore, P. Z. S. 1865, p. 490. n. 21, pl. 31. fig. 16.

♂ ♀, Murree, 23rd August and 3rd September, 1885.

Rather less strongly marked than usual.

"*Mancipium ajaka* common at Murree in August under the shade of trees."—*J. W. Y.*

78. Ganoris gliciria.

Papilio gliciria, Cramer, Pap. Exot. ii. pl. 171. figs. E, F (1779).

♀, Campbellpore, 9th June and 14th November; ♂ ♀, Murree, 15th and 25th August.

"Fairly common, May and June; common, October and November."—*J. W. Y.*

The name of *Mancipium canidium* has been given to Major Yerbury for this species. Now the name *Mancipium* was first employed by Hübner in his 'Tentamen,' the publication of which

is extremely doubtful, and the genus (in any case) was not described in that list of names; if adopted, it should be used in the Stephensian sense (*i. e.* either for *daplidice* or *cardamines*), and Westwood's action would fix the type as *cardamines*. Secondly, the identification of *Papilio canidia* is doubtful, and would probably apply to two or three species with equal accuracy, and therefore I prefer to give this species the name applied to it by Cramer.

79. Ganoris nipalensis.

Pieris brassicæ, var. *nipalensis*, Gray, Lep. Ins. Nepal, pl. 6. figs. 1 & 3 (1846).

♂, Campbellpore, 22nd and 29th May and 12th June, 1885.

"Common in May, June, July, October, November, December. The cabbages in my garden are covered at the present time (11th January, 1886) with the caterpillars of some white butterfly[1], and there are some half-dozen chrysalides on the walls of the bungalow; they all probably belong to this species."

80. Euchloë lucilla, sp. nov. (Plate XXXV. fig. 4.)

Allied to *E. charlonia* of Algeria, from which, however, the following characters readily distinguish it:—Wings above gamboge- instead of lemon-yellow; the discocellular black patch broader, regular, and quadrate; the apical area browner, and, instead of forming a triangular patch, widely excavated and diffused on its inner edge and truncated at its inferior extremity; the yellow streak across it much as in *E. charlonia*: under surface differing, at a glance, in the absence of the apical grey-green patch of primaries, the yellow instead of grey-green secondaries, the larger pale costal spots, the better marked grey-edged white discocellular spot, and the absence of the pale spots on the median interspaces. Expanse of wings 35 millim.

Campbellpore, 27th May, 1885.

"*Anthocaris charlonia*: rare, only three specimens taken—the first on the 21st May, the second on the 23rd, and the third on the 27th.

"Nos. 1 and 2 were found on the same plant of *Stachys parviflora*, No. 3 taken on the wing about a mile away."—*J. W. Y.*

I can only suppose that the name *A. charlonia* was given by Mr. de Nicéville; yet it would seem strange that a gentleman who claims to be almost an arbiter in questions relating to geographical distribution, should unhesitatingly give the name of an Algerian insect to a species obtained in North-western India.

Papilioninæ.

81. Papilio cloanthus.

Papilio cloanthus, Westwood, Arc. Ent. i. pl. 11. fig. 2 (1841).

Murree, 10th September, 1885 (very ragged).

[1] "Black: dorsal line white or yellow, spiral line yellow; yellowish-green irregular Δ-shaped patches speckled with black running up into the black from the spiral lines, but never reaching the dorsal lines; length about two inches."

"Rare: only three specimens taken, end of August and beginning of September."—*J. W. Y.*

82. PAPILIO ERITHONIUS.

Papilio erithonius, Cramer, Pap. Exot. iii. pl. 232. figs. A, B (1782).

Campbellpore, 18th October, 1885.

"A few in June and July; common in October and November."—*J. W. Y.*

The single example sent in the present collection belongs to a rather rare sport of the species, in which the usual orange spots on the under surface are replaced by greyish testaceous spots.

83. PAPILIO ASIATICUS.

Papilio machaon, var. *asiatica*, Ménétriés, Cat. Mus. Petr., Lep. i. p. 70 (1855).

Campbellpore, 9th July; Murree, 1st October, 1885.

"A few at Campbellpore in June and July; common at Murree in August; found commonly on the lower slopes of Thundiani in September 1885."—*J. W. Y.*

84. PAPILIO ARCTURUS.

Papilio arcturus, Westwood, Ann. Nat. Hist. ix. p. 37 (1842).

♂, Murree, 13th August, 1885.

Major Yerbury sends this and the following under the same number, which accounts for the different identifications received by him from Mr. de Nicéville and Col. Swinhoe.

85. PAPILIO POLYCTOR.

Papilio polyctor, Boisduval, Sp. Gén. Lép. i. p. 205. n. 18 (1836).

♀, between Abbottabad and Kala Pani, 25th September, 1885.

Respecting these two species Major Yerbury says:—"Fairly common at Murree in August; a few seen along the hills as far as Thundiani in September." It would therefore appear that *P. polyctor* is a month later than *P. arcturus*; only the single specimen of the former sent to us is much worn and must have been quite a month on the wing.

HESPERIIDÆ.

86. PARNARA MANGALA.

Hesperia mangala, Moore, P. Z. S. 1865, p. 792.

Murree, 8th and 10th September; Thundiani, 24th September; Hassan Abdal, 13th October, 1885.

Major Yerbury has received the names of *P. bada* and *P. beavani* for this species, and he says:—"There are two 'skippers' under this number: both species were common at Murree in August and September." Neither of these species is represented amongst the five examples in this collection, all of which are quite typical *P. mangala*, the row of spots on the secondaries being larger and

more nearly in line than in either of the above-named species. Whether with a large series it will be possible to unite the three forms remains to be seen; so far they hold their own as tolerably constant types. *P. mangala* always has the lowest spot on the primaries larger and more quadrate than in the other two.

87. GEGENES KARSANA.

Hesperia karsana, Moore, P. Z. S. 1874, p. 576, pl. 67. fig. 6.

♂, Campbellpore, 21st July, 1885.

"A few in June and July; common in October and November."—*J. W. Y.* As, however, the following is placed under the same number, the later dates probably refer exclusively to it.

88. GEGENES NOSTRODAMUS.

Hesperia nostrodamus, Fabricius, Ent. Syst. iii. 1, p. 328. n. 246 (1793).

♂, Campbellpore, 29th October; near Attock Bridge, Khairabad side, 15th November, 1885.

The two males now sent are the first Indian examples of *G. nostrodamus* that I have seen; it is a tolerably common species in Southern Europe, whereas *G. karsana* appears to be confined to India.

89. PYRGUS EVANIDUS.

Pyrgus evanidus, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. v. p. 223.

♂, Campbellpore, 31st May, 1885.

"Uncommon; a few seen in June (three specimens taken)."—*J. W. Y.*

SPHINGIDÆ.

90. HEMARIS SAUNDERSII.

Sesia saundersii, Walker, Lep. Het. viii. p. 83. n. 7 (1856).

♂, Murree, October 1885.

"Not uncommon in August and September."—*J. W. Y.*

This is rather a rare species in European collections: only one of our few specimens is in good condition.

91. MACROGLOSSA STELLATARUM.

Sphinx stellatarum, Linnæus, Syst. Nat. i. 2, p. 803. n. 27 (1766).

Murree in September.

"Not uncommon in August and September."—*J. W. Y.*

92. RHOPALOPSYCHE NYCTERIS.

Macroglossa nycteris, Kollar in Hüg. Kaschm. iv. 2, p. 458, p. 19. fig. 5.

Murree in September; Campbellpore, 20th November, 1885.

"Common in August and September."—*J. W. Y.*

93. CHÆROCAMPA ALECTO.

Sphinx alecto, Linnæus, Mus. Lud. Ulr. p. 357 (1764).

♀, Murree in August.

"One specimen taken."—*J. W. Y.*

94. CHÆROCAMPA CELERIO.

Sphinx celerio, Linnæus, Syst. Nat. i. 2, p. 800 (1766).

♂ ♀. Campbellpore in May.

95. DEILEPHILA LIVORNICA.

Sphinx livornica, Esper, Ausl. Schmett. ii. pp. 87, 196, pl. 8. fig. 4 (1785).

♂ ♀, Campbellpore in May.

96. NEPHILA HESPERA.

Sphinx hespera, Fabricius, Syst. Ent. p. 546. n. 33 (1775).

♂, Campbellpore, 18th November, 1885.

Var. MORPHEUS.

Sphinx morpheus, Cramer, Pap. Exot. ii. p. 84, pl. 149. fig. D (1779).

♀, Campbellpore, 18th November, 1885.

The differences between these two varieties were supposed at one time to be characteristic of the sexes; but this is not the case, as both sexes occur with and without the silver spots.

97. PROTOPARCE ORIENTALIS.

Protoparce orientalis, Butler, Trans. Zool. Soc. vol. x. p. 609. n. 21, pl. xci. figs. 16, 17 (1875).

♀, Campbellpore, August 1885.

LEUCANIIDÆ.

98. LEUCANIA EXTRANEA.

Leucania extranea, Guénée, Noct. i. p. 77. n. 104.

♀, Campbellpore.

99. LEUCANIA COLLECTA.

Leucania collecta, Walker, Cat. Lep. Het. ix. p. 105. n. 63 (1856).

Campbellpore, July 1885.

CARADRINIDÆ.

100. CARADRINA SABULOSA.

Caradrina sabulosa, Swinhoe, P. Z. S. 1884, p. 516. n. 23, pl. xlvii. fig. 6.

Campbellpore, 5th, 10th, 28th, and 30th July, 1885.

Seven examples were forwarded by Major Yerbury, exhibiting a considerable amount of variation; as a rule they are much better defined in all their markings than in Col. Swinhoe's figure.

XYLOPHASIIDÆ.

101. PRODENIA CARADRINOIDES.

Laphygma? caradrinoides, Walker, Cat. Lep. Het. ix. p. 190. n. 8 (1856).

♀, Campbellpore, 27th July, 1885.

The single specimen sent appears to belong to this species, but has been so much knocked about on the journey from Campbellpore as to be only just recognizable: it is quite unfit to put into the collection.

NOCTUIDÆ.

102. AGROTIS AVERSA.

Agrotis aversa, Walker, Cat. Lep. Het. x. p. 345. n. 92 (1856).

Agrotis certificata, Walker, *l. c.* Suppl. vol. ii. p. 697 (1865).

Caradrina triturata?, Walker, Cat. Lep. Het. x. p. 295. n. 30 (1856).

♂, Murree, 9th August, 1885.

As indicated by the name given to them, Walker's types of *Caradrina triturata* are so much frayed as to be practically unidentifiable; what is left of them, however, indicates close affinity to, if not identity with, *Agrotis aversa*.

103. AGROTIS ARISTIFERA.

Agrotis aristifera, Guénée, Noct. i. p. 266. n. 426 (1852).

♂, Campbellpore, 30th July, 1885.

104. AGROTIS SUFFUSA.

Phalæna-Noctua suffusa, Gmelin, ed. Syst. Nat. i. 5, p. 2541. n. 1028.

♀, Kalabagh, 17th September, 1885.

105. OCHROPLEURA TRIANGULARIS.

Ochropleura triangularis, Moore, P. Z. S. 1867, p. 55.

Murree, 9th August, 1885.

ACONTIIDÆ.

106. BANKIA OPELLA.

Acontia opella, Swinhoe, P. Z. S. 1885, p. 456. n. 68, pl. xxvii. fig. 16.

Campbellpore, 6th July, 1885.

107. XANTHODES INNOCENS.

Xanthodes innocens, Walker, Cat. Lep. Het. xv. p. 1752 (1858).

Campbellpore, 28th July, 1885.

Nearly allied to *X. graellsii* of Europe, but with the curved longitudinal brown stripe on the primaries narrower and greyer; the primaries themselves are also somewhat paler.

EURHIPIDÆ.

108. PENICILLARIA EXCITANS, sp. n.

Allied to *P. geyeri*; of the same size, form, and general pattern, but the whole of the whity-brown markings of primaries and basal two thirds of secondaries altered to snow-white; the testaceous areas replaced by brick-red and the dull brown by pale ash-grey; the collar snow-white excepting at the base, the prothorax edged with white, the thorax reddish, the abdomen greyish towards the base; the under surface white, with black and grey markings instead of pale brown with darker brown markings. Expanse of wings 42 millim.

Bugnoter, September 19th, 1885.

TOXOCAMPIDÆ.

109. PLECOPTERA REFLEXA.

Plecoptera reflexa, Guénée, Noct. ii. p. 431. n. 1303.

Trigonodes? gammoides, Walker, Cat. Lep. Het. xv. p. 1833 (1858).

Poaphila? simplex, Walker, *l. c.* p. 1840 (1858).

Campbellpore, 26th and 30th July, 1885.

110. TOXOCAMPA ORIENTALIS, sp. n.

Allied to *T. lilacina* of Japan; of the same colours and pattern on the upper surface, but considerably larger and with the fringe of secondaries paler: on the under surface the entire external third excepting the fringe is much darker; the costa of primaries from the middle is ochraceous, and the basal two thirds of the secondaries brownish white, with a distinct black discocellular spot and an arched dusky stripe across the disk. Expanse of wings 47 millim.

Murree, 7th August, 1885.

POLYDESMIDÆ.

111. PANDESMA QUENAVADI.

Pandesma quenavadi, Guénée, Noct. ii. p. 438. n. 1310.

Campbellpore, 30th June, 6th, 7th, and 25th July, 1885.

The specimen last enumerated is unusually dwarfed and dark, but does not appear to differ in any other respect from ordinary examples; it is a little rubbed, and consequently the black markings are partly obliterated, which may account for its being differently numbered by Major Yerbury.

HOMOPTERIDÆ.

112. ALAMIS UMBRINA.

Alamis umbrina, Guénée, Noct. iii. p. 4. n. 1321.

Var. *Alamis albicincta*, Guénée, *l. c.* n. 1322.

Campbellpore, 29th June and 30th July, 1885.

113. Homoptera vilis.

Homoptera vilis, Walker, Cat. Lep. Het., Suppl. iii. p. 889 (1865).

Campbellpore, 27th July, 1885.

The single specimen of this species forwarded by Major Yerbury was much damaged in transit.

Ophiusidæ.

114. Achæa melicerte.

Phalæna-Noctua melicerte, Drury, Ill. Ex. Ent. i. p. 46, pl. 23. fig. 1.

Campbellpore, 27th July, 1885.

Also much damaged.

115. Ophiusa albivitta.

Ophiusa albivitta, Guénée, Noct. iii. p. 271. n. 1707.

Campbellpore, July 1885.

A good deal rubbed.

116. Grammodes stolida.

Noctua stolida, Fabricius, Sp. Ins. ii. p. 218. n. 54.

♂, Campbellpore, 23rd July, 1885.

Euclidiidæ.

117. Trigonodes hyppasia.

Phalæna-Noctua hyppasia, Cramer, Pap. Exot. iii. p. 99, pl. 250. fig. E (1782).

Trigonodes compar, Walker, Cat. Lep. Het. xiv. p. 1451. n. 9 (1857).

Campbellpore, November 1885.

Hypenidæ.

118. Hypena tatorhina?

Hypena tatorhina, Butler, Ill. Typ. Lep. Het. iii. p. 60, pl. lv. fig. 13 (1879).

♂, Kala Pani, 24th September, 1885.

One worn and broken specimen, apparently of this species.

119. Rhynchina, sp. n.?

Two examples, both broken and therefore unfit for description.

Murree, 9th August; Bugnoter, 19th September, 1885.

This species somewhat resembles "*Hypena antiqualis*."

Pyralidæ.

120. Aglossa pinguinalis.

Phalæna-Pyralis pinguinalis, Linnæus, Fauna Succica, p. 1320.

Murree, 15th August, 1885.

121. Surattha albipennis, sp. n.

Allied to *S. invectalis* of Ceylon, but the primaries of a more uniformly pale sandy-brown tint, the belt beyond the middle being only flecked with black and white like the interno-basal area, the outer border of this belt also less abruptly angulated; the external area grey, irrorated with white and with a marginal series of black-tipped fusiform white spots; secondaries white instead of whity brown; abdomen also paler; under surface paler. Expanse of wings 22 millim.

♂, Campellpore, 30th July, 1885.

The genus *Surattha* was also described by Walker under the names *Pindicitora* and *Calarina*; the types belong to one species only.

122. Pyralis elachia?

Pyralis elachia, Butler, Ill. Typ. Lep. Het. iii. p. 70, pl. lviii. fig. 3 (1879).

Campbellpore, July; Murree, August 1885.

Two worn examples belonging apparently to this species; they chiefly differ from the type in their slightly darker secondaries.

123. Pyralis incongrua. (Plate XXXV. fig. 5.)

Allied to *P. glaucinalis* and *P. yokohamæ*; of the same size as the latter, but in pattern much nearer to *P. nannodes*; from the latter it only differs in its superior size and the almost perfectly straight, instead of irregular, whitish stripes across the primaries; from *P. glaucinalis* and *P. yokohamæ* it differs in the much greater width between these stripes in addition to their greater regularity: the colouring in all four species is very similar. Expanse of wings 27 millim.

Kala Pani, 24th September, 1885.

Hercynidæ.

124. Aporodes meleagrisalis.

Herbula meleagrisalis, Walker, Cat. Lep. Het. xvii. p. 324. n. 11 (1857).

Campbellpore, 7th July, 1885.

Asopiidæ.

125. Samea yerburii, sp. n. (Plate XXXV. fig. 6.)

Allied to *S. magna* of Japan; of the same colours, but with whitish-centred discocellular lunules, the whitish patches quite differently arranged and not forming bands: primaries with two patches—the first small and oblong, in the middle of the cell, the second transverse quinquefid, between the end of the cell and the dusky discal line, the latter unequally bisinuate, not sharply angulated as in *S. magna*, less defined and with a pale (not whitish) external edging; veins whitish towards the outer margin; fringe with a

brown-spotted whitish basal line: secondaries with a small white spot in the cell close to the terminal or discocellular lunule; a large irregular quadrifid patch beyond the cell and bounded by the discal stripe, which is similar in character to that of the primaries, the projecting part of this stripe (its anterior half) being bounded by five white lunules; fringe with a white basal line: body of the same golden-glossed smoky-grey tint as the wings, the abdomen with whitish edges to the segments: wings below paler than above, silvery, the secondaries almost white. Expanse of wings 37 millim.

Murree, 7th and 9th August, 1885.

126. HYMENIA FASCIALIS.

Phalæna-Pyralis fascialis, Cramer, Pap. Exot. iv. pl. 398. fig. O (1782).

Bugnoter, 19th September, 1875.

BOTIDIDÆ.

127. MECYNA RUSTICALIS.

Pyralis rusticalis, Hübner, Pyral. p. 26. n. 3, pl. 18. fig. 121.

Campbellpore, 5th July, 1885.

SCOPARIIDÆ.

128. STENOPTERYX HYBRIDALIS.

Pyralis hybridalis, Hübner, Pyral. p. 29. n. 20, pl. 17. fig. 114.

Murree, 2nd August, 1885.

129. SCOPULA VINCTALIS.

Scopula vinctalis, Walker, Cat. Lep. Het., Suppl. iv. p. 1476 (1865).

Campbellpore, July 1885.

An unusually dark specimen of this widely distributed species.

130. DOSARA CŒLATALIS.

Dosara cœlatalis, Walker, Cat. Lep. Het. xix. p. 829. n. 1 (1859).

Campbellpore, November 1885.

Does not differ from Ceylonese specimens.

131. UDEA FOTALIS.

Scopula fotalis, Swinhoe, P. Z. S. 1885, p. 875. n. 165, pl. lvii. fig. 9.

Campbellpore, 30th July, 1885.

CHALCOSIIDÆ.

132. AGALOPE BASALIS.

Agalope basalis, Walker, Cat. Lep. Het. ii. p. 438. n. 1 (1854).

♂, 8th September, 1885.

"Common in September."—*J. W. Y.*

Major Yerbury sent three males of this species; it is perfectly constant in all its characters, and therefore readily separable from the two north-eastern forms.

ZYGÆNIDÆ.

133. ZYGÆNA CASCHMIRENSIS.

Zygæna caschmirensis, Kollar in Hüg. Kaschm. iv. p. 459. n. 1, pl. 19. fig. 6.

Murree, 9th August, 1885.

"Common in September."—*J. W. Y.*

ARCTIIDÆ.

134. THYRGORINA, sp. n.?

One worn specimen, too much injured for description, but apparently new to science.

Murree, 9th August, 1885.

This species should be common, and, even if not, it is so conspicuous an insect that the only wonder is that it should not exist either in the collections of the British Museum or of Mr. F. Moore; of course it might have been passed by under the impression that it was some common *Spilosoma* or *Aloa*.

LITHOSIIDÆ.

135. DEIOPEIA THYTER.

Deiopeia thyter, Butler, Trans. Ent. Soc. London, 1877, p. 361. n. 253.

Campbellpore, 5th July, 1885.

"Common in May, June, and July."—*J. W. Y.*

LIPARIDÆ.

136. ARTAXA ANGULIGERA, sp. n.

Primaries above pale ochreous, crossed beyond the middle by a tolerably broad belt of dark-brown scales crossed by yellow veins, and with a rather acute angle on its outer edge within the second median interspace; a few scales of the same colour near the base and others in spots on the external border: secondaries much paler than primaries, quite white towards costa: body ochreous; antennæ white, with grey pectinations; under surface wholly whitish. Expanse of wings 26 millim.

Murree, 9th August, 1885.

137. ARTAXA SCINTILLANS.

Somena scintillans, Walker, Cat. Lep. Het. vii. p. 1734 (1855).

♂ ♀ (in coitû), Murree, 12th August, 1885.

The female obtained by Major Yerbury differs from the male considerably—a most unusual thing in this genus. The colouring and pattern more nearly resemble those of *A. limbata*; from the latter it principally differs in its smaller size and uniformly paler

tint, the abdomen grey instead of blackish, and the marginal spots of the primaries smaller.

138. Chærotriche vitellina.

Liparis vitellina, Kollar in Hüg. Kaschm. iv. 2, p. 471. n. 4 (1848).

Euproctis gamma, Walker, Cat. Lep. Het. vii. p. 1731 (1855).

Artaxa princeps, Walker, *l. c.* Suppl. ii. p. 331 (1865).

Murree, 7th and 9th August, 1885.

139. Porthesia xanthorrhæa.

Liparis xanthorrhæa, Kollar in Hügel's Kaschm. iv. 2, p. 470 (1842).

♂ ♀, Campbellpore, 24th June, 1885.

140. Porthetria obfuscata.

♂. *Lymantria obfuscata*, Walker, Cat. Lep. Het., Suppl. ii. p. 367 (1865).

♂ ♀, 5th to 11th August, 1885.

The female (which is a cripple) was sent to me, along with its eggs, some time ago; it nearly resembles the female of *P. japonica* excepting that it is smaller. Some of the eggs were hatched about the beginning of May and, by my advice, were placed upon young hawthorn; upon this and upon oak they have since lived, but their growth has, so far, been very slow; at the present time (June 5th) they are in their second moult and measure 11 millim. in length. Dorsal surface slate-grey, with a central series of seven spots commencing on the fourth segment, the fifth of these spots ochreous, the others red; the spots are connected by a slender longitudinal pale line and are bounded on each side by black spots; the subdorsal line is slender and whitish; the sides and ventral surface ash-grey; a lateral series of testaceous tubercles crowned with radiating bristles and connected by a very slender blackish line; tubercles of the second and two last segments very prominent and terminating in very long bristles; legs testaceous; head dark testaceous, the eyes bounded internally by two large fusiform black spots.

Lasiocampidæ.

141. Trabala vishnou.

Gastropacha vishnou, Lefebvre, Zool. Journ. iii. p. 207.

♂ ♀, Murree, 3rd September, 1885.

"Cocoons very common all along the hills from Murree to Thundiani, August and beginning of September. The males all came out early in September, the females later; the latter appear to remain on their cocoons, as several were taken thus late in September. Cocoon and chrysalis sent."—*J. W. Y.*

The cocoon of *T. vishnou*, which bears some resemblance to a quaint bearded face, is too well known to be worth redescribing here.

142. CHILENA SIMILIS?

Chilena similis, Walker, Cat. Lep. Het. v. p. 1071. n. 1 (1855).

♂ ♀, Campbellpore, from cocoon, July 1885.

The pair forwarded to me are very large for this species, but, so far as can be judged from the much rubbed and frayed specimens, there appears to be no difference of pattern.

143. MEGASOMA VENUSTUM.

♀. *Megasoma venustum*, Walker, Cat. Lep. Het. vi. p. 1449. n. 6 (1855).

♀, Campbellpore, 20th July, 1885.

MUSTILIIDÆ.

144. MUSTILIA COLUMBARIS, sp. n. (Plate XXXV. fig. 7.)

Pale sandy greyish brown; primaries crossed by two dark greyish lines, the inner one very irregularly sinuated, commencing in a brown costal streak, the second regular, oblique, from inner margin to apex; a brown patch at second third of costa and one or two diffused spots on outer border; a black spot at end of cell: secondaries with one irregularly angulated line beyond the middle; costal area whitish; external area dusky; a black dot at end of cell: head white: under surface uniform pale sandy brown, reddish towards outer margin, a single straight grey line across the wings. Expanse of wings 61 millim.

Murree, 13th August, 1885.

145. CALIGULA SIMLA.

Saturnia simla, Westwood, Cat. Orient. Ent. p. 41, pl. 20. fig. 1.

Murree, August 1885.

One specimen is labelled as "from chrysalis said to have come from the snows, Cashmere." All the specimens arrived in a more or less shattered condition.

NOTODONTIDÆ.

146. ICHTHYURA CUPREATA, sp. n.

Brownish or dust-grey; primaries darker than secondaries and varied with irregular bands of pale reddish cupreous; the wings crossed by whitish lines forming in large irregular characters the letters VB (left-hand wing); a submarginal series of unequal dust-grey spots is left between the cupreous bands on the disk; secondaries pale towards the base, the costa white; thorax dark grey-brown: under surface pale and without markings. Expanse of wings 28 millim.

Campbellpore, 26th July, 1885.

DREPANULIDÆ.

147. ARGYRIA CINEREA, sp. n. (Plate XXXV. fig. 8.)

Pale dove-grey; primaries darker in the centre; all the wings

with a large rounded testaceous central patch edged with dark grey and flecked with black, whitish, and metallic silver scales; submarginal and marginal leaden-grey lines, with a series of spots of the same colour between them; under surface wholly greyish white. Expanse of wings 33 millim.

Campbellpore, 5th July, 1885.

Quite unique in the genus.

Urapterygidæ.

148. Urapteryx yerburii, sp. n.

Nearest to *U. clara*[1] of the N.E. Himalayas, but differing in the more widely separated and greyer bands across the primaries, the more numerous grey striations on the wings, the paler fringes, the red-centred grey spot in the præcaudal angle of the secondaries, and the narrower tail to these wings; the abdomen is white (as it probably is in fresh specimens of *U. clara*). Expanse of wings 56 millim.

Murree, 2nd October, 1885.

Ennomidæ.

149. Rumia mimulina, sp. n.

Nearly allied to *R. cratægaria* of Europe, with almost the same pattern and coloration, but usually larger and always with the chocolate-coloured markings, especially the subapical costal spot of primaries, considerably broader; the form of the so-called "reniform" spot also differs somewhat. Expanse of wings 40–43 millim.

Murree, 8th and 12th September, 1885.

This species so singularly resembles the European insect that until I had examined a considerable number of specimens of the latter, and thus completely satisfied myself that no variety approaching the Indian insect ever occurred in *R. cratægaria*, I was tempted to regard the two specimens sent home by Major Yerbury as sports of the latter species: on looking over Mr. Moore's collection, I found a third example of the Indian species, above which (but separated by a label) was placed, for purposes of comparison, a specimen of the European species.

Oxydiidæ.

150. Pyrinia? phœnico-tæniata.

Aspilates phœnico-tæniata, Kollar in Hügel's Kaschm. iv. 2, p. 487 (1842).

Murree, 7th August, 1885.

This species is new to the collection; it corresponds so closely with Kollar's description that I have very little doubt as to the correctness of my identification.

151. Hyperythra phantasma.

Hyperythra phantasma, Butler, P. Z. S. 1881, p. 614. n. 62.

Campbellpore, 11th November, 1885.

[1] Ill. Typ. Lep. Het. vi. pl. cxiii. fig. 6.

This species, when fresh, is decidedly greenish, and therefore contrasts strongly with the allied *H. swinhoei*, recently captured specimens of which are decidedly reddish.

Boarmiidæ.

152. Boarmia iterata, sp. n.

Near to *B. repandaria* of Europe, the basal area of the wings more or less suffused with grey, all the markings much more strongly defined excepting the pale submarginal stripe, which is indistinct and less perfectly dentate-sinuate; the first and second black lines on the secondaries are also twice the width apart; the under surface is greyish white instead of sandy buff, and the primaries are strongly clouded with blackish. Expanse of wings 41 to 47 millim.

Murree, 24th and 28th August, 4th September; Kala Pani, 24th September, 1885.

Boarmia iterata is a common, though unnamed, Indian species; it is allied to *B. pleniferata*, but more nearly to the European insect.

153. Gnophos? obtectaria.

Gnophos obtectaria, Walker, Cat. Lep. Het., Suppl. v. p. 1597 (1866); Butler, Ill. Typ. Lep. Het. vi. p. 66, pl. cxvi. fig. 8 (1886).

♂, Murree, 8th September, 1885.

This species should be separated from *Gnophos*, as the antennæ of the male are distinctly bipectinated; it may perhaps prove to belong to one of the many allied genera already characterized in this family. Only one worn specimen was sent by Major Yerbury.

154. Gnophos? pærlita, sp. n.

Allied to *G. obtectaria*: granite-grey, all the ordinary markings on the upper surface indistinct, centre of the wings slightly paler than the remainder of the surface, so as to give the appearance of a diffused band, this in the primaries is partly bounded by an abbreviated zigzag blackish line, and on the secondaries by a series of blackish dots on the veins; there is also a blackish spot at the end of each discoidal cell; the external border is slightly ash-coloured, with a faintly indicated paler zigzag inner edging, the fringe is traversed at the base and in the middle by slender pale lines, and the abdominal fringe is white: below pure white, the wings with black discocellular spots and a broad blackish external border; fringe spotted with white; legs greyish above. Expanse of wings 48 millim.

Kala Pani, 24th September, 1885.

There is a series of this obscure-looking species in Mr. Moore's collection.

155. Gnophos dispunctata.

Gnophos dispunctata, Walker, Cat. Lep. Het. xxi. p. 469. n. 28 (1869).

Murree, 4th September, 1885.

"A single specimen, sitting with open wings on a rock."—*J. W. Y.*

156. GNOPHOS VITREATA.

Scotosia vitreata, Moore, P. Z. S. 1867, p. 656.

♂, Kala Pani, 24th September, 1885.

The single specimen obtained is greener than those in Mr. Moore's collection, but does not otherwise differ.

GEOMETRIDÆ.

157. JODIS DETRACTA.

Geometra detracta, Walker, Cat. Lep. Het. xxii. p. 521. n. 27 (1861).

Campbellpore, 30th July, 1885.

158. THALASSODES OPALINA.

Thalassodes opalina, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 214. n. 38 (1880); Ill. Typ. Lep. Het. vi. p. 70, pl. cxvii. fig. 9 (1886).

Murree, 6th September, 1885.

IDÆIDÆ.

159. IDÆA ORNATA (local form *I. deliciosaria*, Wlk.).

Phalæna ornata, Scopoli, Ent. Carn. p. 219. n. 545.

Murree, 31st August, 1885.

The markings are a little blacker than in the typical European form.

An example of a second species, of this or an allied genus, was found at Murree on 28th August, but as there is only one much broken example I can do nothing with it; it is numbered 29.

MACARIIDÆ.

160. MACARIA SUFFLATA.

Macaria sufflata, Guénée, Phal. ii. p. 88. n. 1059, pl. 17. fig. 8 (1857).

Barracoo, near Rawal Pindee, 9th October, 1885.

New to the Museum collection; the description by M. Guénée is much better than his figure, which is decidedly unsatisfactory. The "*Tephrina incessaria*" of Walker is a species of the same group, as also is the "*Epione brongusaria*" of the same author.

161. NADAGARA GRISEA.

Nadagara grisea, Butler, P. Z. S. 1883, p. 172. n. 140.

Murree, 7th September, 1885.

FIDONIIDÆ.

162. STERRHA SACRARIA.

Phalæna-Geometra sacraria, Linnæus, Syst. Nat. i. 2, p. 863. n. 220.

Murree, 8th, 11th, and 12th August; Campbellpore, 30th October, 1885.

163. PHYLETIS HERBICOLENS, var.

Delocharis herbicolens, Butler, P. Z. S. 1883, p. 173. n. 141.

♀, Murree, 6th September, 1885.

Differs from the type in its pale greenish-grey, instead of pinky-white tint, with the bands more distinctly green instead of brown. It is allied to *P. silonaria*, and the variation here described seems to be the prevalent type of colouring in the males of this genus.

164. PHYLETIS INCONSPICUA, sp. n.

♂. Evidently allied to *P. meonaria*. Brownish grey; the primaries crossed at basal third by an indistinct brown line, beyond the cell by a brown-edged band, and at the outer margin by a border of the same width as the band: secondaries with the costal area and base pale buff, a brown discal line parallel to outer margin and a slender blackish marginal line; all the wings with black discocellular dots; fringes plum-coloured at base and testaceous at the tips: thorax grey, antennæ and abdomen testaceous: wings below pale buff suffused with rose-red, crossed beyond the middle by a darker, slightly arched line; fringes grey at base, pink at tips; a black discocellular dot in all the wings: primaries with greyish discoidal area: body below pale buff tinted with pink. Expanse of wings 32 millim.

Murree, 30th August, 1885.

The relative number of lines across the wings differs wholly from that of *P. meonaria*, but the colouring seems very similar.

EPIFIDONIA, gen. nov.

Allied to *Fidonia* (*F. concordaria*[1]); differing in its more slender body, less hairy palpi, more slender and less hairy legs, acute subfalcate primaries, the much longer discoidal cells in all the wings, and in the less angular discocellulars of the secondaries.

[1] *F. concordaria* is a yellow-winged species similar to those of New Zealand. Mr. Meyrick, whose study of the Geometrina appears to have commenced with a Catalogue of the New-Zealand species, has proposed for some of these yellow-winged species the generic name *Pantlea*, a name used five times previously in Zoology. In his opinion the supposed new genus is nearly allied to *Larentia*, whereas the whole structure of the body is totally dissimilar: the form and neuration of the wings bear no near relationship to those of *Larentia*; in the latter genus the wings are delicate, thinly scaled, much elongated, the veins lying close together, the cells prolonged towards the median vein, the second and third median branches and the radial of secondaries equidistant at their origins, whereas in the New-Zealand *Fidonia* the radial is halfway between the median and subcostal veins. These points should be considered in conjunction with the different structure of the antennæ, palpi, legs, and, in fact, whole body, which, however, Mr. Meyrick considers beneath his notice, basing his classification solely upon neuration, which he indeed believes to have been modified to suit the altered shape of the wings; yet, with singular inconsistency, he states that "the shape of the wing, often employed by superficial observers, is not of the least value, being purely specific."

165. Epifidonia signata, sp. n. (Plate XXXV. fig. 9.)

Chocolate-brown; costa and discoidal area of primaries and centre of secondaries more or less suffused with ochraceous, the costal area of the latter wings, excepting at apex, widely bright ochreous; wings striated throughout with black, the primaries crossed in the middle by two well-separated blackish stripes, angulated towards costal margin; an oblique snow-white subcostal spot near apex; secondaries with a double blackish line from centre of abdominal margin to discoidal cell: body greyish: wings below bright ochreous with broad dark-brown tapering apical borders and a number of scattered black striations; primaries with a discal abbreviated band commencing below the white subapical spot; two central black lines; secondaries with an ill-defined central black line; pectus whitish, venter ochraceous. Expanse of wings 29 millim.

Murree, 2nd, 9th, and 28th August, 1885.

Zerenidæ.

166. Abraxas fuscescens, sp. n. (Plate XXXV. fig. 10.)

Primaries whity brown, speckled and mottled with blackish; base of costa ochreous; two widely separated divergent bands of spots, formed by blackish mottling, limiting the central area; a spot of a similar character on the costa just beyond the middle, an oblique oval spot at the end of the cell, and a spot immediately beyond the outer band at centre of second median interspace: secondaries sericeous creamy white, sparsely speckled with dark grey; a spot at the end of the cell and a slightly sinuous discal series of the same colour: head, collar, and tegulæ ochreous spotted with black, remainder of body cream-coloured with dorsal black spots: primaries below paler than above, the costa slightly ochraceous; body below yellowish cream-coloured, the venter with four series of black spots. Expanse of wings 48 millim.

Kalabagh, 16th September, 1885.

167. Abraxas virginalis, sp. n. (Plate XXXV. fig. 11.)

Wings above pure white; base of primaries ochreous, dotted with black and bounded by an irregular series of brownish dots; an imperfect band at basal fourth and the costa mottled with pale silver-grey; an annulus of the same colour closing the cell; two contiguous sinuous series of annular silver-grey spots across the disk, the inner series with black-dotted ochreous centres; an ochreous streak partly connecting the two series between the third median branch and the inner margin; three larger grey spots and a number of scattered annular dots beyond the discal series; six ocelloid marginal spots extending into the fringe: secondaries almost exactly as in *A. pantaria*; body paler than in the latter species: under surface of wings more strongly marked than above, but without the ochreous tinting. Expanse of wings 44 millim.

Murree, 13th August, 1885.

Larentiidæ.[1]

168. Melanthia restituta.

Melanippe restitutata (sic), Walker, Cat. Lep. Het. xxv. p. 1297 (1862).

Campbellpore, July; Murree, 2nd August, 1885.

The *Melanthia gratulata* of Walker, from Vancouver, is Packard's *Rheumaptera brunneicillata*.

169. Scotosia dubiosata.

Scotosia dubiosata, Walker, Cat. Lep. Het. xxv. p. 1352. n. 21 (1862).

Murree, 8th September; Bugnoter, 19th September, 1885.

"Not uncommon."—*J. W. Y.*

170. Scotosia venimaculata.

Scotosia venimaculata, Moore, P. Z. S. 1867, p. 657.

Thundiani, 24th September, 1885.

The single specimen sent is of a greyish-brown tint, with a pale golden or bronze gloss; it shows no trace of the rosy suffusion commonly seen on the wings of Darjiling specimens; all the markings are, however, identical, and it is possible that the absence of the reddish colouring may be due to fading or to individual variation.

171. Cidaria perpulchra, sp. n.

Allied to *C. aurata* and *C. aliena*; nearest to the former, but differing in the dark-grey instead of copper-brown basal area of the primaries, the much more irregular band following it, owing to the different form of the dark postmedian belt; the latter (which is blackish grey instead of brown) commences transversely instead of obliquely, is deeply bisinuated, and forms an angle at the median vein, it is wider than in *C. aurata* as far as the second median branch, and its anterior edge, instead of being narrowly incised on the lower radial interspace, is cleft so as to form a wide >-shaped incision; the external border is much less rufous and the pale markings upon it are paler and of twice the width; the secondaries are almost white instead of pale grey-brown; the series of silver spots on the under surface of the secondaries is wanting. Expanse of wings 29 millim.

Murree, 8th August, 1885.

This species in coloration more nearly resembles *C. corylata* than either of the two others of the same group.

172. Cidaria jameza?

Cidaria jameza, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 452 (1878); Ill. Typ. Lep. Het. iii. p. 58, pl. lv. fig. 9 (1879).

Murree, 20th August, 1885.

The single worn specimen in the collection is rather larger than Japanese examples, but I can discover no other difference.

[1] The collection contains a *Eupithecia*, but it is too much worn for identification.

173. Cidaria albigirata?

Cidaria albigirata, Kollar in Hügel's Kaschm. iv. 2, p. 489 (1848).

Murree, 12th August, 1885.

This agrees tolerably closely with Kollar's description, but his statement that it belongs to the neighbourhood of *Cidaria prunata* and *suffumata* is misleading, if this be his species, since it is closely allied to the European *C. picata*, and decidedly more closely than to either of the above-mentioned insects; it occurs also in Afghanistan.

174. Phibalapteryx, sp. n.?

A single specimen, much faded, worn, and without any antennæ or palpi, apparently of a new species.

Bugnoter, 19th September, 1885.

Crambidæ.

175. Jartheza chrysographella.

Chilo chrysographellus, Kollar in Hügel's Kaschm. iv. p. 494 (1848).

Campbellpore, 30th July, 1885.

176. Apurima xanthogastrella.

Apurima xanthogastrella, Walker, Cat. Lep. Het. xxvii. p. 194. n. 1 (1863).

Campbellpore, 28th July, 1885.

Tortricidæ.

177. Cerace tetraonis, sp. n.

Primaries above black, regularly dotted with pale yellow; costal border crossed by numerous short yellow striæ; a longitudinal subcostal bright red stripe from base to outer margin: secondaries with the discoidal cell and costal area nearly to apex bright orange ochreous, remainder of the wing black; five black costal spots; an ochreous apical spot; abdominal third of wing spotted all over with ochreous: body blackish, head and collar spotted with yellow, abdomen with ochreous margins to the segments: primaries below without yellow dotting, the red stripe replaced by an ochreous patch filling the discoidal cell and a spot on outer margin; the yellow colouring on the secondaries paler than above, otherwise similar; body below whitish. Expanse of wings 28 millim.

Murree, 28th August, 1885.

Allied to *C. onustana* of Nepal.

Choreutidæ.

178. Tegna hyblæella.

Tegna hyblæella, Walker, Cat. Lep. Het., Suppl. v. p. 1810 (1866).

Campbellpore, 20th July, 1885.

EXPLANATION OF PLATE XXXV.

Fig. 1. *Azanus uranus*, p. 366.
2. *Taraeus extricatus*, p. 366.
3. *Spindasis hypargyros*, p. 369.
4. *Euchloë lucilla*, p. 376.
5. *Pyralis incongrua*, p. 383.
6. *Samea yerburii*, p. 383.
7. *Mustilia columbaris*, p. 387.
8. *Argyria cinerea*, p. 387.
9. *Epifidonia signata*, p. 392.
10. *Abraxas fuscescens*, p. 392.
11. —— *virginalis*, p. 392.

9. List of a Collection of Birds from the Province of Tarapacá, Northern Chili. By P. L. Sclater, M.A., Ph.D., F.R.S., Secretary to the Society.

[Received June 25, 1886.]

(Plate XXXVI.)

Mr. H. Berkeley James, F.Z.S., has placed in my hands for determination a collection of bird-skins made for him by Carlos Rahmer, of the National Museum, Santiago, in the province of Tarapacá, formerly in Peru, but now, I believe, annexed to Chili. The collection, which was made in January and February last, contains 150 skins referable to 53 species, amongst which a new Flamingo, as I shall presently point out, is of special interest.

The nearest fauna to Tarapacá that has received much attention is that of the Desert of Atacama just to the south, which was explored in 1853–4 by Dr. R. A. Philippi, of Santiago[1]. Prof. Philippi's list of birds contains 33 species, only 11 or 12 of which are identical with those in the present collection.

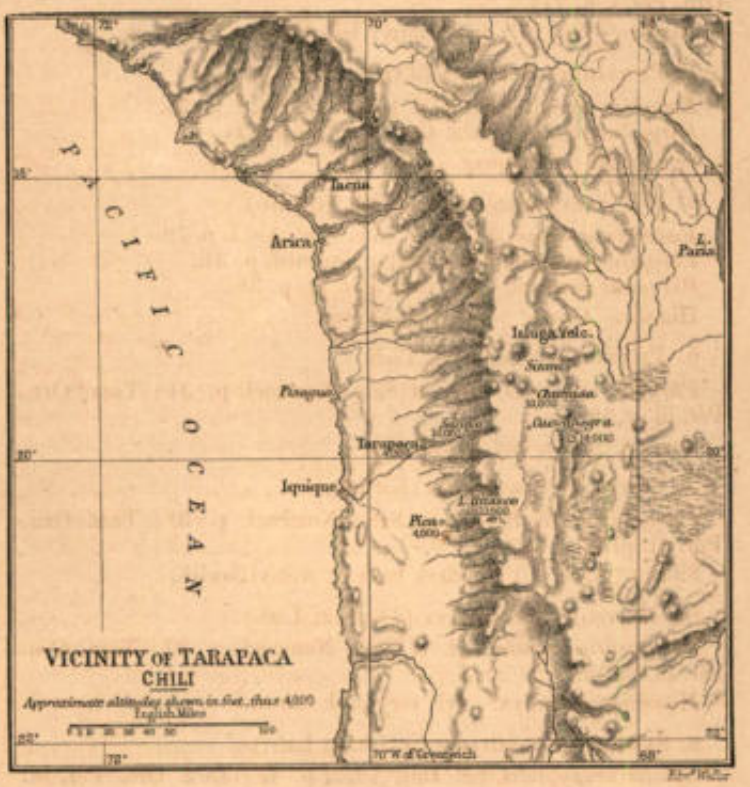
But our leading authority on the Birds of Peru, of which Republic the district of Tarapacá until lately formed part, is Taczanowski's 'Ornithologie du Pérou.' I have, therefore, referred throughout to this most useful work except in the case of the following seven species, which are not included by Taczanowski, and are therefore additions to his avifauna, namely:—*Sycalis aureiventris*, *Upucerthia ruficauda*, *Synallaxis modesta*, *Bolborhynchus orbignesius*, *Phœnicopterus jamesi*, *Fulica leucoptera*, and *Ægialitis occidentalis*. Of these seven, one (*Bolborhynchus orbignesius*) was hitherto only known from Bolivia; two, so far as is yet ascertained, are peculiar to Tarapacá (namely *Phœnicopterus jamesi* and *Ægialitis occidentalis*), and the remaining four are Chilian species not hitherto recorded so far north.

The species in the present collection from Tarapacá which have not yet been met with in Chili are 20 in number, namely:—*Turdus*

[1] 'Reise durch die Wüste Atacama,' &c. v. Dr. R. A. Philippi: Halle, 1860.

chiguanco, Phrygilus plebeius, Chrysomitris atrata, Sycalis uropygialis, Muscisaxicola albifrons, Centrites oreas, Cinclodes bifasciatus, Bolborhynchus orbignesius, Phœnicopterus andinus, P. jamesi, Metriopelia aymara, Chamæpelia cruziana, Gymnopelia erythrothorax, Gallinula galeata, Fulica gigantea, F. ardesiaca, Vanellus resplendens, Ægialitis occidentalis, Recurvirostra andina, and *Tinamotis pentlandi.*

Fig. 1.



The sketch now exhibited (fig. 1) will show most of the different places in which the collection was formed.

1. TURDUS CHIGUANCO, d'Orb. et Lafr.

Turdus chiguanco, Seebohm, Cat. Birds B. M. v. p. 225; Sel. et Salv. P. Z. S. 1867, p. 984 (Islay).

Merula chiguanco, Taez. Orn. Pér. ii. p. 494.

Sibaya. One ♀: iris brown; feet and beak yellow.

Obtained by Whitely near Islay, Peru, in 1867.

2. Anthus, sp. inc.

Sacaya. One ♂ : iris brown ; feet brown ; beak dark horn-colour.

A young bird, nearest to *A. furcatus*, d'Orb. et Lafr. (Tacz. Orn. Pér. i. p. 459).

3. Atticora cyanoleuca (Vieill.).

Atticora cyanoleuca, Sharpe, Cat. Birds B. M. x. p. 186 ; Tacz. Orn. Pér. i. p. 244.

Huasco. One ♀ : iris brown ; legs brown ; feet black.

4. Phrygilus atriceps (d'Orb. et Lafr.).

Emberiza atriceps, d'Orb. et Lafr. Syn. Av. i. p. 76.
Phrygilus atriceps, Tacz. Orn. Pér. iii. p. 34.

Sacaya and Lalcalhuay.

5. Phrygilus unicolor (d'Orb. et Lafr.).

Emberiza unicolor, d'Orb. et Lafr. Syn. Av. i. p. 79.
Phrygilus unicolor, Scl. et Salv. Nomencl. p. 31.
Phrygilus rusticus, Tacz. Orn. Pér. iii. p. 38.

Huasco. One ♂ : iris dark brown.

6. Phrygilus plebeius, Tsch.

Phrygilus plebeius, Scl. et Salv. Nomencl. p. 31 ; Tacz. Orn. Pér. iii. p. 39.

Huasco, Sitana, and Lalcalhuay.

7. Phrygilus fruticeti (Kittl.).

Phrygilus fruticeti, Scl. et Salv. Nomencl. p. 31 ; Tacz. Orn. Pér. iii. p. 37.

Sibaya. One ♂ : iris dark brown ; feet yellowish.

8. Chrysomitris atrata (d'Orb. et Lafr.).

Chrysomitus atrata, Scl. et Salv. Nomencl. p. 34 ; Tacz. Orn. Pér. iii. p. 53.

Huasco and Sacaya. Iris very dark brown.

9. Sycalis uropygialis (d'Orb. et Lafr.).

Sycalis uropygialis, Scl. Ibis, 1872, p. 47 ; Tacz. Orn. Pér. iii. p. 58.

Huasco and Sitana. Three examples, ♂ et ♀ : sexes alike.

10. Sycalis aureiventris, Ph. et Landb.

Sycalis aureiventris, Scl. Ibis, 1872, p. 47, pl. iii.

Chumisa. One ♀ : iris dark brown.

11. Muscisaxicola albifrons (Tsch.).

Muscisaxicola albifrons, Tacz. Orn. Pér. ii. p. 209.

Sacaya. One ♀ : iris dark brown ; feet and beak black.

12. Muscisaxicola rufivertex, d'Orb. et Lafr.

Muscisaxicola rufivertex, Tacz. Orn. Pér. ii. p. 216.

Huasco. ♂ et ♀ : iris bright brown ; bill and feet black.

13. Centrites oreas, Scl. et Salv.

Centrites oreas, Tacz. Orn. Pér. ii. p. 222.

Sacaya. One ♂ : iris very dark brown ; feet and beak black.

14. Geositta cunicularia (Vieill.).

Geositta cunicularia juninensis, Tacz. Orn. Pér. ii. p. 93.

Sacaya and Sitana. ♂ et ♀, alike : iris dark brown ; feet black ; beak horn-colour.

15. Upucerthia ruficauda (Meyen).

Ochetorhynchus ruficaudus, Scl. P. Z. S. 1867, p. 324.

Upucerthia ruficauda, Scl. et Salv. Nomencl. p. 62 ; iid. P. Z. S. 1879, p. 619.

Lalcalhuay. ♂ : iris brown ; feet and beak black.

16. Cinclodes bifasciatus.

Cinclodes bifasciatus, Scl. P. Z. S. 1858, p. 448 ; Tacz. Orn. Per. ii. p. 3.

Upucerthia atacamensis, Phil. Reise d. d. Wüste Atacama, p. 161, t. iii.

Chumisa, Sacaya, and Sibaya. Males : iris dark brown ; feet and beak black.

17. Cinclodes fuscus (Vieill.).

Cinclodes fuscus, Scl. et Salv. P. Z. S. 1867, p. 985.

Cinclodes rivularis, Tacz. Orn. Pér. ii. p. 112.

Chumisa, Cueva negra, and Sacaya. Iris brown ; feet black.

18. Leptasthenura ægithaloides (Kittl.).

Leptasthenura ægithaloides, Tacz. Orn. Pér. ii. p. 120.

Huasco. Iris dark brown.

19. Synallaxis modesta, Eyton.

Synallaxis modesta, Scl. P. Z. S. 1874, p. 23.

Sacaya and Sitana. Two ♂ et ♀ : iris dark brown.

20. Oreotrochilus leucopleurus, Gould.

Oreotrochilus leucopleurus, Tacz. Orn. Per. ii. p. 278 ; Gould, Mon. Troch. ii. pl. 71.

Chumisa and Lalcalhuay. Two females, with nest and eggs.

The nest consists of an oblong mass of grey and brown wool (apparently Llama's), with a few bits of moss intermixed. It is pointed at the lower extremity. In a shallow open depression are two white pyriform eggs ; they measure about 0·7 by 0·45 inch.

21. Bolborhynchus orbignesius.

Myiopsitta orbignesia, Bp. Rev. et Mag. de Zool. 1854, p. 151.
Bolborhynchus orbignesius, Scl. et Salv. P. Z. S. 1879, p. 635.
Bolborhynchus d'orbigni, Finsch, Papag. ii. p. 129.

Lalcalhuay. Males and females: sexes alike; iris dark brown.

These specimens agree with Bolivian skins of this little-known species.

22. Buteo erythronotus (King).

Buteo erythronotus, Tacz. Orn. Pér. i. p. 115.

Lalcalhuay. ♀: iris brown; feet yellow.

23. Milvago megalopterus (Meyen).

Milvago megalopterus, Tacz. Orn. Pér. i. p. 101.

Sitana. ♂: iris brown; feet yellow.

24. Ardea candidissima (Gm.).

Ardea candidissima, Tacz. Orn. Pér. iii. p. 393.

Sitana. ♂: iris yellow; feet black.

25. Phœnicopterus andinus, Philippi.

Phœnicopterus andinus, Philippi, Reise d. d. Wüste Atacama, p. 164, tt. iv., v.; Tacz. Orn. Pér. iii. p. 423.

Huasco. Two females, in full plumage. "Iris very dark brown; feet whitish yellow; beak, fore part black, hind part whitish yellow; between the nostrils brick-red; lowest hinder part of lower mandible and a small spot before the eyes violet."

An egg is of a uniform chalky white, with irregular adherent chalky layers, as in some Cormorants' eggs. It measures 3·6 by 2·1 inches, and is only slightly more pointed at the small end.

26. Phœnicopterus jamesi, sp. nov. (Plate XXXVI.)

Ph. *albus, capite colloque superiore et alis extus roseo indutis; cervicis undique, dorsi superioris et pectoris plumarum apicibus cum scapularibus et secundariis externis elongatis et subalaribus sanguineo-rosaceis; remigibus nigerrimis; subalaribus longis sanguineis; pedibus rubris; rostri basi flava, apice nigra; loris nudis in pelle carneis; digito postico nullo: long. tota circ.* 36·0, *alæ* 16·0, *caudæ* 6·5, *tarsi* 8·0.

Hab. in Andibus, prov. Tarapacensis.

Obs. A *Ph. andino* cui pedibus tridactylis affinis, forma et pictura rostri, scapularibus et secundariis productis, et pedibus rubris sanè diversus.

An adult male in full dress and a male and female not in full dress of this new species of three-toed Flamingo were obtained by Rahmer at Sitana, at a height of about 12,000 feet, at the foot of the Volcano Tsluga. In a letter announcing this discovery, Mr. Rahmer has proposed to call the species "*jamesi*," a name which I adopt with great pleasure.

There can be no question about the distinctness of this species from *P. andinus*. Besides the differences specified above, the conformation of the bill is of itself sufficient to render *Ph. jamesi* distinct in all ages. As will be seen by the sketches now exhibited (figs. 2 and 3), the bill is much shorter and smaller in *Ph. jamesi*, the naked space at the lores wider and differently shaped, and the upper mandible is much narrower. The very different disposition of the colours will be likewise seen from the figures. In *P. jamesi* the terminal black portion is much smaller, and is succeeded by an

Fig. 2.

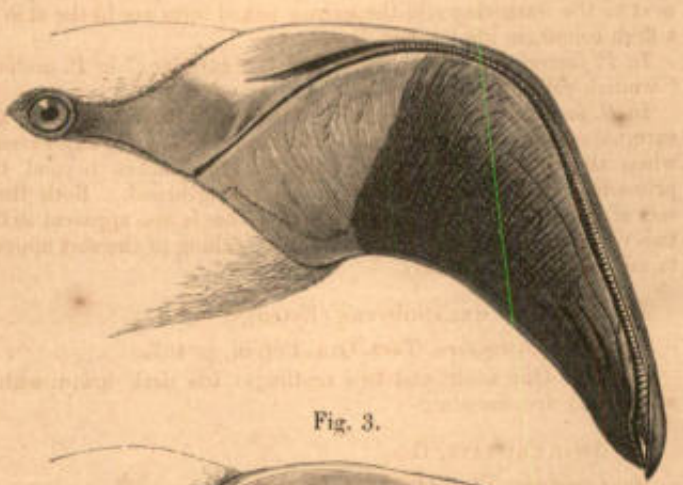


Fig. 3.

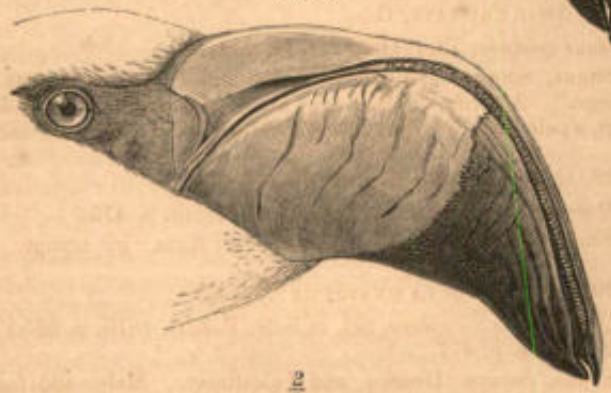


Fig. 2. Bill of *Ph. andinus*.
Fig. 3. Bill of *Ph. jamesi*.

orange-yellow which occupies the whole basal portion, while the narrow rim at the front, the lores, and the naked skin round the eye are red, in life (according to Rahmer) "carmine." There is besides a red spot terminating the yellow at the front of the upper mandible. In *P. andinus* the black terminal portion is much more extended; this is succeeded by a pale or "whitish yellow" base; and the part between the nostrils is "brick-red." The lower part of the gonys next to the feathering and the narrow naked lores are in the skin of a flesh-colour, in life "violet."

In *P. jamesi* the legs are red, in life "carmine;" in *P. andinus* "whitish yellow."

In *P. jamesi*, as will be seen in the figure (Plate XXXVI.), the external secondaries are elongated into filiform plumes, which extend, when the wing is closed, as much as two inches beyond the primaries, and scapularies are similarly lengthened. Both these sets of plumes are of a bright rosy red. This is also apparent in the two younger specimens of *P. jamesi*, but nothing of the sort appears to take place in *P. andinus*.

27. Bernicla melanoptera (Eyton).

Bernicla melanoptera, Tacz. Orn. Pér. iii. p. 467.

Sacaya. One adult and two nestlings: iris dark brown with a white rim; feet carmine.

28. Anas cristata, Gm.

Anas cristata, Tacz. Orn. Pér. iii. p. 473.

Sitana, Sacaya, and Huasco. Examples of both sexes: "iris orange." A series of eight eggs are of the usual colour of Ducks' eggs, a pale fulvous white; they measure about 2·6 by 1·7 inch.

29. Querquedula cyanoptera (Vieill.).

Querquedula cyanoptera, Tacz. Orn. Pér. iii. p. 475.

Sitana and Sacaya. Examples of both sexes: iris orange.

30. Querquedula oxyptera (Meyen).

Querquedula oxyptera, Scl. et Salv. P. Z. S. 1876, p. 385; Tacz. Orn. Pér. iii. p. 477.

Sitana, Sacaya, Huasco, and Lalcalhuay. Males and females: iris dark brown. Ten eggs of this Duck accompany the skins; they are duller and smaller than those of *Anas cristata*, and measure about 2·3 by 1·5 inch.

31. Querquedula puna (Tsch.).

Querquedula puna, Tacz. Orn. Pér. iii. p. 478; Scl. et Salv. Ex. Orn. pl. xcix.

Sitana and Sacaya. Examples of both sexes: "iris brown."

Five eggs are larger and more pointed than those of *Q. oxyptera* and of a pale fulvous white. They measure about 2·3 by 1·75 inch.

32. Dafila spinicauda (Vieill.).

Dafila spinicauda, Tacz. Orn. Pér. iii. p. 481.

Sitana. A pair: "iris brown."

33. Metriopelia melanoptera (Gm.).

Metriopelia melanoptera, Tacz. Orn. Pér. iii. p. 239.

Lalcalhuay. A ♂: "iris dark blue; feet black."

34. Metriopelia aymara (d'Orb.).

Metriopelia aymara, Tacz. Orn. Pér. iii. p. 240.

Huasco and Sitana. Examples of both sexes: iris black or very dark brown; feet flesh-coloured.

35. Melopelia meloda (Tsch.).

Melopelia meloda, Tacz. Orn. Pér. iii. p. 241.

Pica. A single specimen: "iris brown; feet carmine; beak black."

36. Chamæpelia cruziana (d'Orb.).

Chamæpelia cruziana, Tacz. Orn. Pér. iii. p. 248.

Pica. Examples of both sexes: "iris dark red, with white rim; feet brick-red."

37. Gymnopelia erythrothorax (Meyen).

Gymnopelia erythrothorax, Tacz. Orn. Pér. iii. p. 249.

Sibaya. A young male: "iris light blue; feet flesh-colour; naked skin round the eye orange."

38. Gallinula galeata (Licht.).

Gallinula galeata, Tacz. Orn. Pér. iii. p. 327.

Sitana. A single skin: "iris brown."

39. Fulica gigantea, Eyd. et Soul.

Fulica gigantea, Tacz. Orn. Pér. iii. p. 329.

Cueva negra near Sacaya. Four examples, all females: "iris red-brown; feet dark brickdust-red; bill red-brown, with the ridge and point white, and a spot on each side yellow."

Two eggs of this species are of the usual character of this group: they are of a pale stone-colour, sparingly spotted and speckled with two shades of reddish grey, and measure about 2·8 by 1·8 inch.

40. Fulica ardesiaca, Tsch.

Fulica ardesiaca, Tacz. Orn. Pér. iii. p. 328; Scl. et Salv. Ex. Orn. pl. lvii.

Huasco. Examples of both sexes, alike: "iris brown-red; feet yellowish green; joints and edges of toes greyish; bill with the ridge and borders of mandible white, the point yellowish green, and a spot near nostrils yellow; blaze chocolate."

41. Fulica leucoptera, Vieill.

Fulica leucoptera, Scl. et Salv. Ex. Orn. p. 119, pl. lx.
Fulica chloropoides, Landb. Wiegm. Arch. 1862, pt. i. p. 218.
Fulica stricklandi, Hartl. J. f. O. 1853, Extrah. p. 86.

Huasco. One ♀: "iris red-brown; feet and bill yellowish green; ridge of bill white; spot near nostrils yellow; spot above the beak chocolate."

42. Vanellus resplendens (Tsch.).

Vanellus resplendens, Tacz. Orn. Pér. iii. p. 336.

Sitana and Sacaya. Three males, two females; sexes alike: iris carmine; beak and feet carmine; point of beak black.

Neither Tschudi nor Taczanowski appear to have noted that there is no hind toe in this species.

43. Ægialitis occidentalis, Cab.

Ægialitis occidentalis, Cab. J. f. O. 1872, p. 158, et 1885, pl. vi. fig. 1 (head).

Sitana, Huasco, and Cueva negra. Examples of both sexes: "iris brown; feet black."

Mr. Seebohm has kindly determined these specimens, and sends me the subjoined remarks:—

"Although Cabanis gives no locality, nor mentions the colour of the legs and feet, there can be no doubt that his name refers to this species. He says it is a larger bird than *Æ. nivosus*, but like it has white lores. He also refers to the rusty hind head and neck.

"It appears to be the South-American representative of *Æ. ruficapillus*, which inhabits the coasts of Australia, Tasmania, and occasionally New Zealand."

44. Oreophilus ruficollis (Wagl.).

Oreophilus ruficollis, Tacz. Orn. Pér. iii. p. 347.

Lalcalhuay. One ♂: iris dark brown; bill black; feet carmine.

45. Thinocorus orbignyanus, Less.

Thinocorus orbignyanus, Tacz. Orn. Pér. iii. p. 281.

Sacaya. Examples of both sexes: iris brown; bill horn-colour; feet yellow.

Three eggs are much pointed, and call to mind those of the Grallæ: they are of a shining buffy white, finely speckled with greater and lesser black and blackish specks, and measure about 1·5 by 1·1.

46. Phegornis mitchelli, Fraser.

Leptopus mitchelli, Fraser, P. Z. S. 1844, p. 157.
Phegornis mitchelli, Tacz. Orn. Pér. iii. p. 372.

Sitana. One ♂: "iris dark brown, almost black; feet yellowish; beak black."

A scarce bird, originally described from Chili, where Philippi says it is found on the high Cordillera of the Central Provinces [1]. The same naturalist also obtained it near Rio Frio in the desert of Atacama (Reise d. d. Wüste Atacama, p. 163). Jelski met with it on the Lake of Junin, Central Peru.

47. Recurvirostra andina, Ph. et Landb Wiegm. Arch. 1863, pt. i. p. 131; Harting, Ibis, 1874, p. 257, pl. ix.

Three examples of this scarce bird from Huasco. "Iris orange with a yellow rim; legs bluish grey; beak black."

48. Tringa maculata, Vieill.

Tringa maculata, Tacz. Orn. Pér. iii. p. 356.
Huasco. "Iris light brown."

49. Tringa bairdi (Coues).

Tringa bairdi, Tacz. Orn. Pér. iii. p. 359.
Huasco, Sacaya, and Cueva negra. "Iris dark brown."

50. Gambetta melanoleuca (Vieill.).

Totanus melanoleucus, Tacz. Orn. Per. iii. p. 365.
Sitana.

51. Gambetta flavipes (Gm.).

Totanus flavipes, Tacz. Orn. Pér. iii. p. 367.
Sacaya.

52. Larus serranus, Tsch.

Larus serranus, Tacz. Orn. Pér. iii. p. 452.
Huasco, Sitani, and Cueva negra. Examples of both sexes: "iris dark brown; bill and feet dark brown-red."

53. Tinamotis pentlandi, Vig.

Tinamotis pentlandi, Tacz. Orn. Pér. iii. p. 310.
Huasco. One ♂: "iris chocolate; legs whitish greenish; feet black."

[1] "Cat. Av. Chilenas," in Anales de la Univers. de Chile, tom. xxxi. p. 272.

10. Note on the Presence of a Columella (Epipterygoid) in the Skull of *Ichthyosaurus*.

By A. Smith Woodward, F.G.S., of the British Museum (Natural History). (Communicated by Professor Flower, LL.D., F.R.S., President.)

[Received June 3, 1886.]

In the skulls of fossil Reptiles and Amphibia it so rarely happens that the bones on the inner side of the temporal fossa, and those between the orbits, are well exposed to view, that even in some of the most familiar genera very little has yet been ascertained regarding the special characters of any of these ossifications. In so conspicuous a form as *Ichthyosaurus*, for example, there appears to be no published reference to these structures beyond the brief statements of Profs. Huxley, Cope, and Sir Richard Owen, and even these do not afford any very definite information. Prof. Huxley determined[1] the presence of a distinct pro-otic, and the doubtful absence of ali- and orbito-sphenoids; Prof. Cope gives[2] a diagrammatic outline of the "columella"; while Sir Richard Owen appears to have been less successful in his researches, having met with nothing but unsatisfactory indications of small "alisphenoids" (? pro-otics), and especially remarking that there is "no trace or sign of the Lacertian columellar bone"[3].

In making the latter statement, the distinguished palæontologist just mentioned evidently overlooked Prof. Cope's previous researches upon the osteology of the Ichthyosaurian skull; and having lately discovered that there is no foundation for the assertion in the British Museum specimens, that formed the basis of Sir Richard Owen's monograph, I venture to offer a few remarks upon the subject, by way of pointing out the mistake. A detailed description of the interesting bone in question may also be acceptable, since Prof. Cope's materials appear to have been less complete and satisfactory than those now afforded by the fossils from the English Jurassic.

The first specimen of interest in this connection is a small slab of Lias from Lyme Regis, exhibiting a number of dislocated cranial bones, which Mr. William Davies long ago recognized as belonging to *Ichthyosaurus*, but which do not appear, hitherto, to have been submitted to so careful a study as their admirable state of preservation renders desirable. In the middle of the fossil, the basioccipital, basisphenoid, and presphenoid are arranged in irregular series, with their upper aspect exposed; in front are the remains of the supra-occipital and parietals; and on either side are scattered a number of

[1] T. H. Huxley, 'Anatomy of Vertebrated Animals,' 1871, p. 211.

[2] E. D. Cope, "On the Cranium of the Ichthyopterygia," Proc. Amer. Assoc. Adv. Sci. vol. xix. (1870), pp. 200–203. (For this reference I am indebted to the kindness of Mr. J. W. Hulke, F.R.S.)

[3] R. Owen, "Fossil Reptilia of the Liassic Formations.—III." (Mon. Pal. Soc. 1881), p. 96; also, 'History of British Fossil Reptiles,' vol. iii. (1884), p. 54.

other cranial elements in a more or less well-preserved state. Among the latter are two long bones with expanded extremities, lying lengthwise, one on either side of the basi- and presphenoids; and the form and situation of these elements, considered in connection with the evidence of other specimens presently to be noticed, can leave no doubt that they are the homologues of the columella (epipterygoid, Parker) found in Lacertilia, Rhynchocephalia, Anomodontia, Dinosauria[1], and Chelonia. The bone on the right shows a side view, while that on the left is seen either from behind or before, and although both are fractured to a certain extent, their boundaries are readily distinguishable.

The right columella is 0·045 metre in total length, and is shown of the natural size in fig. 1[2] (p. 407). The upper end exhibits a triangular expansion, which, before fracture, must have measured about 0·016 metre in greatest breadth; and the long terminal upper border thus produced has a gently arched contour. Immediately below the expanded portion the bone becomes much constricted, having a diameter of only 0·003 metre, and at the distance of 0·019 metre from the lower extremity it commences again to widen, but here in an unsymmetrical manner. From the upper expansion downwards the anterior edge is nearly straight, but at the point just mentioned the hinder edge rapidly curves backwards, until the bone attains a maximum breadth of 0·012 metre, when the border once more descends almost vertically for some distance, and finally curves to the front. The lower end, however, has evidently been much crushed, like the remainder of the bone, and perhaps does not give an exact idea of its original shape.

The left columella, presenting only an anterior (or hinder) view, does not add any further details to the foregoing description; but this side of the fossil is of especial interest, since, as pointed out to me by Mr. G. B. Howes, there appears to be some indication of a downwardly-directed process of the parietal to meet the columella, such as exists in the living *Cyclodus*[3]. There is no indication of the fusion of the upper end of the bone with the parietal (or ? "squamosal"), such as Prof. Cope describes (*l. c.* p. 204) in the American form.

In a skeleton of *Ichthyosaurus* from the collection of the late Prof. Tennant (No. R 44 of the B.M. Register), the postorbital and adjoining bones are so far removed and displaced as to permit an admirable view of the lower end of the right columella, which is uncrushed, and still in contact with the pterygoid immediately behind the orbit. This is shown of the natural size in fig. 2. Its front edge is almost vertical, but curves slightly forwards near the lower termination, and there is a sharp anterior outer ridge along the whole length of the bone. The expanded portion exhibits a

[1] See O. C. Marsh, "Restoration of *Brontosaurus*," Amer. Journ. Sci. (3) vol. xxvi. p. 83; "On the Diplodocidæ," *ibid.* (3) xxvii. p. 163; "The Order Theropoda," *loco. cit.* p. 332.

[2] The drawings have been made by Mr. W. H. Hill.

[3] T. H. Huxley, 'Anatomy of Vertebrated Animals,' p. 189, fig. 69.

long inferior border, decidedly marked off from a short posterior border, but the precise nature of its original articulation is unfortunately not apparent. The pterygoid seems to have slipped somewhat from its natural position.

Fig. 1.

Fig. 2.

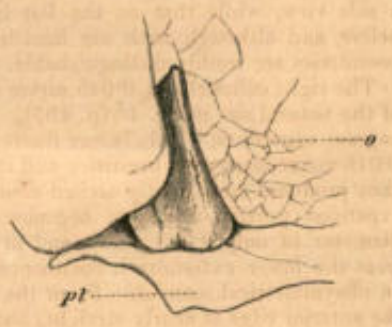


Fig. 3.

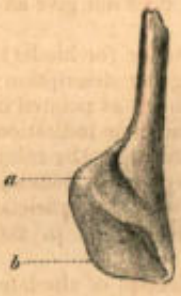


Fig. 4.

Fig. 1. Right columella of *Ichthyosaurus*, much crushed ; inner side view. [B.M., No. 2000. 40 *.]

Fig. 2. Lower portion of right columella of *Ichthyosaurus*; outer side view : *pt*, pterygoid ; *o*, crushed bones in orbit. [B.M., No. R 44.]

Fig. 3. Lower portion of left columella of *Ichthyosaurus intermedius*; inner side view. [B.M., No. 2000. 15.]

Fig. 4. Left columella of *Hatteria punctata*; outer side view : *pt*, pterygoid; *qu*, quadrate.

The fragmentary skull of *Ichthyosaurus*[1] figured by Hawkins in his 'Book of the Great Sea-Dragons,' pl. 19. fig. 1, also exhibits the lower two thirds of the left columella, and this is interesting as

[1] This specimen has been identified with *I. intermedius*, Conyb., by Sir Richard Owen, and bears his MS. label.

displaying an uncrushed inner view: the bone, however, though well shown in Mr. O'Neill's drawing, is not specially marked, and it is therefore advisable to append a separate sketch, such as is given in the woodcut, fig. 3 (p. 407). The general outline is similar to that of the examples already described, but the additional characters of the inner aspect are well worthy of note. In the constricted portion of the bone, the shaft is compressed to form a sharp ridge, which terminates in an abrupt prominence at the point where the lower expansion commences, and beneath this the broad surface is divided into two distinct, apparently articular, facettes. The upper and hinder division (*a*) is slightly hollowed and somewhat triangular in shape; while the lower facette (*b*) is more elongated, and is separated from the first in its anterior portion by being more deeply impressed in the bone.

Among the crushed cranial bones, immediately behind the sclerotic plates, in another specimen of *Ichthyosaurus* in the National Collection the columella is also distinctly visible; but this does not supply any additional facts of importance.

On comparing the bone under consideration with its homologue among recent Reptiles, none is found to exhibit a more striking similarity than that of *Hatteria* (fig. 4, p. 407). As Dr. Günther has pointed out [1], the columella in this genus is particularly remarkable for the great expansion of its extremities; and it is also peculiar from the fact that the lower end articulates not only with the pterygoid, but also with an inward extension of the quadrate. Moreover, so far as can be ascertained from a complete skull, the columella appears to show some signs of contracting this articulation by an overlapping of the two bones in a vertical plane; and the upper end is connected with cartilage, and not directly in contact with the parietal above.

Unfortunately at present it is only possible to compare the *form* of the element in each of these types. In none of the fossil Ichthyosaurs I have examined are the precise relations of the bone very distinct. As already stated, however, the first fossil is remarkably suggestive of a direct articulation of the upper end of the columella with a downward process of the parietal; and the originals of figs. 2 and 3 exhibit so close a resemblance to the corresponding parts in *Hatteria*, that there is also strong evidence of the lower articulation being double. But it ought to be remarked that in *Ichthyosaurus* no inwardly directed extension of the quadrate has hitherto been observed [2], and the discovery of more satisfactory specimens must yet be awaited before it is possible to arrive at any definite conclusion.

[1] A. Günther, "Contribution to the Anatomy of *Hatteria* (*Rhynchocephalus*, Owen)," Phil. Trans. 1867, p. 599, pl. xxvi. figs. 3, 4.

[2] H. G. Seeley, "Similitudes of the Bones in the Enaliosauria," Journ. Linn. Soc. (Zoology) vol. xii. (1876), p. 309.

11. Descriptions of some new Species of Heterocera from Tropical Africa.

By Herbert Druce, F.L.S., F.R.G.S., F.Z.S.

[Received June 16, 1886.]

(Plates XXXVII. & XXXVIII.)

Saturniidæ.

Attacus albidus, sp. n. (Plate XXXVII. fig. 1.)

♂. The primaries very similar to *A. ploetzi*, but the white band is closer to the outer margin, four round white spots between the apex and the anal angle. Secondaries pure white excepting the outer margin, which is narrowly bordered with reddish brown, with black and fawn-coloured lunular markings as in *A. ploetzi*; the vitreous spot long, narrowly edged with black, bordered on the inner side with yellow. The underside the same as above. Head and thorax reddish brown, a wide white band at the base of the thorax, the abdomen brown banded with white; antennæ and legs pale yellowish brown. The female the same as the male, but slightly more reddish in colour, and with all the vitreous spots considerably larger. Expanse, ♂ 7 inches, ♀ 6½ inches.

Hab. West Africa, Cameroon Mountains. Mus. Druce.

This very fine species comes into the group containing *A. vacuna*, Westw., *A. ploetzi*, Weymer, from both of which it is at once distinguished by the pure white secondaries.

Antheræa dolabella, sp. n. (Plate XXXVIII. fig. 2, ♂.)

♂. Primaries chrome-yellow, crossed by three irregular black bands, beyond which, along the outer margin, are a series of dusky patches, the base of the wing shaded with pink. Secondaries bright pink, broadly bordered with chrome-yellow, from the apex to the anal angle with several indistinct dusky black patches; nearest the anal angle a wide black band, dividing the two colours, crossing from near the apex to the inner margin; a large round deep yellow ocellus with a wide black border, on the outer edge of the black is a ring of bluish-fawn colour; in the centre of the ocellus is a very small vitreous spot. Head and thorax and upperside of abdomen bright pink, the underside of abdomen chrome-yellow banded with black; tegulæ chrome-yellow; antennæ black; legs black and yellow. Expanse 4½ inches.

Hab. East Central Africa. Mus. Druce.

This very beautiful species is quite unlike any other known to me.

Bunæa pygela, n. sp. (Plate XXXVIII. fig. 1, ♂.)

♂. Primaries uniform pale pinkish brown, darkest along the costal margin; the outer and inner margin narrowly edged with pink; underside as above, but shaded with dark yellow from the base to about the middle; a small black spot at the end of the

cell. Secondaries dark orange-yellow, bordered from the apex to the anal angle and thence along the inner margin to the base with bright pink; a large central round fawn-coloured ocellus broadly edged with black. The underside uniform pale pinkish brown. Head and thorax orange-yellow; collar and underside of the thorax pure white; a wide pink band at the base of the thorax. Abdomen, upperside orange-yellow, underside pale pinkish brown; the anus pink; antennæ brown, deeply pectinated; legs pale brown. Expanse 3½ inches.

Hab. East Africa, Matebele Country. Mus. Druce.

This species is allied to *B. pygmæa*, Maassen, from which it is at once distinguished by not having the black band across the primaries and the absence of the white dot at the end of the cell, and difference in the colour of the antennæ.

Lasiocampidæ.

Stibolepis sylvia, sp. n.

Primaries silvery white, brownish black along the costal margin, the apex, and outer margin; the veins from the cell to the outer margin dusky. Secondaries silvery white, with the apex and outer margin narrowly edged with brownish black; the veins a short way up from the margin dusky. Underside as above, excepting that the primaries have less black at the apex. Head and thorax yellowish white. Abdomen dark yellow; antennæ black; legs yellow. Expanse 2¾ inches.

Hab. West Africa, Cameroons (*Thompson*). Mus. Druce.

This beautiful species is allied to *Stibolepis nivea*, Butler, from which it is at once distinguished by its smaller size and entire absence of the black marginal band of that species.

Chrysopoloma rosea, sp. n. (Plate XXXVIII. fig. 3.)

Primaries fawn-colour, shaded with pink along the inner margin, crossed beyond the middle by a row of brownish-red spots. Secondaries pale yellow, the fringe pinkish. The head, thorax, and abdomen pale yellowish-fawn colour; legs brownish black; antennæ black. Expanse 1⅞ inch.

Hab. East Africa, Delagoa Bay. Mus. Druce.

This pretty little species is allied to *Chrysopoloma obtusa*, Walker, also from East Africa.

Chrysopoloma citrina, sp. n. (Plate XXXVIII. fig. 4.)

Primaries pale yellow, crossed about the middle, from the costal to the inner margin, by a band of very small brown spots, beyond which is a second band, extending from the apex to the inner margin; the second band is very much wider, and near the inner margin it has several whitish spots; a submarginal row of minute dots extending from the apex to the anal angle. Secondaries pale yellow, with a central and submarginal row of small brown spots. The fringe of both primaries and secondaries pale yellow; the underside

uniform pale yellow. Head, thorax, and abdomen yellow; legs yellow, banded with brown. Expanse 1¾ inch.

Hab. West Africa, Old Calabar. Mus. Druce.

In form this species resembles *C. rudis*, Walker, but in colour and markings it is very distinct.

LECHENOPTERYX FULVIA, sp. n.

Primaries pinkish brown, crossed near the outer margin from near the apex to the inner margin by a black line, bordered on the inner side with yellow; a small white dot edged with black at the end of the cell; secondaries pinkish brown, with the same coloured line extending from the apex to the inner margin close to the anal angle. Underside much paler than above, and the black lines not edged with yellow. Head, thorax, and abdomen pinkish brown; antennæ brown; legs darker brown. Expanse 1¾ inch.

Hab. East Africa; Zanzibar. Magila (*Craven*). Mus. Druce.

EXPLANATION OF THE PLATES.

PLATE XXXVII.

Fig. 1. *Attacus albidus*, sp. n., ♂, p. 409.

PLATE XXXVIII.

Fig. 1. *Bunæa pygela*, sp. n., ♂, p. 409.
2. *Antheræa dolabella*, sp. n., ♂, p. 409.
3. *Chrysopoloma rosea*, sp. n., p. 410.
4. —— *citrina*, sp. n., p. 410.

12. First Report on Additions to the Batrachian Collection in the Natural-History Museum. By G. A. BOULENGER.

[Received June 28, 1886.]

(Plate XXXIX.)

The following is a list of all the species of Batrachians added to the National Collection since the publication of the last edition of the Catalogue (1882). To such names as are not mentioned in that work, reference to the original description is appended; an asterisk indicates that the type specimen is in the collection. The list is followed by the descriptions of a few new species.

ECAUDATA.

*1. *Ceratobatrachus guentheri*, Blgr. P. Z. S. 1884, p. 212.—Solomon Islands (*Guppy*).
*2. *Rana bufoniformis*, Blgr. l. c. p. 210.—Solomons (*Guppy*).
*3. *Rana sternosignata*, Murray, Ann. N. H. (5) 1885, xvi. p. 120.—Sind (*Murray*).
*4. *Rana guppyi*, Blgr. l. c. p. 211—Solomons (*Guppy*).
*5. *Rana opisthodon*, Blgr. l. c. p. 211.—Solomons (*Guppy*).
6. *Rana septentrionalis*, Baird.—Canada (*Lataste*).

*7. *Rana forreri*, Blgr. Ann. N. H. (5) 1883, xi. p. 343.—Presidio, W. Mexico (*Forrer*).
*8. *Rana macrocnemis*, Blgr. P. Z. S. 1885, p. 22.—Brusa (*v. Maltzan*).
9. *Rana iberica*, Blgr.—Serra de Gerez, Portugal (*Gadow*).
10. *Rana latastii*, Blgr.—Various localities in North Italy (*Camerano* and *de Betta*).
*11. *Rana martensi*, Blgr., *infra*.—Yedo (*v. Martens*).
*12. *Rana pustulosa*, Blgr. Ann. N. H. (5) 1883, xi. p. 343.—Ventanas, W. Mexico (*Forrer*).
13. *Rana nicobariensis*, Stol.—Nias (*Sandemann*).
*14. *Rana masonii*, Blgr. Ann. N. H. (5) 1884, xiii. p. 397.—Batavia (*Mason*).
*15. *Rana macropus*, Blgr., *infra*.—Loo Choo Islands (*Carpenter*).
16. *Rana ulcerosa*, Bttg.—Nossi Bé (*Senckenberg Mus.*).
17. *Rana granulata*, Bttg.—Nosi Bé (*Senckenberg Mus.*).
18. *Rana buergeri*, Schleg.—Japan (*Anderson*).
19. *Rhacophorus dispar*, Bttg.—Nossi Bé (*Senckenberg Mus.*).
*20. *Rhacophorus lateralis*, Blgr. Ann. N. H. (5) 1883, xii. p. 162.—Malabar (*Beddome*).
*21. *Ixalus asper*, Blgr., *infra*.—Larut, Perak (*Wray*).
*22. *Cornufer guppyi*, Blgr. P. Z. S. 1884, p. 211.—Solomons (*Guppy*).
*23. *Cornufer solomonis*, Blgr. l. c. p. 212.—Solomons (*Guppy*).
*24. *Rappia burtonii*, Blgr. Ann. N. H. (5) 1883, xii. p. 163.—Gold Coast (*Burton* and *Cameron*).
25. *Nyctixalus margaritifer*, Blgr. Ann. N. H. (5) 1882, x. p. 35.—Willis Mountains, Java (*v. Huegel*).
*26. *Prostherapis femoralis*, Blgr. P. Z. S. 1883, p. 635.—Yurimaguas (*Hahnel*).
27. *Mantella ebenaui*, Bttg.—Nossi Bé (*Senckenberg Mus.*).
*28. *Dendrobates reticulatus*, Blgr. l. c. p. 635.—Yurimaguas (*Hahnel*).
*29. *Dendrobates fantasticus*, Blgr. l. c. p. 636.—Yurimaguas (*Hahnel*).
*30. *Dendrobates hahnelii*, Blgr. l. c. p. 636.—Yurimaguas (*Hahnel*).
*31. *Hypopachus oxyrrhinus*, Blgr. Ann. N. H. (5) 1883, xii. p. 344.—Presidio (*Forrer*).
*32. *Microhyla fissipes*, Blgr. Ann. N. H. (5) 1884, xiii. p. 397.—Taiwanfoo, Formosa.
33. *Rhombophryne testudo*, Bttg.—Nossi Bé (*Senckenberg Mus.*).
34. *Cophyla phyllodactyla*, Bttg.—Nossi Bé (*Senckenberg Mus.*).
35. *Pseudis mantidactyla*, Cope.—Rio Grande do Sul (*v. Ihering*). Montevideo (*Paris Mus.*). R. de la Plata (*Gairdner*).
*36. *Phyllobates trilineatus*, Blgr. P. Z. S. 1883, p. 636.—Yurimaguas (*Hahnel*).
37. *Hylodes brocchii*, Blgr. in Brocchi, Miss. Sc. Mex., Batr. p. 60.—Vera Paz (*Salvin*).
38. *Hylodes augusti*, Brocchi.—Ventanas (*Forrer*).

*39. *Hylodes vertebralis*, Blgr., *infra*.—Intac, Ecuador (*Buckley*).
*40. *Paludicola gracilis*, Blgr. Ann. N. H. (5) 1883, xi. p. 17.—Rio Grande do Sul (*v. Ihering*). Uruguay.
41. *Paludicola falcipes*, Hens.—R. Grande do Sul (*v. Ihering*).
42. *Paludicola olfersii*, Martens, Nomencl. Rept. Mus. Berol. p. 40.—Brazil (*Berlin Museum*).
*43. *Leptodactylus discodactylus*, Blgr. P. Z. S. 1883, p. 637.—Yurimaguas (*Hahnel*).
44. *Leptodactylus gracilis*, D. & B.—Rio Grande do Sul (*v. Ihering*).
*45. *Leptodactylus rhodomystax*, Blgr. l. c. p. 637.—Yurimaguas (*Hahnel*).
*46. *Leptodactylus diptyx*, Bttg. Zeitschr. f. Naturw. 1885, lviii. p. 244.—Paraguay.
*47. *Limnodynastes olivaceus*, De Vis, Proc. Linn. Soc. N. S. W. 1884, ix. p. 66.—Queensland (*Ling Roth*).
48. *Empemphix nattereri*, Stdchr.—Paraguay.
49. *Bufo mexicanus*, Brocchi.—Ciudad (*Forrer*).
*50. *Bufo andersonii*, Blgr. Ann. N. H. (5) 1883, xii. p. 163.—Ajmere and Muscat (*Blanford*). Tatta, Sind.
*51. *Bufo formosus*, Blgr. P. Z. S. 1883, p. 140.—Yokohama ('*Challenger*').
52. *Bufo punctatus*, B. & G.—La Paz, Cal. (*Smithson. Inst.*).
53. *Hyla nasica*, Cope.—Rio Grande do Sul (*v. Ihering*). Soriano, Uruguay (*Havers*). Paraguay.
*54. *Hyla glandulosa*, Blgr. Ann. N. H. (5) xii. 1883, p. 164.—Guatemala (*Godman*).
*55. *Hyla macrops*, Blgr. l. c. p. 164.—Treasury Island, Solomons (*Guppy*).
56. *Hyla thesaurensis*, Ptrs.—Treasury Island (*Guppy*).
57. *Hyla staufferi*, Cope.—Guatemala (*Godman*).
*58. *Pternohyla fodiens*, Blgr. Ann. N. H. (5) 1882, x. p. 326.—Presidio (*Forrer*).
*59. *Phyllomedusa iheringii*, Blgr. Ann. N. H. (5) 1885, xvi. p. 88.—Rio Grande do Sul (*v. Ihering*).
*60. *Phyllomedusa perlata*, Blgr. P. Z. S. 1883, p. 638.—Yurimaguas (*Hahnel*).
*61. *Triprion spatulatus*, Gthr. Ann. N. H. (5) 1882, x. p. 279.—Presidio (*Forrer*).
62. *Scaphiopus couchii*, Baird.—Presidio (*Forrer*).
*63. *Megalophrys longipes*, Blgr. P. Z. S. 1885, p. 850.—Perak (*Wray*).

CAUDATA.

*1. *Hynobius lichenatus*, Blgr. Ann. N. H. (5) 1883, xii. p. 165.—Awomori, Japan (*Lewis*).
*2. *Geomolge fischeri*, Blgr., *infra*.—Manchuria (*Fischer*).
3. *Plethodon croceater*, Cope.—San Diego, Cal. (*Forrer*).
*4. *Spelerpes peruvianus*, Blgr. Ann. N. H. (5) 1883, xii. p. 165.—Moyobamba, Peru (*Roff*).

APODA.

*1. *Epicrionops bicolor*, Blgr. Ann. N. H. (5) 1883, xi. p. 202.—Intac, Ecuador (*Buckley*).
*2. *Cœcilia buckleyi*, Blgr. Ann. N. H. (5) 1884, xiii. p. 398.—Intac (*Buckley*).
3. *Dermophis thomensis*, Bocage.—S. Thomé (*Berlin Mus.*).
*4. *Cryptopsophis multiplicatus*, Blgr. Ann. N. H. (5) 1883, xii. p. 166.—Seychelles (*Günther*).
5. *Gymnopis unicolor*, A. Dum.—Cayenne (*Bavay*).
*6. *Scolecomorphus kirkii*, Blgr. Ann. N. H. (5) 1883, xi. p. 48.—Near Lake Tanganyika (*Kirk*).
7. *Chthonerpeton indistinctum*, R. & L.—Porto Alegre (*Berlin Mus.*).

RANA MARTENSI, sp. n.

Allied to *R. temporaria*. Vomerine teeth in two rather oblique oval groups, extending posteriorly beyond the line of the choanæ. Head about as long as broad, very similar to that of *R. agilis*; nostril equally distant from the eye and the end of the snout; interorbital space narrower than the upper eyelids; tympanum rather large, its diameter equalling about two thirds that of the eye, from which it is separated by a space equal to about half its diameter. The first finger extends beyond the second. The tibio-tarsal articulation reaches the eye or the nostril; tibia shorter than the fore limb. Inner metatarsal tubercle rather strong, blunt, oval; outer tubercle absent, or scarcely marked; subarticular tubercles of fingers and toes moderate; toes two-thirds webbed. Skin smooth; lateral fold rather narrow, moderately prominent. Coloration very similar to that of *R. agilis*, save that the whitish streak bordering the temporal spot inferiorly does not extend forwards beyond the eye. Male with internal vocal sacs.

Yedo; several specimens (4410, 4411) in the Berlin Museum, one of which was obtained for the British Museum. Collected by Dr. E. von Martens (*cf.* Preuss. Exped. n. Ost-Asien, Zool. i. p. 111).

RANA MACROPUS.

Ixalus japonicus, Hallow. Proc. Ac. Philad. 1860, p. 501.

Vomerine teeth in two rather indistinct oblique series between the choanæ, widely separated in the middle. Snout obtuse, as long as the diameter of the orbit; nostril nearer the end of the snout than the eye; canthus rostralis well marked, curved; loreal region concave; eye large; interorbital space narrower than the upper eyelid; tympanum very distinct, measuring not quite half the diameter of the eye. Fingers moderate, slightly depressed, first shorter than second; toes moderate, three-fourths webbed; tips of fingers and toes dilated into well-developed disks, which are much smaller than the tympanum; subarticular tubercles moderate; a single, oval, inner metatarsal tubercle; no tarsal fold. When the fore limb is stretched

forwards, the femoro-tibial articulation reaches the shoulder and the tibio-tarsal far beyond the end of the snout; tibia as long as the fore limb. Upper surfaces with small warts intermixed with elongate fold-like ones, which form an)(-shaped figure on the scapular region; a strong fold from eye to shoulder. Dark brown above, with darker marblings and regular cross bars on the limbs; lips with a series of dark brown spots; lower surfaces white.

From snout to vent 34 millim.

A single (half-grown?) specimen was obtained at Oho Sima, Loo Choo Islands, and presented to the Museum by Lieut. Alfred Carpenter, R.N., of H.M.S. 'Magpie.'

IXALUS ASPER, sp. n. (Plate XXXIX. fig. 1.)

Snout rounded, as long as the diameter of the orbit; canthus rostralis very feebly marked; loreal region concave; nostril nearer the tip of the snout than the eye; interorbital space broader than the upper eyelid; tympanum very distinct, nearly as large as the eye. Fingers free, toes three-fourths webbed; disks well developed; subarticular tubercles weak; a small inner metatarsal tubercle. The tibio-tarsal articulation reaches nearly the tip of the snout. Upper parts rough with small conical warts; belly granular, throat perfectly smooth. Blackish above and below; the warts of the upper surfaces appearing as white dots; belly marbled with white; flanks, lower surface of limbs, and hinder side of thighs with irregular white network. Male without vocal sac.

From snout to vent 35 millim.

Two specimens, male and female, presented by L. Wray, Esq.; caught breeding in the water on Hill Garden, Larut, Perak, at an altitude of 3300 feet.

HYLODES VERTEBRALIS, sp. n.

Tongue oval, entire. Vomerine teeth in two oblique groups considerably behind the choanæ. Snout rounded or subacuminate, as long as the greatest orbital diameter; canthus rostralis distinct; nostril nearer the tip of the snout than the eye; fronto-parietals a little concave, their edges slightly prominent, their width equalling once and one third that of the upper eyelid; tympanum distinct, two fifths the diameter of the eye. Fingers moderate, first shorter than second; toes moderate, quite free, fringed; disks quite as large as the tympanum; subarticular tubercles moderate; two metatarsal tubercles. The tibio-tarsal articulation reaches the eye. Back smooth, sides with small warts; belly granular. Blackish brown above; one specimen with a whitish vertebral band; lower surfaces yellow, brown-speckled; groin and sides of thighs with dark-brown network.

From snout to vent 38 millim.

Two female specimens, from Intac, Ecuador; collected by Mr. Buckley.

Distinguished from *H. buckleyi* by a less stout habit, larger digital expansions, and narrower fronto-parietals.

Geomolge, g. n.

Tongue large, subcircular, free on the sides. Palatine teeth in two arched, slightly angular series, separated by a narrow interspace. Toes five. Tail cylindrical at the base, compressed at the end.

Intermediate between *Onychodactylus* and *Ranidens* in the palatine dentition; distinguished, besides, from the former by the absence of claws, from the latter by the shape of the tail, which indicates a land animal.

Geomolge fischeri, sp. n. (Plate XXXIX. fig. 2.)

Physiognomy that of *Onychodactylus japonicus*. Head small, longer than broad, broader than the neck; snout rounded; eyes large, prominent; no labial lobes. Body cylindrical, four and a half or five times the length of the head. Limbs in every respect similar to those of *Onychodactylus japonicus*, save the absence of claws; the male likewise with tibio-tarsal dilatation. Tail longer than head and body, cylindrical in its anterior half, becoming gradually compressed and keeled towards the end, which is obtusely pointed. Anal opening subcruciform, as in *Onychodactylus*. Skin smooth; fourteen or fifteen costal grooves; paratoids and gular fold as in *Onychodactylus*. Brown above, with blackish variegations, most crowded on the sides, which also bear some whitish spots; lower surfaces brownish white.

	♂. millim.	♀. millim.
Total length	163	—[1]
From snout to vent	70	80
Head	12	14
Width of head	9½	10
Fore limb	17	20
Hind limb	*22	22
Tail	93	—[1]

Two specimens from Chaborowska, on the River Ussuri, Manchuria, collected by Hr. Dörries, of Hamburg; they were obtained for the British Museum through Dr. J. G. Fischer, in honour of whom the new species is named.

EXPLANATION OF PLATE XXXIX.

Fig. 1. *Izalus asper*, upper view.
1 *a*. —— ——, lower view.
2. *Geomolge fischeri*, ♂.
2 *a*. —— ——, side view of head.
2 *b*. —— ——, open mouth.

[1] Tail injured.

November 16, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following reports on the additions made to the Society's Menagerie during the months of June, July, August, September, and October, 1886:—

The total number of registered additions to the Society's Menagerie during the month of June was 226, of which 24 were by birth, 129 by presentation, 52 by purchase, and 21 were received on deposit. The total number of departures during the same period by death and removals was 120.

The following are of special interest:—

1. A Glaucous Macaw (*Ara glauca*), purchased of the Zoological Gardens, Antwerp, June 3rd.

Of this near ally of Lear's Macaw[1] we have not previously possessed a living specimen. The present species is of nearly the same size and general coloration as *A. leari*, but is at once distinguishable by the glaucous blue of the body.

2. Two young Tcheli Monkeys (*Macacus tcheliensis*), presented by Dr. S. W. Bushell, C.M.Z.S., of Pekin, June 17th, obtained from the mountains near the "Jung-ling," or Eastern Mausoleum of the reigning dynasty of China, which is situated some 70 miles east of Pekin. The animals are covered with a thick fur, which fits them to endure the bitterly cold winter of this part of Northern China, where the thermometer frequently goes below zero of Fahrenheit. We are also indebted to Dr. Bushell for former examples of this Monkey.

3. A Bald Ouakari (*Brachyurus calvus*), ♂, purchased 12th June, of a dealer in Liverpool, new to the Society's collection.

Of the curious Monkeys of the genus *Brachyurus*, on which our late Prosector, Mr. Forbes, wrote an excellent paper in 1880 (see P. Z. S. 1880, p. 627), we have already had specimens of *B. melanocephalus* and *B. rubicundus*, and we have now for the first time an example of the perhaps still more curious *B. calvus*, which, according to Castlenau, is confined to the forests on the north bank of the Amazons, between the rivers Putumayo and Japurá.

The registered additions to the Society's Menagerie during the month of July were 166 in number; of these 82 were acquired by presentation, 44 by purchase, 33 by birth, and 6 were received on deposit. One young Pheasant, received during the month, was bred from some eggs laid in the Society's Gardens and sent into the country to be hatched. The total number of departures during the same period by death and removals was 105.

Among the additions may be specially noticed two rare American Parrots—a Lear's Macaw (*Ara leari*) and a Lineolated Parrakeet (*Bolborhynchus lineolatus*), acquired by purchase.

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[1] See P. Z. S. 1879, p. 551

The total number of registered additions to the Society's Menagerie during the month of August was 98; of these 50 were acquired by presentation, 14 by purchase, 15 by birth, 6 were received on deposit, and 5 in exchange. Eight Elliot's Pheasants, received during the month, were bred from some eggs laid in the Society's Gardens and sent into the country to be hatched. The total number of departures during the same period by death and removals was 104.

The total number of registered additions to the Society's Menagerie during the month of September was 80; of these 42 were acquired by presentation, 4 by purchase, 2 by exchange, 19 were bred in the Gardens, and 13 were received on deposit. The total number of departures during the same period by death and removals was 84.

The following are of special interest:—

A Spot-ringed Snake (*Liophis poecilogyrus*) from Brazil, presented by Edgell Hunt, Esq., September 9th, new to the collection.

Two Elegant Galidias (*Galidia elegans*) from Madagascar, presented by Burt C. Müller, Esq., September 16th.

The total number of registered additions to the Society's Menagerie during the month of October was 77, of which 11 were by birth, 45 by presentation, 5 by purchase, 6 by exchange, and 10 were received on deposit. The total number of departures during the same period by death and removals was 112.

An extract was read from a letter addressed to the President by Dr. Emin Bey, dated Wadilai, Eastern Equatorial Africa, Jan. 1st, 1886.

After speaking of the skull of a Chimpanzee and of some skins and skeletons of other Mammals and Birds obtained in Monbottu, which he proposed to send to the Society, Dr. Emin Bey continued as follows:—

"It may be interesting for you to hear that an anthropoid Ape exists in Uganda and Unyoro. I cannot say whether it is identical with the Monbottu Chimpanzee or not. While staying in these countries the negroes told me much about this animal, and in a MS. map which I forwarded to Dr. Petermann I fixed its northern limit at 2° N. lat. Now I hear that this Ape is frequent in the thick forests near Ugóma, and I hasten to beg my friend King Kabrega for some specimens."

A letter was read addressed to the Secretary by Dr. Chr. Lütken, of Copenhagen, F.M.Z.S.

Referring to Mr. O. Thomas's statement (P. Z. S. 1886, p. 78) that *Chiropodomys penicillatus* was a rare animal in Museums and that its distribution was not certainly known, Dr. Lütken announced

that the Museum of Copenhagen had received in 1878 a specimen of this mammal in spirit from Buitenzorg, Java, forwarded by the late Mr. Köbke, Danish Consul at Batavia, and that he has been informed by Mr. H. Winge that several specimens of it from the same locality were in the Museo Civico of Genoa.

A letter was read from Dr. A. B. Meyer, C.M.Z.S., communicating the following remarks by Mr. K. G. Henke on a specimen of a hybrid Grouse, in the Dresden Museum, referred to by Dr. Collett in a previous communication:—

"Dr. Collett has declared (*suprà*, p. 225, note) a hybrid which I have figured, 'Zeitschrift für die gesammte Ornithologie,' 1885, p. 47, pl. iii., 'to be clearly only a partial albino of *Tetrao tetrix* fem.,' but without giving his reasons for this opinion.

"I will not discuss the question now, whether *Tetrao tetrix* or *Lagopus albus* was the father of this specimen, as it is treated and refigured, not as a single example of its kind, but together with others, similar and varying, in Dr. Meyer's forthcoming work 'Unser Auer-,Birk- und Rackelwild,' which will be illustrated by 15 coloured folio plates. I only wish to remark here, that Dr. Collett's view of the said specimen does not appear to be correct, as supposing it really were a partial albino, a strong partial melanism would still be present, to account for the many black patches and markings, of which there is no trace in the female *Tetrao tetrix* —a coincidence which no one will admit, and which never has been observed. Besides, the albino of *Tetrao tetrix*, fem., has no such regular markings as the specimen in question.

"I therefore cannot agree with Dr. Collett, but am convinced that he is mistaken in declaring the Dresden specimen to be a partial albino."

Prof. Flower exhibited a specimen of an Armadillo, now belonging to the Museum of the Scarborough Philosophical Society, but the origin of which unfortunately appeared to be unknown. It was evidently a member of the genus *Tatusia*, and closely allied to the common *T. novemcincta* or *T. peba*, from which it differed mainly in having the whole of the carapace covered with a thick coating of light brown, fine, but rather stiff hair, about an inch and a half in length. The same kind of hair grew on the cheeks, the proximal portion of the limbs, and (though less abundantly and shorter) on the whole under surface of the body. The cephalic shield, the snout, the hands and feet, and the tail (except quite at the base) were bare. The covering of the hair of the back and sides was so thick as completely to conceal the carapace, except near the antero-inferior margin of the scapular region; but the usual scutes and bands were seen to be present on separating the hair, which only grew from the intervals between them. The length of the head was $3\frac{3}{4}$, of the body $8\frac{1}{2}$, and of the tail $8\frac{1}{2}$ inches. Unfortunately nearly the whole of the skull had been removed, but some of the anterior teeth which remained in the jaws were of very small size and appeared to indicate that the animal was young.

There was little doubt of the specific identity of the specimen with that belonging to the Vienna Museum, described by Fitzinger under the name of *Cryptophractus pilosus*[1], and also with two specimens from Guyaquil in the Lima Museum, described and figured by Burmeister as *Praopus hirsutus*[2], if, as was probably the case, the smaller size of the present specimen could be attributed to its not being full-grown. So far as Prof. Flower knew, these were the only published indications of the existence of this somewhat remarkable species, or at all events very distinct variety, of Armadillo, of which no specimen existed in our National collection.

Prof. Bell exhibited and made remarks upon an object (apparently of the nature of an amulet) supposed to have been made from some portion of the skin of a mammal. It had been obtained from the natives at Moreton Bay, and sent to Kew, being supposed to be of vegetable origin.

Mr. Seebohm exhibited a skin of the Lesser White-fronted Goose, *Anser albifrons minutus* (*Anser erythropus*, Linn. Syst. Nat. i. p. 197), which had been shot on the 16th of September last near Holy Island, on the coast of Northumberland, by Mr. Alfred Crawhall Chapman, of Sunderland. It was the first recorded example of the small form of the White-fronted Goose which had been obtained on the coasts of our islands, and it was especially interesting as being a young bird in first plumage. It proved to be a female on dissection, and bore a remarkable resemblance to the young in first plumage of the dark-bellied or typical form of the Brent Goose, *Anser brenta*; but its much greater expanse of wing (4 feet) and its large legs and feet, which were yellow-ochre in colour when first shot, precluded the possibility of confounding it with that species. Its very small bill, quite as small as that of the Brent Goose, showed it to be a small example of the small form of the White-fronted Goose, but in so young a bird the white forehead had not yet appeared.

Mr. W. T. Blanford exhibited a stuffed skin, the first perfect specimen he had seen, of *Paradoxurus jerdoni*, described and figured in the Society's Proceedings for 1885 (pp. 613, 802, pl. xlix.). For this specimen, which was killed at Kâteri (Kartary) on the Nilgiri hills, Mr. Blanford was indebted to Mr. G. F. Hampson, of Dunsandle, Ootacamund, who had identified the species from the description, and had confirmed the suggestion already made by Mr. Blanford, *l. c.* p. 613, that this species inhabits the Nilgiri hills as well as the Animalé range.

The following papers were read :—

[1] Tageblatt, Nr. 32; Versamml. deutsch. Naturf. u. Aerzte, 1856, Nr. 6, S. 123. I am only acquainted with this reference through Fitzinger's subsequent paper, "Die natürliche Familie der Gürtelthiere (Dasypoder)," in Sitz. der k. Akad. der Wissensch., Band lxiv. 1 Abth. (1871).

[2] Abhandl. naturf. Gesell. Halle, B. vi. p. 147 (1861).

1. On the Lepidoptera of Mhow, in Central India.

By Colonel C. Swinhoe, F.L.S., F.Z.S.

[Received June 3, 1886.]

(Plates XL. & XLI.)

I collected Lepidoptera at Mhow from September 1881 until August 1882, with the assistance of a trained native, whose captures were daily recorded. My military duties kept me well employed, and as I also collected birds and took notes on them during the whole of this period, the results of which have since appeared in 'The Ibis,' I had not much time to give to the study of Lepidoptera; and therefore this paper only professes to contain a list of Lepidoptera taken in Mhow and its immediate neighbourhood for a year, with the addition of a few taken by my subordinates at the sub-stations of Neemuch and Assirghur.

I am indebted to Lord Walsingham for working out the specimens of Tortricidæ and Tineina.

Types of all the new species mentioned in this paper have been presented by me, as usual, to the British Museum.

I. RHOPALOCERA.

Nymphalidæ.

Euplœinæ.

1. Tirumala limniace.

Pap. limniace, Cramer, Pap. Exot. i. pl. 59. f. D, E (1775).

Common from September to July.

2. Salatura genutia.

Pap. genutia, Cramer, Pap. Exot. iii. pl. 206. f. C, D (1779).

Common from September to July.

3. Limnas chrysippus.

Pap. chrysippus, Linn. Syst. Nat. p. 471 (1758).

Common everywhere from September to March.

4. Limnas alcippoides.

Limnas alcippoides, Moore, P. Z. S. 1883, p. 238, pl. 31. f. 1.

I took one example of this variety at Mhow in June 1882, and one at Panghur near Neemuch in November 1884.

5. Crastia core.

Pap. core, Cramer, Pap. Exot. iii. pl. 266. f. E, F (1780).

March and June. Very plentiful in March; only one example taken in June.

SATYRINÆ.

6. MELANITIS LEDA.

Pap. leda, Linn. Syst. Nat. i. 2, p. 773 (1767).

June, July; September and October.

7. MELANITIS ISMENE.

Pap. ismene, Cramer, Pap. Exot. i. pl. 26. f. A, B (1775).

Common during the cold weather from the latter end of October to the beginning of March. I took, however, one example in June 1882.

8. CALYSISME PERSEUS.

Pap. perseus, Fabr. Syst. Ent. p. 488 (1775).

October and April. Only one example taken in the latter month; it was fairly common in October 1881.

9. CALYSISME DRUSIA.

Pap. drusia, Cramer, Pap. Exot. i. pl. 84. f. C, D (1779).

I found one example of this variety of *C. mineus*, Linn., in a collection of Butterflies taken at Mhow in 1881 by Major Yerbury, R.A. It is smaller and paler than the types in the British Museum, but is otherwise identical.

Cramer's type came from China, but I have typical examples in my collection from the Kangra valley and from Darjiling.

10. YPTHIMA INICA.

Ypthima inica, Hewitson, Trans. Ent. Soc. ser. 3, vol. ii. p. 285 (1865).

Mhow, December; Depalpore, November.

This is said to be an African insect, but the examples taken as above are identical with Hewitson's type.

11. YPTHIMA ALKIBIE, n. sp.

Upperside dark brown, with the ocelli as in *Y. inica*, but the general coloration is darker and brighter. Underside pale whitish brown, thickly covered with short delicate pale reddish-brown strigæ, which are uniformly disposed, but paler on the costa and margins of the fore wings in most specimens, and both wings with a marginal brown line and submarginal brown, slightly sinuated fascia; the ocelli as in *Y. inica*, but one or other of the three minute ocelli on the hind wings is often more or less obsolete. Hind wings with three pale reddish-brown speckled zigzag bands, and can easily be distinguished from *Y. inica* because the inner discal band curves outwardly, whereas in the type of *Y inica* this band curves inwards.

Expanse of wings $1\frac{1}{10}$–$1\frac{2}{10}$ inch.

Mhow, November to March, very plentiful; Depalpore, January and February.

12. YPTHIMA MAHRATTA.

Ypthima mahratta, Moore, Journ. As. Soc. Bengal, vol. liii. pt. 2, no. i. p. 1 (1884).

Mhow, July and November; Neemuch, September to November.

13. YPTHIMA ALEMOLA.

Ypthima alemola, Swinhoe, P. Z. S. 1885, p. 127.

April to July.

14. YPTHIMA DÆDALEA, n. sp.

Allied to *Y. ariaspa*, Moore.

Upperside dark brown, with the ocelli as in *Y. inica*, the one on the hind wing being minute, but with a clear ring of yellow round it. Underside pale grey, marginal lines brown; both wings covered with short brown strigæ, uniformly disposed, with a submarginal whitish fascia, bordered on the outer side by an incomplete brown, slightly zigzag line; pupils of the ocelli pale blue, metallic; fore wing with one subapical large ocellus, bi-pupilled: hind wing with three light distinct ocelli—one large (slightly smaller than the one on the fore wing), subapical, placed well inside the wing, almost in the disk, and with its upper part overlapping the second subcostal nervule; one a little smaller, in the interspace between the second and third median nervules; and a third, the smallest, is duplex at the anal angle; these ocelli are very curious: commencing with the largest one near the apex of the fore wings, they are gradually smaller, and the three first are in a perfectly straight line, the minute duplex one at the anal angle being at an obtuse angle inwards; all the ocelli have broad uniform yellow rings with brown borders, and the duplicate ocellus at the anal angle is distinctly divided with yellow, but not cut between by the brown ring, which borders the outer yellow only, making it a complete duplex ocellus.

Expanse of wings $1\frac{2}{10}$ inch.

Mhow, June 1882.

15. YPTHIMA RARA.

Ypthima rara, Butler, P. Z. S. 1883, p. 145, pl. xxiv. f. 1.

May to November, very plentiful; Neemuch, November.

16. YPTHIMA COMPLEXIVA, n. sp. (Plate XL. fig. 2, ♀.)

Shape, colour, and markings above identical with *Y. rara*. The underside is, however, quite different, colour pale greyish, covered with dark chocolate-brown strigæ, and with an indistinct incomplete submarginal zigzag line, more distinct in parts of the hind wings: fore wings with a large subapical ocellus, bi-pupilled, with a deep yellow ring, bordered with brown, pupils bright blue metallic, and with another smaller blind ocellus just below it, also with a yellow ring round it: hind wings with three black, very minute spots where the ocelli should be placed, as in *Y. inica*.

Expanse of wings $1\frac{5}{10}$ inch.

Depalpore, November.

17. LETHE NEELGHERRIENSIS.

Satyrus (Cyllo) neelgherriensis, Guérin, Delessert's Voy. dans l'Inde, pt. ii. p. 74, pl. 21. f. 1, 1 *a* (1843).

March, April, and May.

ACRÆINÆ.

18. TELCHINIA VIOLÆ.

Pap. violæ, Fabr. Syst. Ent. p. 460 (1775).

Mhow, September (*Yerbury*).

NYMPHALINÆ.

19. ATELLA PHALANTA.

Pap. phalanta, Drury, Ill. Ex. Ent. i. pl. 21. f. 1, 2 (1773).

Common, September to July.

20. PYRAMEIS CARDUI.

Pap. cardui, Linn. Faun. Suec. p. 276 (1761).

Common from September to December.

21. JUNONIA LEMONIAS.

Pap. lemonias, Linn. Mus. Ulr. p. 277 (1764).

Common from September to July.

22. JUNONIA HIERTE.

Pap. hierte, Fabr. Ent. Syst. Suppl. p. 424 (1798).

Common from September to July.

23. JUNONIA ORYTHIA.

Pap. orythia, Linn. Mus. Ulr. p. 278 (1764).

Common from September to July.

24. JUNONIA ASTERIE.

Pap. asterie, Linn. Syst. Nat. i. 2, p. 769 (1767).

Common from September to November.

25. JUNONIA ALMANA.

Pap. almana, Linn. Mus. Ulr. p. 272 (1764).

October, January, and March.

26. HYPANIS POLINICE.

Pap. polinice, Cram. Pap. Exot. iv. pl. 375. f. G, H (1782).

October to December.

27. HYPANIS SIMPLEX.

Hypanis simplex, Butler, P. Z. S. 1883, p. 146, pl. 24. f. 8.

Mhow, June, July, and October; Depalpore, January; Assirghur, September.

28. HYPOLIMNAS BOLINA.

Pap. bolina, Linn. Mus. Ulr. p. 295 (1764).

Mhow, July. Neemuch, November; Assirghur, October.

29. HYPOLIMNAS AVIA.

Pap. avia, Fab. Ent. Syst. iii. 1, p. 111 (1793).

Mhow, September and October; Neemuch, September to November, in great plenty.

This is merely the large form of the preceding.

30. HYPOLIMNAS MISIPPUS.

Pap. misippus, Linn. Mus. Ulr. p. 264 (1764).

September to February.

The females all mimic *L. chrysippus*.

31. NEPTIS EURYMENE.

Neptis eurymene, Butler, P. Z. S. 1883, p. 145, pl. 24. f. 5.

February to April.

32. SYMPHÆDRA NAIS.

Pap. nais, Forst. Nov. Spec. Ins. p. 73 (1771).
Pap. thyelia, Fabr. Ent. Syst. iii. 1, p. 142 (1793).

Common from October to July.

33. CHARAXES FABIUS.

Pap. fabius, Fabr. Spec. Ins. ii. p. 12 (1781).

June and October.

34. CHARAXES AGRARIUS, n. sp. (Plate XL. fig. 3, ♂.)

Allied to *C. athamus*, Drury, and *C. kamasta*, Moore. Smaller than either; nearest to the latter, but differs in having both wings with the discal transverse band one-fourth narrower in width, the subapical spot on the fore wing is small, whereas in *C. kamasta* this spot is a lengthened square, and in the male there are two smaller upper apical spots. On the hind wing the submarginal white spots are prominent, but there is no outer marginal row of ochreous lunules.

Expanse of wings $2\frac{8}{10}$–$2\frac{9}{10}$ inches.

Mhow, October; Assirghur, October.

LYCÆNIDÆ.

35. POLYOMMATUS BÆTICUS.

Pap. bæticus, Linn. Syst. Nat. ii. p. 789 (1766).

September to February.

36. CATOCHRYSOPS STRABO.

Hesperia strabo, Fabr. Ent. Syst. iii. 1, p. 287 (1793).
Lyc. kandarpa, Horsf. Cat. Lep. E. I. C. vol. i. p. 82 (1829).

Common from September to July.

37. CATOCHRYSOPS CNEJUS.

Hesperia cnejus, Fabr. Ent. Syst. v. Suppl. p. 430 (1798).
July to October.

38. CATOCHRYSOPS PATALA.

Lycæna patala, Kollar, Hüg. Kaschm. iv. 2, p. 418 (1848).
October to February. Very plentiful in October.

39. CATOCHRYSOPS HAPALINA.

Catochrysops hapalina, Butler, P. Z. S. 1883, p. 148, pl. 24. f. 2, 3.
December and January.

40. CATOCHRYSOPS ELLA.

Catochrysops ella, Butler, P. Z. S. 1881, p. 606.
September to November.

41. JAMIDES BOCHUS.

Pap. bochus, Cramer, Pap. Exot. iv. pl. 391. f. C, D (1782).
September to November.

42. ZIZERA MAHA.

Lycæna maha, Kollar, Hüg. Kaschm. iv. 2, p. 422 (1848).
Mhow, April, May, and June; Manpore, June.

43. ZIZERA CHANDALA.

Polyommatus chandala, Moore, P. Z. S. 1865, p. 504, pl. 31. f. 5.
November, February, April, and May.
Mr. Moore, in P. Z. S. 1882, p. 245, has put this species as a synonym to the preceding one. This I think is a mistake. He had, if I recollect rightly, only two examples, both males, in his collection. They were quite common at Mhow; and I found no difficulty in recognizing them, they are much paler blue than *Z. maha*. The females are the same colour as the males, instead of brown like *Z. maha*, and the underside in both sexes has very faint spots on the hind wings, each spot having a whitish ring round it.

44. ZIZERA KARSANDRA.

Polyommatus karsandra, Moore, P. Z. S. 1865, p. 505, pl. 31. f. 7.
October to May.
This insect is very variable in colour; the type is brown. Irrespective of sex, the colour varies from blue to dark brown. I have many examples from Quetta, Metazai, Sukkur, Karachi, the Punjaub, Central India, the Deccan, and also from Aden, of many shades of colour, quite impossible to separate.

45. ZIZERA DICRETA.
Zizera dicreta, Butler, P. Z. S. 1883, p. 150.
October to May.

46. ZIZERA PYGMÆA.
Lycæna pygmæa, Snellen, Tijd. voor Ent. xix. pl. 7. f. 3 (1876).
September to December.

47. ZIZERA SANGRA.
Polyommatus sangra, Moore, P. Z. S. 1857, p. 772, pl. 41. f. 8.
Lycæna indica, Murray, Trans. Ent. Soc. 1874, p. 525.
October to February.
Varies much in size in different localities. I have four definite uniform sizes taken in four different parts of India; some are slightly paler than others, but otherwise all are identical. The uniform manner in which almost all the different Indian species of *Zizera* are marked on the wings below is very curious. *Z. pygmæa* has markings peculiar to itself, but all the others mentioned in this paper have the spots below arranged in almost exactly the same manner, *Z. sangra* differing from the others merely in the absence of the spot inside the cell.

48. NACADUBA ARDATES.
Lycæna ardates, Moore, P. Z. S. 1874, p. 574, pl. 67. f. 1.
November.

49. EVERES PARRHASIUS.
Hesperia parrhasius, Fabr. Ent. Syst. iii. 1, p. 289 (1793).
February and March.

50. CHILADES PUTLI.
Lycæna putli, Kollar, Hüg. Kaschm. iv. 2, p. 422 (1848).
September to December.

51. CHILADES VARUNANA.
Polyommatus varunana, Moore, P. Z. S. 1865, p. 772, pl. 41. f. 6.
May, September, October, November, and December.

52. CHILADES LAIUS.
Pap. laius, Cram. Pap. Exot. iv. pl. 319. f. D, E (1782).
November and December.

53. TARUCUS PLINIUS.
Hesperia plinius, Fabr. Ent. Syst. iii. 1, p. 284 (1793).
September to July.

54. TARUCUS NARA.
Lycæna nara, Kollar, Hüg. Kaschm. iv. 2, p. 421 (1848).
September to July.

55. Tarucus theophrastus.

Hesperia theophrastus, Fabr. Ent. Syst. iii. 1, p. 281 (1793).

September to July.

56. Azanus ubaldus.

Papilio ubaldus, Cramer, Pap. Exot. iv. pl. 390. f. L, M (1782).

January, April, and May.

57. Azanus zena.

Lycæna zena, Moore, P. Z. S. 1865, p. 505, pl. 31. f. 9.

September, October, and November.

58. Aphnæus elima.

Aphnæus elima, Moore, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 51 (1877).

March.

59. Aphnæus ictis.

Aphnæus ictis, Hewitson, Ill. D. L. p. 61, pl. 25. f. 8, 9 (1865).

November to July.

60. Aphnæus bracteatus.

Aphnæus bracteatus, Butler, P. Z. S. 1883, p. 147, pl. 24. f. 10, 11.

October to June.

61. Aphnæus æstivus, n. sp. (Plate XL. fig. 1.)

Upperside pale reddish grey, with the bands on the underside showing faintly through the wings; marginal line brown, fringe silvery white: hind wings with two brown spots on the anal angle on a slightly reddish ground. Underside pale yellowish cream-colour, bands pale reddish brown with metallic marks: fore wings with two short bands before the middle which do not go below the cell; a median band broken in the middle, followed by a costal spot like a figure of 8, followed by two more larger spots, one touching the costa and the other below it like a figure of 8 broken off in the middle; then a submarginal and a marginal band, marginal line dark brown: hind wing with an inner median and discal band, and with a submarginal and marginal band like those on the fore wings; marginal line brown, and some brown marks on the abdominal margin. All the bands on both wings are margined with dark brown on both sides, and have a peculiar zigzag appearance in consequence of the zigzag formation of their borders.

Expanse of wings $1\frac{4}{10}$ inch.

Mhow, May.

62. Virachola isocrates.

Hesperia isocrates, Fabr. Ent. Syst. iii. 1, p. 266 (1793).

February, April, and November.

63. Baspa melampus.

Pap. melampus, Cram. Pap. Exot. iv. pl. 362. f. G, H (1782).
September to June.

64. Nilasera apella, n. sp. (Plate XL. fig. 4, ♂.)

Allied to *N. amantes*, Hewitson.

Upperside of a brighter and paler blue, but similar to *A. amantes* in the deep costal band on the fore wings of the male, which is absent in the female, and in the far deeper costal band of the hind wings and marginal band of both wings. The underside is, however, quite different, the ground-colour being of a uniform pale brownish grey with an ochreous tinge, this tinge showing quite distinctly on the brown portions of the fore wings, the costal portion and much of the hind wing being silvery grey. Fore wings with one small spot in the cell near the base, and a larger one also within the cell, a little forward of its centre, the upper portions of both touching the subcostal vein; another spot, square and larger at the end of the cell, and a smaller one below this in the angle of the first median interspace, and below this is a spot elongated into a band running along the interspace for more than half its length below the first median branch, and half filling up that portion of the interno-median interspace; there is also a discal row of six confluent spots from the costa, commencing with a small one and getting gradually larger and ending on the first median branch at the end of the band; all the spots brown, surrounded with yellowish white, the white borders being clearest round the two spots in the cell and the two outside it. Hind wing with four or five brown spots near the base, a central whirl of spots of the same colour, disconnected, and irregular like a zigzag band, a discal whorl of similar spots but paler, and the space on each side filled in with other bands of spots so pale as to be only here and there visible. Margins of both wings brown, diffused inwardly; a black spot at the anal angle, and a white silvery streak on the margin running from this spot to the first median branch, and clouded with dark brown atoms. Tails black, tips white.

Expanse of wings $2\frac{1}{16}$ inches.
Mhow, March.

65. Tajuria jehana.

Tajuria jehana, Moore, P. Z. S. 1883, p. 529, pl. 49. f. 7.
September.

Papilionidæ.

Pierinæ.

66. Terias læta.

Terias læta, Boisduval, Sp. Gén. i. p. 174 (1836).
September to July. The commonest Butterfly in Mhow.

67. TERIAS DRONA.

Terias drona, Horsfield, Cat. Lep. E. I. C. p. 137, pl. 1. f. 13 (1829).

September, October, and November.

68. TERIAS VENATA.

Terias venata, Moore, Cat. Lep. E. I. C. i. p. 65, pl. 2. f. 2 (1857).

June, July, September, and October.

69. TERIAS RUBELLA.

Terias rubella, Wall. Trans. Ent. Soc. ser. 3, vol. iv. p. 323 (1867).

October to April. In great numbers.

70. TERIAS HECABE.

Pap. hecabe, Linn. Mus. Ulr. p. 249 (1764).

February, July, and September.

71. TERIAS HECABEOIDES.

Terias hecabeoides, Mén. Cat. Mus. Petr., Lép. i. p. 85, pl. 2. f. 2 (1855).

September, October, and November.

72. TERIAS ÆSIOPE.

Terias æsiope, Mén. Cat. Mus. Petr., Lép. i. p. 85, pl. 2. f. 3 (1855).

October.

73. TERIAS EXCAVATA.

Terias excavata, Moore, P. Z. S. 1882, p. 252.

September to December. Very plentiful in December.

74. TERIAS PURREEA.

Terias purreea, Moore, P. Z. S. 1882, p. 252.

November to May.

75. TERIAS ASPHODELUS.

Terias asphodelus, Butler, P. Z. S. 1883, p. 151, pl. 24. f. 13.

December to April.

76. TERIAS NARCISSUS.

Terias narcissus, Butler, P. Z. S. 1883, p. 151.

December to February.

77. BELENOIS MESENTINA.

Pap. mesentina, Cramer, Pap. Exot. iii. pl. 270. f. A, B (1782).

Common all the year round.

This is a very variable species; some of the males are deep yellow

on the secondaries below, and many of both sexes vary much in the depth of the markings above, they also vary much in size. I have a female from Neemuch with the apical portion entirely black, and both males and females identical with and not separable from a pair in my collection taken by Major Yerbury *in copulâ* at Haithalkim in Arabia, and identical with Walker's type in the British Museum of *B. lordaca* from Damascus. Mr. Butler (P. Z. S. 1884, p. 492) says the males sent him by Major Yerbury from Huswah and Haithalkim are smaller than the Damascus type; but I have males both large and small from these localities, and a pair from the Punjaub quite as large as the Damascus insect, the male being a typical *B. lordaca* and the female only slightly paler in its marginal black borders.

78. HUPHINA PHRYNE.

Papilio phryne, Fabr. Syst. Ent. p. 473 (1775).

September, October, and November.

79. HUPHINA ZEUXIPPE.

Pap. zeuxippe, Cram. Pap. Exot. iv. pl. 362. f. E, F (1782).

April, May, and June.

80. HUPHINA CASSIDA.

Pap. Danaus cassida, Fabr. Ent. Syst. Suppl. p. 427. n. 595, 596 (1798).

November to May.

81. GANORIS RAPÆ.

Papilio rapæ, Linn. Faun. Suec. p. 270 (1761).

I took a worn female of this species in a garden at Mhow on the 6th of June, 1882, which I have still in my collection; it is out of place in this list, but as I took it there myself I record it; its chrysalis might have come from England with somebody's baggage.

82. APPIAS LIBYTHEA.

Pap. libythea, Fabr. Syst. Ent. p. 471 (1775).

June.

83. APPIAS ARES.

Appias ares, Swinhoe, P. Z. S. 1885, p. 138.

January.

84. DELIAS EUCHARIS.

Pap. eucharis, Drury, Ill. Exot. Ent. ii. pl. 10. f. 5, 6 (1773).

Common from September to July.

85. NEPHERONIA GAEA.

Nepheronia gaea, Felder, Reise Nov., Lep. ii. p. 130 (1865).

February and April.

86. Catopsilia pyranthe.

Pap. pyranthe, Linn. Mus. Ulr. p. 245 (1764).
Common all the year round.

87. Catopsilia philippina.

Pap. philippina, Cram. Pap. Exot. iv. pl. 361. f. C, D (1782).
September to April.

88. Catopsilia crocale.

Pap. crocale, Cram. Pap. Exot. i. pl. 55. f. C, D (1779).
July.

89. Catopsilia catilla.

Pap. catilla, Cram. Pap. Exot. iii. pl. 229. f. D, E (1782).
Common from September to April.

90. Ixias meridionalis.

Ixias meridionalis, Swinhoe, P. Z. S. 1885, p. 140, pl. 9. f. 5, ♀.
May to August.

91. Ixias depalpura.

Ixias depalpura, Butler, P. Z. S. 1883, p. 153, pl. 24. f. 6, 7.
Depalpore lakes, November, December, and January.

92. Ixias kausala.

Ixias kausala, Moore, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 49 (1877).

Depalpore lakes, November, December, and January.

Very plentiful. All the females taken were albinos; the type female in Mr. Moore's collection is primrose-coloured, and I have a primrose female taken with a male (identical with Mr. Moore's type) in the Western Jumna canal.

93. Teracolus pernotatus.

Teracolus pernotatus, Butler, P. Z. S. 1876, p. 159, pl. 7. f. 1.
Mhow, September; Neemuch, September.

94. Teracolus bimbura.

Teracolus bimbura, Butler, P. Z. S. 1876, p. 161, pl. 7. f. 3, 4.
January.

This *Teracolus* (which was originally named from specimens taken at Bimbur in Cashmir) is the most widely spread of all the genus. I have it from many parts of India.

Papilioninæ.

95. Opheides erithonius.

Pap. erithonius, Cram. Pap. Exot. iii. pl. 232. f. A, B (1782).
Common from September to March.

96. Laertias pammon.

Pap. pammon, Linn. Mus. Ulr. p. 189 (1764).
♀. *Pap. polytes*, Linn. Mus. Ulr. p. 186 (1764).
Common from September to March. The females taken were all of *M. diphilus* form.

97. Menelaides diphilus.

Pap. diphilus, Esper, Ausl. Schmett. pl. 40 B. f. 1 (1785–98).
Common from September to March.

Hesperidæ.

98. Pyrgus galba.

Hesperia galba, Fabr. Ent. Syst. iii. 1, p. 352 (1793).
July, October, and December.

99. Plesioneura indrani.

Plesioneura indrani, Moore, P. Z. S. 1865, p. 789.
September.

100. Telicota augias.

Pap. augias, Linn. Syst. Nat. i. 2, p. 794 (1767).
Common from September to July.

101. Padraona mæsa.

Pamphila mæsa, Moore, P. Z. S. 1865, p. 509, pl. 30. f. 9.
February to May.

102. Parnara bevani.

Hesperia bevani, Moore, P. Z. S. 1878, p. 688.
July.

103. Chapra agna.

Hesperia agna, Moore, P. Z. S. 1865, p. 791.
July.

104. Chapra mathias.

Hesperia mathias, Fabr. Ent. Syst. Suppl. p. 433 (1798).
December to April.

105. Suastus gremius.

Hesperia gremius, Fabr., Butler, Cat. Fabr. Lep. B. M. p. 271, pl. 3. f. 7, ♀.
Hesperia divodasa, Moore, Cat. Lep. Mus. E. I. C. i. p. 255.
Mhow, May, November, and December, scarce; Depalpore, January, one taken; Neemuch, September to November, common.

106. Isoteinon nilgiriana.

Isoteinon nilgiriana, Moore, P. Z. S. 1883, p. 533.
March.

107. Taractocera sagara.

Pamphila sagara, Moore, P. Z. S. 1865, p. 792.
April to July.

108. Ismene alexis.

Papilio alexis, Fabr. Syst. Ent. p. 533 (1775).
July.

109. Badamia exclamationis.

Pap. exclamationis, Fabr. Syst. Ent. p. 530 (1775).
♀. *Pap. ladon*, Cramer, Pap. Exot. iii. pl. 284. f. C (1782).
June and July.

II. HETEROCERA.

Sphingidæ.

1. Cephonodes hylas.

Sphinx hylas, Linn. Mantissa, i. p. 539 (1771).
September and December.

2. Macroglossa gyrans.

Macroglossa gyrans, Walker, Cat. Lep. Het. viii. 91 (1856).
July, September, and November. Common in September and in great plenty in November.

3. Macroglossa belis.

Sphinx belis, Cram. Pap. Exot. i. p. 147, pl. 94. f. C (1779).
June, September, and November. In great plenty in November.

4. Lophura hyas.

Lophura hyas, Walker, viii. 107 (1856).
November.

5. Chærocampa alecto.

Sphinx alecto, Linn. Mus. Lud. Ulr. p. 357 (1764).
March and September.

6. Chærocampa thyelia.

Sphinx thyelia, Linn. Mus. Lud. Ulr. p. 360 (1764).
Common from September to November.

7. Chærocampa celerio.

Sphinx celerio, Linn. Syst. Nat. i. 2, p. 800 (1766).
Common from September to December.

8. Chærocampa oldenlandiæ.

Sphinx oldenlandiæ, Fabr. Sp. Ins. ii. p. 148 (1781).
July and September.

9. DEILEPHILA LIVORNICA.

Sphinx livornica, Esper, Ausl. Schmett. ii. pp. 87, 196, pl. 8. f. 4 (1785).

June.

10. DAPHNIS NERII.

Sphinx nerii, Linn. Syst. Nat. i. 2, p. 798 (1766).

September, October, and November.

11. POLYPTICHUS DENTATUS.

Sphinx dentata, Cram. Pap. Exot. ii. p. 42, pl. 125. f. G (1779).

October.

12. LEUCOPHLEBIA BICOLOR.

Leucophlebia bicolor, Butler, P. Z. S. 1875, p. 16, pl. 2. f. 5.

June and July.

13. BASIANA CERVINA.

Basiana cervina, Walker, viii. 237 (1856).

August (*Forsayeth*).

14. ACHERONTIA STYX.

Acherontia styx, Westwood, Cab. Orient. Ent. p. 88, pl. 42. f. 3 (1847).

September.

15. ACHERONTIA MORTA.

Acherontia morta, Hübner, Verz. bek. Schmett. p. 140 (1816).

February and September.

16. PROTOPARCE ORIENTALIS.

Protoparce orientalis, Butler, Tr. Z. S. 1877, vol. ix. part 10, p. 609.

June, July, and September.

17. NEPHELE HESPERA.

Sphinx hespera, Fabr. Syst. Ent. p. 546 (1775).

Common from September to June. Very plentiful in November.

Hawk-Moths were in extraordinary abundance in September 1881 in Mhow. A large thorny tree in my garden remained in full blossom for the greater part of that month, and I spent many evenings sitting under it watching these moths. About half an hour before sunset a few *Cephonodes hylas* would come, to be followed in a short time by *Macroglossa belis* and *M. gyrans*; then would fly by with a rush a single *Nephele hespera*. He would circle round and fly away, and a minute afterwards thousands of these insects would take possession of the tree. The solitary one always came first, apparently to see that all was safe, then flew away and a multitude of

them would come, and the *Macroglossa* and *Cephonodes* would disappear. In about half an hour the *Nephele* would vanish as suddenly as they came, just about the time it was getting dark; and from then till nine or ten o'clock *Chærocampa thyelia*, *C. celerio*, *Daphnis nerii*, and *Protoparce orientalis* would be hovering about the flowers, and by ten o'clock the tree would be deserted, and it would remain deserted until just before daybreak, when it always again had a crowd of visitors. They invariably came and went in the same order. I never found any on the tree during the middle of the night.

SYNTOMIDÆ.

18. ERESSA CONFINIS.

Syntomis confinis, Walker, vii. 1592 (1856).

April and October.

I never saw this insect on the wing; I usually found them lying dead in the early morning in the verandah of my house.

19. SYNTOMIS CYSSEA.

Sphinx cysseus, Cramer, Pap. Exot. iv. 124, pl. 355. f. B.

January to March; June, September, and November.

Flying in swarms over the flowering poppy-fields in February.

AGARISTIDÆ.

20. EUSEMIA AFFLICTA.

Eusemia afflicta, Butler, Ent. M. M. xii. p. 118 (1875).

June.

LITHOSIIDÆ.

21. ARGINA CRIBRARIA.

Argina cribraria, Clerck, Icones, pl. 54. f. 4.

September and October.

22. ARGINA NOTATA.

Argina notata, Butler, Trans. Ent. Soc. 1877, part iv. Dec. p. 365. n. 270.

September.

23. ARGINA ASTREA.

Phalæna astrea, Drury, Ill. Exot. Ins. ii. pl. vi. f. 3.

September, October, and November.

24. DEIOPEIA PULCHELLA.

Tinea pulchella, Linn. Syst. Nat. i. 2, p. 884. no. 349.

September to March.

25. DEIOPEIA LOTRIX.

Phalæna lotrix, Cramer, Pap. Exot. ii. 20, pl. 109. f. E.

September to March.

26. ÆMENE TENEBROSA.

Æmene tenebrosa, Moore, P. Z. S. 1878, p. 34.
May and June.

27. LACIDES FICUS.

Noctua ficus, Fabr. Ent. Syst. iii. p. 27. no. 62.
September and October.

ARCTIIDÆ.

28. ALOPE RICINI.

Bombyx ricini, Fabr. Ent. Syst. iii. 1, p. 473 (1793).
Alope ocellifera, Walker, iii. 620 (1856).
August (*Forsayeth*).

29. CREATONOTUS INTERRUPTUS.

Phalæna interrupta, Linn. Syst. Nat. Phal. 116.
September.

30. MICROSEMYRA PALLIDA.

Microsemyra pallida, Butler, P. Z. S. 1883, p. 155.
October.

31. ALOA PUNCTISTRIGA.

Spilosoma punctistriga, Walker, iii. 676 (1855).
June and September.

32. ALOA EMITTENS.

Creatonotus emittens, Walker, iii. 638 (1855).
June.

33. ALOA SANGUINOLENTA.

Bombyx sanguinolenta, Fabr. Ent. Syst. iii. 1, p. 473 (1793).
September (*Forsayeth*).

LIPARIDÆ.

34. PERINA BASALIS.

Perina basalis, Walker, iv. 966 (1855).
September and October.

35. CHARNIDAS TESTACEA.

Cycnia testacea, Waker, iii. 683 (1855).
October, December, and March.

36. EUPROCTIS LUNATA.

Euproctis lunata, Walker, iv. 837 (1855).
September.
Both sexes vary much in colour from deep chrome-yellow to pure creamy white.

37. PORTHESIA MARGINALIS.

Euproctis marginalis, Walker, vii. 1731 (1865).
June, September, and November.

38. ENOME DETERSA.

Lymantria detersa, Walker, xxxii. 365 (1865).
September to February.

39. ENOME INCERTA.

Lymantria incerta, Walker, iv. 880 (1855).
September, December, and February.

40. LYMANTRIA OBSOLETA.

Lymantria obsoleta, Walker, iv. 880 (1855).
September, November, December, and April.

41. OLENE FUSIFORMIS.

Nioda fusiformis, Walker, v. 1070 (1855).
September (*Forsayeth*).

42. PSALIS SECURIS.

Psalis securis, Hübner, Samml. exot. Schmett. iii. 9, 146. f. 291, 292.
August (*Forsayeth*).

43. CHILENA STRIGULA.

Lasiocampa strigula, Walker, xxxii. 563 (1865).
September (*Forsayeth*).

NOTODONTIDÆ.

44. CETOLA DENTATA.

Cetola dentata, Walker, v. 1016 (1855).
July and September.

45. ANTHEUA DISCALIS.

Antheua discalis, Walker, iii. 767 (1855).
Mhow (*Yerbury*).

46. BIRETA GALBANA, n. sp. (Plate XL. fig. 5.)

♂ ♀. Thorax, fore wings, and antennæ yellowish cream-colour; head reddish brown, a stripe of the same colour down the centre of the thorax. Fore wings sparsely irrorated with black atoms, except in the centre, where they cluster together, forming a slight shade; three rows of black dots—first just before the middle, consisting of two dots, one on the median vein, and the other close to the hinder margin; the second discal, one on each nervule; the third marginal, minute but very distinct, one on the extremity of each nervule. Hind wings and abdomen pure white; underside pure white.

...ots on the female are generally smaller than those on the ...ale.

Expanse of wings $1\frac{3}{10}$ inch.

June and July.

47. Dabarita icterica, n. sp. (Plate XL. fig. 8.)

Head, thorax, antennæ, and fore wings pale reddish yellow, top of head and collar whitish; fore wings with two outwardly oblique, thin, yellowish, slightly sinuous lines, rather close together, the first just before the middle, the second beyond the middle; the basal half of the wing the darkest, caused by numerous latitudinal brick-dust coloured minute regular lines or strigulæ, diffuse and terminating between the two lines. Abdomen pale dirty straw-colour; hind wings white, semidiaphanous; underside white, shining.

Expanse of wings $1\frac{1}{10}$ inch.

June.

48. Ichthyura restitura.

Ichthyura restitura, Walker, xxxii. 433 (1865).

October.

49. Oræsia emarginata.

Noctua emarginata, Fabr. Ent. Syst. iii. 2, p. 240.

October.

Limacodidæ.

50. Miresa albipuncta.

Nyssia albipuncta, Herr.-Schäff. Lep. Exot. Sp. Ser. i. f. 179.

October.

51. Candyba punctata.

Candyba punctata, Walker, vii. 1761 (1856).

Belgoræa subnotata, Walker, xxxii. 497 (1865).

June.

Walker's type of *C. punctata* is said to have come from Central Brazil, but the types of the above two species are identical.

52. Natada basalis.

Natada basalis, Walker, v. 1110 (1855).

June and July.

53. Parasa lepida.

Phalæna-Noctua lepida, Cram. Pap. Exot. ii. p. 50, pl. 130. f. E (1779).

September.

54. Aphendala tripartita.

Aphendala tripartita, Moore, Trans. Ent. Soc. 1884, p. 376.

June and July.

55. Susica cosmiana, n. sp. (Plate XL. fig. 9, ♀.)

Allied to *S. fraterna*, Moore. ♂ pale reddish ochreous; ♀ greyish ochreous, covered with silvery minute speckles, with the head and collar whitish. ♂ ♀ with a minute spot at end of cell, more than two thirds of the wing from the base suffused with reddish, bounded by a reddish line curving outwardly from the costa near the apex, stopping short before the outer third of the hinder margin. Hind wings paler, reddish grey in the ♂, greyish ochreous in the ♀. Underside in both sexes pale shining reddish ochreous.

Expanse of wings $\frac{8}{10}$ inch.

October to February.

Bombycidæ.

56. Trilocha varians.

Naprepa varians, Walker, v. 1153 (1855).

October and December.

Lasiocampidæ.

57. Taragama ganesa.

♂. *Bombyx ganesa*, Lefebvre, Zool. Journ. iii. p. 211 (1827).
♀. *Bombyx siva*, Lefebvre, *l. c.* p. 210.

August (*Ferbury*).

58. Trisula variegata.

Trisula variegata, Moore, Cat. Lep. E.I.C. ii. p. 420 pl. 12 A. f. 1 (1858–9).

September.

59. Trabala vishnu.

♀. *Gastropacha vishnu*, Lefebvre, Zool. Journ. iii. p. 207 (1827).
♂. *Amydona prasina*, Walker, vi. 1417 (1855).

September (*Forsayeth*).

60. Lebeda buddha.

♂. *Bombyx buddha*, Lefebvre, Zool. Journ. iii. p. 209 (1827).
♀. *Bombyx brahma*, Lefebvre, *l. c.* p. 208.

August (*Forsayeth*).

61. Eupterote ignavus, n. sp. (Plate XLI. fig. 1, ♂.)

Allied to *E. mutans*, Walker.

Male of a soft yellowish-fawn colour, the internal bands being much more deeply bent inwards towards the costa than in *E. mutans*; the insect is also much smaller and of altogether a different colour; the bands on the hind wings are very distinct and, except at the base, are identical with those on the fore wings, which is not the case with *E. mutans*. Antennæ, head, thorax, and all the bands and markings rufous-brown; marginal border of both wings outside the outer double straight band much paler than the rest of the wings.

Basal third of the hind wings clothed with long pale hairs. Underside clear greyish yellow, with the bands and marks as above but paler.

Female of a uniform rufous-brown, coloured somewhat similarly to ♂ *E. undata*, Blanchard. Bands dark rufous-brown, placed as in the male but much straighter, less toothed and hardly at all bent in towards the costa, and the brown spots outside the outer straight band of the fore wings are wanting in the female; antennæ, head, and body dark rufous-brown. Underside pale rufous; markings as above but much paler.

Expanse of wings, ♂ $3\frac{5}{10}$, ♀ 4 inches.

June.

DREPANULIDÆ.

62. ARGYRIS EXTRUSATA.

Ephyra extrusata, Walker, xxii. 637 (1861).

October.

SATURNIIDÆ.

63. ANTHERÆA NEBULOSA.

Antheræa nebulosa, Hutton, Journ. As. Soc. Bengal, 1869, p. 16.

Common in the jungles below Assirghur from August to October.

COSSIDÆ.

64. PHRAGMATÆCIA MINOR.

Phragmatæcia minor, Moore, Desc. Lep. Col. Atkinson, part i. p. 87.

June.

65. BRACHYLIA ACRONYCTOIDES.

Brachylia acronyctoides, Moore, P. Z. S. 1879, p. 411, pl. 34. f. 4.

June.

NOCTUES.

LEUCANIDÆ.

66. LEUCANIA EXTRANEA.

Leucania extranea, Guénée, Noct. i. 77, 104.

April.

67. LEUCANIA AUREOLA.

Leucania aureola, Walker, ix. 108.

September, in great numbers for about a fortnight.

68. LEUCANIA INFERENS.

Leucania inferens, Walker, ix. 105.

Mr. Butler identified some Moths I sent him in 1882, taken in September 1881, as this species. I therefore enter it in this list, but I have no Mhow examples in my collection now, neither have I any note in my diary of Lepidoptera of having taken this insect in Mhow.

69. Leucania byssina, n. sp. (Plate XL. fig. 6.)

Antennæ, head, thorax, and fore wings pale greyish white, very slightly tinged with ochreous. Fore wings shining, irrorated with black atoms, a black spot at the end of the cell, another before the middle in the interno-median area, a discal row of black points curving outwardly, deeply bent in towards the costa, and a marginal row of black points. Fringe long, same colour as the wing. Abdomen, hind wings above, and the entire surface below pure shining white.

Expanse of wings 1–1$\frac{1}{10}$ inch.

June.

70. Axylia furtiva.

Axylia furtiva, Swinhoe, P. Z. S. 1885, p. 448.

September.

Heliothidæ.

71. Alaria lanceolata.

Alaria lanceolata, Walker, xxxiii. 767.

September.

72. Pradatta bivitta.

Leucania bivitta, Walker, ix. 108.

September. The above two species were together in great numbers in September 1881 for about a week.

73. Pradatta beatrix. (Plate XLI. fig. 5.)

Pradatta beatrix, Moore, P. Z. S. 1881, p. 365.

Antennæ, head, thorax, and fore wings bright rosy pink. Fore wings with a cream-coloured stripe from base to outer margin, passing through the whole length of the cell. Abdomen and hind wings silvery white, the latter in some specimens stained here and there with rosy. Underside silvery white, brownish towards the basal centre of the fore wings, and stained with rosy grey here and there on both wings.

Expanse of wings 1 inch.

September.

74. Heliothis armigera.

Noctua armigera, Hübner, Noct. pl. 79. f. 370.

October, November, and December.

75. Heliothis rubescens.

Thalpophila rubescens, Walker, xv. 1681.

December.

76. Heliothis peltigera.

Noctua peltigera, Wien. Verz. 89. 2.

June and December.

77. HELIOTHIS SUCCINEA.

Heliothis succinea, Moore, P. Z. S. 1881, p. 362.
November.

78. ADISURA LEUCANOIDES.

Adisura leucanoides, Moore, P. Z. S. 1881, p. 368.
October.

79. ANTHÆCIA SWINHOEI.

Anthæcia swinhoei, Butler, P. Z. S. 1883, p. 162.
Assirghur, October.

GLOTTULIDÆ.

80. GLOTTULA DOMINICA.

Phalæna-Noctua dominica, Cram. Pap. Exot. iv. p. 238, pl. 399. f. H.
August (*Forsayeth*).

CYMATOPHORIDÆ.

81. RISOBA OBSTRUCTA.

Risoba obstructa, Moore, P. Z. S. 1881, p. 328.
July.

APAMIIDÆ.

82. PRODENIA RETINA.

Neuria retina, Frivaldsky, Herr.-Schäff. Eur. Schmett. ii. 292, Noct. pl. 29. f. 145.
October.

83. LAPHYGMA EXIGUA.

Noctua exigua, Hübner, Samml. Eur. Schmett., Noct. f. 362.
February and March.

84. ILATTIA CEPHUSALIS.

Ilattia cephusalis, Walker, xvi. 209.
September and October.

85. MAMESTRA DOLOROSA.

Mamestra dolorosa, Walker, xxxii. 667.
October and November.

86. PERIGIA SERVA.

Celæna serva, Walker, xv. 1689.
October.

87. PERIGIA CENTRALIS.

Perigia centralis, Walker, xi. 734.
June.

NOCTUIDÆ.

88. AGROTIS SEGETUM.

Phalæna-Noctua segetum, Gmel. ed. Syst. Nat. i. 5, p. 2539. 1018.
January to April.

89. AGROTIS SUFFUSA.

Phalæna-Noctua suffusa, Gmel. ed. Syst. Nat. i. 5, p. 2541. 1028.
February.

90. AGROTIS ARISTIFERA.

Agrotis aristifera, Guénée, Noct. i. 266. 426.
April, June, November, and December.

91. AGROTIS LASSA, n. sp.

Allied to *A. repulsa*. Antennæ, head, thorax, and fore wings dark brownish fawn-colour. Fore wings of the male very narrow; fore wings of both sexes with some brown marks, like strigulæ here and there; on the male the usual stigmata are not visible; on the female the orbicular is represented by a black ring, and the claviform and reniform are both visible, but obscure and black; and the latter is like a small smudged figure of 8. Hind wings white, semi-hyaline, with the costa and outer border tinged with fawn-colour. Abdomen grey, with the segments marked out with some white hairs. Underside paler, with the thorax, abdomen, and fore and hind wings streaked with silvery-white speckles.

Expanse of wings 1½ inch.
March and April.

HADENIDÆ.

92. RADINACRA VARIANA, n. sp. (Plate XL. fig. 10.)

Antennæ, head, thorax, and fore wings brownish fawn-colour. Fore wings with the lines sinuous, dark brown, one subbasal extending only halfway down from the costa, another before the middle, and one submarginal; all these complete and bending slightly outwardly; three yellowish dots on the costa near the apex; the third line runs through the reniform stigma, which is hardly visible, the orbicular is indicated by a faint white spot. Abdomen greyish brown. Hind wings and underside pale brownish grey. Both wings above and below shining, almost gilded.

Expanse of wings 1 inch.
September.

XYLOPHASIDÆ.

93. SPODOPTERA CILIUM.

Spodoptera cilium, Guénée, Noct. i. 156. 249.
March and October.

94. SPODOPTERA INFECTA.

Prodenia infecta, Walker, ix. 196.
October.

ERASTRIIDÆ.

95. LEPTOSIA QUINARIA.

Leptosia quinaria, Moore, P. Z. S. 1881, p. 371.

April.

ACONTIIDÆ.

96. ACONTIA SIGNIFERA.

Acontia signifera, Walker, xii. 793.

September.

97. ACONTIA NIGRIPALPIS.

Acontia nigripalpis, Walker, xxxv. 1965.

Assirghur, October.

98. ACONTIA BADIA, n. sp.

Of a uniform pale reddish fawn-colour. Fore wing with whitish lines, thin, sinuous—one antemedian, one postmedian, one submarginal, and one marginal; a dark brown central band, stopping short of the costa, and expanding outwardly towards the apex, in some specimens overlapping the second line, in others having this line as its outer border for some distance upwards from the hinder margin; the inner border of this band is upright, bent inwardly on the centre and well defined, and within this band is a deep black reniform mark, and another black mark beyond. Hind wings slightly darker towards the border, and rather more grey-coloured than the ground-colour of the fore wings. Underside: fore wings greyish brown, with the costa and hinder margin broadly pinkish yellow; hind wings pale ochreous grey.

Expanse of wings $\frac{8}{10}$ inch.

October.

99. ACONTIA CROCATA.

Acontia crocata, Guénée, Noct. ii. 218. 989.

October.

100. ACONTIA INDA.

Acontia inda, Felder, Reise Nov. iv. pl. 108. fig. 23.

June.

101. ACONTIA QUADRIPARTITA.

Acontia quadripartita, Walker, xxxiii. 786.

June.

102. ACONTIA EXCISA.

Acontia excisa, Walker, MS., Swinhoe, P. Z. S. 1885, p. 455.

September.

103. PHOTHEDES VEPRECULA.

Phothedes veprecula, Swinhoe, P. Z. S. 1885, p. 456.

June, September, and October.

104. Phothedes frausa, n. sp.

Yellowish cream-colour. Fore wings diffused with pinkish, costa broadly grey; an indistinct silvery sinuous inner line, which in some specimens is disconnected and in some is wanting; a similar outward line from the outer two thirds of the hinder margin up to the apex; this line in many specimens runs in a brownish-grey shade, and there are streaks and marks of this colour on the costa, on the hinder margin towards the base, and marginal marks; fringe also of same colour. Hind wings in some examples slightly grey towards the outer border, in others pure pale yellowish cream-colour, paler than the ground-colour of the fore wings. Underside of the same colour but paler, more whitish, shining, and quite unmarked.

Expanse of wings $\frac{7}{10}$ inch.

July.

Quite common for a few days. A somewhat variable-looking insect, because the colours and markings are much stronger in some than in others, the ground-colour in some females being almost pure pinkish.

105. Hiccoda herbaria, n. sp.

Upperside, body, and wings white. Fore wings sparsely irrorated with reddish-brown dots and atoms, some marks of the same colour on the costa and outer margin, a sinuous line within a diffused band, from the outer two thirds of the hinder margin to the apex; a square blackish large spot in the disk within this band; fringe white, marked with black marks. Hind wings with the outer half shaded with pale reddish brown; fringe pure white. Underside whitish, shaded with grey, darkest on the costa. Palpi black, last joint very minute and pure white; fore tarsi black with white bands.

Expanse of wings $\frac{6}{10}$ inch.

June and July.

106. Tarache nivosa, n. sp. (Plate XLI. fig. 14.)

Head and thorax snow-white; antennæ and thorax reddish grey, the latter marked with pure white within the segments, may be altogether white in freshly emerged specimens. Fore wings reddish slate-colour, in some specimens pale brown-pink, a deep snow-white band extending along four fifths of the costa, filling nearly the whole basal area with the dark colour of the wings, forming an elbow upwards in the centre part of the band; a reddish indistinct line crossing the band at the basal third, just before the elbow, a spot at the base within the band, also the orbicular and reniform spots all of the general colour of the wing, clear and distinct; the dark part of the wing has white marks showing through here and there, and a brownish elbow parallel with the stigmata, giving the appearance of three spots in a longitudinal row; marginal marks white; fringe white. Hind wings in some specimens white with greyish borders, in others of a uniform pale slaty grey; fringe white. Underside pale grey, unmarked.

Expanse of wings $\frac{8}{10}$ inch.
June and September.
A well-marked and pretty little insect.

ANTHOPHILIDÆ.

107. THALPOCHARES ROSEANA.

Thalpochares roseana, Moore, P. Z. S. 1881, p. 370.
April and May.

108. THALPOCHARES RIVULA.

Thalpochares rivula, Moore, Desc. Lep. col. Atkinson, ii. p. 140 (1882).
March.

109. AGROPHILA SULPHURALIS.

Phalæna-Pyralis sulphuralis, Bergestr. Ins. Suec. i. 16.
October.

110. ANTHOPHILA INNUBILA, n. sp.

Upperside of a uniform shining cream-colour, the fore wings rather darker than the hind wings, and tinged with ochreous, especially on the costa. Fore wings sparsely covered with silvery-white freckles, and with a whitish line which extends upwards from the centre of the hinder margin towards the apex and then angles inwards, meeting the costa at the outer two thirds; there is also a faint indication of a similar inner line parallel to this just inside the middle. Eyes black; antennæ ochreous. Underside paler than the upperside, shining, unmarked.
Expanse of wings $\frac{8}{10}$ inch.
June.

111. EUBLEMMA AMABILIS.

Eublemma amabilis, Moore, Lep. Ceylon, iii. p. 54.
June.

PLUSIIDÆ.

112. PLUSIA VERTICILLATA.

Plusia verticillata, Guénée, Noct. ii. 344. 1168.
September.

113. PLUSIA EXTRAHENS.

Plusia extrahens, Walker, xii. 929.
June and October.

114. PLUSIA CIRCUMFLEXA.

Phalæna-Noctua circumflexa, Linn. Syst. Nat. 128.
April.

115. Plusia orichalcea.

Noctua orichalcea, Fabr. Sp. Ins. ii. 227. 92.
October (*Forsayeth*).

Hyblæidæ.

116. Hyblæa puera.

Phalæna-Noctua puera, Cram. Pap. Exot. ii. 10, pl. 103. f. D, E.
Mhow (*Yerbury*).

Gonopteridæ.

117. Cosmophila xanthindyma.

♂. *Cosmophila xanthindyma*, Boisd. Faun. Ent. Mad. Bourb. et Maur., Lép. p. 94, pl. 13. f. 7 (1833).
♀. *Cosmophila indica*, Guénée, Noct. ii. 396. 1256 (1852).
July, September, and October; in great numbers in September.

Polydesmidæ.

118. Pandesma quenavadi.

Pandesma quenavadi, Guénée, Noct. ii. 438. 1310.
May, July, and September.

119. Polydesma boarmoides.

Polydesma boarmoides, Guénée, Noct. ii. 441. 1314.
June.

120. Polydesma brevipalpis.

Alamis brevipalpis, Walker, xiii. 1051.
June and July.

121. Bamra acronyctoides.

Bamra acronyctoides, Moore, Desc. Lep. col. Atkinson, ii. p. 160 (1882).
Mhow (*Yerbury*).

Homopteridæ.

122. Homoptera vetusta.

Homoptera vetusta, Walker, xxxiii. 875.
June, July, and October.

123. Alamis umbrina.

Alamis umbrina, Guénée, Noct. iii. 4. 132.
July and October.

124. Alamis continua.

Alamis continua, Walker, xxxiii. 877.
September (*Forsayeth*).

125. GIRPA FRATERNA.

Girpa fraterna, Moore, Lep. Ceylon, iii. p. 94 (1884).
September and October.

126. GIRPA INANGULATA.

Hulodes inangulata, Guénée, Noct. iii. 210. 1612.
Remigia optativa, Walker, xiv. 1510.
Remigia optatura, Walker, xv. 1848.
September and October.

HYPOGRAMMIDÆ.

127. SELEPA CELTIS.

Selepa celtis, Moore, Cat. Lep. E. I. C. ii. p. 353, pl. ix. *a*. f. 9.
October (*Forsayeth*).

128. SELEPA OCCULTA.

Selepa occulta, Swinhoe, P. Z. S. 1885, p. 461.
June.

129. SELEPA CURVIFERELLA.

Subrita? curviferella, Walker, xxxv. 1745.
September (*Forsayeth*).

CATEPHIDÆ.

130. ERYGIA APICALIS.

Erygia apicalis, Guénée, Noct. iii. 50. 1381.
November.

131. BRIARDA BOLINOIDES.

Briarda bolinoides, Walker, xv. 1802.
July.

132. ANOPHIA OLIVESCENS.

Anophia olivescens, Guénée, Noct. iii. 48. 1379.
June.

OMMATOPHORIDÆ.

133. PATULA MACROPS.

Phalæna-Noctua macrops, Linn. Syst. Nat. ii. 225.
June and September.

134. ENTOMOGRAMMA TORSA.

Entomogramma torsa, Guénée, Noct. iii. 204. 1605.
October.

135. HOMÆA CLATHRUM.

Homæa clathrum, Walker, xiv. 1334.
July.

HYPOPYRIDÆ.

136. SPIRAMIA HELICINA.

Speiredonia helicina, Hübner, Samml. exot. Schmett. iii. 14. 219. f. 437, 438.

March, June, July, and September.

OPHIDERIDÆ.

137. ARGADESA MATERNA.

Phalæna-Noctua materna, Linn. Syst. Nat. ii. 840. 17.

July.

138. OTHREIS FULLONICA.

Phalæna-Noctua fullonica, Linn. Syst. Nat. ii. 812. 16.

July.

OPHIUSIDÆ.

139. OPHIODES SEPARANS.

Ophiodes separans, Walker, xiv. 1357.

September (*Forsayeth*).

140. OPHIODES TRIPHÆNOIDES.

Ophiodes triphænoides, Walker, xiv. 1358.

Mhow (*Yerbury*).

141. SPHINGOMORPHA CHLOREA.

Phalæna chlorea, Cram. Pap. Exot. ii. p. 12, pl. 104. f. C.

September and November.

142. ACHÆA MELICERTE.

Phalæna-Noctua melicerte, Drury, Ins. i. p. 46, pl. 23. f. 1.

July to November.

143. ERCHEIA DIVERSIPENNIS.

Ercheia diversipennis, Walker, xiii. 1108.

September (*Forsayeth*).

144. OPHIUSA ALBIVITTA.

Ophiusa albivitta, Guénée, Noct. iii. 271. 1707.

July.

145. OPHIUSA JOVIANA.

Phalæna-Noctua joviana, Cram. Pap. Exot. iv. p. 237, pl. 399. f. B.

Depalpore, November.

146. OPHIUSA ARCTOTÆNIA.

Ophiusa arctotænia, Guénée, Noct. iii. p. 272 (1852).

Mhow (*Yerbury*).

147. GRAMMODES AMMONIA.

Phalæna ammonia, Cram. Pap. Exot. iii. p. 98, pl. 250. f. D.

July and September.

EUCLIDIIDÆ.

148. TRIGONODES HIPPASIA.

Phalæna-Noctua hippasia, Cram. Pap. Exot. iii. p. 99, pl. 250. f. E.

September, October, and November.

149. ACANTHOLIPES AFFINIS.

Docela affinis, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. v. p. 225 (1880).

Mhow, October; Assirghur, October.

150. ACANTHOLIPES ACERVALIS, n. sp.

♂. Cream-colour, sparsely irrorated with brown atoms; head and collar pure white. Fore wings with a black dot in the cell and one or two in a line beyond it, a short grey longitudinal streak from the end of the cell to the outer border, some short grey streaks on the border, made by the interspaces near the border being nearly filled up with grey color, a black dot near the external angle (this is not present in all specimens); hinder margin grey. Hind wings ochreous grey towards the outer border. Underside white, fore wings suffused with purplish grey, darkest along the costa. Mhow, October.

150A. ANTHOPHILA PULCHRA, n. sp.

♀. Allied to *A. purpurina*. Cream-colour; head and collar pure white. Fore wings with the costa and outer half suffused with purplish grey, gradually darkening towards the outer border, where there is a white streak running from the apex halfway down the outer margin, and then making a short streak inwards. Hind wings dark grey. Underside similar to the male, the purple on the fore wings rather darker.

Expanse of wings $\frac{8}{10}$ inch.

Mhow, November.

REMIGIIDÆ.

151. REMIGIA FRUGALIS.

Noctua frugalis, Fabr. Ent. Syst. iii. 2. 138.

Common from July to December.

152. REMIGIA ARCHESIA.

Phalæna-Noctua archesia, Cram. Pap. Exot. iii. p. 145, pl. 273. f. F, G.

July, September, and October.

POAPHILIDÆ.

153. POAPHILA HAMIFERA.

Poaphila hamifera, Walker, xxxiii. 992.

July.

THERMESIIDÆ.

154. AZAZIA RUBRICANS.

Ophiusa rubricans, Boisd. Faun. Lép. Mad. p. 106. 11, pl. 16. f. 1.

September.

155. MESTLETA BACCALIX, n. sp. (Plate XL. fig. 7.)

Pale pinkish cream-colour. Fore wings irrorated with pinkish-brown atoms; with four equidistant parallel whitish oblique lines—subbasal, antemedian, median, and postmedian; each line nearly straight from hinder margin till near the costa, where it abruptly bends inwards to the costa; each line margined with pinkish brown on its inner side; outer border darker than the rest of the wing, with a whitish subapical line running inwards from the costa for a short distance; fringe pinkish brown with white tips. Hind wings paler than the fore wings, pale pinkish brown towards the outer margin; fringe pinkish grey, with white tips. Underside whitish; legs marked with pinkish brown; body dark brown-pink; fore wings suffused with pinkish brown towards the apex; fringe of both wings as on the upperside.

Expanse of wings $\frac{8}{10}$ inch.

December.

FOCILLIDÆ.

156. HINGULA UNICOLORIS, n. sp.

Dark brown; antennæ articulated with white, tips of the palpi white; head white on the inside of the eyes; wings saturated with pinkish; fore wings with some black marks on the costa, a black streak at the end of the cell; both wings with black points on the outer margin, and with two irregular, very indistinct black lines across the wings difficult to distinguish. Underside slightly paler than the upperside, in one specimen quite unmarked, in another with faint traces of outer and submarginal lines.

Expanse of wings 1 inch.

February and September.

PLATYDIDÆ.

157. EPISPARIS SIGNATA.

Episparis signata, Walker, xxxiii. 1032.

July.

HYPENIDÆ.

158. RHYNCHINA PERVULGALIS.

Rhynchina pervulgalis, Swinhoe, P. Z. S. 1885, p. 471, pl. 28. f. 5.

May and September.

159. RHYNCHINA XYLINA, n. sp.

Palpi, head, and collar white, speckled with grey, the palpi in

some specimens mostly grey; antennæ grey, articulated with white, ciliated in the male, filiform in the female; thorax and fore wings dark grey speckled with white; an antemedian upright sinuous double white line, a median, outwardly oblique, sinuous double white line sharply bent inwards to the costa, round the reniform stigma, which is white and prominent; there is also an orbicular spot of the same colour, smaller and less prominent, some white marks on the costa near the apex, and a submarginal and a marginal brown line with white points. Hind wings and underside pale grey, unmarked; abdomen grey with white segmental lines; male with a prominent grey anal tuft.

This little insect varies much in the shade of its general coloration, some specimens being reddish grey, and in many the white predominates.

Expanse of wings $\frac{5}{10}$–$\frac{6}{10}$ inch.

June and July; common in the cotton-fields.

160. HYPENA ABDUCALIS.

Hypena abducalis, Walker, xvi. 67.

Common in July.

This species is very variable; some are strongly marked like the type, others have merely a whitish curved line on the fore wings from the tip to the base, with a few streaks, and the general colour of the wing is pale and quite different to the type.

HERMINIIDÆ.

161. NODARIA EXTERNALIS.

Nodaria externalis, Guénée, Delt. et Pyral. 64. 78.

October.

162. APPHADANA MISERA.

Apphadana misera, Butler, P. Z. S. 1883, p. 166.

Mhow, October; Assirghur, October.

163. SPADIX VEGETUS.

Spadix vegetus, Swinhoe, P. Z. S. 1885, p. 475, pl. 28. f. 14.

June and September.

164. BYTURNA DIGRAMMA.

Bocana digramma, Walker, xxxiv. 1170.

September and October.

165. LABANDA PAMPHOSALIS.

Bocana pamphosalis, Walker, xix. 887.

October.

GEOMETRITES.

ENNOMIIDÆ.

166. HYPERYTHRA SWINHOEI.

Hyperythra swinhoei, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. v. p. 223 (1880).

Mhow, February; Ajnot, November.

167. CHIZALA DECIPIENS.

Chizala decipiens, Walker, xx. 263.

March.

BOARMIIDÆ.

168. HYPOCHROMA DISPENSATA.

Hypochroma dispensata, Walker, xxi. 435.

March.

169. BOARMIA CORNARIA.

Boarmia cornaria, Guénée, Phal. i. 254. 390.

February and October.

170. PETELIA MEDARDARIA.

Petelia medardaria, Herr.-Schäff. Exot. Schm. pl. 94. f. 534.

July.

AMPHIDASIDÆ.

171. BUZURA PANTERINARIA.

Amphidasis panterinaria, Bremer und Grey, Beitr. zur Schmett.-Fauna des nördlichen China's, p. 21. 107.

June.

GEOMETRIDÆ.

172. NEMORIA CARNIFRONS.

Nemoria carnifrons, Butler, P. Z. S. 1883, p. 169.

September and October.

173. NEMORIA FREQUENS.

Nemoria frequens, Butler, P. Z. S. 1881, p. 616.

Mhow, March, April, and November; Ajnot, November.

174. TIMANDRA DIATOMARIA.

Timandra diatomaria, Walker, xxvi. 1616.

September, October, and November.

EPHYRIDÆ.

175. EPHYRA CLEORARIA.

Acidalia cleoraria, Walker, xxiii. 792.

Mhow, February to June, also in October; Depalpore, November and December.

176. Ephyra inexacta.

Epione inexacta, Walker, xxvi. 1497.
October.

Idæidæ.

177. Idæa addictaria.

Acidalia addictaria, Walker, xxii. 749.
October.

178. Idæa patularia.

Acidalia patularia, Walker, xxxv. 1633.
Delapore, November.

179. Idæa remotata.

Acidalia remotata, Walker, xxii. 748.
Depalpore, November.

180. Idæa absconditaria.

Acidalia absconditaria, Walker, xxiii. 757.
October, November, and December.

181. Idæa walkeri.

Idæa walkeri, Butler, P. Z. S. 1883, p. 170.
Acidalia extimaria, Walker, xxiii. 794.
October and January.

182. Idæa negataria.

Acidalia negataria, Walker, xxiii. 751.
Mhow, December; Depalpore, November.

183. Idæa chotaria.

Idæa chotaria, Swinhoe, P. Z. S. 1885, p. 858, pl. 57. f. 14.
April and June.

184. Hyria bilineata.

Hyria bilineata, Butler, P. Z. S. 1883, p. 170.
Assirghur, October.

Caberidæ.

185. Stegania uvidula.

Stegania uvidula, Swinhoe, P. Z. S. 1885, p. 860.
July.

Macariidæ.

186. Macaria eleonora.

Phalæna eleonora, Cram. Pap. Exot. iii. p. 172, pl. 288. f. E, F, G.
July.

187. MACARIA HEBESATA.

Macaria hebesata, Walker, xxiii. 931.

September.

188. MACARIA ZEBRINA.

Tephrina zebrina, Butler, P. Z. S. 1883, p. 171.

March, April, and May.

189. MACARIA ARENARIA.

Tephrina arenaria, Swinhoe, P. Z. S. 1884, p. 527, pl. 48. f. 13.

December.

190. MACARIA LITHINA.

Tiphrina lithina, Butler, P. Z. S. 1883, p. 171.

March and October.

I believe these to be females of *M. zebrina*, though at first sight they do not look like it, having no median bands; but I have never taken a male, and the female of the allied species, *M. strenuata*, Walker, is often also without bands and is hardly distinguishable from *M. lithina*.

191. MACARIA PEREMPTARIA.

Macaria peremptaria, Walker, xxiii. 929.

October.

192. MACARIA GRANITALIS.

Tephrina granitalis, Butler, P. Z. S. 1883, p. 171.

September.

FIDONIIDÆ.

193. STERRHA SACRARIA.

Phalæna-Geometra sacraria, Linn. Syst. Nat. i. 2, p. 863. 220.

February, May, and June.

194. STERRHA PAULULA, n. sp. (Plate XLI. fig. 7.)

White; eyes black; thorax and fore wings irrorated with ochreous atoms; fore wings with a reddish-ochreous dot at the end of the cell, and with two oblique outer lines of the same colour close together, from the outer two thirds of the hinder margin, where they are separate, opening out in their centre and meeting at the apex; abdomen and hind wings pure white. Underside white; fore wings pale ochreous towards the costa.

Expanse of wings $\frac{8}{10}$ inch.

May.

LARENTIIDÆ.

195. LYCAUGES DEMISSUS, n. sp.

Eyes black; top of head pure white; antennæ, body, and wings cream-colour, both wings irrorated with brown atoms, which are

densely packed in places, forming bands along the costa and on all the borders of both wings. Fore wings with an oblique central band of the same colour (also irrorated with darker atoms) from the centre of the hinder margin to the apex; a row of brown dots between this band and the outer margin, the dots being connected together with a line of pale atoms; a brown dot at the end of the cell and sometimes one or two more in a row inwards; fringe white, densely irrorated with brown atoms, making it clearly interlined. Hind wings with a brown dot at the end of the cell, with a central band of the same colour as that in the fore wings, the band being curved inwardly to the costa; an outward row of dots connected together by brownish atoms, and a marginal row of dots; fringe as in fore wings; in some specimens the outer line of atoms in both wings is double, with the dot on the inside line. Underside like the upperside, but darker and duller.

Expanse of wings $\frac{9}{10}$ inch.

February to June; common.

196. NADAGARA GRISEA.

Nadagara grisea, Butler, P. Z. S. 1883, p. 172.

May.

PYRALES.

PYRALIDÆ.

197. PYRALIS LUCILLALIS.

Pyralis lucillalis, Walker, xvii. 268.

April and September.

198. PYRALIS UBERALIS.

Pyralis uberalis, Swinhoe, P. Z. S. 1884, p. 523, pl. 48. f. 10.

May.

199. CLEDEOBIA HYPOTIALIS.

Cledeobia hypotialis, Swinhoe, P. Z. S. 1885, p. 866.

June, September, and October; in great plenty in June.

ENNYCHIIDÆ.

200. PYRAUSTA STULTALIS.

Botys stultalis, Walker, xviii. 669.

June and September.

201. RHODARIA JUNCTURALIS.

Rhodaria juncturalis, Walker, xxxiv. 1283.

September.

ASOPIIDÆ.

202. HYMENIA FASCIALIS.

Phalæna-Pyralis fascialis, Cram. Pap. Exot. iv. p. 236, pl. 398. f. O.

June, July, and September.

203. Coptobasis opisalis.

Desmia opisalis, Walker, xvii. 346.
July and September.

204. Coptobasis ænealis.

Coptobasis ænealis, Swinhoe, P. Z. S. 1885, p. 867.
July.

205. Samea inscitalis.

Ædiodes inscitalis, Walker, xxxiv. 1297.
September.

206. Leucinodes auxialis, n. sp. (Plate XLI. fig. 12.)

Head and thorax reddish brown, covered with white marks; abdomen pure pearl-white, with pale reddish-brown bands in the last four segments. Fore wings pure pearl-white, with a broad reddish-brown band at the base, and another on the outer border, diffused inwardly, and filling up the outer third of the wing; a white line at the base, and another submarginal, both sinuous, and showing distinctly on the brown bands, which are also covered with white marks as on the thorax; there are also some pale reddish marks on the costa in the central portion of the wing. Hind wings white, semihyaline, with a discal waved line and an interrupted marginal band diffused inwardly; both pale reddish brown; fringe of both wings white. Underside white, with the bands and marks pale, showing through the wings.

Expanse of wings $\frac{7}{10}$—$\frac{8}{10}$ inch.
April.

Hydrocampidæ.

207. Paraponyx affinialis.

Paraponyx affinialis, Guénée, Delt. et Pyral. 270. 259.
October, November, January, March, April, and June; very plentiful.

Hercynidæ.

208. Herbula meleagrisalis.

Herbula meleagrisalis, Walker, xvii. 324.
April.

Spilomelidæ.

209. Salbia perspicualis.

Zebronia perspicualis, Walker, xxxiv. 1347.
October.

210. Zebronia aurolineatus.

Zebronia aurolineatus, Walker, xvii. 478.
Assirghur, October.

211. ZEBRONIA GRAPHICALIS, n. sp.

Allied to *Z. obrinusalis*, Walker.

Ochreous; fore wings with a black dot at the end of the cell and three black dots on the costa—one basal, one before and another beyond the middle, exactly as in *Z. aurolinealis* and *Z. plutusalis*. Both fore and hind wings crossed by five dark ochreous, slightly sinuous bands; marginal line dark ochreous; fringe long, with pale tips. Underside paler; wings unmarked, except a deep black spot at the end of the cell of the fore wings; all the legs with black knees; fore tarsi with three black bands.

Expanse of wings $\frac{8}{10}$—1 inch.

February, March, and July.

MARGARODIDÆ.

212. PYGOSPILA TYRESALIS.

Phalæna-Pyralis tyres, Pap. Exot. iii. p. 124, pl. 263. f. C.

Pygospila tyresalis, Guénée, Delt. et Pyral. 312. 340.

Mhow (*Yerbury*).

213. PHAKELLURA INDICA.

Eudioptis indica, Saunders, Zool. ix. 3070.

September, October, and November.

214. GLYPHODES FESSALIS, n. sp. (Plate XLI. fig. 13.)

Palpi unusually long, much longer than the breadth of the head; antennæ, palpi, head, thorax, and abdomen pure white; a reddish band on each side of the collar, joining a similar band on the costa of the fore wings; outer border of fore wings with a band of the same colour—in some specimens purplish, margined inwardly with a brown line. Hind wings white, semihyaline, with an outer border slightly paler than that on the fore wings, and which becomes gradually attenuated to the anal angle; fringe of both wings white. Underside white, shining, with the bands faintly showing through.

Expanse of wings $\frac{6}{10}$ inch.

April and May.

215. EUCLASTA DEFAMATALIS.

Ilurgia defamatalis, Walker, xviii. 544.

November.

BOTIDIDÆ.

216. BOTYS AUREA.

Botys aurea, Butler, Ill. Typ. Lep. Het. iii. p. 76, pl. 59. f. 11 (1879).

October.

217. BOTYS INCOLORALIS.

Botys incoloralis, Guénée, Delt. et Pyral. 332. 369.

October.

218. Botys obstrusalis.

Botys obstrusalis, Walker, xviii. 663.
July, September, October, and November.

219. Botys neoclesalis.

Botys neoclesalis, Walker, xviii. 635.
June.

220. Botys molusalis.

Botys molusalis, Walker, xix. 1409.
August (*Forsayeth*).

221. Ebulea catalaunalis.

Botys catalaunalis, Duponchel, Lép. de France, viii. p. 330. pl. 232. f. 8.
September, October, and November.

222. Scopula damastesalis.

Scopula damastesalis, Walker, xix. 1013.
July and September.

223. Scopula vinctalis.

Scopula vinctalis, Walker, xxxiv. 1476.
July.

224. Scopula strenualis.

Botys strenualis, Walker, xxxiv. 1409.
August (*Forsayeth*).

Steniidæ.

225. Diasemia geometralis.

Lepyrodes geometralis, Guénée, Delt. et Pyral. 278. 271.
Assirghur, October.

Phycidæ.

226. Nephopteryx suffuscalis, n. sp.

Cinereous brown; whitish, shining, beneath; palpi stout, pubescent, curving upwards, not rising higher than the vertex, third joint lanceolate, short, not one third of the length of the second; antennæ rather stout, brown marked with white; top of head whitish; palpi, thorax, and fore wings cinereous brown, some silvery-white atoms on thorax and on the fore wings near the base; reniform stigma represented by a whitish spot; four sinuous incomplete black lines across the fore wings—basal, antemedian, postmedian, and submarginal; marginal points black; fringe long, greyish brown; hind wings pale whitish cinereous.

Expanse of wings $\frac{5}{10}$ inch.
March and April.

227. Homœosoma gratella.

Homœosoma gratella, Walker, xxvii. 26.

February and April.

Crambidæ.

228. Schœnobius bisignatus.

Schœnobius bisignatus, Zeller, MS. (col. B.M.), P. Z. S. 1885, p. 878.

June and July.

229. Chilo aurifusellus.

Crambus aurifusellus, Walker, xxxv. 1756.

June and July.

230. Chilo interruptellus.

Chilo interruptellus, Moore, P. Z. S. 1872, p. 581, pl. 34. f. 5.

June.

231. Chilo ortellus, n. sp. (Plate XLI. fig. 3.)

White; palpi fawn-colour, porrect, about as long as the breadth of the head, second joint with large white tufts above, third acutely conical, as long as the second; antennæ white, stout, pectinated in the male, branches reddish, short; top of head pure white; thorax grey, with a black central stripe and a white band on each side; abdomen pure white. Wings white; fore wings with the upper portions suffused with yellowish-fawn colour, and with a broad black longitudinal central stripe from base to outer margin, attenuated at both ends; marginal points black, and a few black atoms distributed over the surface of the wing: hind wings pure white, unmarked. Underside white, with the stripe and marginal points on the fore wings showing through the wings, and in the male with the costal portions and outer border of the fore wings and costa of hind wings suffused with dirty reddish grey.

Expanse of wings, ♂ $1\frac{3}{10}$, ♀ $1\frac{4}{10}$ inch.

June and July.

232. Charltona kala.

Charltona kala, Swinhoe, P. Z. S. 1885, p. 879, pl. 57. f. 4, ♂.

June and July.

233. Jartheza chrysographella.

Chilo chrysographella, Kollar, Hügel's Kasch. p. 494 (1848).

February to April, June and October.

234. Jartheza cassimella, n. sp. (Plate XLI. fig. 4 ♂, fig. 6 ♀.)

Allied to *J. xylinella*.

Pale yellowish fawn-colour; labial palpi porrect, stout, longer than

the breadth of the head, last joint minute; maxillary palpi half the length of the labial palpi. Antennæ of the male pectinated, branches very short; of the female filiform, with short bristles, colour grey. Top of head and thorax chestnut-brown, latter with a white band on each side; abdomen grey, with white segmental lines.

Fore wings yellowish fawn-colour, with two dark brown, diffuse, incomplete longitudinal stripes, one running a short distance out of the centre of the cell towards the outer border, the other from the base on the submedian vein for about two thirds of the length of the wing, each stripe containing a glistening silver-white streak; a submarginal narrow semidentate brown band and black lunular small spots on the veins close to, but not touching, the outer margin; fringe grey, with a brown line in its centre. Hind wings smoky grey, unmarked; fringe white. Underside whitish, shining; fore wings suffused with grey; legs fawn-colour, brown on their inner sides; tarsi with brown bands.

Expanse of wings, ♂ $1\frac{2}{10}$, ♀ $1\frac{5}{10}$ inch.

June and July; common.

235. Crambus partellus.

Crambus partellus, Swinhoe, P. Z. S. 1885, p. 879.

October.

236. Crambus multivagellus, n. sp.

White; antennæ thin; labial palpi slender, as long as the breadth of the head; maxillary palpi one third of the length of the labial palpi; abdomen extending a little beyond the hind wings; fore wings acute, rather narrow, outer border oblique, costa slightly convex; wings and body above and below pure white, shining, unmarked.

Expanse of wings $\frac{5}{10}$ inch.

June, July, and September.

237. Urola inclaralis.

Crambus inclaralis, Walker, xxxvii. 166.

June and July.

238. Eromene bella.

Eromene bella, Hübner, Tin. f. 69.

April and June.

239. Surattha invectalis.

Surattha invectalis, Walker, xxvii. 76.

June.

240. Hypotia allalis, n. sp. (Plate XLI. fig. 2.)

White; fore wings with the costal line and basal third very pale reddish cinereous, an oblique broad pale reddish-brown band beyond

the middle, on the inner margin of which is the reniform stigma, brownish, rather large, lunular; marginal line reddish brown, this line runs round the apex on to the costa and round the hinder angle a little way on the hinder margin; some faint, very pale, reddish marks on the outer third of the wing. Hind wings white, marginal line reddish brown; fringe on both wings interlined—white, pale reddish brown, and white. Antennæ, palpi, and body pure white; a thin brown band on the abdomen near the base, in some specimens like a fine line. Underside white, with the costal portion of the fore wings suffused with reddish.

Expanse of wings $\frac{7}{10}$ inch.

Mhow, June.

NYCTEOLIDÆ.

241. EARIAS FRONDOSANA.

Earias frondosana, Walker, xxvii. 204.

Assirghur, October.

242. EARIAS TRISTRIGOSA.

Earias tristrigosa, Butler, P. Z. S. 1881, p. 614.

April.

243. EARIAS SPEIPLENA.

Aphusia speiplena, Walker, xii. 770.

October and December.

TORTRICIDÆ.

244. PHYCODES HIRUNDINICORNIS.

Phycodes hirundinicornis, Guénée, Noct. ii. 389. 1249.
Tegna hyblæella, Walker, xxxv. 1810.

April and September.

245. DICHRORAMPHA SUBSEQUANA.

Tortrix subsequana, Haworth; Stephens; Wood, fig. 1021.

June and October.

TINEIDÆ.

246. ALAVONA BARBARELLA.

Alavona barbarella, Walker, xxviii. 515.

May and June, in great numbers.

247. ALAVONA COSSUSELLA.

Alavona cossusella, Walker, xxxv. 1816.

June and July, in great numbers in the former month.

248. ALAVONA INDECORELLA ?

Alavona indecorella, Walker, xxviii. 515.

June.

Four male specimens, all more or less rubbed; they are in size and appearance more like Walker's type of the above than of any other insect in this genus, but they cannot safely be determined as identical with this species.

249. ALAVONA MINOR, Walsingham, n. sp. (Plate XLI. figs. 10, 11, ♂ ♀.)

Palpi dull ochreous, shaded with brownish beneath; head ochreous; antennæ cinereous; thorax brownish. Fore wings pale whitish fawn, shaded at the base of the costal margin with brownish, a series of brown spots around the apical and outer portions of the costal margins; between these and the end of the cell, in brightly marked specimens, is a second series of similar spots parallel to the apical margin, but turning outward to the anal angle at their lower end; a brownish spot is situated at the upper angle of the cell, another on the outer third of the fold. The markings in this species appear to be frequently almost obsolete, but the marginal spots are nearly always distinguishable. Hind wings slightly paler than the fore wings; abdomen tinged with brownish. Male, expanse 24 millim.

The female has no markings, so far as can be judged from a single specimen in poor condition, but is much smaller than the female of *Alavona cossusella*, Walker. Female, expanse 26 millim.

June and July, common.

250. TINEA SUBOCHRACEELLA, Walsingham, n. sp. (Plate XLI. fig. 9.)

Head tufted, bright yellowish ochreous; labial palpi ochreous, faintly tinged with greyish, short and drooping, not thickly clothed; maxillary palpi as long as the labials. Fore wings shining ochreous, faintly tinged at the base of the costa and about the fringes and apex of the wings with purplish grey. Hind wings greyish ochreous, with a slight coppery tinge; abdomen and legs pale ochreous.

Expanse 13 millim.

April.

A single specimen, received from the Rev. J. H. Hocking, from Dharmsala, by Lord Walsingham, measures 15 millim. in the expanse of the fore wings.

Two others of my Mhow specimens Lord Walsingham says are apparently not distinct from this species, although one of them is slightly larger in size (expanse 17 millim.), and is almost entirely devoid of the greyish tinge of the fore wings.

The insect has much the appearance of *Myrmecocela ochraceella*, Tgstr., but differs in the form of the labial palpi.

251. Hapsifera deviella.

Drosica deviella, Walker, xxviii. 520.

January, June, and July.

252. Setomorpha tineoides, Walsingham, n. sp. (Plate XLI. fig. 8.)

Palpi pale greyish above, tinged with fuscous beneath; antennæ greyish fuscous; thorax and fore wings spotted and mottled with ill-defined patches of brownish fuscous scales, these are very numerous across the middle of the wing and form a series of spots around the costal, apical, and a portion of dorsal margins. Hind wings greyish, with a faint purplish tinge; abdomen greyish fuscous.

Expanse of wings 14 millim.

April, May, and June.

Cryptolechiidæ.

253. Depressaria swinhoei.

Depressaria swinhoei, Butler, P. Z. S. 1883, p. 174.

October.

EXPLANATION OF THE PLATES.

Plate XL.

Fig. 1. *Aphnæus æstivus*, n. sp., p. 428.
2. *Ypthima complexiva*, ♀, n. sp., p. 423.
3. *Charaxes agrarius*, ♂, n. sp., p. 425.
4. *Nilasera apella*, ♂, n. sp., p. 429.
5. *Bireta galbana*, n. sp., p. 438.
6. *Leucania byssina*, n. sp., p. 442.
7. *Mestleta baccalix*, n. sp., p. 452.
8. *Dabarita icterica*, n. sp., p. 439.
9. *Susica cosmiana*, ♀, n. sp., p. 440.
10. *Radinacra variana*, n. sp., p. 444.

Plate XLI.

Fig. 1. *Eupterote ignavus*, ♂, n. sp., p. 440.
2. *Hypotia allalis*, n. sp., p. 462.
3. *Chilo ortellus*, ♂, n. sp., p. 461.
4. *Jartheza casimella*, ♂, n. sp., p. 461.
5. *Pradatta beatrix*, n. sp., p. 442.
6. *Jartheza casimella*, ♀, p. 461.
7. *Sterrha paulula*, n. sp., p. 456.
8. *Setomorpha tineoides*, n. sp., p. 465.
9. *Tinea subochraceella*, n. sp., p. 464.
10. *Alavona minor*, ♂, n. sp., p. 464.
11. —— ——, ♀, p. 464.
12. *Leucinodes auxialis*, n. sp., p. 458.
13. *Glyphodes fessalis*, n. sp., p. 459.
14. *Tiracha nivosa*, n. sp., p. 446.

2. Contributions to the Anatomy of *Geococcyx californianus*.

By R. W. Shufeldt, C.M.Z.S.

[Received June 28, 1886.]

(Plates XLII.–XLV.)

The investigations I am enabled to record in the present paper have been made possible through the kindness of Mr. W. F. Peacock, of Marysville, California.

This gentleman on the 23rd of July, 1885, came into possession of a fine male *Geococcyx*, which had been captured for him alive by a man who had run the specimen down on horseback. Mr. Peacock, having been informed by me that I only desired the skeleton of the species, killed and eviscerated it, and filled the abdominal cavity with powdered charcoal and pyroligneous acid, which preparation brought it safely into my hands after three days' travel during the most sultry weather.

Upon receiving it I at once consigned it to a vessel containing strong alcohol; so that, at this date (May 1886), the specimen is before me in excellent condition.

Owing to the fact, however, that it has been eviscerated, I am unable upon the present occasion to say anything about those organs which are situated in the thorax and abdomen, and will confine myself principally to examinations of the muscles of the limbs, the carotids, the trachea (if it be not injured), and the pterylosis.

It will be remembered by those who are familiar with my work that I have already published a full account of the skeleton of *Geococcyx* elsewhere[1], and to that paper the present memoir may be considered a second instalment.

Just now I am far removed by many thousand miles from the libraries and museums, and in a country where such American forms as might with profit be compared with our present subject do not occur. I have by me, however, an excellent field library, consisting of many of the standard anatomical works, including the collected "Scientific Papers" of Garrod and Forbes. Neither of the last-named anatomists have anything to say about our Ground-Cuckoo, and I am inclined to think that neither of those untiring workers in avian morphology ever came into possession of such material. Further, so far as my memory serves me, no one has yet paid any special attention to the structure of *Geococcyx californianus*. This being the case, I have reason to hope that my present contributions will not come amiss.

Garrod's investigations upon the anatomy of the Cuculidæ demonstrated the fact that both of the carotid arteries are present in these birds (Coll. Scientif. Papers, p. 169). His statement to this effect is based upon his having examined the following species:—

[1] Journ. of Anat. and Physiology, Lond. vol. xx. pt. 2, Jan. 1886, pp. 244–266, pls. vii., viii., and ix.

Cuculus canorus,
Cacomantis sepulcralis,
Chrysococcyx sp.,
Centropus senegalensis,
Guira piririgua,
Phœnicophaes sp.

The same authority finds the accessory femoro-caudal muscle present in :—

Centropus senegalensis,
Centropus phasianus,
Guira piririgua,
Phœnicophaes sp.,

and absent in the following species :—

Cuculus canorus,
Chrysococcyx sp.,
Cacomantis sepulcralis.

Of this latter peculiarity Mr. Garrod said, "Amongst the Cuculidæ, the Ground-Cuckoos (*Centropus*, *Guira*, *Phœnicophaes*) differ from *Cuculus* and its allies in having the accessory femoro-caudal developed, whilst it is absent in the latter, their respective formulæ being AB. XY., and A. XY. This peculiarity, when added to those in the pterylosis, justifies the division of the family into two subfamilies, which may be termed the Centropodinæ and the Cuculinæ" (*loc. cit.* p. 210).

According to this author, the ambiens muscle also being present in the Cuculidæ it throws this group into the subclass named by him the Homalogonatæ; and Mr. Garrod brings forward his very interesting researches upon the plantar tendons in birds to still further support his classification of this particular group. The arrangement of these tendons I will again refer to further on.

Cuculidæ have the cæca also present and possess a nude oil-gland.

To briefly recapitulate, then, the above and a few other structural characters of this group brought to light by this talented investigator, we find that the Cuculidæ are homalogonatous birds with two carotids; with the sciatic artery the main one in the leg (except *Centropus*); Cicouine, as regards the presence of the expansor secundariorum muscle (see Garrod's Coll. Scientif. Papers, pp. 323–29); and finally, as I say, have a nude oil-gland and the cæca.

Forbes examined specimens of *Geococcyx affinis*, and showed some interesting points in regard to the bursa Fabricii, which in the Cuculidæ he says "presents a very characteristic shape, the peduncle being long and thin, and the extremity club-shaped, giving the whole somewhat the appearance of a shortened and clumsy antenna of a butterfly. It disappears completely in adult birds" (Forbes's Coll. Scientif. Papers, p. 11). This author, on the page of the work quoted, presents us with a figure of the cloaca and bursa of *Geococcyx affinis*.

At the present time, the American Ornithologists' Union place the Cuckoos of this country in an order *Coccyges*, having three suborders, the *Cuculi*, the *Trogones*, and the *Alcyones*, our genus *Geococcyx* falling into the first under the subfamily Coccyginæ, there being one other associated with it, the genus *Coccyzus*.

Not long ago I showed some of the peculiarities of the coloration and extent of the naked skin-tracts upon the head of this bird[1]; I regret to say, however, that I have not at hand an account of the pterylosis of the Cuculidæ, so on the present occasion I must content myself with an accurate description of that feature in *Geococcyx californianus*, and leave the comparisons to be made by others who may be more fortunate in this respect.

Of the Pterylosis of Geococcyx.

So carefully have I drawn the two views of our subject, which are presented in Plate XLII., showing the pterylæ and their exact limits and extent, that a few words will suffice to complete the description. It will be seen that the "capital area" is quite complete, being broken only by the naked and coloured skin-tracts about the eye and on the back of the head. These latter vermilion-tinted skin areas are divided in the median line behind by a very narrow pteryla, which is directly continuous with the posterior middle strip of an equal width, and which terminates at the root of the neck, where it is somewhat abruptly lost in a central, sparsely scattered tract, just anterior to the spinal pterylosis. This posterior cervical strip is continuous above with the capital area. Upon the anterior cervical region we find the tract quite broad above, where it is continuous with the feather-tracts of the gular space; but as we proceed down the front of the neck this tract bifurcates at about halfway between the trunk and the throat, each separate strip thus formed being extended on either side to a point opposite a clavicular head, where it merges into the "ventral" and "humeral tracts."

A "humeral tract" is but faintly marked in our Ground-Cuckoo; and it is seen to pass, on the posterior aspect of the brachium, from the shoulder toward the elbow, but is gradually lost before it arrives at the latter point (Plate XLII. fig. 1).

The "ventral tracts" are very broad anteriorly, and are bounded mesially by curved lines, which overlie the clavicular limbs. These tracts, on either side, also bifurcate as we proceed in the direction of the abdomen. The outer strip grows gradually narrower, and makes a graceful curve round under the arm-pit, below which it abruptly terminates. The mesial strip formed by the bifurcation of the ventral tract is long and narrow, being gently convex outwards for its entire length. The distal extremities of these strips become extremely slender as they converge towards the vent, around which they pass to merge with each other behind this opening, and with the feather-tract covering the underside of the coccygeal protuberance (Plate XLII. fig. 2).

[1] Ibis, 1885, pp. 286–288, pl. vii.

The spinal pterylosis is represented by two broad, longitudinal tracts well separated from each other in the middle line by a naked-skin area overlying the vertebral column. These spinal pterylæ gradually converge towards each other as they approach the pelvic region, over which they merge into one feather-space, which becomes pointed behind and terminates just in front of the nude oil-gland.

The upperside of the coccygeal protuberance is also sparsely feathered, being divided from a more generously covered area below by the line of horizontally arranged pits for the quill-butts of the rectrices of the tail. An exceedingly narrow tract, on either side, springs from the posterior margin of the outer bifurcation of the ventral tract just below the arm-pit, to run longitudinally down the side, in front of the thigh, to become lost before it arrives at the margin of the vent. This strip seems to be composed simply of a double row of feathers, and might appropriately be termed the *lateral tract*.

The patagium of the arm is very thinly feathered anteriorly, while its dorsal aspect is quite completely covered; the remainder of the pterylosis of the pectoral limb presents us with nothing of a peculiar nature. The posterior marginal boundary of this "alar tract" is, as usual, terminated by the row of quill-butts of the primary feathers of the wing.

Passing now to the crural region, we find a posterior limb but sparsely feathered, while a conspicuous "femoral tract" extends obliquely across the dorsal aspect of the thigh, and rapidly narrowing, runs along the pubic line, finally merging into the "caudal tract."

Geococcyx shows its best-marked *apteria* in front, in the mesial space between the inner strips of the ventral tracts, and laterally to the outer side of the spinal pterylosis, where, indeed, for a considerable space no feathers may be said to occur at all. A well-marked dorso-longitudinal naked area is also to be seen. In this Ground-Cuckoo we notice a membrane, stretching between the thigh and leg, which corresponds to the patagial fold of the pectoral limb, and fully as well-developed.

Before closing this part of our subject it is of interest to observe the general form of *Geococcyx*, which, now that its feathers have been removed, can be studied to the best advantage. It will be seen how perfectly its figure has come to assume a shape best adapted to the peculiar requirements of the bird. Its pelvic limbs are large, muscular, and consequently powerful, while the pectoral ones are decidedly less so, though by no means weak or inefficient. The body-form of this prince of avian racers is what almost might be called "clipper built," so admirably fashioned is it to the needs and ends of a rapid running bird of the size of our subject.

With these few remarks upon the external organization and appearance of *Geococcyx* we will now close this part of our discussion, and pass to the consideration of some of the features presented in the structure of the remainder of its economy.

On the Mode of Insertion of the Patagial Muscles of the Pectoral Limb.

Having considerable faith in the value in classification of the arrangement of the insertional extremities of the tendon of the *tensor patagii brevis* muscle, and the forms of the patagial muscles generally, as *single characters*, it was with no little interest that I carefully removed with my scalpel the integuments over this region, for the first time in my experience in *Geococcyx*. The late Mr. Garrod's excellent work in this direction is now familiar to all ornithologists; but on this occasion I refrained from consulting any of the accurate drawings he has left us illustrating these parts in many groups of birds until I had actually completed my dissection, and my drawing of it, which is shown in Plate XLIII. fig. 2. I then opened his "Collected Scientific Papers" and proceeded to compare my figure with his numerous illustrations of the same dissection among other birds.

Being familiar with the arrangement of this tendon in a great many North-American birds from my own labours, I was confident that the condition of things in *Geococcyx californianus* was a marked departure from anything I had previously met; nor did I expect to find anything in Garrod's illustrations that would prove to be exactly like it. But in this last hope I was very agreeably disappointed, for I find that it corresponds almost exactly with the state of affairs found by this talented anatomist to be present in certain Galbulidæ. To satisfy one's self of this fact it is but necessary to compare my figure with the Jacamar dissected by Mr. Garrod, as shown in his work (plate 23. fig. 1, tendon of *tensor patagii brevis* in *Urogalba paradisea*), and the striking resemblance will be at once appreciated. He has simply cleared his tendon more completely of its investing fascia than I have, and still further separated its several slips; while in my figure of *Geococcyx* the tendon is shown as it presents itself immediately after turning back the integuments, or, in other words, exactly *in situ*. The liberty taken by Mr. Garrod to still further show these slips and their exact insertions is perfectly permissible, and often resorted to for the purpose named.

It will be seen that after the tendon of the *tensor patagii brevis* arrives over the proximal third of the belly of the *extensor metacarpi radialis longior* muscle in *Geococcyx* it trifurcates, one slip passing downwards to become inserted immediately below and on the outer aspect of the *extensor carpi ulnaris* muscle; the shortest slip at once attaches itself to the *extensor metacarpi radialis longior*, while the longest division of all passes with the last-named muscle to become inserted with it upon the outer condyle of the humerus.

As for the muscular portion of these patagial muscles above in this Ground-Cuckoo, I have represented them with the arm turned somewhat differently than the position Mr. Garrod was wont to give it. It will be seen, however, that the bulk of this muscular portion in *Geococcyx*, as in *Urogalba*, belongs to the *tensor patagii brevis* muscle.

It is still further interesting to compare the arrangement of these tendons in *Geococcyx* with the similar structures as they were found to exist by Mr. Garrod in *Upupa epops* and *Cuculus canorus*, both of which are figured upon the same plate alluded to above. We at once observe that our subject differs considerably in these particulars not only from the Hoopoe, but still more from the Cuckoo. Indeed, so far as *Upupa* is concerned, it simply lacks the long slip going to the humeral condyle in order to make the arrangement of the insertional extremities of the *tensor patagii brevis* agree with the corresponding arrangement as found in my specimen of *Geococcyx*.

So far as this one character is concerned, then, it points to the fact that a certain affinity exists connecting our *Geococcyx* with the Galbulidæ.

Fig. 1.

Fig. 2.

Fig. 1. Muscles at the outer side of the elbow of the right wing of *Caprimulgus europæus*.

Fig. 2. The same of the left wing of *Steatornis*. (Both figures after Garrod.) *tpb*, tensor patagii brevis; *ecr*, extensor carpi radialis (extensor metacarpi radialis longior of the present writer); *b*, biceps; *d*, deltoid; *t*, triceps; *h*, humerus.

Further, the marked difference in this particular between *Geococcyx* and *Cuculus canorus* is not to be overlooked.

Now, strange to say, there is still another (and what we must believe to be a widely separated) group of birds that possesses an arrangement of the insertional extremity of the *tensor patagii brevis* very much as we find it in our present subject. These are no others than the *Caprimulgi*.

I reproduce (figs. 1 & 2) Prof. Garrod's figures of these parts in *Steatornis* and *Caprimulgus europæus*, the better to show this similarity. It will be seen in these Caprimulgine birds, however, that the lowest slip merges with the fascia to the outer side of the ulna, while in my specimen of *Geococcyx* it goes to the *extensor carpi ulnaris* muscle.

Garrod pointed out another character of some value, which he

discovered during his dissections of the arms of birds; this was the presence or absence of the *expansor secundariorum* muscle (Coll. Sci. Papers, p. 323). As this delicate muscle and its tendon is well developed in the Storks, he, for convenience sake, termed it the Ciconine character. He found the Cuculidæ to be Ciconine birds so far as this structure was concerned, but I find after a very careful search in both pectoral limbs of my specimen of *Geococcyx* that this character is missing in it. This, then, constitutes another difference between *Geococcyx* and the Cuculidæ.

Of the Pectoral Muscles.

All three of the pectoral muscles are present in this bird, and all conspicuously developed, although the *pectoralis tertius* is considerably larger in comparison than is usually the case. Their muscular fibres are remarkable for their fine texture and compactness, both of which qualities, added to their pale colour, lend to these structures a very delicate appearance.

Nothing of a peculiar nature seems to distinguish either the *pectoralis major* or *secundus*, as they both arise and are inserted in a manner common to the majority of the class.

On the other hand, the *pectoralis tertius*, although inserted as we usually find it in birds, has no sternal origin, but arises from the externo-anterior aspect of the sternal extremity of the coracoid, as well as from the side of the shaft of the same bone.

Recent dissections of mine, performed upon various species of the Corvidæ, go to show that in them this muscle has quite an extensive origin upon the sternum, and its bulk sinks into insignificance when compared with the size of the great pectoral as it exists in all of the species of this latter group which I have examined.

On the Myology of the Pelvic Limb in Geococcyx.

Quite recently I have completed a very extensive chapter on the muscles of birds, and the MS. of this piece of work, with the nearly one hundred woodcuts that illustrate it, are at hand at the present writing. So with the bird now before us I will, without further explanation, adopt the myological nomenclature which I have proposed in my MS., without discussion of such points as wherein I may differ in homologies or terms with other authorities. Such differences, and I trust they may be few and well sustained, must be left for decision until such time as the work referred to appears in type.

It is my aim here to enter quite extensively into the description of the muscles of the pelvic limb of *Geococcyx*, as they offer us many points of interest.

We find the *sartorius* muscle (Plate XLIV. fig. 1, *S*) powerfully developed in *Geococcyx*, as are the majority of the muscles of the thigh in this bird. It arises, semitendinous, from the crest of the neural spine of the last vertebra of the dorsal region of the spine, from the summit of the anterior portion of the crista of the sacrum, and from the adjacent surface of the superior aspect of the ilium on the cor-

responding side. The fibres, forming an oblong and rather thick muscle, pass downwards and backwards to the region in front of the knee. Here it becomes inserted by a special slip of fascia that is thrown off and merges with the general fascia surrounding the knee-joint; and, secondly, by a more carneous insertion into the inner half of the superior rim of the cnemial crest of the tibia and the continuous inner margin of the summit of that bone.

The *sartorius* bounds anteriorly the superficial group of muscles of the thigh; consequently its anterior border is free. Its posterior border above unites quite intimately with the overlapping *gluteus primus* muscle; while this border below is sharp and free, although here, too, the *gluteus* also overlaps it, and a delicate connective tissue binds them together.

The *gluteus primus* (Plate XLIV. fig. 1, *gl.pr*) constitutes that great and rather complex muscle which makes up the central fleshy portion of the outer aspect of the thigh. It arises by a strong fascia from the summit of the coossified neural spines of the anterior sacral vertebræ, and by carneous fibres from the outer rim and under surface of the whorl-like, overarching portion of the ilium behind; and finally from the contiguous portion of the pelvis over the anti-trochanter, between these anterior and posterior origins. In front the muscle consists first of a strong layer of semitendinous fascia, which closely overlies the *gluteus medius* muscle beneath it, and overlaps the sartorius anteriorly. The posterior origin and mid-division become rapidly carneous and more massive as we proceed in the direction of the caudal extremity of the body. So that, where we find it arising from beneath the overarching part of the ilium behind, the muscle fills about one fourth of the convexity there formed, the *semitendinosus* filling the remainder of this curious cavity. The fibres of the strong, semitendinous, muscular sheet springing from these several origins, or rather along this continuous line of origin, now pass, converging as they do so, towards the anterior aspect of the knee-joint. The semitendinous portion anteriorly becomes fleshy as it arrives along the outer pelvic margin, with which it is quite intimately connected. The hinder division of the muscle remains thick and carneous until it comes to the knee-joint. Here all the fibres again become tendinous and fascia-like, and, uniting with a similar structure contributed by the *extensor femoris* lying beneath it, the combined sheath thus formed surrounding the well-developed patella, closely invests the front and sides of the knee-joint, and is finally inserted all round the anterior and externo-lateral borders of the summit of the tibia.

The most superficial muscles of the leg are the *gastrocnemius* and the *peroneus longus*.

As we would naturally expect, the *gastrocnemius* muscle (Plate XLIV. fig. 1, *g*) in *Geococcyx* is wonderfully well-developed. All three of its heads are strongly defined, and the fleshy belly of the muscle is massive and thick.

Its *external head* arises, curiously enough, by two perfectly distinct tendinous slips. One of these, a strong, flat tendon, comes off from

the outer surface of the external condyle of the femur, while the second slip, also strong but somewhat more rounded, arises from the back of the external femoral condyle, just above the trochlear surface. Between these two tendons of the external head of the *gastrocnemius* we find the loop for the *biceps* and the tendon of that muscle itself, the loop being quite intimately attached to the free edge of the outer tendon. Below the loop, these tendons merge with each other and terminate in the commencing fibres that compose the external head of the gastrocnemius proper.

The *internal head* of the gastrocnemius, or what is really the middle head in birds, is quite median in position, and is represented merely by a long, narrow, muscular slip that arises by a delicate, though strong, cord-like, tendon from the middle of the intercondyloid notch of the femur.

The *tibial head* of the muscle under consideration is massive in its dimensions when compared with the divisions of origin of the gastrocnemius already described. It arises fleshy from an extensive surface on the inner aspect of the head of the tibia as high up as the marginal boundary of its summit; and from the muscular fascia surrounding certain of the deep thigh-muscles, which are inserted into the distal end of the femur, and consequently are adjacent to the posterior aspect of the head of the tibia.

At a point about opposite the junction of the upper and middle third of the shaft of the tibia the internal and tibial heads of the gastrocnemius merge with each other, while between their free edges above passes the exceedingly delicate tendon of the semimembranosus muscle.

All of the fibres of this complicated origin of the gastrocnemius muscle now converge and pass directly down the back of the leg of the bird. They also merge with each other in such a manner that, were we to examine the muscle at about the middle third of the leg, we would find it composed of two well-defined bellies, rather thin, nearly of equal size, united somewhat firmly by an intervening fascia, and each being convex on their superficial aspect and the reverse on their under sides, which concavity accurately moulds itself to the deeper layer of muscles of the leg, which the gastrocnemius completely covers.

At the lower fourth of the tibial shaft the fibres terminate in a broad, flat, and glistening tendon, which passes flat-wise over the shallow and longitudinal groove of the *tibial cartilage*, at which point the tendon is considerably thickened. Next, crossing the tibio-tarsal joint, it becomes internally attached to the hinder surface of the hypotarsus of the metatarsal bone, below which protuberance it finally merges into the deeper layer of the podothecal sheath confining the flexor tendons.

The *peroneus longus* (Plate XLIV. fig. 1, *p.l*) arises from the entire free margin of the cnemial crest in front of the head of the tibia, and by somewhat specialized, though delicate, tendons, one each from the apices of the pro- and ectocnemial processes of the same part of the bone. These latter tendons pass down on the under surface

of the muscle, which latter must be cut across and reflected in order to discover them. From this origin the *peroneus longus* as a rather thick, concavo-convex muscle passes down in front of the leg, its outer edge dipping down for attachment between the *tibialis anticus* muscle, which it almost completely covers, and the flexors to its outer side; its inner edge is free and thin, and overlaps the gastrocnemius.

Low down on the outer side of the tibial shaft the fibres of the *peroneus longus* have converged to terminate in a small narrow tendon. This tendon, just above the condyles of the tibia, bifurcates, the short slip of the bifurcation going to the fascia covering the block of cartilage (which I have termed the tibial cartilage) at the back of the tibio-tarsal joint for attachment, while the longer slip passes across the articulation to the bundle of tendons at the back of the tarso-metatarsus to merge with one of the special flexors.

Removing this superficial layer of muscles of the pelvic limb and turning our attention once more to the thigh, the following ones are presented to our view for examination:—

The *gluteus medius* muscle (Plate XLIV. fig. 2, *gl.m*) is found to be strong and tendinous. It, as in all of the birds that I have examined, fills the concavity of the preacetabular portion of the pelvis, and here in *Geococcyx* extends laterally much beyond the bone, as this bird has a very narrow pelvis anteriorly, while it demands the use of a powerful set of gluteal muscles.

The *gluteus medius* arises by a strong, flat tendon from the superior surface of the outer moiety of the anterior iliac margin, by a dense fascia from the entire line bounding the preacetabular concavity, and finally by fleshy fibres from the upperside of the ilium itself. The fibres of the roundish muscle thus formed converge as they pass to the caput femoris, and, just before arriving at the bone, they terminate in a dense flat tendon, which, passing over a bursa, is inserted at a point on the antero-external aspect of the femoral trochanter.

The *gluteus minimus* (Plate XLIV. fig. 2, *gl.min*) is a very much smaller muscle than the *gluteus medius*, and is found immediately beneath it to its outer side. In form it is oblong, and fully three times as long as wide. It arises from the outer superior surface of the fore part of the ilium, and passing obliquely downwards and backwards as a flat narrow band of fibres, it becomes inserted by semitendinous ones on the outer aspect of the upper third of the femur, just below the trochanter. This muscle may also ride over a small bursa, just before it arrives at its insertion.

The *extensor femoris* is readily divisible at its lower half into two parts, the bulkier anterior one representing the *cruræus* (Plate XLIV. fig. 2, *cr*), and the posterior division the *vastus externus* (Plate XLIV. fig. 2, *V.E*).

As a whole, this powerful extensor of the leg upon the thigh arises from the antero-external aspect of nearly the entire length of the shaft of the femur, and from a portion of the trochanter at its summit. At about its lower fourth it terminates in a broad tendinous expansion, which, as has already been described, is amply reinforced by other insertional portions of the superficial muscles of the thigh.

The *patella* is found encased in front in this great tendinous sheath of the knee-joint, and below the apex of this sesamoid we find the enveloped track of the tendon of the *ambiens* muscles, as it passes round in front of the femoro-tibial articulation. The combined tendon of the *extensor femoris* is finally inserted into the cnemial crest of the tibial and the lateral boundaries of the summit of that bone. Some of the superficial muscles on the outer side of the leg are so extended as to take a certain amount of their origin from this great tendinous expansion.

In Plate XLIV. fig. 2 I have very thoroughly divided these two subdivisions of the *extensor femoris*, in order to show their relative size, as well as their relation to each other and the surrounding structures.

The *biceps flexor cruris* (Plate XLIV. fig. 1; fig. 2, *Bi*) arises by carneous fibres upon quite an extensive portion of the under surface of the over-curled part of the ilium behind the acetabulum, and by a long tendinous slip which comes off from the free anterior margin of this part of the ilium. The fibres converge as they pass downwards, and unite to form a somewhat flattened muscle. Opposite the head of the tibia, the biceps terminates in a round tendon, of cord-like dimensions, which passes through a special loop to make its way between some of the muscles at the back of the leg, to become inserted on the tubercle intended for it on the outer side of the superior moiety of the shaft of the fibula. The loop of the *biceps* (Plate XLV. fig. 1, *l*) is flat and fashioned like a delicate tendinous ribbon. Its upper end arises from the side of the shaft of the femur above the external condyle, while the lower end comes off from this protuberance just below the insertion of the outer slip of the external head of the *gastrocnemius* muscle. A branch of the sciatic nerve also passes through this loop in company with the tendon of the *biceps*.

The *semitendinosus* (Plate XLIV. figs. 1, 2, *St*; Plate XLV. fig. 1, *St*) is a marvellously well-developed muscle in this form, as is also its accessory head. Its origin fills about three fourths of the nether cavity formed by the posterior overarching portion of the ilium, under which it arises.

Posteriorly, the fibres forming its free margin are so arranged as to create a rounded border; the lower end of its arc terminating about opposite the post-pubis of the pelvis. From this origin the fibres of the *semitendinosus* pass downwards and forwards as a great, though somewhat compressed muscle. When within rather more than a centimetre's length of the shaft of the femur, they terminate in an oblique tendinous raphe, which latter forms the bounding-line between this muscle and the next.

The *accessory semitendinosus* (Plate XLV. fig. 1, *a.s.t*) is composed of coarser fibres than the muscle just described. It springs from a longitudinal line occupying the distal half of the shaft of the femur, and from the upper surface of the hinder aspect of the external condyle of that bone. The fibres pass backwards and a little upwards to become inserted into the tendinous raphe just alluded to.

The lower extremity of this tendinous raphe terminates, in *Geococcyx*, in a thin, flat, and delicate tendon, which continues down-

wards and forwards to the inner surface of the head of the tibia, where it becomes inserted, the point of insertion being found above that of the *semimembranosus* muscle, the insertional tendon of which overlaps it.

The *semimembranosus* (Plate XLIV. figs. 1, 2; Plate XLV. fig. 1, *Sm*) in *Geococcyx*, though thoroughly developed, is rather a slender and thin muscle, markedly so when we compare it with the massive *semitendinosus* which overlies it.

It arises from the outer surface of the ischium, for its posterior two thirds, on a line situated a few millimetres above the lower free edge of that element of the pelvis. The fibres gradually converge as they pass downwards and forwards, to terminate in a very delicate and thin ribbon-like tendon, which, passing between the broad tibial head of the *gastrocnemius* and the proximal extremity of the shaft of the tibia, becomes finally thereupon inserted on its internal surface. The hinder margin of the *semimembranosus* is free, while its border anteriorly is juxtaposed to the posterior edge of the adductors.

In the bird before us the *ambiens* muscle (Plate XLV. fig. 1, *amb*) is conspicuously developed.

It arises from the apex of the prominent prepubic spine of the pelvis, and the fibres passing directly down to the inner side of the femur, and parallel with that bone, form a strong fusiform muscle. As it approaches the patella it terminates in a small flattened tendon, which, piercing the fascial envelop of the knee-joint below the inferior apex of that sesamoid, passes round the joint, to become finally lost to the outer side and opposite the summit of the tibia, where some of its tendinous fibres merge with the fibres of origin of the *flexor perforatus digitorum*, or, at least, with one of its divisions.

The *ambiens* is overlaid by the *sartorius* muscle, and in the figure is brought into view only through the aid of a small dissecting-hook and chain, which pull it forwards in order that it may be better seen.

The *femoro-caudal* muscle and the *accessory femoro-caudal* are both present and fully developed.

The *femoro-caudal* (Plate XLV. fig. 1, *f.c*) arises, tendinous, from the lower posterior border of the pygostyle. It soon becomes fleshy and as a narrow, muscular ribbon passes through the tissues overlying the lateral group of caudal muscles proper. Opposite the posterior border of the pelvis it expands to form a prettily-shaped and compressed spindle, closely covering the *obturator externus* muscle and the side of that bone. As it nears the femur it again contracts, receives the fibres of its accessory head, and is finally inserted upon the femoral shaft, at the posterior aspect of its proximal third.

The *accessory femoro-caudal* (Plate XLV. fig. 1, *a.f.c*) arises beneath the overarching part of the postacetabular portion of the ilium, just behind the acetabulum and beyond. Its fibres pass obliquely downwards and forwards to join with those of the *femoro-caudal*, and to become inserted with them into the upper part of the femur as already described.

The *obturator externus* (Plate XLV. fig. 1, *o.e*) arises from the outer surface of the ischium above the "obturator space," the

muscle being thin and closely pressed to the pelvis. The fibres converge as they near the femur and terminate in a strong, flat tendon which becomes inserted on the outer aspect of the trochanter of that bone, which insertion is slightly overlapped by the tendon of the *gluteus medius* muscle.

The *adductors* arise from the infero-external margin of the ischium, between the anterior edge of the *semimembranosus* and the obturator foramen.

The *adductor longus* (Plate XLV. fig. 1, *a.l*) is the more anterior of the two and consequently arises the higher on the pelvis, and comes off in front of the *adductor magnus*, which it largely overlaps. Its fibres pass obliquely to the posterior aspect of the shaft of the femur, down which they become inserted as far as its middle, along the *linea aspera*, a line which is well marked in our subject.

The *adductor magnus* (Plate XLV. fig. 1, *a.m*), like the one just described, is also a broad ribbon-like muscle, arising from the ischium between the *semimembranosus* and a middle point on the underside of the *adductor longus*, close up to its semitendinous origin. Anteriorly its margin is free, while posteriorly it is juxtaposed to the anterior border of the *semimembranosus*. Passing parallel with those of the other adductor, its fibres are inserted into the distal moiety of the *linea aspera* of the femoral shaft, down to the intercondyloid notch of that bone, where this muscle makes a very substantial insertion.

Removing all the muscles of the thigh thus far described, we find that in this region we have the following ones remaining. They are shown in my drawing (Plate XLV. fig. 2), together with a few as yet undescribed muscles of the leg.

A very important muscle is the *obturator internus* (Plate XLV. fig. 2, *o.i*), and in *Geococcyx* it exists as we find it in the majority of the class. Prof. Garrod laid some stress on the point whether this muscle arose from a triangular or an oval area. Here it arises from a decidedly oval one, and as usual this is from the mesial surfaces of the ischium and the post-pubic element of the pelvis. Its tendon emerges from the obturator foramen, and overlapping the *gemellus* muscle, passes to the outer aspect of the upper part of the trochanter of the femur, where it is inserted.

The *gemellus* (Plate XLV. fig. 2, *ge*) is a short, thick, carneous muscle, which arises about the outer rim of the obturator foramen of the pelvis. Its fibres passing obliquely upwards and forwards are inserted with the tendon of the *obturator internus* muscle on the trochanter of the femur. This bird also has a few of the fibres of its *gemellus* muscle inserted into the tendon of the *obturator externus* muscle, at least I found this to be the case in the specimen before me.

We find the *vastus internus* (Plate XLV. fig. 2, *v.i*) to be a strong, fusiform muscle, that is only fully discovered after we have removed the *ambiens* and the *adductors*. It lies on the postero-internal aspect of the shaft of the femur, arising from the *linea aspera* nearly as high up as the head of that bone, and increasing in bulk as it descends, still making attachment to the *linea aspera*, it only becomes free just above the condyles. At this point it terminates in a flat tendon, which, crossing the articulation of the knee, becomes inserted into the

front part of the inner marginal rim of the summit of the tibia. This muscle constitutes a powerful auxillary to the action of the *extensor femoris*, and it appears to be quite a constant one in the class Aves.

The description of the *vastus internus* completes our account of the musculature of the thigh. A brief recapitulation of them shows us that *Geococcyx* possesses in this region all of the muscles that we usually find there in birds.

The entire group including the *ambiens*, the *femoro-caudal*, the *accessory femoro-caudal*, the *semitendinosus*, the *accessory semitendinosus*, and the *semimembranosus*, so ably introduced into taxonomy by Garrod, are all present and wonderfully well developed. Then we have all three *glutei* represented, with an ample *extensor femoris*, and its auxiliary the *vastus internus*, a handsome *biceps flexor cruris*, with its interesting pulley at the back of the knee. Next, the two *obturators* and the *gemellus*; and finally two powerful *adductors*, the *magnus* and *longus*.

We may now once more direct our attention to the leg, and investigate the muscles there found in its second layer.

First among these stands the *tibialis anticus* (Plate XLIV. figs. 1, 2, *tib.ant*). This interesting muscle arises, as most commonly among birds, by two very distinct heads. The under and at the same time the smaller one of these comes off by a tendon from a little pit that is found on the anterior aspect of the external condyle of the femur; the second or larger portion of the muscle completely covers over the first, except of course its tendon, which extends further up. This latter head arises from a line extending all round within the cnemial crest and the pro- and ectocnemial ridges of the tibia. The fibres of the two heads extend directly down in front of the tibial shaft, at the lower third of which they gradually merge with each other, and finally terminate in a strong tendon, which, passing through the oblique fibrous loop, or bridge rather, at the front and lower end of the tibia, pass across the tibio-tarsal joint, to become inserted on the anterior surface of the upper third of the tarso-metatarsus bone, just below its head.

The *soleus* (Plate XLV. fig. 2, *so*), found at the back of the leg, is another well-developed muscle of this layer in *Geococcyx californianus*. It arises from behind the tibia, on its inner side, and just below the marginal rim of its summit. The fibres at once form a little flat muscle, rather longer in shape than the fish from which it derives its name, and soon terminate at the lower or tail-end in a tendon. This tendon, long and narrow, passes directly down the postero-internal aspect of the leg to become inserted into the dense fascia covering the tibial cartilage at its supero-internal angle.

Great care and patience are necessary in the study of the arrangement and distribution of the tendons of the flexors and extensors in the leg and foot of a bird, and to this rule *Geococcyx* by no means forms any exception.

In describing these I will present them in the order that they most conveniently came under my hand after the removal of the muscles alluded to in the foregoing paragraphs.

After we have cut away the *tibialis anticus*, we find another, and only one other, muscle occupying the anterior aspect of the tibia. This is the *extensor longus digitorum*.

The *extensor longus digitorum* (Plate XLV. fig. 1, *e.l.d*) arises from the anterior aspect of the in-half of the tibial shaft as high up as the *tibialis anticus* muscle, which covers it; it also arises from a tense fascia which comes off from the lower free edge of the procnemial crest of the tibia; and finally from a longitudinal line extending obliquely down the front of the shaft of the tibia to its lower third. This obliquity finally brings the tendon in which the *extensor longus digitorum* terminates to the middle line.

Just above the condyles of the tibia, it here passes through the little bony bridge; emerging from which it crosses the ankle-joint in front, then passes down the anterior aspect of the tarso-metatarsus bone, overlying the short extensor. At the upper end of this last-named bone, and over the ankle-joint, this tendon is firmly bound down by a fibrous fascia. In some birds we know a special bony span exists for it on the upper part of the tarso-metatarsus, as in certain Owls. When the tendon of this muscle arrives at the anterior aspect of the trochleæ of the distal end of the tarso-metatarsus, it expands and bifurcates. The tendinous expansion becomes more or less attached to the underlying tissues, while each bifurcation passes one over the second, and the other over the third toe, for their entire lengths, to become inserted into the upper points of their ungual phalanges.

Now from the side of the tendon that goes to the third toe another slip is differentiated off in a very peculiar manner, owing to the reversion of the toe in question. For it not only passes over the top length for insertion of this fourth digit, as in the case of the others, but its slip also splits off to make a separate insertion at the extremity of the basal phalanx of the third digit. I have had the opportunity of dissecting three feet, with the view of studying this point, and I find it to obtain in all of them.

The *extensor brevis digitorum* (Plate XLV. fig. 1, *e.b.d*). This is a muscle I find that, in common with many other authors, I have described in my MSS. as the *extensor hallucis brevis*, from the fact that its tendon goes to the hallux alone. But here, so extraordinary is its development, that no such term would be either adequate or appropriate.

Even here the short extensor of the hallux has a certain amount of individualization, though it is not fully differentiated from the other part of this *extensor brevis*. It, however, is not attached more than halfway down the anterior aspect of the shaft of the tarso-metatarsus, at which point it terminates in a delicate thread-like tendon; this passes directly over the upper border of the accessory metatarsal, and along the top of the basal joint of the hallux, to become inserted in the usual manner in the base of the claw-joint. Now the remainder of the *extensor brevis digitorum* is attached down the shaft of the tarso-metatarsus, as far as the distal trochleæ; the outer portion of it developing a tendon about halfway down, which is concealed by the carneous fibres which overlie it.

This tendon passes round beneath the trochlea for the fourth toe and is really inserted on the *underside of the basal joint* of this digit at its proximal extremity; so that in the case of this toe it seems as though it would act almost as a *flexor*. With the second and third toes, however, the carneous fibres of the muscle under consideration are continued all the way to the trochleæ, where they terminate, in either case, in a strong, flat tendon, which passing over the joint is inserted *on the upperside* of the proximal extremity of the basal joint. Here, of course, the muscle acts (in the case of the second and third toes) as an auxiliary to the long extensor.

Not a little room is here open to us for speculation as to how the tendon of this short extensor in the case of this fourth toe exactly came to assume its present point for insertion, as the digit gradually and finally became permanently reversed. Indeed, the high development of this short extensor in *Geococcyx* over the vast majority of the class is, too, an interesting fact; and did the reversion of the digit precede or follow the muscular development? No doubt the completeness of the latter, and its perfection for an avian type, has come about as a demand on the part of the habits of the bird itself and its marvellous fleetness of foot.

The *tibialis posticus* (Plate XLV. fig. 1, *tib. post*) is a very slender muscle in *Geococcyx*, but closely resembles the same muscle as I have found it in all other birds which I have examined for their myology. My reasons for terming it the *tibialis posticus* are fully given in my MSS. and will appear in due time. It seems to be one of the *peronei* of the senior Edwards.

As in a number of the Passeres, we find it here to arise from the antero-lateral aspect of the shaft of the fibula below the tubercle for the insertion of the *biceps flexor cruris*, from the interosseous membrane between the leg-bones, from the contiguous surface of the shaft of the tibia, and, finally, from the fascia separating it from the deep flexors of the leg. The fibres pass directly down the outer side of the tibia as a long, slender, fusiform muscle. At the lower fourth of the shaft of this bone they terminate in a small tendon, which, passing in front of the external malleolus, crosses the ankle-joint to become inserted into the supero-external rim of the summit of the tarso-metatarsus.

The *flexor perforatus indicis secundus pedis* (Plate XLIV. fig. 2, $f.p_1$) is even a better developed muscle than I found it to be among typical Corvidæ, some of which I have recently dissected, and it is fully as well individualized.

It arises from the fascia at the outer side of the knee-joint, and from the contiguous surface of the external condyle of the femur. Here it receives the anastomosing fibres of the extremity of the tendon of the *ambiens*.

The muscle is fusiform in shape and accurately moulded on the flexor it covers at its side. Its tendon in descending the leg is thin and ribbon-like. At the ankle it passes through the tibial cartilage, and crossing the joint goes through, with the second tier of tendons, the cartilaginous cap on the back of the hypotarsus of the tarso-metatarsus. Passing down behind this latter bone, and

through the annular ligament in the sole of the foot, it proceeds to the underside of the second toe, beneath the second phalanx of which it expands to form a tubular sheath for the passage of the deep flexor, while at the same time it becomes attached to the side of this joint of the toe in question.

The carneous portion of this muscle in the leg is to the *outer* side of the loop for the *biceps flexor cruris*, and, owing to the fact that it varies in form and size in different birds, it is as well to bear this in mind.

The *flexor perforatus medius secundus pedis* (Plate XLIV. fig. 2, $f.p_2$), as in all of the birds I have examined, is one of the best developed perforated tendons at the back of the leg. Its fascia of origin merges with the enveloping fascia about the knee-joint, while it also arises by a strong tendon, common to it and the *flexor perforatus indicis secundus pedis*, from the external aspect of the outer condyle of the femur.

Finally, it is attached more or less by carneous fibres down the shafts of the leg-bones to a point below their middle, or rather the middle of the leg. Below this the muscle terminates in a strong tendon, which, taking an oblique course through the tibial cartilage, passes as usual over the ankle-joint, through the hypotarsus, and down the back of the tarso-metatarsus.

In the foot it perforates the more superficial flexor of the basal phalanx of the outermost of the two anterior toes, then the turn bifurcates over the prebasal joint to allow the deep flexor to pass through, these bifurcations becoming the insertions of this muscle, and they are attached to the sides of the shaft of the second joint of the toe alluded to, or the external one of the two in front.

The *flexor perforatus annularis primus pedis* (Plate XLIV. fig. 2, *f.p.a*) in this bird seems to have acquired a more central position on the back of the leg than in many others that I have dissected, and, moreover, its tendon, as will be seen from the figure, is quite superficial.

It arises from between the condyles of the femur by a slight semitendinous slip, and from the side of the *flexor longus hallucis*. The muscle itself is somewhat of a fusiform outline and rather flat; it lies to the *inner* side of the loop for the *biceps*. About one third the way down the back of the leg it terminates in a small though very long tendon, which, passing quite superficially through the tibial cartilage and over the ankle-joint and hypotarsus, runs in common with the other flexors down the back of the tarso-metatarsus, turns to the rear in the sole of the foot to become inserted on the underside of the distal end of the basal phalanx of the reversed digit. In the specimen before me this insertion is to the outer side of the deep flexor, and the tendon is not slit for its passage. Nothing could be more engaging than the examination of these *reversed* tendons in the sole of the foot of this Ground-Cuckoo, for the greatest nicety in accommodation has been accomplished as they have gradually come to assume their present position. No doubt some of the departures observed from the more common arrangement of them are due to the reversion of the digit in question.

Strong, fibrous bands are so disposed in this plantar region as to

admirably hold the several groups of flexor tendons in place, and at the same time they act as pulleys for their guidance and afford correct application of the force intended to flex the toes.

The *flexor longus hallucis* (Plate XLIV. figs. 2, *f.l.h*; Plate XLV. figs. 1, 2, *f.l.h*) has two separate heads, the one coming off from the outer side of the external condyle of the femur, and the other, far more fleshy, arising from the posterior aspect of the same bone between the condyles. Above this muscle is overlapped by the more superficial flexors, while in turn it has beneath it the *flexor perforans digitorum profundus*. About halfway down the leg it gives way to a strong tendon, which, passing deep in the tibial cartilage, crosses the ankle-joint to pass through the outer canal of the osseous portion of the hypotarsus of the tarso-metatarsus. Down the back of the shaft of this latter bone the tendon exhibits a disposition to develop an osseous rod in its continuity, but this does not actually occur in my specimen. It lies in this region just above the tendon of the deep flexor, and, immediately above the sole, makes a fibrous connection with it of some extent. This fibrous "vinculum" is in no way oblique as it is described by Garrod for many birds, but passes directly from one tendon to the other for about 8 millimetres, and were it not known that it as a rule passes obliquely *from* the *flexor longus hallucis*, it would be quite impossible here to designate which tendon was responsible for the connection.

In the foot the long tendon of the *hallux* passes in the usual way to become inserted on the tubercle at the underside of the proximal end of the ungual phalanx.

As its name indicates, our next muscle, the *flexor perforatus indicis primus pedis* (Plate XLV. fig. 1, f_1), has its tendon attached to the nether side of the basal phalanx of the index digit, and consequently aids in bending that toe.

Above, as a flat, long muscle, it comes off by a thin tendon from the external surface of the outer femoral condyle, arising with the *flexor perforatus medius secundus pedis*.

We also have in *Geococcyx* an unusually large *flexor perforatus medius primus pedis* (Plate XLIV. fig. 2, f_2), which here arises by two slips, an outer tendinous one, from the external condyle of the femur, which has a common origin with other muscles there arising and is intimately connected with the dense fascia about the front of the knee-joint; while the second slip arises from between the femoral condyles, in common with other flexors that come off from that point. The two heads are quite independent, but merge with each other before they terminate in their common tendon at the lower third of the tibial shaft.

It passes through the tibial cartilage, overlaid by, but in close company with, the far more diminutive and narrower tendon of the *flexor perforatus annularis primus pedis*.

When it arrives under the basal phalanx of the median toe, the outer one of the anterior pair, it bifurcates to allow the other two flexor tendons to pass, while the slips thus formed become attached to the sides of the shaft of this joint close to its distal head.

It will at once be seen that *Geococcyx californianus*, in common with the vast majority of birds, has no special tendon devoted to the flexing of the *second* or prebasal phalanx of the *fourth* toe (here the reversed one). Provision is made for this in various ways in different birds. Here, in the subject before us, a special slip is thrown off for attachment from the deep flexor tendon as it passes over the prebasal joint in question, which slip virtually fulfils the function of a *flexor perforatus annularis secundus pedis*, did such a muscle with an independent tendon exist.

The *flexor perforans digitorum profundus* (Plate XLV. fig. 2, *f.p.p*). This muscle is deep to all the flexors, and is situated directly on the posterior aspect of the tibia and fibula. It arises by two heads, one from the upper part of the tibia immediately below the overhanging rim of its summit, and the other, smaller, from the back of the head of the fibula. In the Corvidæ there is a well-developed third head, which comes off from above the fibular notch of the outer condyle of the femur, and in these birds, too, there is no fibular head to this muscle, but two tibial ones instead. *Geococcyx* agrees however, with most birds in having this muscle attached nearly the whole length of the posterior aspect of the shaft of the tibia by lightly attached carneous fibres.

About a centimetre about the tibial cartilage it terminates in a strong subcompressed tendon, which, passing *beneath* the cartilage referred to, crosses the ankle-joint in front of all the other flexor tendons, and then passes through the inner of the two longitudinal perforations of the hypotarsal apophysis of the tarso-metatarsus. Down the posterior aspect of the shaft of this bone the tendon still maintains its anterior position and exhibits a predisposition to ossify. But this does not actually take place in the specimen before me. Above the distal trochleæ, it makes the fibrous connection with the tendon of the *flexor longus hallucis* already described. This band is shown in the figure. Once within the limits of the post-trochlear space, the tendon of this muscle behaves in a manner common to most birds—that is, it quadrifurcates, and each branch takes a course close up to the joints on their plantar aspects, and running through the slits in the perforated tendons pass in each case to the ends of the toes, where they become attached or inserted upon the infero-proximal tubercles of the unequal phalanges. The one passing along under the fourth digit sends up a slip which is attached to the underside of the shaft of the prebasal joint, thus making good the deficiency here of what is represented in the other toes by an independent tendon.

The tibial head of this muscle at its origin is directly covered by the *soleus*, while in the aperture existing between the two heads we can discern the *popliteus*.

These flexor muscles, and others on both the front and rear of this limb, are moulded upon each other in a manner that can only be justly appreciated by a personal examination. In some the connections are quite feeble, the intervening tissue being easily separable, while in others the intimacy is very close, and great care is

demanded on the part of the investigator to see that the separation is made along the proper divisions.

I am convinced from my studies that a greater difference is to be found among the various muscles of birds than we have ever accredited them with, and this fact leads me to believe that the day will come when these differences can be called into play in taxonomy with excellent effect. Perhaps if the myology of the leg is examined as carefully as Prof. Garrod examined the muscles of the thigh in this class, fully as many interesting and valuable distinctions will come to light.

The *popliteus* (Plate XLV. fig. 2, *popl*) is quite well developed in *Geococcyx*, where it is seen to arise from an oblique line on the back of the tibial shaft below the head of the bone, and the fibres converging to pass upwards and outwards are inserted by a short tendon into the corresponding aspect of the head of the fibular, close to the superior fibres of insertion of the *flexor perforans digitorum profundus*. When engaged upon my dissections of the *Corvidæ*, recently I ascertained that this muscle was absent at least in the American forms of the group. This was also the case with the two peculiar muscles next to be described.

The *flexor brevis hallucis* (Plate XLV. fig. 2, *f.b.h*) is an exceedingly interesting little muscle, and one that it has not been my good fortune to have seen in birds before, as I have just said, nor can I find at hand any description of it for this class by any previous anatomist.

It arises from the side and the lower margin of the inner aspect of the hypotarsus of the tarso-metatarsus, and from some of the shaft of this bone immediately below. The fibres converge to terminate in a small tendon, which, passing down the postero-internal aspect of the shaft, goes to the inner side of the basal joint of the hallux, about which it winds to finally become inserted on its underside, at the proximal extremity of this joint, just a little beyond its articulation with the tarso-metatarsal trochlea.

Thus it will be seen that this little muscle is entirely devoted to assist in flexing the hallux. Its mesial fibres meet those of the muscle next to be described, down the mid-longitudinal line of the shaft of the bone which gives it origin.

Equally engaging with the last is another still smaller muscle, the *extensor brevis annularis* (Plate XLV. fig. 2, *E.b*), on the opposite side of the same bone. Here we find its origin is much the same as for the *flexor brevis hallucis*, coming off from the external aspect of the hypotarsus and the shaft below. It soon terminates in an extremely delicate little tendon, which, passing directly down to the fourth or reversed toe, becomes inserted on the supero-inner aspect of the basal phalanx of this digit.

By its contraction it will act as a direct extensor of this toe, a requirement no doubt made necessary through the feeble manner in which this digit is now served by the slip which goes to it from the common extensor of these phalanges.

This tendon of the short extensor gets its leverage by the fascia which circularly binds down all the tendons of the flexors and

extensors, just above the sole on the one side, and which passes above the distal trochleæ on the other.

As we pass the muscles we have described for this limb in review, it will at once be recognized that the list is unusually complete. All the ordinary muscles of the thigh are present as found in birds, and all highly developed. In the leg marked specialization and organization are everywhere evident, while exceptional muscles are here, too, fully represented.

This complexity by no means diminishes as we proceed towards the foot, for the arrangement of the tendons as they course down the tarso-metatarsus and the special musculature of this division of the limb is manifestly indicative of high organization.

Finally, we have the complex insertional extremities of the intricate system above laid before us in the foot; and the most exquisite examples of adaptation, compactness, and final requirements are to be seen throughout the structure on every hand.

Notes on the Arterial System.

Fortunately the evisceration that had been performed upon my specimen before it came into my hands has not injured the heart and great vessels. So by a careful dissection I am enabled to state that there are two carotids in *Geococcyx californianus*, and that their arrangement and the method of their branching at the base of the heart is normal. In other words, the bird in this respect is to be included with the *Aves bicarotidinæ normales*, as defined by Garrod.

I would remark, however, that the carotids come off from the innominates at points considerably further removed from the heart than that anatomist depicts them in his diagram of this condition. The branching is the same, however, and no doubt Mr. Garrod's figures were intended to illustrate this point above all others, to which end they serve an excellent purpose.

Turning to the arterial system in the pelvic limb, I find that the main artery of the leg is the *sciatic*. This agrees with the vast majority of birds, and, so far as I am aware, it is only in *Centropus phasianus* among the Cuculidæ that the rare condition of the femoral artery being the main one obtains.

Of the Bursa Fabricii.

As I said at the beginning of this memoir, Forbes has already called our attention to the peculiarity of form of this structure in the young of *Geococcyx affinis* (P. Z. S. 1877, p. 312), and says that it completely disappears in the adult. I can verify this statement so far as the specimen before me is concerned, for in it this bursa is not present, while the region otherwise is characterized as we find it in the adults of the *Centropodinæ*.

The Trachea. (Plate XLIII. figs. 3 and 4.)

For the entire length of this subcylindrical tube, the osseous rings which compose it fail to meet in the longitudinal median line posteriorly.

The interval thus formed, which is not very great, is occupied by a thin membrane which is continuous with the *internal tympaniform membrane* of the lower larynx. As to shape, the trachea diminishes in calibre gradually from above downwards, and nowhere in its continuity does it present any enlargements or dilatations.

This does not apply exactly to the bronchial bifurcations, for each one of them shows a disposition to swell just before arriving at the contracted parts of these tubes, where they impinge upon the lung-tissue.

We may reckon either of these bifurcations as being partially surrounded by 13 *semirings*. Of course in this bird, as I say, the entire trachea may be regarded as having only semirings, but had the usual number of these united behind, there would still have remained the 13 semirings to each bronchial tube. An osseous *pessulus* is not present in *Geococcyx*, and the *internal tympaniform membrane* is quite extensive. There does not even seem to be any thickening of this membrane in our subject where this bony little bridge is located in those birds where it exists.

As to its myology, the lower larynx is exceedingly simple in arrangement and meagrely supplied. Viewing the inferior part of the trachea and the bronchial tubes from in front, we can see but one pair of muscles, and these are the delicate *sterno-tracheales*. They are attached on either side to the last five tracheal rings (fig. 3, Plate XLIII.); the insertion seemingly consisting of two slips, the inferior one being attached to the lowermost of the five rings. These muscular slips soon merge with each other; and the muscle itself stretches across in the usual manner, for attachment to the inner surface of the costal process of the sternum.

From a near view we discover another pair of muscles; these are the *tracheo-laterales* (fig. 4, Plate XLIII.). They here extend the whole length of the tracheal tube, on its postero-lateral aspect, rather than fairly on its sides, as in the majority of birds. On either side they are carried down clear to the last bronchial semiring for attachment, *i. e.* not reckoning the aforesaid few semideveloped rings which we find at the terminal extremities of these bronchial bifurcations.

This position of the *tracheo-lateralis* muscle is just the reverse of what Garrod found in such a bird as *Opisthocomus* (Scientif. Mem., p. 466, fig. 1); for, according to this authority, these muscles may be seen in the Hoatzin on an anterior view, and, moreover, in it they pass down *in front* of the *sterno-trachealis*.

Garrod made many excellent examinations of the thoracic extremity of the trachea in the Gallinæ, and among the representatives of this group an extraordinary variety of forms of this part of the bird's economy was discovered (P. Z. S. 1879, p. 354). As the paper I refer to is profusely illustrated by drawings of the gallinaceous trachea, I have been enabled to compare them with the corresponding parts as I found them to exist in *Geococcyx*. But of all the types given, I fail to find a single one that in any way resembles the subject before us.

This is the less to be looked for, however, when we come to

consider how greatly the Gallinæ differ among themselves in this part of their structure. So whatever affinities *Geococcyx* may have with this group, it is not evident in the form assumed by its trachea nor in the musculature of the lower larynx.

Of the Tongue.

My memoir upon the skeleton of this bird contains an illustration of the hyoid arches as they are found in it (Journ. of Anat., Jan. 1886, pl. viii. fig. 8), and here it will be of interest to show the form of the tongue itself.

It will be seen from the figure of this organ (Plate XLIII. fig. 1) that its tip is rounded, and that its anterior moiety is ensheathed in a horny theca of a jet-black colour; the posterior half, however, is soft and fleshy, with its lateral margins fringed with delicate fleshy spines of a pure white colour and directed backwards.

From above downwards it is somewhat compressed, while its form as a whole is that of an isosceles triangle the base of which is rather less than one third of a side, and which exhibits a deep angular notch.

The lateral margins of the superior larynx are smooth and sharp, while its hinder edge supports a spine-like fringe, very similar to the one found on the borders of the posterior moiety of the tongue. Immediately back of this we observe the large and capacious entrance to the gullet, a feature which I have also included in my illustration of the parts under consideration.

The delicate, backward-extending limbs of the hyoidean apparatus curve up but very slightly behind the cranium in this Ground-Cuckoo.

Of the Ossiculum lacrymo-palatinum.

Careful search was made for this ossicle in my specimen of *Geococcyx*, both orbits being included in the examination, but I am confident that no such bone is found in it. This bonelet was first described by Brandt, and is best seen in certain Albatrosses, and I have elsewhere described its location and appearance in *Diomedea brachyura*.

According to Forbes, "it also occurs in forms so different from these as the Musophagidæ, many Cuculidæ, *Chunga* and *Cariama*, as well as in some Laridæ and Alcidæ, so that its presence is obviously of no particular taxonomic value" (Coll. Mem. p. 415).

It was this account of its occurrence in certain Cuculidæ that incited me to search for it in our present subject, but, as I have said, it does not possess it.

In birds where it exists it is represented, when thoroughly ossified, by a delicate styliform bar connecting the descending limb of the lacrymal bone with the upper surface of the palatine.

Conclusions.

By the aid of the researches of Garrod and Forbes into the

structure of the Cuculidæ and allied forms, together with the facts brought to light in the present article, we can arrange in a tabular form a number of the anatomical similarities and differences existing among *Geococcyx californianus* and the groups with which it is more or less nearly related; so that we may gain some idea as to its probable position in the system, at least as correctly as our present knowledge of its morphology seems to indicate.

The group or types compared.	Ambiens.	Fem.-caud.	Acet. f.-c.	Semitend.	Acc. semit.	Exp. secund.	Carotids.	Obt. int.	Cæca.	Oil-gland.	Tendon of tensor patagii brevis, &c.
Geococcyx californianus.	+	+	+	+	+	−	2 norm.	Oval.	?	Not tufted.	Differs from *Cuculus.*
Cuculidæ	+	+	±	+	+	peculiar.	2	Triang.	+	Not tufted.	Lacks the humeral slip.
Opisthocomus	+	+	+	+	+	?	2	Triang.	+	Tufted.	
Gallinæ	+	±	+	+	+	+	2	Triang.	+	Tufted.	
Corvidæ	−	+	−	+	+	−	right − left +	Oval.	+	Not tufted.	

As I have already said, in the opinion of the American Ornithologists' Union, so far as it is expressed in their published Code and Check-List, the genera *Geococcyx* and *Coccyzus* are contained in the one and same subfamily COCCYGINÆ. Now a careful examination of the structure of the subject of this memoir undoubtedly demonstrates, beyond cavil, that its anatomical characters are essentially very different from the corresponding ones as we find them in the true Cuckoos. Taking into consideration the weight which we are obliged to attach to important morphological differences in Aves, I can only remark here that these differences are certainly super-generic; in other words, they clearly point to the correctness of Garrod's suggestions, who proposed that the Cuculidæ should form two SUBFAMILIES, the *Centropodinæ* and the *Cuculinæ*—the first to contain the Ground-Cuckoos, and the latter the true Cuckoos. The studies of the structure of the forms in question demonstrate that this change in classification is a sound one and should be adopted.

The classification of the family of North-American Cuckoos would then be:—

Family CUCULIDÆ.

Subfamily CROTOPHAGINÆ. (Anis.)

Genus CROTOPHAGA.

Species: *C. ani.*
C. sulcirostris.

Subfamily CENTROPODINÆ. (Ground-Cuckoos.)

Genus GEOCOCCYX.

Species: *G. californianus.*

Subfamily CUCULINÆ. (True Cuckoos.)

Genus COCCYZUS.

Species: *C. minor.*
C. americanus.
C. erythrophthalmus.

It is hardly necessary to add, from what we know of the osteology of these subfamilies, that this classification will be strongly supported by a comparison of that part of the anatomy of the several forms.

EXPLANATION OF THE PLATES.

PLATE XLII.

Fig. 1. Pterylosis of *Geococcyx californianus*, ventral aspect.
2. " " " dorsal aspect.

PLATE XLIII.

Fig. 1. Tongue, upper larynx, and entrance to œsophagus of *Geococcyx californianus*, seen from above. (Life-size, and drawn by the author from the specimen.)
2. Mode of insertion of patagial muscles.
3. Lower larynx, dorsal aspect.
4. Lower larynx, ventral aspect.

PLATE XLIV.

Lettering of this and following Plate.

gl.pr, gluteus primus; *gl.m*, gluteus medius; *gl.min*, gluteus minimus; *St*, semitendinosus; *a.s.t*, accessory semitendinosus; *Cr*, cruræus; *V.E*, vastus externus; *v.i*, vastus internus; *Bi*, biceps flexor cruris; *l*, tendinous loop of biceps; *amb*, ambiens; *Sm*, semimembranosus; *S*, sartorius; *a.l*, adductor longus; *a.m*, adductor magnus; *f.c*, femoro-caudal; *a.f.c*, accessory femoro-caudal; *o.e*, obturator externus; *o.i*, obturator internus; *ge*, gemellus; *p.l*, peroneus longus; *tib.ant*, tibialis anticus; *tib.post*, tibialis posticus; *g*, gastrocnemius; *so*, soleus; *popl*, popliteus; *e.l.d*, extensor longus digitorum; $f.p_1$, flexor perforatus indicis secundus pedis; $f.p_2$, flexor perforatus medius secundus pedis; f_1, flexor perforatus indicis primus pedis; f_2, flexor perforatus medius primus pedis; *f.l.h*, flexor longus hallucis; *f.b.h*, flexor brevis hallucis; *f.p.a*, flexor perforatus annularis primus pedis; *f.p.p*, flexor perforans digitorum profundus; *E.b*, extensor brevis annularis; *e.b.d*, extensor brevis digitorum.

Fig. 1. The outer aspect of the right pelvic limb of *Geococcyx californianus*; the integuments have been removed, and the drawing is designed to show the superficial muscles of the part. Life size, by the author from his own dissections.
2. Outer view of the right pelvic limb of *Geococcyx californianus*, the superficial muscles removed and the next layer being exposed. Life size, by the author from his own dissections. The limb is drawn in a different position from what it is in fig. 1, which will account for the shortening of some of the muscles and their change of form.

PLATE XLV.

Fig. 1. Outer aspect of the right pelvic limb of *Geococcyx californianus* showing the third layer of deep muscles, with a dissecting-chain pulling the *ambiens* into view. Life size, by the author from his own dissections.

2. Outer aspect of pelvis and right pelvic limb of *Geococcyx californianus*. Designed to show the deep muscles of the region, and the bones have been slightly rotated from their normal positions in order to bring them into view. *a*. Vinculum between deep flexor and *flexor longus hallucis*. Drawn by the author from his own dissections.

3. Description of three Species of *Scelidotherium*.

By R. LYDEKKER, B.A., F.G.S., F.Z.S., &c.

[Received September 20, 1886.]

(Plates XLVI.–XLIX.)

In the 'Zoology of the Voyage of the Beagle,' published in 1840, Prof. Sir Richard Owen founded the genus *Scelidotherium* on the evidence of a considerable portion of the skeleton of a large megatherioid Edentate found by Darwin in the Pleistocene of Bahia Blanca, in Patagonia, and applied the specific name of *leptocephalum*. In the following year and in 1842, Lund published in the volumes of the Copenhagen Academy descriptions and figures of more or less imperfect remains of various allied animals from the Brazilian caves, all of which were eventually referred either to Owen's genus or to the new genus *Platyonyx*, no less than seven new specific names being applied to these specimens. In 1850 the late Prof. P. Gervais published, in the results of Castelnau's Voyage ('Mammifères fossiles de l'Amérique méridionale'), a description and figure of a skull from Buenos Ayres which he referred to the type species of *Scelidotherium*, and also of a second one from Tarija in Bolivia, which he did not name specifically but thought might be a new species. In 1857 Sir Richard Owen published a second memoir in the 'Philosophical Transactions,' in which he described and figured two skulls brought over in 1854 by Bravard from the Pleistocene of the Argentine Republic, both of which he referred to the type species. An important notice of the group was contributed by Dr. H. Burmeister, of Buenos Ayres, in his 'Description Physique de la République Argentine'[1] (1879), where he described a skeleton which he likewise referred to the type species, and also gave reasons for adopting Lund's genus *Platyonyx* for some of the allied forms. In 1880 Messrs. H. Gervais and Ameghino, in a memoir published under the title of 'Mammifères fossiles de l'Amérique méridionale,' gave a synopsis of all the previously named species of *Scelidotherium* and *Platyonyx*, and applied the new specific name of *S. tarijense* to the above-mentioned skull from Bolivia, figured by P. Gervais; and also founded a second

[1] Vol. i. part iii. pp. 322-345, pl. xiv. There is no copy of the Atlas in any of the London libraries.

new species, for which they proposed the name of *S. capellini*, on the evidence of a lower jaw from the Pleistocene of Buenos Ayres. In 1881 Dr. Burmeister published in the Monatsb. k. preuss. Ak. Wiss. (pp. 374–380) a description with figures of the manus, pes, and knee-joint of a skeleton of *Scelidotherium* from the Pleistocene of the Argentine Republic, which was referred to *S. leptocephalum*. In 1885 Dr. Fischer[1] described a skeleton lately acquired by the Paris Museum of Natural History, which he refers to *S. leptocephalum*; while in 1886 Señor Ameghino[2] has applied the new name of *Scelidotherium? bellulum* to a single tooth from Parana. Finally it may be observed that the so-called *Scelidotherium ankilosopum*, Bravard[3], is the same as *Mylodon* (*Grypotherium*) *darwini*, Owen. Other memoirs of minor import, which need not be quoted here, have also been published.

It will be seen from the above that no less than eleven specific names have been applied to animals of this group; six of which are included by Messrs. Gervais and Ameghino, in the memoir cited, in *Scelidotherium*, while four are referred to *Platyonyx*, the eleventh being of later date. Among the seven included under the former genus, there is no difficulty in regard to accepting the typical *S. leptocephalum* and *S. tarijense*; *S. capellini*, however, as being founded on a specimen which has not yet been figured, must be regarded merely as a nominal species; while *S. minutum*, Lund, is apparently founded upon immature specimens, and *S. bellulum* upon a single unfigured tooth. With regard to *S. bucklandi* and *S. oweni* of Lund, the type specimens are so imperfect that they do not appear to me to afford characters of sufficient importance to enable other specimens to be identified with them; and I have therefore been compelled to ignore these names when considering the affinities of the specimens described below. Of the four so-called species ranged by Messrs. Gervais and Ameghino under *Platyonyx*, the only one that can be regarded as satisfactory is *P. brongniarti*, which is founded on a nearly complete skull. *P. cuvieri* is founded on a fragment of a mandible which does not afford more satisfactory characters than the one on which *S. bucklandi* is founded; while *P. blainvillei* and *P. agassizi* have been named on still more unsatisfactory evidence, and must certainly therefore be regarded as not of more than nominal value.

The object of the present communication is, first, to show that one of the specimens figured by Sir Richard Owen in the memoir in the 'Philosophical Transactions,' already cited, does not belong to *S. leptocephalum*, which also leads to the conclusion that the specimen described by Dr. Burmeister in his second memoir under the same name is likewise distinct; and, secondly, to describe a skull belonging to a series of specimens, from the Pleistocene of Chili, recently acquired by the British Museum. In the course of this paper it will be shown that there appears no reason for the retention

[1] Comptes Rendus, vol. ci. p. 1291 (1885).
[2] Bol. Ac. Nac. Cordoba, vol. ix. p. 184 (1886).
[3] In P. Gervais's 'Zool. et Pal. Générales,' sér. i. p. 132 (1867–69).

of the so-called genus *Platyonyx*, which is either founded on a misidentification, or on characters which cannot be regarded as of more than specific value.

With these few words of introduction, the descriptive portion of the memoir may be commenced.

SCELIDOTHERIUM LEPTOCEPHALUM, Owen.

The type species is represented in English collections by the imperfect type skeleton from Patagonia preserved in the Museum of the Royal College of Surgeons, and by two imperfect skeletons collected by Bravard in the Argentine Republic and preserved in the British Museum. The skull from the latter country, figured by P. Gervais in the 'Mammifères fossiles de l'Amérique méridionale' (Castelnau's Voyage), pl. xi. fig. 1, apparently also belongs to this species.

The type cranium is considerably damaged, but the two British-Museum crania (Nos. 37308 and 32995), taken together, exhibit nearly all the important features; the second of these specimens is figured from the lateral aspect by Sir R. Owen in the 'Philosophical Transactions' for 1857, pl. viii. fig. 1. In Plate XLVI. of the present memoir I have figured the former specimen, the occiput being restored from No. 32995. In the figured specimen the greater portion of the nasals is preserved, and its more important characters are as follows:—

The facial profile is strongly curved, and presents a well-marked frontal protuberance behind the orbit; the cranium is of moderate width, and the nasals of great relative length, being when complete at least equal to one half the total length of the frontal aspect of the cranium. In correlation with the elongated nasals the facial portion of the maxilla is lengthened, and a large portion of it appears on the frontal aspect. The lachrymal is not very prominent, and the aperture of its canal looks directly outwards. The anterior border of the zygomatic process of the maxilla is inclined backwards; the fronto-parietal ridges are widely separated, and the interdental portion of the palate is not excessively narrow.

The mandible associated with the figured cranium has an elongated symphysis, the portion in advance of the teeth being nearly twice the length of the whole dental series, and the superior border of the anterior portion of the ramus nearly straight.

The more important measurements of the figured skull are as follows:—

Length of broken nasals	0·270
Length of facial part of maxilla	0·170
Width of the two occipital condyles	0·108
Length from condyle to last tooth	0·242
Length of dental series	0·113
Length of mandibular symphysis	0·156
Interval between hinder border of symphysis and last tooth	0·350
Interval between do. and first tooth	0·050

The only other part of the skeleton to which I wish to call attention is the astragalus, and I have accordingly figured the type specimen in Plate XLIX. fig. 3. It will be seen from this figure that the external trochlear ridge for articulation with the tibia is not prominent, and scarcely projects above the level of the internal tuberosity. The astragalus (B.M. No. 37476) associated with the cranium No. 37308 exhibits precisely similar features, although it is of somewhat larger dimensions. This type of astragalus is very widely different from that of *Megatherium* (in which the external trochlear ridge is extremely prominent), and apparently indicates that the eversion of the foot was not so great as in that genus.

SCELIDOTHERIUM BRAVARDI, n. sp.

This species is founded on an imperfect skeleton in the British Museum, brought by Bravard from the Argentine Republic, which presents features clearly showing that it cannot belong to the type species, to which it has hitherto been referred. The cranium (B.M. No. 37626), which lacks the whole of the dentition and the greater portion of the nasals, has been figured by Sir R. Owen in the 'Philosophical Transactions' for 1857, pl. viii. fig. 2, from the palatal aspect[1], and referred to the type species; an upper view is given in Plate XLVII. of the present memoir. It is extremely unfortunate that the nasals are wanting; but from the structure of the adjacent bones it can be shown that these bones were certainly much shorter than in *S. leptocephalum*, since in the first place the superior border of the facial portion of the maxilla forms a much shorter curve than in the latter, while if the nasals were of the same length as in that species they would have projected far in advance of the premaxillæ. That the nasals were of a shorter type is also evident from a comparison of the figure with that of *S. chiliense* (Plate XLVIII.), when it will be seen that the facial portion of the maxilla is not dissimilar in the two species. The whole cranium is, moreover, relatively narrower than in *S. leptocephalum*, and the frontal profile is quite straight; while only a narrow moiety of the facial portion of the maxilla appears on the frontal aspect; and the lachrymal is characterized by its extreme prominence, and the partially upward direction of the aperture of its canal. The anterior border of the zygomatic process of the maxilla is nearly vertical, while the fronto-parietal ridges are closely approximated, and the interdental portion of the palate (as is well shown in Sir R. Owen's figure) is of excessive narrowness. It will also be seen from the following table of dimensions that while the width of the occipital condyles is smaller than in *S. leptocephalum*, the interval between the condyles and the last tooth is considerably greater, which indicates a great difference in the relative proportions of the two crania. The premaxillæ are well developed.

In the mandible[2] associated with the cranium, while the length of

[1] The teeth have been introduced on one side in this figure.

[2] This specimen is figured by Owen, *op. cit.* pl. viii. figs. 4, 5, with the teeth restored; and apparently in pl. ix. figs. 2, 3, the specimen represented in fig. 2 being erroneously described as belonging to the upper jaw.

the symphysis is greater than in *S. leptocephalum*, the interval between the hinder border of the symphysis and the first tooth is very considerably less. The superior border of that portion of the mandible in advance of the teeth is moreover inclined strongly upwards.

The following dimensions may be compared with those of *S. leptocephalum* :—

Length of facial part of maxilla (about)	0·135
Width of the two occipital condyles	0·095
Length from condyle to last tooth	0·258
Length of upper dental series	0·105
Length of mandibular symphysis	0·175
Interval between hinder border of symphysis and last tooth	0·350
Interval between do. and first tooth	0·032

I will now direct attention to the astragalus. Unfortunately the one specimen of this bone, associated with the cranium, is imperfect, although sufficient remains to show that it differs from the corresponding bone of the type species by the great prominence of the external trochlear ridge, which projects far above the level of the internal tuberosity. In Plate XLIX. fig. 4, there is represented an astragalus from a cavern in Brazil, which, although of larger size than Bravard's specimen, agrees precisely in structure, and either belongs to a male of the present form or to an allied species; and I think a comparison of this figure with that of the astragalus of *S. leptocephalum* will leave no doubt as to the specific distinctness of the two forms. This astragalus agrees precisely with the corresponding bone of a hind foot belonging to a perfect skeleton figured by Dr. Burmeister in the Monatsb. k. preuss. Ak. Wiss. for 1881, plate facing p. 380, fig. 2, and referred (on the authority of Sir R. Owen's figure of the cranium of the present form) to a large male of *S. leptocephalum*. A tibia from Brazil, associated with the figured astragalus, presents a structure of its distal surface modified to accord with this peculiar articulation, which is different from that of the tibia of *S. leptocephalum*; and there are equally well-marked differences in some of the other bones of the present form to which I shall allude on another occasion.

Whether or no the larger bones mentioned above belong to male individuals of the same species as the cranium, I think sufficient evidence has been adduced to show that both the form to which the latter and that to which the former belonged are specifically distinct from *S. leptocephalum*.

Confining, however, attention to Bravard's specimen, it is quite evident that this form is distinct both from *S. tarijense* (in which the mandible is of quite a different type) and *S.* (*Platyonyx*) *brongniarti* (in which the nasals are very short and the premaxillæ aborted); and since it appears impossible to identify it with either of the ill-defined Brazilian forms mentioned above to which specific names have been assigned, I propose that it should be known as

S. bravardi. Should, however, any of my fellow workers be able to identify it with either of such forms, I shall be only too happy to relegate this name to the rank of a synonym.

The structure of the astragalus of *S. bravardi* (as Dr. Burmeister remarks in his description of the larger form which I provisionally associate) approximates very strongly to that of *Megatherium*, although wanting the articular cup for the navicular; and it is therefore probable that the hind foot of this species was more everted than in *S. leptocephalum*. The shorter nasals of the present species also diverge less widely from the *Megatherium* type than do those of the last-named species, and this character is still more developed in the following form.

SCELIDOTHERIUM CHILIENSE, n. sp.

The form to which I propose to apply the above name is represented by a series of specimens purchased during the present year by the British Museum, from a gentleman residing at Lima, which were obtained from the Pleistocene of Tamarugal, in the district of Tarapaca in Chili[1]. The specimens comprise three more or less imperfect crania, the anterior portion of a mandible, and a considerable number of vertebræ and limb-bones. All that I have to say in regard to the limb-bones is, that the astragalus is intermediate in structure between that of *S. leptocephalum* and that of *S. bravardi*, and that the humerus has a well-defined entepicondylar foramen.

The least imperfect of the three crania is represented in Plate XLVIII., and shows nearly the whole of the nasals. The most striking feature of this cranium is the extreme shortness and breadth of the latter bones—their length not exceeding one third of the total length of the cranium—while the mandibular symphysis is also equally short, as will be seen by the following measurements. That this form is totally distinct from *S. leptocephalum* is self-evident. It appears more nearly allied to *S. bravardi*, with which it agrees in the prominence of the lachrymal, the narrowness of that portion of the maxilla appearing on the frontal aspect, the straight facial profile, and the narrowness of the interdental portion of the palate; but differs by its greater width, by the still shorter facial portion, by the probable abortion (as will be shown below) of the premaxillæ, and by the shorter anterior portion and symphysis of the mandible. The mandible is quite unlike that of *S. tarijense*[2], in which the symphysial part is bent upwards very suddenly, nearly the whole of it being above the level of the dental alveoli. The nasals of that species are also much longer than those of the present form.

With the skull of the so-called *Platyonyx brongniarti* from Brazil, figured by Lund in the K. Danske Vid. Selsk. Skr. vol. ix. pl. xxviii., the present specimens agree very closely in general characters; but in addition to being of superior size, the cranium is relatively narrower, and lacks the marked expansion behind the nasals, while

[1] See map, *suprà*, p. 396.

[2] I refer to this species a left mandibular ramus from Brazil in the British Museum (No. 18649 *a*).

the nasals themselves are more pointed posteriorly and wider anteriorly, the width of the anterior expansion being greater than that at the frontal expansion, while the reverse condition obtains in *S. brongniarti*. The resemblance between the two crania is, however, sufficiently close to render it probable that the two forms were closely allied, and that the premaxillæ of the present form were similarly aborted. The dimensions of the present form are as follows:—

Length of the facial portion of maxilla	0·122
Width of the two occipital condyles	0·099
Length from condyles to last tooth	0·238
Length of upper dental series	0·093
Length of mandibular symphysis	0·124
Interval between hinder border of symphysis and first tooth	0·012

Since the present form is decidedly distinct from all the species mentioned above, and since I cannot identify it with either of the other ill-defined forms referred to *Scelidotherium* and *Platyonyx*, I can only adopt the course followed in the case of the preceding species; and I accordingly propose to designate this form as *Scelidotherium chiliense*, since I shall immediately show that the genus *Platyonyx* ought to be merged in *Scelidotherium*.

Platyonyx is stated by Lund (and his view is followed by Dr. Burmeister[1]) to be distinguished from *Scelidotherium* by the absence of an entepicondylar foramen to the humerus, and by the more flattened phalangeals; while, according to Messrs. H. Gervais and Ameghino[2], the crochet of the last lower tooth is more prominent. Sir R. Owen[3], who unites the two genera, is of opinion that the limb-bones referred by Lund to *Platyonyx* really belong to *Glyptodon*. I have no means of deciding which of these two views is correct; but the close general resemblance in the structure of the nasals of *Scelidotherium chiliense* to those of the so-called *Platyonyx brongniarti* leads me to conclude that whether the humerus of the latter was, or was not, provided with an entepicondylar foramen, the species is not entitled to generic distinction from *Scelidotherium*, the alleged differences in the structure of the phalangeals and of the last lower tooth being characters which are certainly not more than specific ones.

Taking the three species, *S. leptocephalum*, *S. bravardi*, and *S. chiliense* together, it will be seen that they form a sequence as here placed in regard to the length of the nasals—*S. chiliense* (together with *S. brongniarti*) being the least, and *S. leptocephalum* the most removed from the type of cranium obtaining in *Megatherium*.

Affinities of the Genus.

In conclusion, I may observe that *Scelidotherium* appears to be a

[1] Monatsb. k. preuss. Ak. Wiss. 1881, pp. 374–380.
[2] 'Mammifères fossiles de l'Amérique méridionale,' p. 151 (1880).
[3] Memoir on the *Mylodon*, p. 170, note.

genus occupying in some respects an intermediate position between *Megatherium* and *Mylodon*, but also showing evidence of a still more widely extended affinity. The dentition is decidedly nearest to that of *Mylodon*, while the hind foot approximates to that of *Megatherium*. The crania of species like *S. chiliense* and *S. bravardi* are those least removed from the *Megatherium* type, and it is these species which come nearest to that genus in the structure of the astragalus. All those forms in which the pes is known exhibit the anchylosis of the first and second phalangeals of the third digit, and the large claw of the same, which are such characteristic features of the type genus of the family. The peculiar *Mylodon darwini* (generically separated by Reinhardt under the name of *Grypotherium*) is the form by which *Scelidotherium* is connected by cranial characters with *Mylodon*; and the connection is so close that it becomes somewhat difficult to give a clear differential diagnosis. In its extremely elongated facial region and peculiar astragalus, *S. leptocephalum* is the species departing most widely from the *Megatherium* type, and it is probable, from the structure of the last-named bone, that in this animal the pes was not everted as it is in *Megatherium*. In both its peculiar features *S. leptocephalum* makes such a very marked approach to the *Myrmecophagidæ*, that it is quite easy to imagine how that family may have taken origin from some member of the *Megatheriidæ*; while the remarkable resemblance in dental characters existing between those members of the genus *Mylodon* which have been separated by some writers under the names of *Pseudolestodon* and *Lestodon* and the *Bradypodidæ* suggests that the modern arboreal Sloths may also originally have sprung from some early member of the same great family of Ground-Sloths.

EXPLANATION OF THE PLATES.

Plate XLVI.

Scelidotherium leptocephalum, Owen. Frontal aspect of the cranium; from the Argentine Republic. British Museum, No. 37308. The occiput has been restored from another specimen. ⅓. *la*, lachrymal; *na*, nasal; *mx*, maxilla.

Plate XLVII.

Scelidotherium bravardi, Lydekker. Frontal aspect of the imperfect cranium; from the Argentine Republic. British Museum, No. 37626. ⅓. Letters as in Plate XLVI.

Plate XLVIII.

Scelidotherium chiliense, Lydekker. Frontal aspect of the cranium. British Museum, No. M. 2819. ⅓. Letters as in Plate XLVI.

Plate XLIX.

Fig. 1. *Scelidotherium bravardi*, Lydekker. The mandible associated with the cranium figured in Plate XLVII. British Museum, No. 37649. ⅓.

2. *Scelidotherium chiliense*, Lydekker. The anterior part of the mandible; from Chili. British Museum, No. M. 2821. ⅓.

3. *Scelidotherium leptocephalum*, Owen. The left astragalus; from Patagonia. Mus. Roy. Coll. Surgeons, No. 3520. ⅓. *a*, external trochlear ridge for tibia; *b*, internal tuberosity.

4. (?) *Scelidotherium bravardi*, Lydekker. The left astragalus; from Brazil. British Museum, No. 18620 *k*. ⅓. Letters as in fig. 3.

4. On two European Species of *Bombinator*.

By G. A. Boulenger, F.Z.S.

[Received September 28, 1886.]

(Plate L.)

Two distinct forms of *Bombinator* occur in Germany. The fact has been known to me for many years, having, when a boy, been struck by the very different appearance of specimens obtained by me at Dresden as compared with the familiar form from Belgium and the Rhine. But it was only during a recent journey to Germany that I was enabled, by examining a larger material, to form a decisive opinion that the two forms are entitled to rank as species.

German authors, so far as can be gathered from their publications, have never seized upon the distinction, although individual variations have caused a var. *brevipes* (Blasius), Koch, to be established. Possibly Fitzinger was the first to separate the two forms correctly by distinguishing a *Bombinator pachypus*, from the mountains of Italy, from the true *B. igneus* of Laurenti. However, perhaps through misrepresentation of Fitzinger's views, nothing but confusion was added by Bonaparte, who, as is well known, introduced that author's MS. name into nomenclature[1]. The result of my search into the synonymy of *Bombinator* is that Linnæus's name *Rana bombina* and Laurenti's *Bufo igneus* apply respectively to the two species now under consideration. The words of Linnæus (Faun. Suec. 2nd ed. p. 101, 1761), "*abdomine luteo nigro maculato*," and those of Laurenti (Syn. Rept. p. 29, 1768) "*infra albido-cærulescens, punctatus maculis læte miniatis*," seem to settle the point; and if, as I have reason to believe, the paler-bellied Frog occurs in Sweden and the brighter one in Austria, "*in paludibus Danubialibus*," it is settled beyond doubt. Although Rösel, as præ-Linnean and polynomialist, has no claim in matters of nomenclature, it is well to say that his, the first scientific, account of *Bombinator* refers to the form which I now name *B. bombinus*. It must also be added that *B. pachypus* and *B. brevipes* are undoubtedly to be regarded as synonyms of *B. bombinus*, and that the sacrum and coccyx figured by Gené (Syn. Rept. Sard.) as that of *B. igneus*, and which has lately been the subject of some discussion, is clearly that of a *Pelobates*.

I may now pass on to the distinctive characters of the two species.

1. Bombinator bombinus, L. (Plate L. fig. 1.)

Habit stouter, snout rather shorter, digits thicker, warts stronger and more crowded than in *B. igneus*. The length of the leg or crus equals or exceeds the distance between the inner metatarsal tubercle and the extremity of the fourth toe. Male with black nuptial excrescences under the second and third toes, sometimes also

[1] Bonaparte's figure was evidently not executed from life, and therefore no importance is to be attached to the coloration attributed to his *B. pachypus*.

under the fourth; without gular pouches, the submaxillary (mylohyoid) muscle being undivided. Upper surfaces without or with very indistinct dark spots. Young with a pair of roundish light spots or a light transverse band between the shoulders and another on the middle of the body; these spots often more or less easily distinguishable in the adult. Lower surfaces varying from sulphur-yellow to orange, with irregular blackish or bluish-grey spots or marblings; the yellow colour usually predominates, and the blackish markings may even be entirely absent. Tips of fingers and toes yellow. Young very pale yellow inferiorly, with bluish-grey spots.

Hab. I have myself collected this species in Belgium, where it is very abundant in the province of Namur, and occurs also near Tournay and Liége, in France near Bordeaux, in Rhenish Prussia, and in the Tyrol near Salzburg, where it is found in great abundance. I have at present before me living specimens from near Frankfort on the Main, kindly given to me by Dr. Boettger. Mr. W. Wolterstorff writes to me from Halle that this species is, in Germany, restricted to more hilly districts; he obtained it at Tiefenort, near Eisenach, near Weismain and Muggendorf, between Bamberg and Baireuth, and round the Starberger See, near Munich. I have examined spirit-specimens from the following localities:—Hanover (Brit. Mus.), Goslar, Harz (Brit. and Berlin Mus.), Geneva (Brussels Mus.), Hungary (Brussels Mus.), Brostenii, Moldavia (Brussels Mus.), and Dalmatia (Brussels Mus.). For several specimens from San Romedio, S. Tyrol, and Marcellise, prov. Verona, I am indebted to the kindness of M. de Betta, and for two from Florence to Prof. Giglioli.

2. Bombinator igneus, Laur. (Plate L. fig. 2.)

The length of the leg is less than the distance between the inner metatarsal tubercle and the extremity of the fourth toe. No nuptial excrescences on the toes. In the male, the submaxillary muscle is divided into an anterior and a posterior portion, with a pouch on each side between the two; this vocal pouch does not communicate with the mouth through any opening, but the skin of the floor of the mouth is loose and plicate, and capable of distention during the inflation of the sides of the throat. Greyish or olive above, with distinct symmetrical blackish or bottle-green spots; sometimes the whole or part of the upper surfaces washed with green; usually a pair of pale green roundish spots between the shoulders. Lower surfaces bluish black with white dots and bright orange or vermilion insular spots; tips of fingers and toes black. Young coloured like the adult.

Hab. This species is common near Berlin, whence I obtained numerous specimens during a recent stay in that city. I also got it at Dresden, and I received some years ago specimens from Brostenii, Moldavia, together with *B. bombinus*; these specimens are in the Brussels Museum, where I have recently compared them with the Berlin examples. Dr. Boettger received it from near Bitterfeld. Mr. Wolterstorff, who was so kind as to send me specimens from

Magdeburg, informs me that it is only found in the plain and never occurs in company with *B. bombinus*, which, however, may inhabit the same districts, but only at a certain altitude, as is, for instance, the case in Thuringia.

Dimensions.

	B. bombinus.		*B. igneus*.	
	♂. millim.	♀. millim.	♂. millim.	♀. millim.
From snout to vent	46	46	46	42
Head	14	14	14	13
Width of head	15	15	15	13
Fore limb	23	20	21	20
Hind limb	55	51	52	48
Tibia	16	15	14	13
Foot, from inner metatarsal tubercle	15	14	16	15·5

EXPLANATION OF PLATE L.

Fig. 1. *Bombinator bombinus.*
2. —— *igneus.*

a. Adult female, upper view.
b. Adult female, lower view.
c. Young, upper view.
d. Young, lower view.
e. Breeding male, lower view of foot.
f. Breeding male, musculature of the throat.

5. Additional Notes upon the Anatomy of the *Trochili, Caprimulgi*, and *Cypselidæ*. By R. W. Shufeldt, M.D. &c.

[Received July 9, 1886.]

To the meeting of this Society on December 1, 1885 [1], I communicated a paper on the "Comparative Osteology of the Trochilidæ, Caprimulgidæ, and Cypselidæ," wherein I ventured to bring forward certain anatomical facts in support of Professor Huxley's expressed opinions upon the probable relations of the Humming-birds, Swallows, Swifts, and Nightjars (P. Z. S. 1867, p. 415).

Although it does not in any way alter the general comparisons I made in my first contribution to this subject, nor my conclusions, yet I find an unfortunate error has crept into the drawings of one of the Plates in the paper in question (plate lxi. fig. 3). How this happened it would be impossible for me to say at the present time, but the humerus of *Trochilus alexandri* in this figure is the *right* one, and *not* the left as stated in the text. It is quite possible that the extraordinary position of the pneumatic foramen in this bone, taken in connection with its diminutive size, or confusing the pair after the skeleton had been disarticulated for the purpose of studying the details, may have had something to do with the mistake.

[1] See P. Z. S. 1885, p. 886.

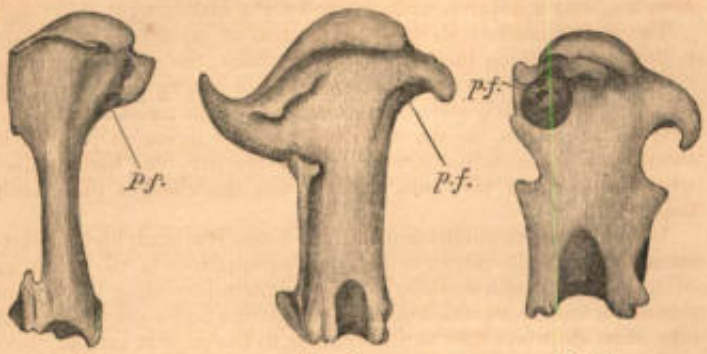

Fig. 1. Fig. 3. Fig. 5.

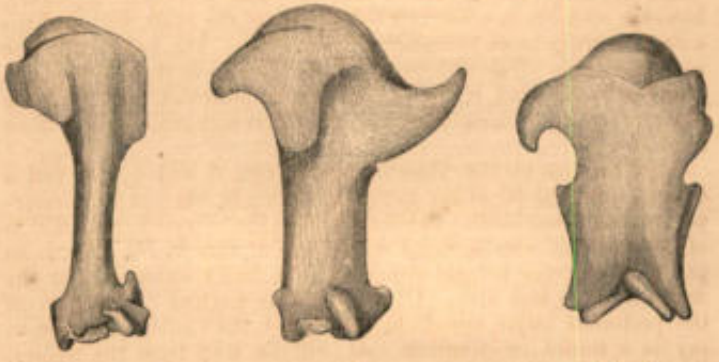

Fig. 2. Fig. 4. Fig. 6.

Fig. 1. Aconal aspect of left humerus of *Tachycineta thalassina*. × 3.
Fig. 2. Palmar aspect of the bone shown in fig. 1. × 3.
Fig. 3. Aconal aspect of the left humerus of *Micropus melanoleucus*. × 4. (This was the *Panyptila saxatilis* of my first paper, but I have now adopted the nomenclature of the A. O. U. for this White-throated Rock-Swift.)
Fig. 4. Palmar aspect of the bone shown in fig. 3. × 4.
Fig. 5. Aconal aspect of the left humerus of *Trochilus alexandri*. × 8.
Fig. 6. Palmar aspect of the bone shown in fig. 5. × 8.

By "aconal" I mean that side of the bone which is next to the body of the bird, and the reverse of this is the "palmar" aspect. All these figures are drawn from the specimens by the author, and *p.f.* calls attention to the *pneumatic fo ss.*

Be this as it may, the oversight has been kindly pointed out to me by Mr. F. A. Lucas, the osteologist of the United States National Museum, and it devolves upon me to set the matter right.

The only changes it demands in the text of my article is, that on p. 908, in describing the humerus of *Trochilus*, the sentence reading "but the radial crest is represented by a strong and gracefully curved hook" should state, instead of the "radial crest," the *ulnar tuberosity*. Again, in the description of this figure on p. 915, it should say the *right* humerus instead of the left; and here as elsewhere in the paper take into consideration the changes that result therefrom.

Now as a correct comparison of these bones is of such high importance, and as I fully intend to carry my comparisons of the structure of these groups still further, I have redrawn, increasing in size and presenting two views, the humeri of the forms under discussion, and offer these drawings here as illustrations to the present article.

From an examination of figures 1 and 2, it must be evident, to any one familiar with the ordinary form of the avian humerus, that in the Swallow the bone departs to some extent from the more common shape it wears among the Passeres. The principal departure, however, consists in a marked *shortening of the shaft*, and perhaps a comparatively more conspicuous radial crest. The bone is likewise *non-pneumatic*. This also we find to be the case in the Swift, where, too, the radial crest is drawn out into an upturned hook, and the ulnar tuberosity is simply drawn out further and consequently more hook-like.

Now turning to the Humming-bird (figs. 5 and 6), we find a humerus that, so far as my knowledge extends, has not its counterpart among living birds. In the first place, the extraordinary position of its pneumatic fossa, *being on the radial side of the bone*, is an exception to every general definition of a bird's humerus that the writer has ever met with. Of the peculiar method of insertion of the pectoralis major muscle in this bird I shall have something to say in a future contribution. As will be seen from the figures, the ulnar tuberosity is a prominent decurved process, and one of the most striking features of this curiously twisted bone. It would be superfluous on my part to point out in the figures the manifest differences existing between the humerus of this Hummer and the Swift; they are even greater than I thought them to be, before I made the oversight above quoted. In addition to its general form, the humerus is highly pneumatic in *Trochilus*, which, as I have said, is not the case among the Cypselidæ, these latter agreeing with the Swallows in this particular in having non-pneumatic humeri.

6. On two Species of Antelopes from Somali-Land. By P. L. Sclater, M.A., Ph.D., F.R.S., Secretary to the Society.

[Received September 20, 1886.]

(Plate LI.)

In Mr. E. Lort Phillips's "Notes on the Antelopes of Somali-Land" (P. Z. S. 1885, p. 930) is mentioned a Gazelle under the name of "Flabby-nosed Gazelle," the single specimen of which, in determining Mr. Lort Phillips's species, I reserved for future examination.

I was in hopes of being able to have the bones removed from the head of the single specimen obtained, in order to ascertain whether there is not some peculiarity in the frontal and nasal bones to accompany the extraordinary development of the nose in this animal. Not having been able to obtain the necessary facilities for this purpose (which, seeing that the specimen is unique and has been excellently mounted, was not much to be wondered at), I will content myself with again exhibiting the head of this remarkable Antelope (Plate LI.), and remarking that I think there can be no question of its belonging to an undescribed species, which I propose to call *Gazella naso*. *Gazella naso*, as its name implies, is sufficiently distinguishable from all other known members of the genus by having the extremity of the snout above the nasal openings developed into a large flabby wrinkled mass, which is scantily covered by short hairs of a grey colour. Above this elevated mass the face is crossed by a broad black bar. Above that again the centre of the forehead and space between the horns is covered by dense fur of a chestnut-red colour. This chestnut-red forehead is bordered on each side by two broad white longitudinal stripes, which extend from the base of the horns down to the nostrils. This longitudinal stripe is again bordered above the eye on the inside to below the eye on the outside by an indistinct blackish stripe. The tear-pits below the eye seem to be particularly large and well developed. The rest of the fur of the head and neck is of the sandy colour usual in most species of this genus. The ears, which are long and rather narrow, are of a greyish colour. In the size and shape of its horns *G. naso* does not differ materially from other species of the group allied to *G. dorcas*. The length of the horns in the present specimen, from the base to the tip, is about 9½ inches; the breadth of the skull between the eyes is 1·7 inch; the length from the occiput to the end of the nose about 8 inches; the length of the ear is 6 inches.

As regards the *Neotragus*, of which specimens were obtained by Mr. Phillips and were likewise left undetermined in the same communication (see P. Z. S. 1885, p. 932), I have now compared the skull and the skin brought by Mr. Phillips with specimens in the British Museum. As regards the skin there is such variation in the coloration of the fur of *Neotragus* that I do not think much reliance can be placed on the somewhat abnormal appearance of this

example, which is nearly paralleled by other specimens in the National Collection. The skull, however, is characterized by the excessive reduction of the nasal bones, which is carried to a much greater extreme than in the typical specimen of *Neotragus kirkii*, Günther (P. Z. S. 1880, p. 20). There are also other points of difference when the skulls are compared together.

But as *Neotragus kirkii* is from nearly the same country, I think it would be hardly justifiable to name a second *Neotragus* from Somali-Land without a better series of materials to base it upon. I will therefore content myself with calling attention to their divergencies, and, as Mr. Phillips has empowered me so to do, with depositing his specimens in the British Museum to await further inquiries.

From the discoveries made by Mr. Hagenbeck's collector, Herr Menges[1], and Messrs. James and Lort Phillips, it is quite evident that there is yet much interesting work to be done among the Mammalia in Somali-Land, and I trust that we shall soon receive additional specimens and further information concerning this interesting animal.

December 7, 1886.

Prof. Flower, LL.D., V.P.R.S., President, in the Chair.

Prof. Bell exhibited and made some remarks on a specimen of *Tænia rana*, the smallest known human parasite, which had lately been obtained for the Museum of King's College.

The following papers were read:—

1. Observations on the Development and Structure of the Ovum in the Dipnoi. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society, and Lecturer on Biology at Guy's Hospital.

[Received December 3, 1886.]

(Plates LII.–LIV.)

The present paper is the continuation of a research into the structure of the ovary in *Protopterus*, the main results of which have already appeared in the last number of the 'Proceedings.' Besides being able to give a more complete account of the ovarian ova in *Protopterus*, I am also able to supplement this account with some few notes respecting the structures to be observed in the ovary of *Ceratodus*. The opportunity of studying *Ceratodus* I owe to the kindness of Prof. Lankester and Prof. G. B. Howes. The material was taken

[1] *Cf.* Sclater, P. Z. S. 1884, p. 538; Noack, Zool. Gart. xxvi. p. 172 et xxvii. p. 39; Kohl, Ann. d. k. k. naturhist. Hofmuseums, i. p. 75 (1886).

from fishes which had been preserved entire in alcohol, and was unfortunately not in a very first-rate condition for microscopical investigation. I have been able, however, to make out the important fact that there is an essential similarity in the structure of the ovarian ova in both forms, and that in *Ceratodus*, as in *Protopterus*, there are, besides the ova, certain other structures resembling ova in many particulars which have a different mode of development. The discovery of this fact in *Ceratodus* renders it practically impossible to suppose that the remarkable processes in the development of the germinal cells of *Protopterus*, described and figured by myself in this and my last paper, are in any way abnormal; it had occurred to me before that there might be something abnormal.

It cost me a great deal of labour, in the way of cutting sections, to ascertain that there was an actual resemblance between *Ceratodus* and *Protopterus*. In my specimen of *Protopterus* I found it quite impossible to make a section of the ovary anywhere without discovering ova of both kinds in nearly equal abundance; in *Ceratodus*, on the other hand (and this statement applies to two specimens), ova of the second kind were extremely rare; I have cut literally hundreds of sections without coming across any evidence of the existence of two kinds of ova. This may be a real difference between the two genera, or may depend upon the season of the year at which the specimens were captured. In every case, however, the ovaries contained numerous mature ova, though the number of these latter was very much less than that of the immature ova.

On the other hand, it is possible that there is really a difference in this respect between *Protopterus* and *Ceratodus*, which show other important anatomical differences.

I have already contributed to the 'Zoologischer Anzeiger' (No. 236) a brief note of the principal facts contained in this paper.

I have but little to add to my former paper on the structure of the ordinary ova of *Protopterus*.

In my last paper I drew attention to the curious specialization of the yolk in the adult ova; in fig. 4 of plate xxviii. of that paper is illustrated an adult ovum which shows a differentiation of the yolk into two distinct layers, which are less distinguishable by their coloration or arrangement of yolk-particles than by the very definite break which separates them. The outer layer of yolk forms a comparatively thin envelope, the greater portion of the ovum being occupied by the central mass of yolk.

Van Bambeke[1] has recently noted and figured a similar condition of the ripe ovum in *Gobius niger* and other fishes, and Pflüger had previously referred to the same phenomenon in Mammalia. According to Van Bambeke, the distinction between the two zones occasionally disappears under the influence of reagents. Van Bambeke speaks of the line of division which separates the two zones as not being a membrane, but merely a condensation of the egg-protoplasm. With this opinion I fully agree: in the first place, the

[1] Arch. d. Biol. t. iv. (1885).

division of the ovum itself into two zones by a definite membrane would seem to be an absurdity; in the second place, no membrane was evident in preparations where the ovum was broken. It might be expected that when the ovum was broken in cutting, the membrane, being presumably of a different hardness to the egg-protoplasm, would project from the cut surface; in no instance, however, did the broken surface show any indication anywhere of a membrane. The line of division between the two yolk-zones presented the appearance in my preparations of an absolute break; the protoplasm was perfectly transparent, and, being unaffected by the staining-reagent, was invisible.

I did not notice this differentiation of the yolk in all the large ova visible in my sections. In some ova, which were full of yolk, and of equal size with those just referred to, there was no trace of any such specialization into a peripheral and central zone; in these cases the yolk was uniform throughout. Such ova were to be found not only in the same ovary, but in the same section with the ova which displayed a differentiation of the yolk. This circumstance renders it improbable that the effect of reagents has caused the yolk to acquire a uniform appearance.

A comparison of the two kinds of ova has led me to the conclusion that the ova in which there is a specialization of the yolk are nearly mature, while those in which the yolk is uniform are degenerating ova.

Another matter relates to the structure of egg-membranes and their homologies, where I have to make a correction.

In my former paper I have referred to the presence in comparatively young ova of a vertically striate membrane lying within the vitelline membrane (*loc. cit.* p. 273, pl. xxviii. fig. 1, *z.r*; pl. xxix. fig. 2, *z.r*). This, it now appears to me, is not the equivalent of the inner of the two membranes which surround the Teleostean ovum[1]. The early disappearance of this membrane and its general structure (granular and with no distinct line of separation from the subjacent egg-protoplasm) were against such an interpretation; I now identify it with more confidence with a specialized layer of the egg-protoplasm described by Brock in *Alburnus lucidus*, *Salmo fario*, and *Perca fluviatilis*, and by Owsiannikow in *Acerina vulgaris*. Brock has figured this layer (the "Zonoidschicht" of His, the "helle Randschicht" of Gegenbaur) in *Alburnus lucidus* (Morph. Jahrb. Band iv. pl. xxviii. fig. 12, *f.g.*), where it is more complicated than in *Lepidosiren* and consists of two layers—an inner homogeneous and an outer vertically striate layer.

Contents of the Ovary of Protopterus.

The following is a detailed account of the structure and development of certain bodies in the ovary which have already been partly described in my former paper; they are nearly as numerous as the ordinary ova.

[1] *Cf.* J. T. Cunningham, "On the Mode of Attachment of the Ovum of *Osmerus perlanus*," P. Z. S. 1886, pt. iii. p. 292, pl. xxx. fig. 4, *z.r.i*, and other memoirs.

Stage I.—The earliest stage of these bodies is represented in fig. 1; its different constituents are figured, highly magnified, in figs. 5, 14–20.

The whole structure is situated near to the surface of the ovary, with which indeed it is still in continuity; the germinal epithelium (*ge*), which is apparently not everywhere present as an external layer in the adult ovary, is here conspicuous by its presence; it forms a mass of cells, the nuclei of which are so large and so closely pressed together that I have found it impossible to detect any cell-outlines (see fig. 1). These thickly clustered groups of epithelial cells seem to correspond to the "epithelial islands" of many writers (see Iwakawa, G. J. M. S. 1882, p. 266). The nuclei of these cells are deeply stained by borax carmine, and for the most part rounded or oval in contour, though frequently (perhaps owing to the hardening-reagent) somewhat angular. The staining-fluid is not evenly taken up by the whole nucleus, but a peripheral layer, sometimes confined to one pole of the nucleus, is very deeply stained, the central regions being comparatively pale.

The germinal epithelium is immediately continuous with a mass of cells which form a hollow sphere, partly occupied by a plug of cells of a somewhat different appearance; the spherical mass of cells is quite close to the surface and connected with the germinal epithelium by a very short neck, which is as wide as the area occupied by the patch of germinal epithelium.

The peripheral mass of cells is already differentiated into two distinct layers, which are distinguishable from each other by the characters of the component cells and more particularly of their nuclei.

The outermost layer is of course the one that is in contact with the germinal epithelium; the outlines of its cells are not very visible in my preparations: between the nuclei of the cells is a fibrous substance moderately stained by borax carmine; this appears to me to be the slightly altered protoplasm of the germinal cells themselves, and not to be an inroad of connective-tissue stroma-cells. The germinal cells bear, however, a very striking resemblance to connective-tissue cells.

Balfour has figured (Q. J. M. S. 1878, pl. xvii. fig. 10) and described (p. 390) a condition of the Elasmobranch ovary which is so far very similar to that which I have just described, and which gives me greater confidence in stating that the cells displayed in fig. 1, *f.é*, of Plate LII. are really germinal and not stroma-cells.

He says (p. 391):—"The surface of the ovarian region . . . is covered by a distinct . . . pseudo-epithelium . . . The cells of the pseudo-epithelium have one peculiarity very unlike that of ordinary epithelial cells. Their inner extremities are prolonged into fibrous processes which enter the subjacent tissue, and, bending nearly parallel to the surface of the ovary, assist in forming the tunic spoken of above. This peculiarity of the pseudo-epithelial cells seems to indicate that they do not essentially differ from cells which have the character of undoubted connective-tissue cells, and renders

it possible that the greater part of the tunic, which has apparently the structure of ordinary connective tissue, is in reality derived from the original germinal epithelium, a view which tallies with the fact that in some instances the cells of the tunic appear as if about to assist in forming the follicular epithelium of some of the developing ova."

The nuclei of the peripheral layer of cells are much like those of the proliferating germinal epithelium, though not quite so darkly stained—perhaps for mechanical reasons. Their shape varies considerably, some being rounded and some more fusiform; but these two extremes are united by numerous intermediate conditions. For the most part the nuclei have taken up the staining-fluid unequally; a patch at one extreme of the nucleus is more darkly coloured, and from this radiate slender threads towards the opposite extreme of the nucleus; the interstitial part of the nucleus is stained of a pale pink. The different forms of these nuclei are represented in fig. 5. The differential staining of the nucleus undoubtedly corresponds to the differentiation of its substance; and the star-like form of the darkly staining part suggests a connection with the phenomena of nuclear division; but I have not observed any cases in which the centres of the star-like bodies in two adjacent nuclei were opposed; in every instance the darkly stained extremity of the nucleus was directed away from the germinal epithelium and along the axis of the layer of cells; this uniformity in the nuclei gives them the appearance of being in rapid motion, of being as it were swept along by a current round the periphery of the sphere of cells.

Here and there the continuity of the layer of cells is interrupted by blood-vessels (*b.l*), usually of small dimensions, which are the forerunners of the richly developed vascular supply of these same bodies in later stages of development. The appearance of blood-vessels was more common on that side furthest from the germinal layer than on that nearest to it.

Towards the opposite extremity of the sphere of cells, *i. e.* that furthest removed from the outside of the ovary, the character of the nuclei of the peripheral layer of cells becomes changed. In this region the nuclei have lost the peculiar arrangement of the nuclear substance and present the appearance of ordinary nuclei (fig. 5 *a*); that is to say, they are oval bodies with finely granular contents and here and there round, darkly stained particles which are disseminated throughout the nucleus.

Within the peripheral layer of cells is another layer of cells which becomes ultimately comparable to a follicular epithelium. Even in this early stage of development it is for the most part distinguishable from the outer layer of cells; the distinction is not only in the character of the cells and their nuclei, but in an absolute line of demarcation which separates the two layers; this consists (fig. 1, *x*) of a narrow band of structureless substance, which bears the closest possible resemblance to a substance produced by the fusion of some of the central cells of the sphere, and which will be described shortly. It is possibly formed by a metamorphosis of the peripheral layer of

the follicular cells, but serves at any rate to determine accurately the boundary line between the follicular layer proper and the mass of peripheral cells which ultimately bear a resemblance to the secondary follicle layer. This limiting band of structureless substance is only met with on that side of the cell-mass towards the outside of the ovary; elsewhere the cells of the follicular epithelium are perfectly continuous with the cells of the peripheral layer.

The nature of the cells of the follicular layer also differs from that of the more peripherally placed cells. The cells themselves are rather larger and irregularly rounded in form; there is no trace of the connective-tissue-like structure described above, in the case of the extra-follicular cells. The cell-contents are clear and for the most part hardly affected by the staining-agent, which has coloured their nuclei deeply; the part of the cell-protoplasm that is coloured is tinged very faintly and shows a reticulate arrangement. The nuclei of the follicular cells differ for the most part from those of the extra-follicular layer by being rounded and even in shape, and all closely similar in size; they are deeply stained, and show a tendency to the same reticulate arrangement of the nuclear substance that has already been mentioned in the extra-follicular cells.

The character of this follicular layer is much the same throughout, only differing in places by the more or less crowded condition of the nuclei, indicating a more or less active multiplication of the cells. On that side of the cellular mass which is furthest from the outside of the ovary, the follicular layer comes into closer relations with the extra-follicular epithelial layer, though still recognizable. The character of the cells and of the nuclei which make up the extra-follicular coat of cells alters, and every transitional condition is met with between these cells and the cells of the follicular epithelium. This seems to indicate that the follicular layer is formed as a differentiation of the mass of invaginated germinal cells.

The whole body is thus surrounded by three distinct and independent layers—(1) the single layer of large follicular cells; (2) a vascular layer, to which reference has already been made and which is extremely developed; (3) an outermost cellular layer, consisting of flattened cells with nuclei elongated in the direction of the circumference of the ovum; this layer, like the follicular layer, is only one cell thick.

For the most part this outer layer has been neglected by writers, or else has been confused with the true follicular layer. Balfour, however, has recognized it in the Elasmobranch ovum [1] and has proposed to call it the "secondary follicle-layer." Owsiannikow figures this layer in the ovum of the Perch [2]; in the explanation of the figure it is called the follicular layer, while the true follicular cells are termed the "granulosa"; in the text of his paper, however, the term endothelium is constantly used for this layer, which is stated to be made up of several rows of cells in many fishes. Concerning the origin of this layer Balfour expresses with hesitation

[1] Quart. Journ. Micr. Sci. vol. xviii. (1878), p. 405, pl. xix. fig. 29, *fc'*.
[2] Mém. Acad. Sci. St. Pétersbourg, t. xxxiii. (1885) no. 4, pl. i. fig. 4, *a*.

the opinion that it may be derived from the germinal epithelium. Owsiannikow suggests three possibilities[1]—either it originates from cells which have made their way out of the blood-vessels (!), or from cells of the subgerminal tissue (stroma?), or, finally, they may be derived from the germinal layer. The latter alternative is adopted by Owsiannikow on certain evidence, which he does not, however, regard as conclusive. The outermost follicular layer of *Lepidosiren* I have already (p. 509) shown without doubt to be derived from the germinal epithelium; I shall therefore adopt the name of *secondary follicular epithelium* for this capsule, which indicates that its origin is similar to that of the true follicular epithelium, which may be briefly termed the *follicular epithelium*.

The two layers that have just been described form a hollow sphere enclosing a central cavity, which is partly occupied by a mass of cells. It is very possible that in the fresh condition the central mass of cells occupies the whole of the space available, but this is not the case in my preparation. A large portion of the central cavity, particularly on the side turned towards the exterior of the ovary, is quite empty, and no structures intervene between the central mass of cells and the follicular layer. On the opposite side, however, the central mass is in close contact for a considerable area with the follicular cells, this area exactly corresponding with the transitional area between the follicular and external layers. These facts would suggest that the central cells are derived from the proliferation of the follicular cells and ultimately of the extra-follicular cells, as these two latter have been shown to be perfectly continuous, the proliferation taking place in a certain limited area only. In this case the apparent cavity which separates the central cells from the follicular on one side will be an indication (exaggerated by the action of the preservative reagent) that there is here no real connection between the central and peripheral layers, though they may be in actual contact in the fresh state.

A number of the central cells are displayed in figs. 14–20 of Plate LIII.; they are more or less irregular in shape, rounded, and of different sizes; the staining-reagent has hardly affected the cell-protoplasm, but has deeply stained the nucleus. The cell-protoplasm is arranged in a reticulate fashion, and closely resembles that of the follicular cells. Some of the cells contain two or more nuclei, which seems to show that the cells themselves are in a condition of multiplication. The most remarkable fact about the nuclei of the central plug of cells is their great inequality in size: some of the variations are exhibited in those figures; the variation is all the more remarkable as it does not occur in the follicular layer, the nuclei of whose cells are of quite a uniform size. There is almost every gradation in size between the smallest and largest nuclei, a fact which perhaps indicates that the smaller ones are the result of nuclear division. The largest nuclei rather excel in size those of the follicular epithelium. There is a similar difference of size in the peripheral layer of cells, particularly obvious at those points where the peripheral layer is in

[1] *Loc. cit.* p. 30.

contact with the interior mass of cells, the follicular layer being at such points indistinguishable.

It is possible that the difference of size in the nuclei corresponds to a distinction between "primitive ova" and "germinal cells" such as has been described by Semper, Balfour, and so many writers in other Vertebrata; in this case the larger nuclei will be the primitive ova. This suggestion must be of course only regarded as such; I have no real evidence to offer except the different size of the nuclei.

In very many instances a degeneration of the nuclei could be observed. This takes place in several ways, some of which may be stages in the same series. Some of the nuclei (figs. 14, 17) remain of the same size and shape as the normal nuclei, but show a much paler colour and fewer nucleoli; in one instance (fig. 15) I observed a commencing disintegration of the nucleus, the substance of which appeared to be in a condition of solution at one point where it passed gradually into the substance of the cell, the limiting membrane of the nucleus being here invisible. In other cases (figs. 19, 20) the nuclei are as darkly stained as the normal nuclei or even rather more so, but instead of presenting a uniform oval contour, the nucleus was variously contorted and irregular in shape.

The centre of the mass, however, is not entirely occupied by cells like those that have just been described. There is a certain amount of an amorphous substance (fig. 1, *p*), well stained with the borax carmine, which lies in patches between some of the central cells, and particularly on the outside, in the space which separates them from the follicular layer. This substance is of an homogeneous appearance, though lighter in colour in some regions than in others; it is rather more abundantly developed in the stage next to be described than in the present (*cf.* fig. 9, Plate LIII.). This substance encloses patches of cells, or sometimes single cells; occasionally the protoplasm of the cells has undergone a certain change at the periphery, where it gradually passes into the homogeneous mass surrounding it; frequently scattered nuclei are to be found imbedded in it, and a comparison of these nuclei with those of the central cells shows them to be identical. The general appearance of the homogeneous substance suggests a coagulated fluid, and it is very like the liquor folliculi of the Mammalian ovum coagulated by alcohol; but this substance cannot be excreted by the central cells or by the follicular cells, because it contains numerous traces of them in the shape of free nuclei with or without a certain amount of partially altered protoplasm attached. These facts rather indicate that the substance in question is produced by the alteration and fusion into a semifluid mass of some of the central cells. This mode of formation is, however, not opposed to a comparison with the Mammalian liquor folliculi, which has been asserted by some to have a similar origin; the great difference is that this semifluid substance has the power of forming yolk, as will be seen after the description of the later stages.

There are other bodies which seem to be referable to the stage just described, though differing in certain structural particulars as well as in their smaller size.

These, like the last, are connected with the germinal epithelium, covering the outside of the ovary, by a pedicle of epithelial cells, which is nearly of the same width as the whole structure and its follicle. The germinal epithelium is in a condition of very active multiplication, the nuclei being very closely crowded together.

The layers of cells which surround the central mass cannot be differentiated; they present the appearance of a mass of cells continuous with the germinal epithelium and forming a layer of cells three or four deep; only here and there (fig. 10, *bl*) were traces of the irruption of the stroma in the shape of small blood-capillaries. The cells which constitute this peripheral layer are precisely similar in their character to the cells which form the outermost of the peripheral layers in Stage I.

In two instances belonging to this stage, which I have been able to study, the homogeneous darkly-staining mass produced by the solution and fusion (?) of the protoplasm of the central cells was much more in amount than in the last described stage. Fig. 11 of Plate LIII. represents the central mass of cells, which are seen to be divided up into partly or entirely isolated clumps by the formation of this homogeneous mass, which contains also free nuclei (fig. 11, *n*). In the third case the condition of the central cells, so far as this fused mass of protoplasmic material is concerned, was much the same as in Stage I.

On the whole these facts appear to indicate that the bodies belong to a somewhat earlier stage than those just described and shown in fig. 1 of Plate LII. Their small size, the undifferentiated condition of the peripheral layers, as well as the very small amount of stroma (blood-vessels) between the cells of these layers, appear to me to point to this conclusion. On the other hand, the greater amount of change in the central cells, *i. e.* the increased amount of the deeply-staining fluid substance between isolated clumps of cells, is against such a supposition, as it is evidently a further development of a process which has only just commenced in the developing structure which I have last described. This latter reason is perhaps not a very powerful argument, because it may easily be supposed that the production of the semifluid protoplasmic substance may be hastened or retarded; the same may be said with regard to the specialization of the follicular layers, only that a specialization in the instances observed by myself goes together with increase of size of the whole body. Accordingly I am inclined to believe that the bodies displayed in fig. 9 of Plate LIII. belong to a younger stage than those illustrated in fig. 1 of Plate LII.

Stage II.—The different layers composing the follicle are more differentiated, and each individual layer is now quite recognizable.

Commencing from the outside, we have the secondary follicular layer, between which and the follicular layer proper is a well differentiated vascular layer, which is easily to be made out through the whole circumference; the blood-vessels are filled with blood, and appear as round, elliptical, or elongated according to the angle of the section. The follicular layer has the appearance of being only

one cell thick, but the nuclei of its constituent cells are so crowded together that it is not easy to be certain upon this point. The outlines of the follicular cells are in many places plainly visible, and irregular processes (Plate LIII. fig. 6) project from these cells toward the interior of the mass. This may very well be owing to the shrinking of the central mass of cells, and the consequent breaking away of its connection with the peripheral epithelium. A comparison of the complete series of sections through the developing ovum (the section fig. 6 is towards the middle of the series) shows that, whether or not there is a connection between the *entire* periphery of the central cells and the follicular epithelium, there certainly is such a connection throughout a limited area lying on that side of the ovum which is nearest the external surface of the ovary, a little above (or below) the pedicle which unites the germinal epithelium with the ovum. In this region the nuclei were more abundant and crowded together than in the central cells of the mass, and were of uniform size and rounded form; in fact they show an exact similarity to the nuclei of the follicular epithelium, which in this stage, as already mentioned, forms a distinct layer. The mass of cells which connects the follicular layer with the central cells is therefore closely similar to the follicular layer, and has the appearance of a proliferation and growth inwards of that layer. The central cells, as in the previous stage, have nuclei of varying size; some are long and oval, and others shorter and more spherical; the latter resemble in every particular the nuclei of the surrounding follicular layer.

A characteristic feature of this stage is the commencing formation of yolk, which is visible here and there (figs. 27–31) in the cells of the central mass, and in the form of droplets of homogeneous appearance and varying size. This formation of yolk is not confined to the central cells, but is recognizable also in the cells which make up the follicular layer.

Here and there among the central cells are homogeneous masses, evidently the same as those referred to in the description of Stage I. as a probable resultant of the breaking-down and fusion of certain of the central cells. These masses were, however, much less developed than in the earlier stage.

This stage is evidently, from the facts above narrated, in a further condition of development than that which I have termed Stage I.; this is also shown in the gradually-advancing separation of the peripheral layers from the germinal epithelium of the ovary.

In the earlier stage the pedicle which unites the epithelial layers with the germinal epithelium on the surface of the ovary is not only very thick, but composed almost entirely of germinal epithelial cells in a state of active multiplication. The stroma of the ovary had barely penetrated into this mass of invaginated germinal cells.

In Stage II. the body is just as near to the surface of the ovary, and there is a shallow depression on the surface of the ovary corresponding in position to the centre of the pedicle of attachment, which would appear to be the remains of the invagination of the germinal epithelium. The activity of the germinal epithelium has, however,

greatly diminished; it forms only a single layer of cells, and the pedicle which connects the body with it is almost entirely composed of stroma-ingrowths, which form for the most part a very lax network of fibres and cells, though denser in the middle, and surrounding a slender cord of germinal cells, the sole remnant of the former epithelial pedicle.

In a somewhat more advanced stage there is an identical structure with that just described as regards the specialization of the peripheral layers and the mass of central cells; the formation of yolk has, however, gone on much faster, and the follicular cells, as well as most of the cells of the central mass, are crammed with variously sized yolk-spherules.

Here and there, especially in the periphery of the central cells, are irregularly shaped masses of yolk-spherules (fig. 24, *a*), among which are occasionally discernible nuclei like those of the surrounding cells. A comparison of Plate LIV. fig. 24 with Plate LIII. fig. 11 will show how very similar in size and extent these irregular patches of yolk are to the patches of amorphous deeply staining protoplasm in the earlier stage; and I cannot but think that they are these same patches of protoplasm produced by the fusion of some of the central cells which have commenced to form yolk-particles on their own account.

Other preparations, again, seem to indicate that the fusion of certain of the central cells either does not take place at all, or takes place after the formation of the yolk. I have a nearly complete series of sections through an ovum in which the yolk has already commenced to be formed; the cells of the follicular epithelium are full of yolk-particles, as are also the central cells. The latter form a compact mass of cells containing abundant yolk-particles, but without any definite patches of yolk lying between the cells, such as could be compared to the patches of protoplasm formed by a fusion of cells. In many sections, however, of this series it happened that the central mass of cells had dropped out, so that I cannot make any positive statements about the point of discussion raised. This particular instance showed very plainly indeed the connection of the mass of central cells with the follicular epithelium; the area of connection was very limited, as has been already mentioned in other cases.

The central cells are united with the follicular epithelium by a bridge of tissue which has every appearance of being an outgrowth of the latter; the nuclei are round and pressed close together as if in a condition of active multiplication; they pass without any break into the follicular epithelium, from the cells of which they cannot, indeed, be distinguished, and gradually on the other side into the mass of central cells. The cells of the latter have the ordinary characters that have been already described. I noticed a very large number of peculiar cells, several of which are illustrated in fig. 4; similar cells are not absent in other cases, but I never have seen them so numerous as in the present case. These cells are easily to be distinguished from the germinal cells among which they lie

by their smaller size, by their very deeply stained protoplasm, and by the fact that they nearly always contain a large number (3–5) of small nuclei close together. I have not yet succeeded in detecting these cells in the follicular layers, but I am nevertheless inclined to think that they are migratory leucocytes. I am at a loss, however, to account for the almost universal division of their nuclei into four or five.

The presence of leucocytes in almost all the tissues and glands of the body is so well known that I need not give any detailed references; the presence of these cells is not, however, to be confounded with the migration of follicular cells. If, however, the identification of the follicular epithelium with a layer of immigrated leucocytes be right, there can be no distinction between the two processes. The observations recorded in this paper, however, plainly show that in *Protopterus* at least there can be no possible confusion between follicular cells and lymphoid corpuscles, which is contradicted by so many other developmental facts. Unless it can be shown that lymphoid cells may arise from the direct metamorphosis of germinal epithelial cells it is quite absurd, in the present case at any rate, to allow any homology between follicular cells and immigrated white lymph-corpuscles.

Stage III.—In this stage (figured diagrammatically in fig. 3, plate xxviiii. of my former paper) the follicular epithelium is undivided from the ovum by any trace of membrane; the cells of which it is composed have dwindled down to a single layer; their diameter bears a very small proportion to that of the enclosed mass of yolk, which has enormously increased in size. The cells of the follicular epithelium are still filled with yolk-spherules presenting no differences from the yolk-spherules which make up the substance of the contained mass. Their nuclei are conspicuous and round in shape. The follicular cells appear to continue to take a share in the nutrition of the body from the fact that they are large and well developed, and that the interstices of the protoplasmic network are largely filled with yolk-spherules: occasionally (*e. g.* figs. 7, 8, *a*) the nuclei of the follicular cells showed signs of degeneration; this is probably preliminary to the evacuation of the cell-contents into the interior. Here and there the follicular cells appeared to be proliferating, the budded-off cells moving into the interior; two such instances are shown in figs. 7, 8. It is of course a difficult matter to decide how far the appearances shown in the two figures cited are due to the proliferation and migration inwards of the follicular cells; they might be explained, by reference to earlier stages, as central cells which have still remained in contact with the follicular layer, only that they occur on all sides, and it has already (p. 511) been stated that the central cells are only in contact with the peripheral for a limited area. On the other hand, a careful comparison of the example from which fig. 8 is taken with another in pretty much the same stage of development, only younger, as evinced by its smaller size, reveals the important fact that the larger contains, in any given section, a larger number of cells in its interior than the smaller. The larger was rather more

than twice the size of the smaller body selected for comparison; the number of cells in the interior was in correspondence with their difference in size. The larger had an average of 64 cells disseminated through the yolk in any given section, the smaller 42; hence the proportion between the two is as 3 : 2.

I am inclined to lay all the more stress on the mathematical statement of the case, as it allows extremely wide limits for possible errors of computation.

On the hypothesis that none of the cells contained in the yolk during later stages are derived from the migration inwards of follicular cells, it is obviously necessary to assume that they are all produced by the division of the central cells, or by certain of these cells which have persisted without division. It is true that the nuclei of the central cells in the earlier stages do multiply, but it is equally certain that others degenerate and disappear; and it seems to me that more undergo the latter than the former change; and I find that in the stage referred to above the smaller body contains considerably fewer cells in any given transverse section than in Stage I. It would then be expected that the larger bodies would contain fewer and fewer cells in their interior. I have, however, just stated that the result of my calculations[1] in this respect has been in the direction of proving an increased number of cells in the more mature bodies. Now, assuming that I have made so large an error as $\frac{1}{3}$ of the total number of cells in the larger, the two would still contain an equal number of cells disseminated through the yolk. But on the hypothesis there ought to be a very considerably less number of cells in the larger body. It is clear therefore that this hypothesis cannot be maintained; and as there is no ground for assuming any third origin of the cells, it seems most probable that they have been largely derived from the proliferation of the follicular layer.

Among those which I have included in this same stage are many that are probably, owing to their smaller size, younger than others which are larger. I have not, however, thought it worth while to separate these into two distinct stages, since they are both characterized by the extraordinary activity of the follicular epithelium, and by the presence of masses of yolk in the interior of the follicle, in which are imbedded numerous cells, themselves filled with yolk-spherules. As a general rule the smaller bodies belonging to this stage can be distinguished from the larger by the more crowded follicular cells; these are smaller, placed closer together, and not confined to a single layer in the smaller, and therefore less mature, specimens; in the larger bodies these cells have increased in size, the nuclei are not so crowded together, and the cells form but a single layer. This condition can hardly have been arrived at by the mere mechanical growth in size of the whole body, which would tend to stretch, and therefore to reduce to a single layer of cells, the follicular epithelium; the cells themselves must either have degenerated, evacuating their contents into the interior, or must have

[1] I have also calculated the number of cells contained in the interior of two other pairs of ova belonging to this stage, and of about the same relative size.

migrated into the interior; the principal evidence is in favour of the latter supposition.

The central mass itself is, as already stated, mainly occupied by a mass of yolk-spherules; these are deeply stained by the colouring-reagent. Among the mass of yolk-spherules are numerous cells which are more scattered in later stages; many of them are in course of degeneration, as evinced by the characters of the nuclei. In my former paper I have figured (*loc. cit.* pl. xxix. figs. 9–20) a number of such cells, and need not refer to the matter again here.

In no case could I observe the faintest trace of a germinal vesicle, nor does any one of the cells found in the interior of the body show any preponderance in size, or difference of any kind from the rest. The vascular layer is highly developed in this stage, in accord with the rapid growth of the follicular cells.

Outside the vascular layer is the secondary follicle-layer, which has much dwindled in importance, and has a still closer resemblance to stroma than it had in the earlier stages.

Contents of the Ovary of Ceratodus.

The ovary of *Ceratodus*, like that of *Protopterus*, contains, besides the ordinary ova which follow a normal course of development, other remarkable structures similar to those of *Protopterus*. The normal kind of ova, which are by far the most abundant, represent a single cell, and agree in most details of structure with the ova of Amphibia and the corresponding ova in *Protopterus*. The mature ova are filled with rounded yolk-spherules approximately of equal size, and entirely unstained by prolonged immersion in borax carmine; the periphery of the ovum is occupied by a delicate layer of egg-protoplasm in which pigment-granules are imbedded; the egg is covered by only a single membrane, which is moderately thick with radial pores; the follicular epithelium is a single layer of flattened cells, of which the nuclei alone are obvious in my preparations. Some ova belonging to this stage are figured by Ayers in his paper. In rather younger ova there is a ball of protoplasm in the centre surrounding the germinal vesicle, and not yet invaded by the formation of yolk; the germinal vesicle has a peripheral row of germinal spots as in *Protopterus*. The formation of the yolk appears also to be on the whole very similar to the process described in *Protopterus*. Aggregations of yolk-granules make their appearance throughout the ovum, but do not seem to be confined at first to the peripheral layers. In the younger stages the yolk-particles are deeply stained by borax carmine, but not in the adult ova.

I have already stated in the remarks introductory to this paper that, as regards my specimens, *Ceratodus* differs from *Protopterus* in the extreme rarity of those bodies which are apparently formed by a fusion of a number of distinct cells. So very rare are these structures that after a diligent search I only succeeded in discovering a single case which could be in all probability referred to Stage I. in the developmental history of *Protopterus* (see p. 508). Certain other

problematical structures will be described in this portion of my paper, although they do not appear to belong to the same series as that which I shall now describe.

The body (fig. 25) is decidedly smaller than in *Protopterus*; it corresponds, however, very nearly to the stage illustrated in fig. 9 of Plate LIII., and which is fully described on p. 513, where the slight differences which it presents from other individuals belonging to Stage I. are pointed out. The correspondence is in structure as well as in size.

The body is placed at some little distance from the external surface of the ovary, but is connected with the germinal epithelium of the surface of the ovary by a slender pedicle of cells; it consists, like the corresponding structure of *Protopterus*, of a hollow sphere of cells which enclose a central mass; the peripheral and central cells are also more or less independent. The peripheral layer of cells forms a continuous whole, but a closer examination shows it to be made up of two layers which are occasionally very distinctly separable from each other. The outermost layer appears to have originated from the germinal epithelium; its nuclei are large, rounded, or oval, and closely pressed together; the cells themselves, which contain these nuclei, have for the most part a stroma-like appearance (see p. 508). Within this layer, which is often several cells thick, is a layer of blood-vessels ensheathed in a mass of tissue of a fibrous retiform character, the fibres (fig. 25, *a*) for the most part forming a layer running parallel with the circumference of the ovum, with interspersed nuclei; this tissue, from its general appearance and from its intimate connection with the blood-cavities (fig. 25, *bl*), is probably derived, like the blood-vessels, from ingrowths of stroma. The nuclei of this presumed stroma-layer are on the whole more elongated in form than those of the outer layer; the blood-vessels were gorged with blood.

The central mass of cells is probably during life in contact with the peripheral layers, but it appeared to be for the greater part at least quite distinct from it, there being no transition between its cells and those of the peripheral layers. The central cells appear to be closely similar in structure to the corresponding cells in *Protopterus*; the protoplasm of the cell is reticulate with large spaces left between the individual strands which form the network; the nucleus is of moderate size, round or oval in shape. Here and there (figs. 25, 26, *f.e*) some of the central cells were disposed in a row, one cell thick, round the periphery, closely applied to the innermost (stroma) layer of the peripheral layers. This is possibly to be compared to the true follicle-layer in *Protopterus*.

Although, as I have already stated, the material at my disposal in the case of *Ceratodus* was not well preserved, certain portions of the ovary were in a better condition than others, and, generally speaking, it was quite possible to make out the relations of the different parts of the organ, both the stroma and contained ova, as well as occasionally the germinal epithelium on the outside; the minutiæ of structure of the different cells were disguised by the inferior

state of preservation, but in most cases the nuclei were very well preserved indeed, showing the rounded or oval form and the granular contents. This will not apply to the germinal vesicle of the ova, which were usually rather altered, showing, however, the peripheral layer of germinal spots. It does not seem likely, therefore, that the structure just described has been so altered as to render its identification impossible.

As already said, the evidence of the existence in *Ceratodus* of the structure formed by a fusion of cells depends upon only one case, which is an early stage corresponding to that of *Protopterus* figured on Plate LIII. fig. 9. This is the only example that I have succeeded in finding after a careful examination of many hundred sections. Besides these, my sections of the ovary contain a few peculiar structures, displayed in figs. 3, 21–23, which are certainly not referable to the same series as the last, and concerning the nature and homologies of which I am in great doubt. The material at my disposal was not sufficiently well preserved to enable me to speak with certainty as to every detail of structure; and I only succeeded in finding a very few of the bodies in question, so that the following account is necessarily meagre.

In fig. 3 of Plate LII. is represented what I believe to be the earliest stage: it consists of a spherical mass of cells bounded externally by an apparently structureless membrane, which separates them from the surrounding ovarian stroma (*a*); the cells are mainly disposed round the periphery of the sphere, the centre of which is largely occupied by spaces in which there is no trace of any fluid; the cells are small and rounded, with a large spherical or oval nucleus; the nucleus, but not the cell-protoplasm, is deeply stained by the reagent used (borax carmine). The cells are exactly similar to the germinal cells so far as I could see; and the conditions I shall describe in the next stage lead me to infer that they are derived from the germinal epithelium.

The second stage differs from that just described in being still continuous with the germinal epithelium; this fact would seem to point to its being an earlier stage than that just described, were it not for another difference in its structure. The body consists, like the last stage, of a mass of cells, but in the interior is a patch of granular substance, which shows a different reaction to the staining-fluid. It is hardly at all affected by the borax carmine and has a yellowish tinge. This central mass encloses here and there a few of the more peripherally-placed cells.

Of the next two stages, displayed in figs. 21–23, I am uncertain which ought to be regarded as the earlier.

In both the mass of cells has dwindled down to a single layer of peripherally-placed cells (*b*), which, as before, are separated from the stroma of the ovary by a conspicuous and apparently structureless membrane. In the centre of the cells is a spherical or oval mass of a substance somewhat granular in appearance, which is not separated from the peripheral layer of cells by any membrane, but only by shrinkage. This mass (figs. 21 and 22) is of a yellowish tint, hardly

affected by the borax carmine, and is throughout of a similar structure; there is no structure resembling a nucleus to be seen. This central mass is clearly a further development of the condition described in the second stage.

In one example, displayed in fig. 23, there is a difference from the condition just described in the presence of a few cells imbedded in the central mass, but clearly distinguishable from it by the nuclei being deeply stained. The cell-protoplasm was, however, hardly distinguishable from the surrounding mass. In the other example (fig. 21) the central mass contained no such cells.

With the exception that it possesses no nucleus, this structure resembles very closely Platner's figure of the Gasteropod ovum[1], which contains a number of cells ("Nährzellen") within its substance, derived from similar cells lying around the ovum.

The first two stages described are about equal in size; the latter two are also about equal to each other, but considerably larger (twice the size) of the former. The comparison of sizes quite supports my identification of the latter two as the later stages in development; and there can be no doubt, I think, that they all belong to the same series.

These structures obviously bear a certain resemblance to the multicellular bodies in this fish and in *Protopterus*; and if I had not succeeded in finding in *Ceratodus* another structure undoubtedly corresponding to the multicellular body of *Protopterus*, I should have certainly regarded the structures at present under discussion as the representatives of the latter.

The principal difference appears to be the non-formation of any secondary follicle-layer, the absence of any special vascular supply, and the fact that yolk is not formed in the early stages. With regard, however, to the apparent absence of the extra-follicular layer, it must be remembered that the close resemblance of the layer to a layer of stroma-cells has already been dwelt upon (p. 508). It seems to me very possible that the structure just described is formed by the fusion of the protoplasm of the centrally-placed cells, the nuclei themselves gradually disappearing.

An examination of better material must, however, settle the question.

General Conclusions, and Comparison of Ova with those of other Vertebrates and Invertebrates.

The general conclusions to be drawn from the facts, in so far as they refer to the Dipnoi, have been partly summed up in the *résumé* at the end of my former paper on this subject. It may be taken as a proved fact that the ovary in the Dipnoi contains two kinds of structures developed from the germinal epithelium. The first kind is an ovum, the equivalent of a single cell, and is similar in all essentials to the ovum in the Amphibia. The second structure, which is very commonly met with in *Protopterus* and but rarely in

[1] "Zur Bildung d. Geschlechtsproducten bei den Pulmonaten," Arch. f. mikr. Anat. Bd. xxvi. (1886) p. 599.

Ceratodus, is the resultant of a large number of cells the protoplasm of some of which undergoes certain changes and forms a more or less fluid mass with the original nuclei suspended in it; this mass appears around and between the rest of the cells, which are destined for its nutrition. The whole structure is surrounded by a definite follicular layer, which also shares in its nutrition by the formation of yolk in its cells and their proliferation inwards. These bodies are surrounded by cellular layers which correspond exactly to the layers which surround the ova of other vertebrates; the difference is that instead of there being a single cell which grows at the expense of the rest, the interior of the mass is formed by numerous cells, all equivalent.

The bodies may be distinguished as *multicellular* or *plasmodial* from the ordinary *unicellular* ova. The share which the follicular epithelium takes in the nutrition of the ovum, I have discussed in detail in my former paper and need not refer to it again here, except to remark that the elaboration of food-material in the follicular layer and its absorption by the ovum has of course no relation whatever to my view that the ovum is a cell-complex. Certain writers have adduced arguments of this kind as a disproof of the unicellular nature of the ovum, which to my mind have no force.

On the other hand, the developmental facts with respect to the cells within the follicle appear to me to be difficult to interpret otherwise than on the assumption that the ovum has the value of more than a single cell.

It is true that I have been unable to detect any earlier stages than the one figured on Plate LII. fig. 1; but the intermediate stages between that and the mature ovum are fairly complete. The discovery of the earlier stages is of great importance; it would decide among others the very important question whether the central mass of cells is, or is not, derived from primitive ova recognizable as such in the germinal epithelium, and whether or not the central mass of cells is formed by the migration inwards of a number of these cells or by the repeated division of one. But, whatever may be the answer to these questions, I have, I think, proved that the ovum is formed out of this central mass of cells. Some of these cells are apparently used as pabulum, but others fuse together into a mass of semifluid substance, which bears a very close resemblance to the liquor folliculi of the mammalian follicle. The resemblance is still more striking if we accept Waldeyer's statements that the liquor folliculi is produced by a direct metamorphosis of the follicular cells, their nuclei remaining, as in the case of *Protopterus*, suspended in it. This substance, however, in *Protopterus* has not a mere passive function, serving, as in the mammal, to aid in the expulsion of the ripe ovum, possibly also in its nutrition; it retains the activity of the cells from which it is derived and secretes yolk; it must therefore be looked upon rather as a plasmodium of these cells than a product of their degeneration, although its deep staining with borax carmine, as opposed to the very light staining of the remaining cells, indicates some chemical change. Furthermore, there is no evidence of any

filled with yolk-particles at the expense of their protoplasm must tend to lose their activity for movement, their energy being spent in the elaboration of yolk; again, the thick layer of cells surrounding the central cells would prevent any of the central cells from leaving the interior of the follicle; the result of further growth would therefore necessarily lead either to the development of a number of distinct ova remaining permanently within the follicle, or to the excessive development of one of the cells, which would ultimately form the ovum, or, finally, to the formation of a single ovum out of the whole mass of cells. There are no facts which point to the truth of either of the first two alternatives, while all the facts at my disposal appear to prove the third alternative; accordingly the temporary fusion of the primitive ova in the Elasmobranch nest and the degeneration of some of them becomes permanent in the Dipnoi, the ovum being the equivalent of a whole "nest." Both Palæontology and Anatomy point to the great age of the Dipnoi, which may therefore easily be supposed to have retained ancient characters in the structure of the ova, as they undoubtedly have in the structure of the genital ducts. It is more generally believed that the Elasmobranchs are at a still lower level of organization; if, however, as Mr. Howes has pointed out to me, the Chimæroids are the ancestors both of Elasmobranchs and Dipnoi, it may as easily be supposed that the egg-nest of the former has been derived from the egg-nest of the Dipnoi, as that the converse process has taken place. In this case the temporary fusion of primitive ova in the Sharks and Rays is a reminiscence of their permanent fusion in *Protopterus* and *Ceratodus*. It does not seem to me possible at present to say which of these views is correct; nor indeed can any comparison at all of the two structures have any great weight until the structure of the ovary has been thoroughly examined in such types as *Chimæra* and some of the more primitive Sharks.

On the whole it appears to me possible to regard these remarkable structures in the Dipnoi as corresponding to the egg-nests of other Vertebrates; but the apparent absence of any protoplasm in the yolk-mass renders it extremely unlikely that the structure develops into an embryo[1]; on the other hand it is often very difficult, in an ovum full of yolk, to distinguish the protoplasmic matrix; it is probable, however, that these structures do not undergo any further

[1] I observed several ova undergoing degeneration—in one case belonging to the type discussed here. The follicular epithelium was in a condition of active degeneration, the cells becoming detached and passing into the interior of the ovum. (This process is not to be confounded with the *nutrition* of the ovum by the follicular cells recorded in this paper and in my last; in the latter case the follicular cells are large, crammed with yolk-particles, and remain a continuous layer; in the degenerating ovum the follicular cells have decreased in size, contain little yolk, and great gaps are left by the disappearance of the cells.) The yolk has also undergone great changes, the yolk-spherules exhibit a vacuolated appearance and are of more irregular size, as if a number had become converted into fat-drops and had run together; the amount of yolk also was less, and the ovum in consequence was collapsed and of irregular shape; at several points the walls of the ovum were altogether indistinguishable. The way in which the ovum degenerates does not in fact

changes, though the degeneration of a few out of an immense number (see footnote) is hardly proof of this. If I were in a position to deny the presence of a germinal vesicle, the absence of this essential element in the ovum would be evidence of some force in the same direction. On the other hand, the energy showed by the central cells and the cells of the follicular epithelium would be entirely thrown away in this case; and it is very difficult to imagine the continuance of such a wasteful process in the ovary—the organ chiefly concerned with the preservation of the race[1].

A formation of ova in the Vertebrata by a fusion of cells has been stated to exist, but has been subsequently denied.

Goette's observations on the formation of the ovum in *Bombinator*[2], referred to in my former paper, have been explained away by Nussbaum[3], who considers that the polynuclear condition described by Goette is the result of the proliferation of the nucleus of a primitive germinal cell, and is not produced by the approximation of the nuclei of a number of distinct cells which subsequently are fused.

The observations of v. Siebold[4] are of interest in relation to this question.

In *Apus* the ova are formed in spherical acini which contain a number of cells of which one grows at the expense of the rest. This cell finally comes to occupy the whole of the interior of its acinus, the remaining cells dwindling indefinitely; the nucleus disappears, and yolk-formation sets in. When the cell has been, for the most part, converted into yolk it moves down the duct which connects the acinus with one of the branching tubes of the ovary, and there fuses with one or more cells which have been produced in other acini by a similar course of development. The fused mass becomes surrounded by a membrane, and is the ovum. In my preliminary notice in the 'Zoologischer Anzeiger' I have referred to the observations of v. Siebold, and

differ very widely from a description (Arch. für mikr. Anat. 1886) of the degenerating ovum of the trout.

I may also take this opportunity of referring to an ovum of *Ceratodus* in a similar condition of degeneration. I erroneously mentioned this ovum (Zool. Anzeig. No. 236) as a nearly fully mature ovum belonging to the multicellular or plasmodial type; it may very likely belong to this type, but the appearances which it presents are indicative of degeneration, and not of maturation. The follicular epithelium is not separated by any membrane from the contents of the ovum (fig. 2); its cells in a few cases are loaded with brown pigment, and many of them have migrated into the ovum, the contents of which have been largely absorbed, probably by these cells; in consequence of this the ovum is collapsed.

I have noticed a similar state of affairs in the ovary of a newt (*Molge waltlii*), which I purpose to describe on some future occasion.

[1] It has been suggested to me, in conversation, by Prof. Lankester that these structures may serve as food for the embryos, being deposited along with the ova, or that they may be reservoirs of nutritive material aiding in the growth of the intra-ovarian ova. Either of these suggestions appears to me to be extremely plausible.

[2] Arch. f. mikr. Anat. Bd. xviii.

[3] Entwickelungsgeschichte der Unke.

[4] Beiträge zur Parthenogenese der Arthropoden. Leipsic, 1871.

erroneously stated that there had been no confirmation or refutation of the truth of his discoveries; I find, however, that I have unwittingly ignored the contents of a paper by H. Ludwig[1], in which there are described a series of important investigations of the ovary of *Apus*. Ludwig finds that there is nothing abnormal in the formation of the ova, and that a number of them do not coalesce as stated by v. Siebold; at least there is no real fusion of the ova, only an accidental running together of the contents of several acini due to ruptures. Ludwig's account is so circumstantial, that there can be no reasonable doubt that the ova of *Apus* are not formed by the concrescence of several cells. The only other instance that I am acquainted with in which the ovum has been stated to arise from the fusion of a number of cells is in the Rotifer *Lacinularia*.

A curiously similar mode of development of the ovum has been recorded by Huxley in *Lacinularia*. A number of cells of the ovary become compacted together, enclosed in a common membrane, and break away to form an ovum, which is, according to Huxley, *never fertilized but develops parthenogenetically*. It is true that the statement about the non-fertilization of these ova has been questioned by a later observer[2], but much weight must obviously be given to the observations of the discoverer of the formation of the 'winter ova' in *Lacinularia*. The mode of origin of these ova is closely parallel to that which I have described above in *Protopterus* and *Ceratodus*. The ovary in the Rotifer consists of a mass of cells, some of which develop into ova, and all of which are comparable of course to the germinal cells in the ovary of the Vertebrate. The fusion of a number of these to form a single ovum is therefore clearly analogous to the fusion of a number of germinal cells in *Protopterus* and *Ceratodus*.

EXPLANATION OF THE PLATES.

PLATE LII.

Fig. 1. Multicellular body in ovary of *Protopterus*, Stage I. *g.e*, germinal epithelium on surface of ovary; *f.e*, follicular epithelium; *f.e'*, secondary follicle-layer; *bl*, blood-vessels; *c*, central cells; *n*, nuclei of central cells; *p*, mass formed by the fusion of the cell-protoplasm of central cells.

2. A portion of an adult ovum of *Ceratodus* in which the egg-membranes have disappeared prior to degeneration of ovum. *a*, stroma-layer; *f.e*, follicular layer; *y*, yolk-spherules.

3. Nest of germinal cells in ovary of *Ceratodus*. *a*, nucleus of stroma-cell; *b*, follicular layer; *d*, central cells.

4. Lymph-cells (?) from multicellular body of *Protopterus*.

5. Nuclei of germinal cells from secondary follicle-layer of body, illustrated in fig. 1. *a*, a nucleus from one of the same cells on the side of the body opposite to the area of invagination.

PLATE LIII.

Fig. 6. Transverse section through a portion of outer surface of multicellular

[1] Arbeit. a. d. Zool.-zoot. Inst. Würzburg, Bd. i.
[2] See Cohn, Zeitschr. f. wiss. Zool. Bd. vii. (1856).

body (Plate LII. fig. 1) in a later stage. Lettering as in last plate.

Fig. 7, 8. Transverse sections through a portion of outer surface of multicellular body in a later stage. *a*, degenerating nuclei; other lettering as before.

9. Multicellular body from ovum of *Protopterus*, differing from that illustrated in fig. 1 mainly by the absence of follicular layer. Lettering as before.

10. Portion of secondary follicular layer at point marked with an arrow in preceding figure; more highly magnified.

11. Central mass of a body belonging to same stage as that figured in fig. 9, to show the mass (*p*) formed by the breaking down of the central cells (*c*), the nuclei of which (*a*) are here and there imbedded in it.

12. One of central cells (Plate LII. fig. 1, *c*) with a large number of nuclei.

13. Three central cells from Stage I. (fig. 1, *b*), to show difference in nuclei.

14–20. Central cells very much enlarged from Plate LII. fig. 1, to show the different stages in degeneration of nuclei.

21. Nest of germinal cells in ovary of *Ceratodus* at a later stage than that in Plate LII. fig. 3. Lettering as in that figure.

PLATE LIV.

Fig. 22. A portion of body represented in Plate LIII. fig. 21, more highly magnified. Lettering as in fig. 21.

23. Nest of germinal cells in ovary of *Ceratodus* at a stage near to that represented in figs. 21 and 22. Lettering as in those figures.

24. Portion of multicellular body in ovary of *Protopterus*, to show masses of yolk (*a*), apparently corresponding to areas occupied by fused masses of protoplasm in earlier stages (*p* in figs. 1, 9, and 11).

25. Multicellular body of *Ceratodus* at a stage corresponding to that of *Protopterus*, illustrated in fig. 1. *a*, fibrous tissue of stroma-layer; other lettering as in fig. 1.

26. A portion of central cells of multicellular body of *Ceratodus*, more highly magnified. Lettering as in fig. 1.

27–31. Central cells of multicellular body of *Protopterus* at an early stage, to show commencing yolk.

32, 33. Central cells of ditto, to show disintegrating nucleus.

2. On the Anatomy and Systematic Position of the Liassic Selachian, *Squaloraja polyspondyla*, Agassiz. By A. SMITH WOODWARD, F.G.S., of the British Museum (Natural History).

[Received October 18, 1886.]

(Plate LV.)

SUMMARY OF PREVIOUS RESEARCHES.

The prolific fish-beds of the Liassic formation have yielded so much valuable material during recent years, that it is now possible to considerably supplement the original anatomical memoirs of Agassiz, Egerton, and the other pioneers in early Mesozoic ichthyology. Many specific types that were at first only known from very

imperfect fragments are already represented by remains as complete as can be expected in a fossil state; and such remains being now forthcoming in the case of the remarkable Selachian, *Squaloraja polyspondyla*, it is proposed once more to bring this interesting form before the notice of zoologists.

The first scientific account of the genus and species under consideration was communicated by Dr. H. Riley to the Geological Society in 1833, and subsequently published, with one slight modification, in that Society's 'Transactions'[1]. A fine specimen in the Bristol Museum, displaying the head and vertebral column, with obscure fragments of the appendicular skeleton, formed the subject of this memoir, and notwithstanding the author's limited means of comparison, he rightly recognized its affinities both with the true Sharks and the Rays, and expressed the circumstance in its generic name. Riley, however, misinterpreted the snout and rostral spine, regarding these as jaws, and originally suggesting the specific name of *dolichognatha* in allusion to their elongated shape; but Agassiz pointed out to him the error in time for correction in an appended note (*l. c.* p. 85), and the distinguished author of the 'Poissons Fossiles' again figured and described the specimen in one of the later parts of his third volume[2]. Agassiz, indeed, was already acquainted with portions of the vertebral column and dermal tubercles of the fish, and had enumerated these in his preliminary manuscript notes under the name of *Spinacorhinus polyspondylus*; but Riley's prior description necessitated the adoption of the generic title *Squaloraja*, though his withdrawal of '*dolichognatha*' allowed the Agassizian specific name to be retained.

But although Agassiz's extensive acquaintance with the Selachian order enabled him to throw further light upon the Liassic genus, and point out its remarkable resemblances to the Pristiophoridæ, he still failed to comprehend the precise nature of the curious snout, and it was left to Mr. William Davies, of the British Museum, with still more materials at his disposal, to offer a complete explanation. In an important paper in the 'Geological Magazine' for April 1872[3], he pointed out that the uppermost rostral prolongation was a true spine, homologous with the frontal spine of the male Chimæroid *Ischyodus orthorhinus*, then made known by Sir Philip Egerton; and he further demonstrated the absence of the appendage in some individuals, which were naturally regarded as females. Davies, moreover, added some notes on the vertebral column, and Hasse has more recently[4] published an account of the structure of the vertebræ in great detail.

[1] H. Riley, "On the Squaloraja," Trans. Geol. Soc. [2] vol. v. 1833, pp. 83–88, pl. iv.

[2] L. Agassiz, 'Recherches sur les Poissons Fossiles,' vol. iii. p. 379, pls. 42, 43.

[3] W. Davies, "On the Rostral Prolongations of *Squaloraja polyspondyla*, Ag.," Geol. Mag. vol. ix. (1872) pp. 145–150, pl. iv.

[4] C. Hasse, "Einige seltene paläontologische Funde," Palæontographica, vol. xxxi. (1885) p. 4, pl. i. figs. 2, 3.

New Specimens.

Up to the present time, therefore, there is no very precise information in regard to the structural features of *Squaloraja* beyond the descriptions of dermal appendages, the snout, and the vertebral column. But the British Museum again furnishes materials for an addition to our knowledge (thanks, especially, to a recent purchase from Mrs. Dollin of Lyme Regis, and the acquisition of the Egerton and Enniskillen collections), and it is upon the national fossils that the present contribution is based. All the specimens are from the well-known Lower Lias of Lyme Regis, Dorsetshire; and, adding Roman numerals for convenience of future reference, they may be briefly enumerated as follows:—

I. The nearly complete skeleton of a male, wanting only a small portion of the caudal region, and shown of the natural size in Plate LV. fig. 1. This specimen exhibits the dorsal aspect, and is particularly interesting on account of the preservation of the limbs and limb-girdles, which have not hitherto been so well displayed. The cranial cartilages are not remarkably distinct, and the dentition is only feebly indicated; but the form and proportions of the snout and rostral spine are very satisfactorily shown, and the vertebral column, except anteriorly, is in a comparatively good state of preservation. (Brit. Mus. no. P 2276.)

II. Portions of the vertebral column and the crushed cranium of an old individual, probably female. (Egerton Collection, Brit. Mus. no. P 2079.)

III. Portion of the skeleton of a young female, viewed from the ventral aspect. There are only obscure remains of the cranial cartilages, but the snout and dentition are beautifully exhibited. The caudal region is also well preserved, but all traces of the abdomen have been removed and destroyed. (Enniskillen Collection, Brit. Mus. no. P 3184.)

IV. A fine skull of a male individual, seen from above, and exhibiting the form of the head, dentition, and rostral spine. (Brit. Mus. no. 47402.)

V. A detached rostral spine, somewhat smaller and less robust than that figured by Davies (*l. c.* fig. 3), but equally curved, the broadened base of insertion wanting. (Enniskillen Collection, Brit. Mus. no. P 3186.)

VI. A complete, much-curved rostral spine, exhibiting only the superior aspect. (Enniskillen Collection, Brit. Mus. no. P 3187.)

VII. The anterior two thirds of a rostral spine, probably belonging to an animal even larger than no. II. (Enniskillen Collection, Brit. Mus. no. P 4574.)

VIII. An extraordinarily slender and acuminate small rostral spine, seen from the dorsal aspect. (Egerton Collection, Brit. Mus. no. P 2081.)

The specimens numbered I. to IV. are almost certainly referable to the already named species, *S. polyspondyla*, Ag., and owe their slight variability to differences in age, as indicated by the condition

of the vertebral column. But the detached spines would appear to afford evidence of two or more forms as yet unrecognized, and the small example, no. VIII., is particularly distinct. It is very possible, indeed, that when more specimens of the genus are available for study, the characters of the rostral appendage will enter prominently into the diagnosis of each species; but I only venture, on present evidence, to distinguish the possessor of the small spine no. VIII. (Plate LV. fig. 6), and this may be appropriately designated by the name of *S. tenuispina*. The fossil in question is separated from its homologue in the known species by its much more slender and acuminate shape, and possibly, though not certainly, by the slight concavity of the proximal half of its upper surface.

During the investigation of these fossils I have had the privilege of discussing the subject with several zoological and palæontological friends, to whom I am indebted for some valuable suggestions noted in the following pages. I desire especially to return thanks to Prof. W. K. Parker, F.R.S., for much kind assistance in regard to the skull; to Mr. G. B. Howes, for a continuance of the help so freely given on previous occasions; to Mr. G. A. Boulenger, for the facilities afforded in the study of the recent Selachians under his care; and to my senior colleague, Mr. William Davies, to whose earlier work reference is so frequently made in the sequel.

Anatomical Description.

External Form.—Commencing the description with a brief notice of the general external form of *Squoloraja*, attention may be first directed to the beautiful specimen no. I., represented in Plate LV. fig. 1. As the shape of the head had already led Agassiz and Davies to suspect, the proportions are found to be very similar to those of the living *Pristiophorus*. Assuming that about three centimetres are missing from the tail of the specimen, the snout will have occupied one quarter of the entire length of the animal. The body must have been but slightly compressed from above downwards, and the pectoral fins were undoubtedly free, having no connection with the head; the shoulder-girdle, however, is placed relatively nearer to the chondrocranium than is the case either in *Pristiophorus* or *Pristis*, though appearances are not improbably deceptive, owing to crushing during fossilization. It is impossible, of course, to determine whether the gill-openings were ventral or lateral, and scarcely any traces of the branchial arches have been preserved. The pectoral fins, as usual, are much larger than the ventrals, and the tail is long and slender, without spine, as admirably shown in no. III. (fig. 7). Unfortunately, all sure indications of dorsal and caudal fins are wanting, though it is scarcely likely that these appendages were absent in the living fish.

Dermal Structures[1].—In regard to the integument and its appendages, the new fossils afford some interesting additional information. No less than eight rostral spines are now available for study; and

[1] The dentition will be more conveniently treated in a later section, p. 534.

the specimens numbered I. and III. reveal a few hitherto unnoted facts concerning the arrangement of the small prickly tubercles.

As already indicated in Davies's large figure, but still more satisfactorily shown in our Plate LV. fig. 1, a series of the tubercles with especially long recurved hooklets is arranged along either edge of the prenasal (intertrabecular) cartilage; and these two rows are precisely paralleled in the snout of certain living species of *Rhinobatus* (e. g. *R. granulatus*). But immediately at the base of the rostrum, where the cartilage is particularly firm and expanded into two lateral elevations (Davies, fig. 2), the tubercles become densely clustered in a manner not observable in the existing form; and this arrangement is in intimate relation with the overlying spine. The disposition of the tubercles along the trunk, even if originally regular, is now no longer evident, and none but scattered examples are to be seen; but the slender tail was provided on each side with a longitudinal row of comparatively large recurved hooklets, upon inconspicuous bases, as is very well shown in the female, no. III. (fig. 7). A small tuft of these dermal structures also occurs at the extremity of each clasper in no. I. (fig. 1, *hk*), and there are distinct indications of a patch of very minute prickles upon the membranous portion of the (right) ventral fin in the same specimen.

In regard to the rostral spine, Davies's figures and descriptions leave little to be added. The conclusion as to its absence in certain individuals (females) is confirmed in an interesting manner by the fossil no. III., which has been so "developed" on the dorsal aspect that there cannot remain the slightest doubt upon the subject. But a new specimen, from the Enniskillen Collection (no. V. fig. 5), still further demonstrates its prehensile character in the individuals that possess it; for a number of blunt conical tubercles, without radiated bases, are clustered together upon its inferior aspect (*h*) to oppose the group of more slender hooklets already described at the base of the snout. When well preserved (as in no. I.), the surface of the spine exhibits the reticulate impressions of the vessels in a once enveloping integument [1]; and on each side there is a marked longitudinal groove (fig. 5, *g*), which gradually disappears on approaching the distal extremity.

The peculiar *form* of the spine is also worthy of note, more particularly as it is repeated in two other cartilaginous fishes whose remains have been found in the same geological formation; it differs but little from that of the rostral appendage in the chimæroid *Ischyodus* [2], and is still more similar to another Liassic spine which there is some reason for suspecting may belong to the remarkable *Prognathodus* [3]. The peculiar shape, indeed, taken together with

[1] Mr. Boulenger has kindly helped me to determine that the corresponding appendage in the living *Chimæra monstrosa* is likewise covered with skin.

[2] Sir P. Egerton, "On a new Chimæroid Fish from the Lias of Lyme Regis (*Ischyodus orthorhinus*, ♂)," Quart. Journ. Geol. Soc. vol. xxvii. 1871, pp. 275–278, pl. xiii.

[3] Sir P. Egerton, "*Prognathodus Güntheri* (Egerton), a new Genus of Fossil Fish from the Lias of Lyme Regis," Quart. Journ. Geol. Soc. vol. xxviii. 1872, pp. 233–237.

the fact of its occurrence in more than a single type, leads to an interesting speculation, suggested to me by Professor Parker. Compared with the distinct anterior intertrabecular cartilage, which forms the axis of the rostrum in such primitive fishes as the glutinous Hags (*Myxine*)[1], scarcely the slightest difference in form can be noted; and it seems not unlikely that we are here concerned with an admirable illustration of the principle, that the contours of superficial structures appended to the cranium are frequently determined, in the main, by the shape of the fundamental cartilages to which they are attached. The fossils, of course, do not permit a determination of the complete form of the intertrabecular cartilage in any of these types, or of its primitive distinctness; but the slight glimpses that can be obtained are rather favourable than otherwise to such a conclusion.

Of the skin itself in *Squaloraja*, only indefinite patches remain, and no small shagreen granules appear to have been developed in it; but the sharp lateral edge, both of the rostral and caudal regions, is strengthened by a series of minute calcified rings (fig. 1, *d*), evidently quite similar to those stiffening the boundaries of the snout in the living Pristiophoridæ.

Cranium and Mandibular and Hyoid Arches.—Nearly all the large fossils under consideration reveal facts of more or less interest in regard to the structure of the skull; nos. I., II., and IV., with Riley and Davies's specimens, present the dorsal aspect, while no. III. and the fragment shown in Davies's plate, fig. 4, afford some particulars as to the conformation of the ventral surface.

The palato-trabecular region (figs. 1, 2, *pa.tr*) extends far forwards in its present crushed condition, and from the centre is produced the long narrow intertrabecular cartilage (*i.tr*) forming the axis of the snout. From each anterior outer angle of this region there also arises a more slender forwardly directed cartilage (*pr. pa*), which gradually tapers to an incurved point, as admirably shown in the left side of no. IV. (fig. 2). This prolongation evidently served to stiffen the edge of the base of the snout, exactly as its well-developed homologue in the living *Pristiophorus*; and there can be little doubt that it represents a definite prepalatine element, such as has not hitherto been recognized in the skulls of the Selachian order. Its form is almost identical with that of the corresponding cartilage in the Myxinoids, as will be at once seen on referring to Prof. Parker's beautiful figures of *Myxine* and *Bdellostoma*[2]; in these fishes, indeed, the process serves a similar purpose, being likewise placed to strengthen the sides of the rostrum.

Immediately behind the origin of the prepalatine "horns," the lateral boundary of the palato-trabecular region gradually curves inwards for some distance, and then as slowly outwards again until it forms a well-marked autorbital prominence; but the olfactory capsules, in their fossilized state, are totally unrecognizable, though

[1] W. K. Parker, "On the Skeleton of the Marsipobranch Fishes.—Part I. The Myxinoids," Phil. Trans. 1883, pl. x. fig. 2.

[2] W. K. Parker, *loc. cit.* pl. x. figs. 1–3 and pl. xvii. figs. 1–3.

the two excavations at the base of the rostrum in the fragment shown in Davies's fig. 4 evidently testify to their normal proportions and situation. In a line with the prominence is fixed the base of the rostral spine (*r.s*), quite at the hinder extremity of the ethmoidal tract; and still more posteriorly, the chondrocranium begins to exhibit considerable lateral compression, though finally widening to a slightly broader occiput.

Extending backwards from the antorbital process, the slender postpalatine cartilage (*pt.pa*) is preserved in most specimens (especially in no. IV. fig. 2), but there is some uncertainty as to whether it formed a distinct element. It tapers slightly to its distal end, and the crushing during fossilization has usually imparted to it the deceptive appearance of connection with the hyomandibular.

No postorbital process can be observed, and the circumstances of preservation are probably accountable for the absence of any trace of a fontanelle in the cranial roof; but there is an interesting V-shaped protuberance (*a.v*) close to the hinder extremity, evidently representing a fold round the hollow into which opened the *aqueductus vestibuli* (or *ductus endolymphaticus*) of each auditory sac.

On the ventral aspect, the parachordal, or "investing mass" (fig. 3, *iv.m*), is produced posteriorly into a pair of occipital condyles (*oc.c*), as already noted by Riley; and there is a well-marked median ridge (*n*), obviously due to the remains of the primitive notochordal sheath. A median foramen (*c.f*) is also somewhat conspicuous, and, if not the result of accident during fossilization, is evidently the passage for the united internal carotid arteries proceeding to the pituitary body [1].

Of the mandibular and hyoid arches, the hyomandibular cartilage (figs. 1, 2, *hm*) is the only portion satisfactorily preserved. In its crushed condition it is seen to extend from each side of the occiput, curving outwards and forwards, and gradually tapering to the distal extremity. In shape it approximates to that of most "Batoidei," being twice as broad proximally as distally, and its apparent continuity with the cranial roof is probably due to the process of fossilization. Not a trace of the pterygo-quadrate and mandibular cartilages appears exposed to view; but the arrangement of the dental plates in the specimen no. III. (fig. 3, *t*) shows that the two rami of the jaw met at the symphysis in a comparatively acute angle, and were not placed in the same straight line, as is the case in so many living Rays.

But the most remarkable feature to be noticed in the skull of *Squaloraja* is presented in the two pairs of transversely elongated appendages, with reflected ends, arising from *beneath* the narrow part of the palato-trabecular region. These curious structures are not well shown in our fig. 1 (*ci.a*, *ci.b*), but can be studied in their entirety in the large specimens figured by Riley and Davies. The most anterior (*ci.a*) is the larger, and is completely displayed on both sides of the last-named fossil; its total length is equal to three times the width of the skull at the position where it emerges,

[1] See T. J. Parker, 'Zootomy,' 1884, p. 62, fig. 20.

and for two thirds of its extent it is directed outwards and exhibits only very slight tapering; the distal third rapidly diminishes to a pointed extremity and is fixed at right angles to the rest in a backward direction. The hinder appendage (*ci.b*) measures only two thirds the length of the first, and is about half as broad; it likewise has an outward and posterior trend, but (in its fossilized state) is much more gradually arched.

The relatively great size of these appendages renders them somewhat difficult of interpretation, and it is scarcely possible to decide whether they consist of true cartilage or are merely dermal in character. In position they correspond very closely with the hinder labials of many living Selachians, and also with the supposed homologous rods that form the axes of the oral barbels in Myxinoids[1]. But in the latter group these appended "feelers" never seem to extend outwards to a length much exceeding half the breadth of the head; and the largest cirri with which I am acquainted in the Selachians are scarcely longer than the rami of the jaws. It seems likely, however, that the structures in *Squaloraja* are the gigantic representatives of the latter, which are elongated outgrowths of the cartilages of the nasal valves[2].

There is no evidence of anterior labials in the specimens of *Squaloraja* already known.

Dentition.—The dentition of *Squaloraja* is very remarkable and has not hitherto been correctly noted. Some indications are to be observed in specimens I. and II., but the teeth are beautifully displayed both in III. and IV.; moreover, the parts in these two instances are practically identical, showing that there were no variations according to sex, as is the case among certain living Selachians (e.g. *Raja*). The dentition of both jaws is preserved in no. III. (figs. 3, 4), but only that of the right side of the mandible affords a good view of the grinding-surface. Each ramus bears only a single dental plate, sharply marked off in front from its fellow of the opposite side, and exhibiting towards the symphysis a gently tumid prominence. For the anterior two thirds of its length the plate is of nearly uniform breadth, but in the last third the outer border gradually trends inwards, producing a more or less pointed posterior extremity. And the efficiency of the grinding-surface is increased by a series of parallel longitudinal ridges or folds of the enamel, which are distinctly worn down towards the outer functional border. Eleven of these rugæ can be counted on no. III. (fig. 4), while fourteen or fifteen are visible in no. IV; but, except on the *under* surface of the plate in no. II., there are no traces of any sutures between them, and even in this specimen the evidence is somewhat obscure. It appears, however, that there were feebly marked longitudinal divisions corresponding to the several rugæ, and that these became accentuated at the outer edge, allowing of the shedding of the worn-out portions as growth proceeded.

[1] W. K. Parker, *loc. cit.* pp. 385, 399, pls. x., xvii. figs. 1–3.

[2] The "Nasenflügelknorpel" of Müller; see C. Gegenbaur, 'Das Kopfskelet der Selachier,' pp. 97–111, pls. xvi., xvii.

Vertebral Column.—In the subject of fig. 1 the vertebral column is beautifully shown beyond the shoulder-girdle, though somewhat imperfect in front. As already described by previous writers, the vertebræ (fig. 8) are merely slender, concentrically marked rings, of the truly "tectospondylic"[1] type, and in the space just mentioned no less than 340 can be counted; in the abdominal region, sixteen of these occupy the length of a centimetre, while in the tail the proportions are so slightly different that only one more ring is comprised within the same distance. The obscure portion in front of the pectoral girdle measures one and a half centimetres in length, probably representing about 24 vertebræ; and if three centimetres are missing from the end of the tail[2], this loss will indicate an additional 48. The total number is thus found to be approximately 400, as estimated by Davies in the large specimen described in 1872.

In the more aged individuals (*e. g.*, no. II.) the vertebral rings are more robust than those of the apparently young (*e. g.*, no. III.); and it is remarkable that in no example is there any trace of the fusion of the elements in the region of the neck.

But it is not necessary to add a detailed account of the structure of the vertebræ themselves, for they have already been carefully examined and described by no less an authority than Professor Carl Hasse, of Breslau[3]. As the result of his researches in this direction, the latter anatomist concludes that in *Squaloraja* "we have to do with an ancestral form of the now living Pristidæ, a form which, in its development, appears to have advanced beyond the existing Pristiophoridæ, and also beyond the oldest Rhinobatidæ," which he has described from the upper Oolite of Bavaria.

The vertebral arches were not of sufficient consistency to leave the slightest trace in the fossil state.

Appendicular Skeleton.—In the subject of fig. 1, as already remarked, the pectoral fins are sufficiently well preserved to exhibit their complete severance from the cephalic region and their correspondence in general character to those of the living *Pristiophorus*. But the remains of the supporting girdle are much less perfect and satisfactory, and the other known specimens do not appear to throw any further light upon the subject. There can be little doubt, however, that the "girdle" was complete, as in the Rays proper, and the well-defined cartilage (*s.sc*) on the right is evidently the characteristic suprascapula. A faint trace of the posterior boundary of the transverse coracoid bar (*cor*) is also shown on the same side.

The proximal cartilages of the fin are only two in number, and well preserved on both sides of the fossil, though most completely displayed on the left. The preaxial element (*pms*) is elongated in a transverse direction, and appears of almost uniform breadth, though its exact shape is evidently destroyed by crushing; it is relatively small, having only about one quarter the size of the postaxial ele-

[1] C. Hasse, 'Das natürliche System der Elasmobranchier,' allgemeiner Theil (1879), p. 44.

[2] The caudal region of the fossil is not completely shown in fig. 1.

[3] C. Hasse, "Einige seltene paläontologische Funde," Palæontographica, vol. xxxi. (1885) p. 4, pl. i. figs. 2, 3.

ment. The latter (*mtp*) is triangular in form, and elongated antero-posteriorly; the foremost border abuts against the hinder edge of the preaxial cartilage, which it equals in transverse extent; and the inner border curves gradually outwards and backwards to meet the nearly straight external boundary at a posterior apex. Judging from the analogy of living Selachians with fins of a similar type, the posterior of these cartilages may be regarded as the metapterygium; while the anterior element may represent the coalesced pro- and mesopterygium (as in *Pristiophorus*[1]), or it may be wholly mesopterygial, with a minute, indistinguishable propterygium at its proximal angle (as in *Heptanchus* and *Hexanchus*[2]).

Beyond the basal cartilages are arranged the cartilaginous rays of of the fin (*r*). These are somewhat obscured both in front and behind by remains of the integument, and it is uncertain whether the first attached to the preaxial element is stouter than the remainder; twenty rays, however, can still be counted on the right side, and there are traces of sixteen on the left; the foremost thirteen are directed almost transversely or outwards, while the following have a more marked backward inclination.

The *pelvic girdle* and its appendages are rather more satisfactorily displayed than the pectoral structures just described. Anteriorly, on each side, the cartilage is prolonged into a remarkably strong prepubic process (*p.pb*), the base of which occupies one fourth of the entire breadth of the girdle; but the forward extent of the prominence is not determinable, owing to imperfect preservation. Posteriorly, on each side, is a long slender iliac process (*il*), especially well seen on the left, and slightly directed outwards; it is much less robust than the prepubic, and appears of almost uniform breadth throughout; in length it equals twice the width of the transverse pubic cartilage (*pub*). Arising immediately within the point of union of the pubic and iliac regions is the basal cartilage (*b.s*) of the pelvic fin, which exhibits no sutural divisions, and (this specimen being a male) is prolonged backwards into a powerful clasper (*cl*). It curves gradually inwards throughout the whole of its rayed portion, and is of almost uniform breadth. On passing into the claspers, the cartilage becomes more calcified, and perhaps slightly broader. The inner edge is straight, but the outer edge exhibits a gentle sigmoid curve, which results in the widening of the rounded terminal extremity; and at the end of each clasper (especially the left) a small tuft of dermal hooklets (*hk*) is preserved. The fin-rays (*r*), which appear to be completely shown on the right, are altogether twelve in number, and the length of the supporting cartilage is scarcely more than one half of that of the appended clasper. There is no distinct evidence of one or more preaxial rays attached to the girdle itself, and the foremost exhibited is no longer than the remainder.

[1] St. G. Mivart, "Fins of Elasmobranchs," Trans. Zool Soc. vol. x. p. 453, pl. lxxviii. fig.1.

[2] C. Gegenbaur, "Schultergürtel der Wirbelthiere, und Brustflosse der Fische," Untersuch. vergl. Anat. Wirb. 1865, pl. ix. figs. 1, 2.

Affinities and Systematic Position.

Proceeding, lastly, to a consideration of the systematic position of *Squaloraja*, it will be observed that the new fossils here described enable us to arrive at a much more definite conclusion than it has hitherto been possible to formulate. Agassiz has pointed out the affinities of the genus with the Pristiophoridæ; Davies has further indicated some resemblances to the Rhinobatidæ, and been led, by his discovery of the rostral spine, to speculate at least as to its family distinctness; while Günther[1] has likewise refrained from more than a suggestion that it is nearly allied to the first-named group.

That the animal is a true Selachian, there cannot be the slightest doubt; nor does it require more than a superficial glance to recognize its resemblance both to the Sharks proper and the Rays. But (as already mentioned by Davies) the possession of a prehensile rostral spine by the male distinguishes *Squaloraja* from all known members of the order, recent or fossil, and suggests affinities with the Chimæroids[2]; while the enormous size of the barbels or cirri seems to have no parallel, at least among living forms. The dentition, too, is evidently unique, so far as our present knowledge extends, and the marked character of the symphysis is a feature of peculiar interest.

Comparing the genus in other points with the various recognized families upon the "borderland" of the two sections of the Selachii, reference may first be made to the Rhinidæ.

Though agreeing with this group in the very slight depression of the body, it is readily distinguished by the elongation of the snout and the inferior position of the mouth; and the anterior border of the pectoral fin is much less produced forwards, owing to the relatively smaller size of the propterygium.

To the oft-mentioned Pristiophoridæ, *Squaloraja* bears a remarkable resemblance, both in the structure of the snout and the general form of the body; but there are no traces of teeth on either boundary of the rostrum; and if the peculiar dental armature of the jaw may be quoted as a family character, this, too, will exclude the genus from the present group.

From the family of Pristidæ, the Liassic form is still further separated by the characters of the head and its anterior prolongation, though agreeing tolerably well in the shape of the trunk and fins.

There are also certain features that prevent its reference to the Rhinobatidæ. The structure of the pectoral fin in this family is quite distinct from that of the fossil, the propterygial element being prolonged far towards the head, so that in some cases it is connected by skin with the cephalic region.

Its distinctness from other families is too obvious to require any special mention, and *Squaloraja* is thus excluded from all recognized divisions of the order. It may even represent a hitherto unknown

[1] A. Günther, 'Study of Fishes' (1880), p. 335.

[2] We regard the Chimæroidei as a distinct *order*, following Professor Huxley, Proc. Zool. Soc. 1876, p. 57.

suborder, but I venture at least to suggest that the genus may be regarded as the type of a new family; and utilizing, as far as possible, the structural features that commonly enter into the diagnoses of zoologists who study living forms, it may be provisionally defined as follows.

Order SELACHII.

Suborder TECTOSPONDYLI.

Family SQUALORAIIDÆ.

Body scarcely depressed, elongate. Head produced into a long flat rostrum, without lateral teeth. Males with a prehensile spine on the upper part of the snout. Dentition sharply divided at the symphysis. Pectoral fins with small propterygium, free.

EXPLANATION OF PLATE LV.

Fig. 1. Skeleton of *Squaloraja polyspondyla* (male), dorsal aspect. [No. I.] *a.v*, situation of auditory openings; *b.s*, basipterygium of pelvic fin; *ci* (*a* and *b*), cirri; *cl*, clasper; *cor*, coracoid; *d*, edge of skin; *hk*, dermal hooklets; *hm*, hyomandibular; *il*, iliac process; *itr*, intertrabecular rostrum; *mtp*, metapterygium; *oc.c*, occipital condyle; *p.pb*, prepubic process; *pa.tr*, palato-trabecular region; *pax*, preaxial basal cartilage of pectoral fin; *pr.pa*, prepalatine process; *pt.pa*, postpalatine (antorbital) process; *pub*, pubic cartilage; *r*, cartilaginous fin-rays; *r.s*, rostral spine; *s.sc*, suprascapula; *t*, dentition; *v*, vertebral column.

2. Skull of ditto (male), dorsal aspect. [No. IV.] Refs. as above.
3. Skull of ditto (young female), ventral aspect. [No. III.] *c.f*, carotid foramen (?); *iv.m*, investing mass; *n*, notochordal sheath.
4. Dental plate of right mandibular ramus of ditto, twice nat. size. [No. III.]
5. Rostral spine of *Squaloraja*, sp., side view. [No. V.] *h*, hooklets; *g*, lateral groove.
6. Rostral spine of *Squaloraja tenuispina*, dorsal view. [No. VIII.]
7. Tail of *Squaloraja polyspondyla* (young female). [No. III.]
8. Section of vertebra of ditto. [No. II.]

All the specimens are from the Lower Lias of Lyme Regis, and preserved in the British Museum. With the exception of fig. 4, the drawings are of the natural size.

3. On an apparently new Parrot of the Genus *Conurus* living in the Society's Gardens. By P. L. SCLATER, M.A., Ph.D., F.R.S., Secretary to the Society.

[Received October 29, 1886.]

(Plate LVI.)

On the 29th of April last we purchased of Mr. Cross, of Liverpool, an example of a Parrot of the genus *Conurus*, which seems to be different from every other species of the genus yet described. The bird, which is still living in the Parrot-house, is at once distinguishable from its congeners by its red throat and collar, whence I propose to call it

CONURUS RUBRITORQUIS, sp. nov. (Plate LVI.)

Green: white of throat and collar only slightly apparent; at the back of the neck bright red; eye-region naked; bill and feet whitish. Whole length 11·5 inches, wing 5·0, tail 4·7.

Hab. South America or West Indies.

Obs. About the size of *C. enops*, but distinguished by its red throat and green under wing-coverts.

4. On an undescribed *Pimelepterus* from Port Jackson. By J. DOUGLAS OGILBY, Department of Fishes, Aust. Mus. Sydney. (Communicated by F. DAY, C.I.E., F.Z.S.).

[Received November 1, 1886.]

PIMELEPTERUS MERIDIONALIS, sp. nov.

B. vii. D. 10–11/12. A. 3/10. V. 1/5. P. 17. C. 17. L. lat. 57–59. L. tr. 10/19. Cæc. pyl. ca. 460. Vert. 11/15.

Length of head from 4·85 to 5·15, of caudal fin from 4·66 to 5·00, of pectoral fins from 7·00 to 7·20, height of body from 3·00 to 3·20 in the total length. *Eyes*: diameter from 4·00 to 4·50 in the length of the head, from 1·60 to 1·75 in that of the snout, and from 2·00 to 2·30 in the convex interorbital space. Body oblong, compressed; a transverse rounded protuberance in front of the eyes. Cleft of mouth small and transverse; upper jaw rather the longer; the maxilla reaches to below the anterior margin of the orbit. Pre-, sub-, and interopercles entire. *Teeth*: a single row of strong curved conical teeth in each jaw, the horizontal portion of which is of equal length with the vertical; behind these rows are narrow bands of similar but much smaller teeth, which probably are intended to finally replace the outer row; vomer, palatines, and tongue densely crowded with minute teeth[1]. *Fins*: dorsal spines of moderate strength, increasing in length to the seventh, which is about one half the length of the head, and much longer than the rays of the dorsal, though only equal to the first anal ray. Pectorals rounded, rather longer than the ventrals, and from two thirds to three fourths the length of the head. Third anal spine longest and strongest; caudal emarginate. *Scales* feebly ctenoid, extending in front of the eyes; much smaller on the head; 18 between the bases of the ventrals and the lateral line, and 8 between that and the base of the sixth dorsal spine; those below the lateral line larger than those above it. *Pseudobranchiæ* well developed. *Gill-rakers* 20. *Colours* dull brownish grey, with a silvery shade below; upper part of head darkest; all the fins dark. Irides a mixture of orange and silver.

[1] In connection with the dentition of *Pimelepterus*, I may mention that *Girella tricuspidata* has a small patch of palatine teeth. Dr. Günther (Cat. i. p. 427) states that "in one species there is a short series of palatine teeth," but he omits mentioning which species possesses this series.

The examples from which this species is described measure respectively 25·10, 26·10, and 28·30 inches, and were all taken in Port Jackson, where this species is locally known as the "Drummer"[1]. I have never seen a small specimen of this fish.

Breeding: only one, the largest of my specimens, showed any signs of breeding; this was a male with the milt but little developed; all three were taken during the month of August.

As food: not held in any estimation, and commanding no sale in the market, nevertheless it is, in my opinion, quite equal to the other herbivorous Sparoids.

Habits: in these it is a true rock-fish, dwelling in the crevices and indentations of our rocky shores, where it finds abundant food and shelter; it is not given to roaming, and is only taken by the trammel, one end of which is attached to the shore, against which the mesh must actually lie, or else the fish would assuredly pass inside, whence it happens that this species is almost always caught within a few feet of the shore.

Note.—From Dr. Ramsay's MS. notes on Australian Fishes, I find that, so far back as 1881, he noticed these differences with regard to the dentition, but never published any communication thereon.

5. On the South-African Tortoises allied to *Testudo geometrica*. By G. A. Boulenger.

[Received November 2, 1886.]

(Plates LVII. & LVIII.)

Upon the suggestion of the Rev. Mr. Fisk, of Cape Town, who has enriched the Society's Menagerie with so many interesting Reptiles, I have undertaken a reexamination of the South-African Tortoises allied to *Testudo geometrica*, and am able to distinguish as many as seven well-marked species, of which the diagnoses follow. The specimens named *T. trimeni*, after the Director of the South-African Museum, and *T. fiski*, were lately exhibited in the Society's Gardens, and were unrepresented in the Natural History Museum. That named *T. smithi*, after the author of the 'Illustrations of South-African Zoology,' is established on a specimen erroneously referred by Gray to *T. verreauxii*. The true *T. verreauxii* being still unrepresented in our collections, its diagnosis is compiled from Smith's description and figure.

[1] It shares the name with *Girella elevata*, Macleay, and *Pachymetopon grande*, Günth. In the 'Annals and Magazine of Natural History' for November 1886, Dr. Günther described *Pimelepterus sydneyanus*, n. sp., from Port Jackson, and suggested that *Pachymetopon grande* (Cat. Austr. Fish. i. p. 106) may be *Pimelepterus fuscus*, Lacépède, and that *Pachymetopon squamosum*, Macleay and Alleyne (Proc. Linn. N. S. Wales, i. p. 275, pl. ix. f. 1), may be *Pimelepterus cinerascens*, Forsk., or *P. tahmel*, Rüppell.

1. Testudo geometrica, L.

Beak strongly hooked. No large tubercle on the hinder side of the thigh.

Lateral marginal plates not forming an angle with the costals. Nuchal longer than broad. Suture between the gulars longer than that between the anals; suture between the humerals as long as that between the femorals, and much longer than that between the pectorals.

Carapace black, with yellow areolæ from which yellow rays radiate; eight or twelve yellow rays on the vertebrals, nine to twelve on the costals, two to four on the marginals. Plastron brown and yellow, the two colours forming more or less ill-defined rays.

Common in the Cape Peninsula.

2. Testudo tentoria, Bell.

Beak strongly hooked. An enlarged tubercle on the hinder side of the thigh.

Lateral marginals usually not forming an angle with the costals. Nuchal minute. Suture between the gulars as long as, or shorter than, that between the anals; suture between the humerals longer than that between the pectorals or the femorals.

Carapace black, the centre of the areolæ with a small yellow or orange spot, from which narrow rays of the same colour radiate; eight to twelve rays on the vertebral, twelve to fourteen on the costals, three or four on the marginals. Plastron brown in the middle (inner half of abdominal plates), yellow on the sides.

Common at Beaufort West.

3. Testudo trimeni, sp. n. (Plate LVII.)

Beak very feebly hooked. No enlarged tubercle on the hinder side of the thighs.

Lateral marginals forming an angle with the costals, a convex border with a well-marked longitudinal groove. Nuchal minute. Suture between the gulars as long as, or shorter than, that between the anals; suture between the humerals not, or but little, longer than that between the pectorals or the femorals.

Carapace black, with broad yellow or orange rays radiating from a small spot on the areolæ; five or six rays on the vertebral plates, and four to eight on the costals; a yellow spot or streak at the junction of two plates; one or two rays on each marginal. Plastron dark brown in the centre, with yellow rays, yellow on the sides.

Length of carapace of adult 105 millim.

Mouth of the Orange River.

4. Testudo verreauxi, Smith.

Beak very feebly hooked. No enlarged tubercle on the hinder side of the thighs.

Lateral marginals forming an angle with the costals. Nuchal well developed, a little longer than broad. Suture between the gulars as long as that between the anals; suture between the humerals much longer than that between the pectorals or the femorals.

Carapace dark brown, each dorsal and costal plate with four or five yellow rays proceeding from the yellow areolæ. Plastron yellow, dark brown in the middle.

Near the sources of the Orange River.

5. TESTUDO SMITHI, sp. n.

Beak feebly hooked. A large tubercle on the hinder side of the thighs.

Lateral marginals not forming an angle with the costals. Nuchal longer than broad. Suture between the gulars nearly as long as that between the anals; suture between the humerals much longer than that between the pectorals or the femorals.

Carapace dark brown, with radiating, narrow, yellow, black-edged rays, meeting in the centre of the areolæ; plastron yellow, with dark brown rays, the brown predominating in the middle.

Length of carapace of adult 115 millim.

A single specimen, with the mere indication "S. Africa."

6. TESTUDO FISKI, sp. n. (Plate LVIII.)

Beak feebly hooked. A large tubercle on the hinder side of the thigh.

Lateral marginals not forming an angle with the costals. Nuchals small, equilateral. Suture between the gulars shorter than that between the anals; suture between the humerals much longer than that between the pectorals or the femorals.

Carapace with brownish-yellow and black rays of nearly equal width, radiating from the yellow areolæ; six black rays on each vertebral and costal plate, and two on each marginal; the anterior and posterior pair of black rays on the costal and vertebral plates meeting their fellows form three series of ocelli. Plastron dirty yellow, brown in the middle.

Length of carapace of adult 75 millim.

A single male specimen, from De Aar, not far from Hopetown, was presented alive to the Zoological Society by Mr. Fisk.

7. TESTUDO SEMISERRATA, Smith.

Beak strongly hooked. A large tubercle on the hinder side of the thighs.

Lateral marginals not forming an angle with the costals; anterior and posterior marginals forming a strongly serrated edge. Nuchal longer than broad. Suture between the gulars as long as, or longer than, that between the anals; suture between the humerals much longer than that between the pectorals or the femorals.

Carapace with brownish-yellow and dark brown or black radiating rays, usually of nearly equal width, six to ten in number on the vertebral and costal plates. Plastron yellowish, with dark brown rays.

Carapace of adult 115 millim.

Common in the districts between Latakoo and the Tropic of Capricorn.

6. Remarks on Prof. W. K. Parker's paper on the Skull of the Chameleons. By G. A. Boulenger.

[Received November 25, 1886.]

I wish to call attention to what I believe to be a serious error in Prof. Parker's paper on the Skull of the Chameleons, printed in the last volume of the Society's 'Transactions' (vol. xi. p. 77, 1881). The adult skulls of two species are described and figured, viz. that of *Chamæleo vulgaris* (pl. xvi.) and that of *C. pumilus* (pl. xix.); but, through some error, the skull of a newly born *C. pumilus* is represented (pl. xv.) as that of the common species; and as the facts derived from this wrongly-identified species are the basis of the author's arguments, his conclusions receive, in some points at least, a severe shock from this discovery. Any one will, I think, on comparing the figures, recognize the mistake now that attention is drawn to it, and it is incomprehensible that, although Prof. Parker's paper has often been quoted during the five years which have elapsed since its publication, it should not have been noticed before. No wonder the author states that he knows "of no skull whatever in which the roof-bones undergo so great a transformation as in this (*C. vulgaris*)" or that he should be struck by the resemblance of the adult *C. pumilus* to the young *C. vulgaris*, regarding the one as representing a sort of arrested development of the other. I have besides no doubt that he is wrong in his interpretation of the three bones forming the roof of the casque. As recently suggested by Baur, the critical bone "parietal," Parker, should be regarded as the supratemporal, and the "interparietal," Parker, as the parietal. That the three bones are perfectly distinct in the young *C. pumilus* is well shown on pl. xv. fig. 3, and it is not surprising that the sutures should have disappeared on a skull in which the ossification is so expanded, roofing over, as it does, the supratemporal fossæ, and studded with tubercles, as is the case in the adult *C. pumilus*. The statement that the skull of the latter species is less aberrant than that of the common one is therefore incorrect.

Should further proofs be required, beyond the inspection of Prof. Parker's own plates, to establish my identification of the species figured, I might add that the separation of the præ- from the post-frontal is a character of *C. pumilus*, and that the specimen received from Mr. Moore, of Liverpool, was no doubt one of a brood, in the possession of Lady Cust, which was born alive in November 1868, and on which Mr. Moore reported at the time (*cf.* Proc. Lit. & Phys. Soc. Liverp. xxiii. p. 49). Now, it is well known that *C. vulgaris* is oviparous, and the fact that *C. pumilus* is ovoviviparous was recorded as early as 1825 (*cf.* Kaup, Isis, 1825, p. 592).

7. On the Wallaby commonly known as *Lagorchestes fasciatus*. By Oldfield Thomas, Natural History Museum.

[Received November 3, 1886.]

(Plate LIX.)

One of the earliest known of all the Australian Marsupials was the beautiful little banded Wallaby which was discovered in 1804 on the islands in Shark's Bay, Western Australia, by Péron and Lesueur, during their famous voyage round the world, and described by them in 1807 under the name of "*Kangurus fasciatus*"[1].

This species was included by all the earlier writers, with the rest of the *Macropodidæ*, in the single genus then recognized, whether called *Kangurus*, *Macropus*, or *Halmaturus*. In 1842, however, it was placed by Gould, on the authority of the typical specimens in the Paris Museum, in Gray's genus *Bettongia*, although in the same year he described two other specimens of it as "*Lagorchestes albipilis*," thus referring them to the genus made by him just previously for the true Hare-wallabies, of which *Lagorchestes leporoides* is the type.

Gould's two mistakes in referring Péron and Lesueur's species to the Hypsiprymnine genus *Bettongia*, and in separating "*L. albipilis*" from it, were corrected by Waterhouse in his excellent general work on the Marsupials, where the species was described[2] under the name of *Macropus* (*Lagorchestes*) *fasciatus*[3]—an identification accepted by Gould in his 'Mammals of Australia,' where the species is figured as *Lagorchestes fasciatus*, by which name it has since been generally known.

The teeth, as well as the external characters, of *L. fasciatus* were described and figured by Waterhouse, and their differences from those of the true Hare-wallabies noted; but he does not seem to have at all appreciated the importance of these differences, which appear to me to be so great as to compel me, 80 years after the first description of the species, to form a new and special genus for its reception. This genus I propose to call *Lagostrophus*[4].

The differences in dentition between *Lagorchestes* and *Lagostrophus* are not of the trivial and unimportant nature of those characteristic of most of the other genera of this very homogeneous family, but are of a kind to show that *Lagostrophus fasciatus* must have not only different food, but even a different manner of eating it to any of the other members of the subfamily *Macropodinæ*.

On examining the incisors of any of the ordinary Kangaroos and Wallabies (Plate LIX. figs. 8, 9, and 12), we find that the whole set form a widely open curve, and that the sizes and proportions of the

[1] Voy. Terres Austr. i. p. 114, Atl. pl. xxvii.
[2] Vol. i. p. 87 (1846).
[3] Nat. Hist. Mamm. i. p. 87 (1846).
[4] Λαγώς, a Hare, and στρόφος, a band or belt.

individual teeth are more or less as follows:—i^1 is the largest of the three, boldly curved forwards, and descending below the level of the other two, its tip sharp and gauge-shaped; i^2 and i^3 are both much smaller than i^1, very narrow transversely, and provided with sharp cutting-edges; of the two, i^3 is nearly invariably the larger. On placing the mandible in position, the large scalpriform lower incisors fit in naturally between the upper ones, not biting vertically upon their edges, but only upon the palate between them (fig. 9). The lower incisors themselves are very uniform in shape, and always provided with sharp cutting-edges along their inner margins (see the section fig. 10), the animals being able, owing to the looseness of the symphysial joint, to separate and approximate these cutting-edges[1], and thus to utilize them as a pair of scissors with which to snip off leaves or grass.

Turning, on the other hand, to *Lagostrophus fasciatus*, we find a very different state of things. First, the two series of upper incisors are close together, meeting at a sharp angle in front and diverging but little behind (fig. 2). Then as to the size of the teeth, i^1, instead of being the largest, is the smallest of the three, at least in cross section, and even vertically it is but little longer than the others (figs. 2 and 6); in shape it is conical, scarcely curved forwards, and with a blunt, rounded or flattened tip. I^2 and i^3 are each longer antero-posteriorly than i^1 and, when looked at externally, have much the same appearance as those of *Lagorchestes*, except that i^3 is longer than i^2, while in *Lagorchestes* and in nearly all other Kangaroos the reverse in this case. But when looked at from below (fig. 2), there appears a very remarkable difference; instead of being narrow and sharp-edged, they are broad and flat-topped, and are evidently not formed for cutting in the true sense at all. The palatal surface of i^2 forms an even oblong, its breadth slightly more than half its length; while the flatness of i^3 is only modified by a broad shallow groove running along its centre, and terminating at its postero-external corner, where it forms a notch on the outer edge of the tooth evidently homologous with that found in a similar position in the other Wallabies.

Trying now the same experiment as before of placing the lower jaw in position, we see at once what a difference the contraction of the incisor series must make in the manner of using them; for the lower incisors, instead of dropping down between the upper ones, come flat upon the top of them, so that there can only be a grinding- and not a cutting-action between the upper and lower teeth.

An examination of the lower jaw of *L. fasciatus* seems to show that this species, and this alone of the *Macropodinæ*, is without the power of using the two rami independently, as the junction between them, instead of being loose and narrow, is broad, close, and firm, the vertical height at the symphysis being so great in proportion to the size of the jaw as to produce a distinct rounded prominence on

[1] See Murie and Bartlett, P. Z. S. 1866, p. 28.

its lower side corresponding to the chin, no trace of such a prominence being present in any of the other genera.

In natural correlation to this structure of the jaw, the lower incisors themselves have not the sharp inwardly projecting edges characteristic of those of the other Kangaroos, and are merely approximated to each other by their flat inner surfaces; the transverse sections of the incisors of the two forms (figs. 4 and 10) show this difference better than any description.

The incisors and symphysis thus indicating a difference in the motion and use of the mandible, we should naturally expect an appreciable change in the shape of those parts of it by which it is attached and moved, and we therefore find, first, that the coronoid process possesses the very unusual character of having its anterior edge slightly concave in its upper half, all other Kangaroos having this part evenly convex; and, secondly, the condyle, instead of having its length and breadth much about equal, is very much broader than long, and is provided with a broad, flat, supplementary internal process (compare figs. 5 and 11).

Canines, present in *Lagorchestes*, are, as in the majority of the Macropodidæ, wholly absent in *Lagostrophus*.

The two premolars of *Lagostrophus*, *i. e.* the smaller anterior deciduous one, pm^3 of the typical dentition, and the larger permanent one, or pm^4 (fig. 7), are both broad and flattened, their posterior decidedly greater than their anterior diameters, with well-developed internal edges, and with four or five shallow vertical grooves on their external surfaces. The premolars therefore correspond with the incisors in being broader and more flattened than is usual; but the difference, at least in comparison with certain of the broader-toothed species, such as *Macropus brachyurus*, Quoy and Gaim., or *Lagorchestes conspicillatus*, Gould, is by no means so striking as in the case of the incisors.

The molars appear to be precisely similar to those of *Lagorchestes* and the other smaller members of the *Macropodinæ*.

The general shape of the skull (fig. 1) presents nothing very remarkable, except that, owing to the approximation of the two incisor series to each other, the premaxillæ bearing them are very much narrower transversely than usual, and therefore give a peculiar slender and pointed appearance to the muzzle.

With regard to the external characters, we have first to note that the rhinarium, notwithstanding the statements of Gould and Waterhouse, is really practically naked, as in the Wallabies, and is not hairy as in *Lagorchestes*[1]. The hair, in fact, only grows down the centre of the nose to the level of the superior internal angle of the nostrils, leaving the whole of the front of the nasal septum bare.

The hind feet, instead of being short-haired as in *Lagorchestes*, are covered with long bristly hairs, very much as in *Petrogale*, these hairs nearly entirely covering up the narrow naked sole, and hiding the short, but strong and conical, central hind claws.

[1] Even in *Lagorchestes* the hairiness is very variable, *L. conspicillatus* having a very much less hairy muzzle than *L. leporoides*, the type of the genus.

Finally, so far as regards colour, the transverse banding of the lower back presents a style of coloration quite unique in this family, and, beyond the *Macropodidæ*, only found among Marsupials in *Thylacinus* and *Myrmecobius*, in which, however, it is far more prominent than in the Banded Wallaby.

The last point for consideration is the systematic position of *Lagostrophus* among the other genera of the family, and I have therefore compared its characters with those of the sections and groups into which Prof. Garrod, in his classical paper on *Dorcopsis* [1], has divided the subfamily *Macropodinæ*. This comparison shows that the differential characters of *Lagostrophus* are of distinctly greater systematic importance than are those separating Prof. Garrod's Section I. from Section II., as these appear to be by no means so persistent or invariable as that author supposed. I cannot therefore consider *Lagostrophus*, as a group, less than equal in value to all the other genera of the subfamily combined, so that the following is the arrangement that I would propose to substitute for Prof. Garrod's :—

Family MACROPODIDÆ.

Subfamily MACROPODINÆ.

Section I.

A. Genera *Macropus*, *Petrogale*, *Onychogale*, *Lagorchestes*.

B. Genera *Dendrolagus* and *Dorcopsis*.

Section II. Genus *Lagostrophus*.

Subfamily HYPSIPRYMNINÆ.

Section I. Genera *Hypsiprymnus*, *Bettongia*, *Aepyprymnus*.

Subfamily HYPSIPRYMNODONTINÆ.

Section I. Genus *Hypsiprymnodon*.

EXPLANATION OF PLATE LIX.

Fig. 1. *Lagostrophus fasciatus*, upper view of skull.
2. —— ——, palatal view of upper incisor teeth.
3. —— ——, palatal view of upper incisor teeth, with the lower jaw in position.
4. —— ——, outline of transverse section of the two lower incisors.
5. —— ——, right condyle of lower jaw.
6. —— ——, side view of upper and lower incisors.
7. —— ——, palatal view of upper and lower incisors.
8. *Lagorchestes leporoides*, as in fig. 2.
9. —— ——, as in fig. 3.
10. —— ——, as in fig. 4.
11. —— ——, as in fig. 5.
12. —— ——, as in fig. 6.

Fig. 1 is of the natural size; all the others are magnified three times.

[1] P. Z. S. 1875, p. 58.

8. On *Phascologale virginiæ*, a rare Pouched Mouse from Northern Queensland. By Robert Collett, C.M.Z.S.

[Received December 2, 1886.]

(Plate LX.)

Phascologale virginiæ, De Tarragon, 1847. (Plate LX.)

Phascologale virginiæ, De Tarr. Revue Zool. 1847, p. 177.

Diagn. Skull with strong sagittal and occipital crests, and distinct *processus postorbitales*. Incisors almost equal; upper canine very long. First premolar very small; third the largest.

Ossa palatina with foramina; *pars mastoidea* scarcely inflated behind the bullæ.

Ears large, almost naked; tail as long as the body and head, scantily clothed with adpressed hairs.

Hind feet slender, hallux very short; sole of metatarsus naked in the middle line; tuberculated callosities at the base of the toes.

Colour blackish, grizzled with silvery white; head reddish grey, with a black stripe from nose to between the ears, and trace of another on the side of the snout. Below greyish; feet pale red, tail reddish grey with black tips [1].

Measurements, taken from the stuffed specimen:—

	millim.
Length of body (with head)	about 125
Length of tail	120
From tip of snout to ear	32
Height of ear, exterior margin	20·5
Height of ear, interior margin	14·5
Sole of hind foot (with claw)	33

Fur rather short, not woolly; each hair bluish grey at the base, the outer third white with black tip, some hairs entirely black.

Feet slender; point of hallux not nearly reaching to the base of the toes.

Skull. The skull is strongly built, with high sagittal and occipital crests, and a distinct *processus postorbitalis*; the dentition is, however, comparatively weak.

	millim.
Length of skull	31·5
Breadth across *arcus zygomaticus*	19
Height	12
Shortest breadth between orbits	5·5
Breadth before the commencement of *a. zygomaticus*.	12
Length of tooth-series in upper jaw	15
Length of tooth-series in lower jaw	13

Dentition:—I. $\frac{4}{3}$; C. $\frac{1}{1}$; P. $\frac{3}{3}$; M. $\frac{4}{4}$ (46).

[1] The colour of the tail and snout is rather indistinct, the hairs being very much worn.

In the upper jaw the first incisor is short, and almost imperceptibly larger than the other incisors. Canine long and curved. The premolars form an almost unbroken series with the canine and first molar. First premolar very small, scarcely higher than fourth incisor; second a little larger; third premolar the largest, the middle cusp being as high as the molars. The molars are rather feeble, with relatively low crowns and blunt cusps; last molar very narrow.

In the lower jaw the canine is a little shorter than that in the upper. Fourth molar only a little smaller than third. Incisors and premolars as in upper jaw.

Compared with *Ph. minima* the brain-case is higher, but narrower, and the *arcus zygomaticus* longer. *Ph. apicalis* has larger *bullæ osseæ*, but shorter *foramina incisiva*; the third premolar in that species is almost rudimentary, and the second premolar larger than the two other premolars together. In both these species the crests on the brain-case are scarcely developed, and the postorbital processes wanting.

Hab. Herbert Vale, Northern Queensland; one specimen, a full-grown male, collected by Dr. Lumholtz, January 1883, is preserved in the Zoological Museum at Christiana.

The specimen was dug out from a hole in the ground, and its habits seemed not to be arboreal[1].

Christiania, 15th November, 1886.

EXPLANATION OF PLATE LX.

Fig. 1. *Phascologale virginiæ*, natural size.
2. Skull, natural size.
3. Canines and premolars, three times natural size.

December 21, 1886.

Prof. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of November 1886:—

The total number of registered additions to the Society's Menagerie during the month of November was 166, of which 64 were by presentation, 22 by purchase, 16 by birth, 4 were received in exchange, and 60 on deposit. The total number of departures during the same period, by death and removals, was 107.

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[1] My friend, Mr. Oldfield Thomas, informs me, on the authority of M. Huet, of Paris, that the original type of this species, the locality of which was unknown, appears to have been lost; and as the animal has been overlooked ever since its first description, I have thought it worth while to figure and redescribe it from the beautiful specimen obtained in Queensland by Dr. Lumholtz.

Mr. Howard Saunders, F.Z.S., exhibited on behalf of Mr. R. J. Howard, of Blackburn, a specimen of a hybrid between the Tufted Duck (*Fuligula cristata*) and the Pochard (*F. ferina*), bred in Lancashire; and read the following extract from a letter addressed to him by Mr. Howard on the subject, dated Fern Bank, Blackburn, Oct. 28th, 1886:—

"I have forwarded for your acceptance a hybrid between the Pochard and the Tufted Duck, knowing that an authenticated specimen will be of interest; for I suppose I must take it for granted that the bird referred to by you in the 4th edition of 'Yarrell' (vol. iv. p. 433) as 'apparently a hybrid between the Tufted Duck and Pochard' is the only one known to you.

"A pinioned pair of Pochards first bred at Woodfold Park in 1882, since which date several broods have been annually reared there ('Yarrell,' vol. iv. p. 414). I found the Tufted Ducks nesting on the same reservoirs in July 1884, some of the young birds being subsequently captured, pinioned and turned down again (ibid. p. 431); the first recorded instance of the breeding of the Tufted Duck in Lancashire. The birds of both species leave the reservoirs during the severe weather of winter.

"On the 9th of May last, I saw a male Pochard apparently paired with a pinioned female Tufted Duck. On the 23rd of the same month two male and one female Tufted Ducks appeared; the male Pochard would not allow the male Tufted Ducks near the pinioned female, but drove them off if they approached within 30 or 40 yards. Soon after this all the drakes left, and I saw little of the ducks until the 20th June, when both appeared on the water; the full-winged female Tufted Duck with a brood of 9, the pinioned one with 10 young hybrids.

"From the first I could easily distinguish the pure-bred young from the hybrids: the upper parts of the former being uniform umber-brown, whilst the latter had the cheeks and throat buff. As the birds began to feather, I noticed that the hybrids were bulkier, the general appearance being more that of the Pochard than of the Tufted Duck; the head, neck, and upper surface were of a much lighter and warmer brown, the feathers about the base of the upper mandible rather lighter-coloured than the rest of the head, but not showing a distinct patch as in the Tufted Duck. We caught two hybrids on the 30th July, and put them on the reservoir in the Blackburn Corporation Park; and on the 2nd August I sent two, in the name of Mr. Thwaites (to whom I am indebted for permission to deal with the birds as I wish), to the Zoological Society's Gardens. Their description is as follows, the sex being uncertain:—Length 15·5 and 15 in.; bill dark blue, almost black, 1·6 in. in length, and a trifle more dilated towards the point than in the pure Tufted Duck; irides yellowish brown; legs and toes blue, darkest at joints, webs black. Two of the young Tufted Ducks, male and female, caught on the 31st July: length 14·5 and 14 in.; bill black, 1·5 in. in length; irides dull yellow; legs and toes as in the above hybrids.

"The bird which I sent you was shot on the 19th August, being

then strong on the wing, and proved, on dissection, to be a male. Those which I put on the reservoirs in our Corporation Park do not appear to have changed in plumage; there is not as yet the slightest sign of a crest."

The above rare hybrid has since been presented to the British Museum of Natural History.

The following papers were read:—

1. On Atavism. A Critical and Analytical Study. By J. Bland Sutton, F.R.C.S., Lecturer on Comparative Anatomy, Middlesex Hospital, Erasmus Wilson Lecturer on Pathology, Royal College of Surgeons.

[Received October 22, 1886.]

In an interesting paper entitled "Critical Remarks on Polydactyly as Atavism," Gegenbaur enters into a masterly discussion of this confessedly difficult subject, and, in the course of summing-up, he ventures to divide atavistic phenomena into two groups—Palæogenetic and Neogenetic.

Atavism he defines as "a re-appearance of a more primitive organization, or a reversion (*Rückschlag*) to a primary state." To choose an example:—the occasional presence of an *os centrale* in the adult human carpus is a reversion to a condition very prevalent in the lower Mammalia. We know that a cartilaginous representative of this ossicle is easy of detection in the embryo; but Atavism does not consist in the existence of a latent germ, but in its becoming perfected and further developed.

In this case the atavistic part exists, by law of inheritance, in the early embryo as a germ which normally disappears, but in some cases becomes further developed. This is Gegenbaur's Palæogenetic Atavism. If the abnormal part (using the term abnormal in its most literal sense) is not found as a germ in the embryo, the reversion is "Neogenetic."

My object is to show that all examples of atavism belong to the Palæogenetic group and that Neogenetic Atavism has no existence.

The question of polydactyly I do not intend to discuss, but shall select the foot of the Horse, as Gegenbaur has done, to serve as illustrations of the principle, and thence extend the view broadly.

The descent of the modern Horse from five-toed ancestors is beyond all question. That the animal of to-day walks on an enlarged third digit with a rudimentary digit on each side in the manus and pes is accepted doctrine. The comparative recent ancestors of the Horse were tridactyle. Gegenbaur states that Hensel's[2]

[1] Morph. Jahrbuch. Bd. vi. S. 584–596. A translation by Drs. Garson and Gadow is given in 'Journal of Anatomy and Physiology,' vol. xvi. p. 615.

[2] "Ueber *Hipparion mediterraneum*." Abk. k. Akad. d. Wissensch. z. Berlin, 1861, S. 65.

investigations point to the probability that the finger typically attached in *Hipparion* to the medial styloid bone was the last to abort. It is certainly noteworthy that in the majority of cases of polydactyly occurring in Horses it is this digit which reappears most frequently.

In the Teratological Gallery in the Museum of the College of Surgeons several specimens of Horses' feet are shown with a well-developed second digit. Cheauveau figures[1] a specimen preserved in the Veterinary Museum at Lyons; but the most complete case of its kind is that figured and described in Prof. Marsh's paper[2] "On Polydactyle Horses, Recent and Extinct." In this instance the inner digit was present on the four feet. Besides giving an interesting account of extra digits noticed by early writers, this eminent palæontologist tells us that the more frequent occurrences of extra digits on the manus is precisely what a study of fossil forms of equine mammals would lead us to anticipate.

These cases support the view as Gegenbaur points out, that the atavistic parts do not belong to forms palæontologically remote or systematically far distant.

In the Spider-Monkey the thumb is normally absent, or represented merely by a nodule of cartilage or fibrous tissue. Yet on one occasion I dissected an *Ateles paniscus* which had on each hand a perfectly developed thumb. This condition is not very uncommon. If the parts be dissected in normal specimens, the thumb is represented by a band of cartilage and fibrous tissue attached to the trapezium. The illustrations which have been used were selected merely to give a clear notion of genuine Atavism—the palæogenetic form. The question of polydactyly is in some instances susceptible of another explanation, which I do not propose to speak of in this paper.

Atavism in relation with the Prostate.

Leaving the skeleton, attention will now be invited to a remarkable instance of Atavism presented by the prostate. In structure and intrinsic relations this organ presents some exceptional features. It is best regarded as a capsule composed of fibrous and unstriped muscular tissue, mixed with tubular glands, surrounding a recess known as the utriculus masculinus. The utriculus separates the termination of the confluent ducts of the vesiculæ seminales and vasa deferentia, whilst it is tunnelled near its anterior aspect by the commencement of the urethra. The glands of the prostate are best considered as tubular alveoli which unite into a smaller number of excretory ducts (about twenty) opening in two depressions of the urethra known as the prostatic sinuses. The tubules are lined by columnar epithelium.

The central recess before mentioned has been named the sinus

[1] 'Anatomie Comparée.'

[2] American Journal of Science and Art, vol. xvii., June 1879.

pocularis, utriculus, or uterus masculinus. Usually it is nearly half an inch long, and opens by a narrow slit in the middle of the caput gallinaginis. It is lined by mucous membrane continuous with that of the urethra, and covered by stratified epithelium. Some small tubular glands open on the free surface of the mucous membrane.

This utriculus is of great interest morphologically, as it represents in the male a persistent portion of the confluent segment of the Müllerian ducts. Weber regarded it as corresponding with the uterus, but Leuckart showed that a part of it must be looked upon as representing the vagina.

My observations induce me to regard the prostate as a suppressed uterus, the fibro-muscular tissue representing the matricial walls, the follicles correspond to the utricular glands, and the utriculus is identical with the cervix uteri and that portion of the vagina immediately adjacent.

The evidence in support of this view will now be put before the reader. In order to render every detail in clear light, we must refer briefly to the fundamental structures concerned in forming a functional uterus.

In the Lizard, in common with the majority of the Sauropsida, the ova are conveyed to the exterior by two muscular tubes lined with mucous membrane, known as oviducts. The eggs, when they escape from the ovaries, are received by the dilated end of the oviduct, known as the infundibulum, and quickly passed onwards; they receive at the commencement of the journey a coating of albumen. Pushed on by the contortions of the tube, they arrive at the third or uterine portion. Here they receive a coating of calcareous matter known as the shell, and are then ready for expulsion. In these oviducts, with their mucous membranes and glands, we have the fundamental condition of the ducts which in the human embryo conspire to form the uterus with its Fallopian tubes and vagina.

In order to clearly describe the manner in which the Fallopian tubes, uterus, and vagina are formed from the Müllerian ducts of opposite sides, each duct may be conceived as made up of three parts:—

The upper third becomes the Fallopian tube; the funnel-shaped and usually fimbriated extremity communicates with the peritoneal cavity. The middle portions of the ducts fuse together, and form the fundus, body, and neck of the uterus, whilst the lower thirds of the Müllerian ducts form a vagina. Such is the commonest arrangement.

On comparing the parts of this compound organ with the Lizard's oviduct, it becomes evident that the infundibulum and albumen segment in the bird represent the Mammalian Fallopian tube, the second or uterine portion corresponding with the uterus and vagina of Eutheria.

On tracing the homologies closer, we find that the portion of the bird's oviduct concerned in secreting albumen corresponds with that portion of the Müllerian duct which forms the fundus and body of the uterus; and the utricular glands, which are concerned in

secreting a thick, viscid, albuminous material, are simply modifications of the simple recesses found in the bird's oviduct. The third, or uterine section of the oviduct, corresponds to the cervix of the uterus and the vagina. To this we shall return. In the male of the higher mammals, the Müllerian ducts by their fusion give rise to the utriculus. This cavity is formed by that portion of the ducts which in the female constitute the cervix uteri and upper segment of the vagina.

Excellent confirmatory evidence of this view is afforded by a rare malformation to which the prostate is liable. Instead of the Müllerian ducts disappearing after the posterior portions have fused to form the utriculus, a segment of each may persist, so as to give rise to a bicornuate utriculus, in fact a miniature uterus. In rarer instances a Müllerian duct may persist through its entire length. Such a case has been described by Dr. Ord [1]. There is good reason to believe that some examples described as double ureters were of this nature.

If the human prostate be examined by cutting it into slices in the direction of the urethra, at any age after puberty, but much more easily at fifty years, small brownish or black bodies, usually of the size of poppy-seeds, will be detected. These bodies, familiar as prostatic concretions, are, as a rule, very much smaller in young subjects, in whom it is often necessary to scrape the cut section of the lateral lobes of the prostate, and submit the juice to microscopic examination in order to detect them. Before puberty they are practically absent; in old age they may attain the dimensions of split peas.

In number they may vary from twenty to two thousand; in size from $\frac{1}{1000}$ of an inch to that of a cherry-stone; in colour bright red, brown, or even black. In consistency they may be soft, hard, or even brittle. Chemically they contain organic matter, about one half, the rest being made up of phosphate and a small quantity of carbonate of lime.

For a careful and detailed account of prostatic concretions, the student should consult an excellent paper by Sir Henry Thompson, entitled, "Some observations on the Anatomy and Pathology of the Adult Prostate" [2].

In the preceding pages an endeavour has been made to prove that the cervix of the uterus and contiguous portion of the vagina correspond to the shell-forming segment of the bird's oviduct. The prostate and utriculus correspond to the uterine cervix and upper part of the vagina, therefore they are homologous with the shell-forming segment of the bird's oviduct.

The shell of an egg consists of animal matter impregnated with salts of lime, and is due to the activity of the glands in the third section of the oviduct. Prostatic concretions are due to the activity of the glands lodged in the prostate. The inference is clear that prostatic concretions and egg-shells agree structurally and chemically, and are produced by homologous organs. Thus man has in his

[1] Medico-Chir. Trans. vol. lxiii. p. 11.
[2] Medico-Chir. Trans. vol. xl. p. 78 (1857).

prostate an unimpeachable witness of an ancestry with the feathered tribe, low down among the oviparous reptiles.

Let me now proceed to show how very little information we possess concerning latent germs which may be present in the embryo. For example, the discovery of the germ of an *os centrale* in the carpus of man was certainly startling. Yet its existence might have been anticipated from what we know of the variations in the number of the carpal ossicles in the adult. Atavism drew the attention of anatomists to a secondary astragalus in the human tarsus, and Bardeleben succeeded in detecting the germ. (This has been questioned by Baur, but his objections are inconclusive.) We must now consider some cases of a different character.

Atavism in relation to Secondary Sexual characters.

As Darwin points out [1], two distinct elements are included under the term "inheritance"—the transmission and the development of characters. The distinction is a most important one, especially in its bearing on the question of Atavism, that the two conditions will be illustrated by concrete examples.

In most species of the Deer tribe it is the rule for the male alone to possess antlers, yet it is a well attested circumstance that under certain diseased conditions of the sexual organs, especially atrophy or degeneration of the ovaries, rudimentary horns which are never shed appear in the female.

This shows us that although the female is in possession of the secondary sexual organs in virtue of *transmission*, yet they remain latent as a rule, and only become developed under extraordinary circumstances. The same holds good for those cases of hens who for years lay eggs, yet eventually cease to do so, put on one side the plumage proper to their sex, and adopt more or less completely the plumage of the cock.

These examples open up the subject of secondary sexual characters. The question of primitive hermaphroditism has been already discussed in a preceding paper, and an attempt was made to show that, for a brief period at least, the embryo presents sexual parts common to the male and female, so that for a time it is absolutely impossible to determine the sex. What is true of the embryo applies equally to animals normally hermaphrodite: no distinctive characters are displayed externally. Also in cases of hermaphroditism occurring in animals normally bisexual, the secondary sexual characters are intermediate to those of the functional male and female. It is therefore fairly evident that the female, though she differs from the male in the non-development of secondary sexual characters, yet possesses them in a latent condition; or, to put the matter briefly, they are transmitted, but not developed.

This raises two questions, each of equal importance:—(1) How are these characters transmitted? (2) What hinders their development?

It seems to me that the second of these questions is the one with which we are chiefly concerned here, and that the non-development of

[1] 'Descent of Man,' 2nd ed. p. 227.

secondary sexual characters can be explained on the principle known as the "Correlation of Organs."

In order, however, to render this explanation tenable, it will be absolutely necessary to prove, as far as possible, that the germs of secondary sexual organs, which only manifest themselves occasionally in the females of dimorphic forms, are really inherited; and, if the female is furnished with the germs of these structures, to show by what method they are transmitted. It is to this somewhat intricate part of the question that we must now direct our attention.

If a careful analysis be made of those structures which constitute secondary sexual characters, we shall find that they are almost entirely developed in connection with the integument. The majority—whether they be horns, bristles, spurs, or teeth, for attack or defence; or exuberance of hair, feathers, wattles, combs, &c., for æsthetic purposes,—the integument and the immediately subjacent tissues are responsible for them.

In the earliest embryos of most mammals we distinguish at a very early stage two layers of cells, known as the epiblast and hypoblast. In most of the Metazoa a new layer is interposed known as the mesoblast; this originates in part from the epi- and in part from the hypoblast. It is the epiblast and the portion of mesoblast immediately adjacent that furnishes secondary sexual organs. From whence is the epiblast derived?

We know now that the essential act of impregnation consists in the union of a spermatozoon with an ovum; the head of the spermatozoon constitutes the male pronucleus, the germinal area the female pronucleus. After the pronuclei have united segmentation begins, and the formation of the fundamental layers is quickly brought about. There are good grounds for believing that the initial streak indicating the commencement of segmentation really marks the line of fusion between male and female pronuclei.

If we measure the size of the head of a functional spermatozoon, it will be found equal to $\frac{1}{6000}$ of an inch, whereas the germinal area of the ovum equals $\frac{1}{200}$ of an inch. It is a very significant fact that the segments which give rise to the epiblast are smaller than those which furnish the hypoblast and mesoblast; to this there are very few exceptions. This is exactly what might be expected, the halves of a globe $\frac{1}{6000}$ of an inch in diameter would certainly be smaller than the halves of a sphere one twelfth the size.

The facts at our disposal seem to point to the conclusion that the epiblast is chiefly derived from the male element, while the female pronucleus is responsible chiefly for the hypo- and greater portion of the mesoblast.

If this be true, the transmission of characters peculiar to the male is not so obscure as many have supposed.

We must now inquire how it is, that if the female possesses all the secondary sexual characters of the male in a latent manner, what is it that prevents them manifesting themselves.

When differentiation of sexes occurs in animals previously hermaphrodite, it involves either the loss of certain characters on the

part of the female, or the acquisition of new characters by the male, or at any rate increased functional importance of certain organs possessed, when in the state of hermaphroditism, by all the forms. By natural selection the male would acquire (or, if already in his possession in a functional condition, they would become more developed) means for seizing and retaining the female, such as the claspers of sharks, the callous pads of frogs, &c. Paternal duty requires the male to protect the young and defend the females from harm; hence horns, teeth (as in the musk-ox), spurs, tusks, &c. become more developed in him.

The duties of the female require her not only to furnish the material out of which the young are to be formed, but in many cases she is required to provide them with nutrition long after they enter the world. The material which the female thus provides is of the very kind necessary, in many instances, to build up such structures as horns, tusks, teeth, and the like. Further, this material is required by the female at the corresponding period of life in which they become developed in the male, viz. on the advent of puberty. We may state with certainty that a distinct correlation exists between the generative organs of the female and the development of the secondary sexual male characters. The more developed and functional the female reproductive organs become, the less likely is she to manifest the secondary characters of the male. It may be argued, that in some cases the female simulates the male, as in the few examples of female Deer possessing horns. Quite true; but so long as the female is engaged in the duties of reproduction, these secondary characters are never developed to the same extent as in the functional male. It must also be borne in mind, that in cases where sterile females, or those which have ceased to bear young, put on external male characters, they rarely attain such proportions or beauty as in the male; for in the males the general excitement produced upon the system by sexual passion has a most powerful stimulant effect upon the growth and development of these structures, which is wanting in the female. So that in her attempts to emulate the male she succeeds to a certain degree, but rarely, if ever, attains to so good a condition.

Hunter has recorded some experiments which have a bearing on this matter:—

"I wished also to ascertain if the parts peculiar to the male could grow on the female, and if the parts of a female, on the contrary, would grow on a male.

"Although I had formerly transplanted the testicles of a cock into the abdomen of a hen, and they had sometimes taken root there, but not frequently, and then had never come to perfection, yet the experiment could not, from this cause, answer fully the intended purpose; there is, I believe, a natural reason to believe it could not, and the experiment was therefore disregarded. I took the spur from the leg of a young cock, and placed it in the situation of the spur in the leg of a hen-chicken; it took root, the chicken grew to a hen, but at first no spur grew, while the spur that was left on the

other leg of the cock grew as usual. This experiment I have repeated several times in the same manner, with the same effects, which led me to conceive that the spur of a cock would not grow upon a hen, and that they were, therefore, to be considered as distinct animals, having very distinct powers. In order to ascertain this, I took the spurs of hen chickens and placed them on the legs of young cocks. I found that those which took root grew nearly as fast, and to as large a size as the natural spur on the other leg, which appeared to be a contradiction to my other experiments. Upon another examination of my hens, however, I found that the spurs had grown considerably, although they had taken several years to do it; for I found that the same quantity of growth in the spur of a cock, while on the cock, during one year, was as much as that of the cock's spur on the hen in the course of three or four years, or as three or four to one; whereas the growth of the hen's spur on the cock was to that of the proper spur of the hen as two to one."

When a female animal belonging to a dimorphic species assumes male characters, it is truly an example of Atavism, or development of transmitted characters normally latent.

This part of the matter has been dwelt upon at some length for the following important reason. If we regard the epiblast and the structures developed therefrom as representing the chief characters derived from the male parent, it opens up a field of interesting inquiry in clinical medicine and pathology regarding hereditary diseases, and it demonstrates clearly enough that we have little knowledge concerning the germs of organs which may be latent in an animal; therefore Neogenetic Atavism is, at its best, exceedingly questionable. To assume that such a form of Atavism exists, is to believe in the sudden development of new characters: this is totally opposed to the fundamental principles of Evolution.

The question is one of great importance to the pathologist, inasmuch as there is very great probability that many aberrations of organs and tissues are atavistic in their nature.

2. On the Systematic Position and Classification of Sponges.

By R. v. Lendenfeld, Ph.D., F.L.S., Assistant in the Biological Laboratory of University College, London.

[Received December 20, 1886.]

I. Introductory Remarks, p. 558.
II. Nomenclature of Spicules, p. 559.
III. The Systematic Position of Sponges, p. 564.
IV. The Classification of Sponges, p. 570.
V. Key to the Recent Families of Sponges, p. 589.
VI. Appendix. List of Publications, p. 592.

I. Introductory Remarks.

Our knowledge of the development and structure of Sponges is of such recent date that we have hardly had time to utilize it for systematic purposes till now.

Whilst the anatomical and embryological work of recent authors, particularly of F. E. Schulze and his pupils, has made us acquainted with the structure of Sponges in a satisfactory manner, our knowledge of species, which was formerly practically confined to those from the Mediterranean and the Atlantic, has been greatly extended by the collections made during the voyages of the 'Alert' and 'Challenger' in all parts of the world, and by my own labours in the Australian seas.

I think, therefore, that the time has now arrived to endeavour to establish a classification of Sponges, and to discuss the position which the Sponges, as a group, occupy in the scale of Nature.

In an Appendix to this paper a nearly complete list of publications on Sponges is given. It has been made by interpolating old, new, and omitted papers in D'Arcy Thomson's (1495) list of 551 papers, the references in which have been verified. I must express my thanks to Mrs. v. Leudenfeld and to Mr. A. Dendy for their share in this work, and also to Mr. Ridley for his kindness in allowing us to use his most valuable MS. notes on this subject.

In the section on the systematic position of Sponges, the principal views held on the subject are discussed, and reasons are given for considering the Sponges as the first Phylum of the Grade Cœlentera, which arrangement has been adopted in this paper.

The main classification of the Orders is the result of my own anatomical work, and has been arrived at independently of other authors. It affords me much pleasure to state that this classification is, in the main, similar to that established by Vosmaer (1550), although we have arrived at our results in different ways, and our diagnoses differ accordingly.

To that section of this paper which deals with the arrangement of the Families and Subfamilies, and the enumeration of the principal Genera, Mr. A. Dendy has contributed the portions relating to the Suborders Clavulina and Halichondrina with the exception of the Tethydæ and Chalininæ. The portions relating to the Hexactinellida and Tetractinellida are compiled from the recent papers of Schulze (1369), Sollas (1453), Vosmaer (1550), and Zittel (1639). The remainder is based on my own MS. notes.

II. Nomenclature of the Spicules.

Various terms for the spicules found in Sponges have been used by different authors. In consequence of this a certain confusion has arisen with regard to the meaning of the terms employed. Vosmaer (1550) made a chivalrous attempt to establish a satisfactory Nomenclature, which, however, has unfortunately not been accepted by recent authors on Sponges except myself, so that it only added to the already existing confusion.

Recently Sollas, Ridley, and Dendy have established a new nomenclature for Monaxonid spicules, which I have agreed to adopt, and which has been used by them and myself. I do not think it perfect, but I am certainly not in a position to replace it by anything better, and therefore adopt and explain it in this paper. Schulze's nomen-

clature of Hexactinellid spicules is here, of course, accepted *en bloc*, and his terms will be defined below. Sollas (1453) has used a number of terms in his preliminary report which I do not understand and which presumably nobody else understands either. It is, therefore, much to be regretted that the greater part of them are unexplained. In consequence of this I will, for the present, abstain from attempting to compile a nomenclature of Tetraxonid spicules pending the publication of Sollas's full report, in which, we may hope, he will explain his new terms.

The spicules of Sponges are, as a rule, of such shape that they appear as more or less modified geometrical figures with definite axes. The axes are always represented by a non-skeletal rod (the so-called axial canal), round which the silica or lime is precipitated in concentric layers. There may be one such axis, or there may be more than one.

Häckel (627) drew attention to this crystalline regularity of sponge-spicules, which has been of great importance in studying the skeletal elements of Sponges.

We can divide the sponge-spicules, as we do the Sponges, into the two groups Calcarea and Silicea, according to their chemical composition. Within each group we distinguish series of forms according to the number and position of the axes. The validity of this classification is proved by the correlation of these different kinds of spicules with other organs in the Sponges.

The following are the different kinds of spicules :—

I. Group Spicula Calcarea.

Composed chiefly of carbonate of lime.

1. *Monaxonia.*

With one straight or curved axis, rod-shaped.

2. *Triaxonia.*

With three distinct axes which may lie in one plane or not. When one of the rays of this tri-act spicule becomes rudimentary, Diaxonia can theoretically be produced. It is, however, advantageous to consider the Diaxon spicules as part of the Triaxonia. The calcareous triaxon spicules have only three rays—triact.

3. *Tetraxonia.*

With four axes and four rays—tetract. The points form the corners of a triangular pyramid. Generally three axes, or rays, are equivalent (tangential), and one (radial) is differentiated, longer or shorter than the others.

II. Group Spicula Silicea.

Composed chiefly of silica.

1. *Anaxonia.*

Without definite axes and with numerous rays—polyact.

To this group belongs one kind of spicule only, namely the stellate and its derivatives.

The following six forms can be distinguished :—

A. *Regularia.*

The rays radiating from one point.

1. *Oxyaster.*

With long, slender, pointed rays (*e. g. Stelletta*). = *st*, Vosmaer.

2. *Euaster.*

With stout, pointed, conic rays (*e. g. Chondrilla*).=*gl. st*, Vosmaer.

3. *Spheraster.*

The rays coalesce to form a solid ball (*e. g. Geodia*).=*gl*, Vosmaer.

B. *Irregularia.*

The centre extends to form a line which may be curved, circular, ring-shaped, or spiral.

4. *Spiraster.*

A stout spiral with thick spines attached (*e. g. Raphyrus*). = st^2, Vosmaer. When spines terminal, *Amphiaster.*

5. *Corona.*

A spined ring (*e. g. Suberocorona*) (?).

6. *Spirula.*

A spiral without spines (*e. g. Spiretta*).

These anaxon spicules never form part of the supporting skeleton, but are invariably flesh-spicules (*Microsclera*).

2. *Monaxonia.*

With one straight or curved axis, sometimes with lamellar outgrowths.

A. *Supporting Spicules* (Megasclera).

1. *Strongylus.*

A cylindrical rod rounded at each end (*e. g. Uruguaga*). = tr^2, Vosmaer.

2. *Oxystrongylus.*

A cylindrical rod abruptly pointed at each end (*e. g. Pachychalina*).

3. *Oxyus.*

A gradually pointed, spindle-shaped spicule (*e. g. Spongilla*). = *ac*, *ac*, and ac^2, Vosmaer. Diact, F. E. Schulze.

4. *Tylotus.*

A cylindrical rod with a knob at each end (*e. g. Crella*). = tr^{23}, Vosmaer.

5. *Tylostylus.*

A cylindrical rod more or less pointed at one end and knobbed at the other (*e. g. Suberites*). = tr^5 *ac*, Vosmaer. Without knob, *Stylus.*

B. *Flesh-Spicules* (Microsclera).

6. *Toxius.*

Curved in the centre, the two ends in a straight line, thus ⌒ (*e. g. Toxochalina*).=⋀, Vosmaer. When in bundles, *Toxodragmata.*

7. *Sigmata.*

S-shaped, curved irregularly, not expanded in one plane (*e. g. Geliodes*).= ∽, Vosmaer. When in bundles, *Sigmadragmata.*

8. *Isochelæ.*

Curved spicules with flat expanded ends extending in the surface of a rotation ellipsoid; both ends equal (*e. g. Desmacidonidæ*). =*anc*^{2}, Vosmaer. Anchorates, auctorum.

9. *Anisochelæ.*

Curved spicules with flat expanded ends extending in the surface of a rotation ellipsoid; ends unequal (*e. g. Desmacidonidæ*). =*anc, anc*, Vosmaer. Anchorates, auctorum.

10. *Diankistra.*

A rod with a hook at each end, divided by a remarkable incision (*e. g. Vomerula*).=∽ Vosmaer. Bundles of hair-like spicules, *Trichodragmata.*

3. *Triaxonia.*

Spicules with three axes and six rays and their derivatives. (For details compare F. E. Schulze's preliminary report.)

1. *Oxyhexact.*

With six pointed rays, the ends of which form the corners of a double square pyramid. The rays represent the crystalline axes.

2. *Oxypentact.*

One ray rudimentary, representing the axes of a simple square pyramid.

3. *Oxytetract.*

Two rays rudimentary, representing the *edges* of a square pyramid.

4. *Oxydiact.*

Four rays rudimentary, only two rays lying in one straight line remain.

5. *Hexaster.*

A star with six, generally equal rays:—

a. *Oxyhexaster.* Rays pointed.
b. *Discohexaster.* Rays terminated by disks.
c. *Floricome.* Rays terminated by a bunch of curved branches.
d. *Graphiohexaster.* Rays much curved.
Plumicome. Rays terminated with a number of plumose branches.

6. *Pinnulæ.*

A star with five or six rays. One of them is particularly highly

developed and branched or covered with disks or scales. The opposite ray smooth or absent. The other four equal (tangential).

7. *Scopulæ.*

Fork- or broom-shaped spicules consisting of a long shaft traversed by an axial rod, to the distal end of which some, generally four, slender anaxial rods are attached.

8. *Amphidiscs.*

A rod with an umbrella-shaped disk at each end.

9. *Uncinatæ.*

A rod with recurved hooks throughout its entire length.

10. *Clavulæ.*

A rod pointed at one end and bearing a knob or disk at the other.

4. *Tetraxonia.*

With four axes radiating from one point. The ends of the spicules lie in the corners of a square pyramid and their derivatives.

	A. *Tetractina.*
With four rays.	
	B. *Triactina.*
With three rays.	
	C. *Diactina.*
With two rays.	
	D. *Monactina.*
With one ray.	

For the reasons given above, I shall abstain from describing the Tetraxonian spicules in detail. I will, however, mention the terms for spicules employed by Sollas in his preliminary report (1453). These, alphabetically arranged, are the following:—

Acerate (Monaxon).
Acerella (Monaxon ?).
Amphiaster (?).
Amphiastrella (Spirastrella ?).
*Amphitetrad.
*Anchors.
Anthaster (?).
Arculus (?).
*Bifurcated Forks.
Calthrops (?).
*Candelabra.
Chiaster (?).
Cylindrical spicules (Monaxonia ?).
Echinella (?).
Ectaster (?).
Erdaster (?).
*Forks.
*Forks with trifurcate arms.
*Fusiform Acerates (Monaxonia).
Globate (Sclemaster).
Globules (?).
Hispidating Acerate (Monaxonia).
*One-pronged (unicellate) Forks.
*Porrectate Forks.
Pycnaster (?).
*Radical Anchors.
Sigmella (?).
*Somal Anchor.
*Somatic Anchor.
Spinispirulæ (Spirastrella).
Spirulæ (Spirulæ).
Stellate (?).
*Tetrad.
*Triona.
Trichite Acerates (Monaxonia).
*Trichite Forks.
*Trifid Forks.
*Two-pronged (dicellate) Forks.

The names marked * presumedly apply to Tetraxon spicules. The others probably belong to different groups.

These pages will give a key to the terms of spicules used below.

There are, however, a number of other terms which require explanation.

The spicules are divided generally into two distinct groups:—(1) Those which together form the supporting skeleton of the sponge: these are called Supporting spicules or Megasclera. (2) Those which lie scattered in the ground-substance and which differ from the former in shape: these are called Flesh-spicules or Microsclera (Tension-spicules of Bowerbank).

F. E. Schulze (1369) uses particular terms for spicules according to their position, which have been adopted in this paper so far as the Hexactinellids are concerned.

These are alphabetically the following:—

Autodermalia. Spicules on the outer surface with free projecting and with centripetal (immersed) differentiated rays.

Autogastralia. Spicules on the gastral surface with free projecting and with centrifugal (immersed) differentiated rays.

Basalia. Spicules of the root-tuft.

Comitalia. Spicules accompanying the fibres.

Epidermalia. Spicules on the outer surface with free projecting differentiated ray only.

Epigastralia. Spicules on the gastral surface with free projecting differentiated ray only.

Hypodermalia. Spicules of the outer surface with immersed radial ray only.—Pentact.

Hypogastralia. Spicules of the gastral surface with immersed radial ray only.—Pentact.

Marginalia. Spicules forming a collar round the osculum.

Parenchymalia. Spicules in the interior.

Pleuralia. Spicules forming a fur.

Principalia. Spicules of the main skeleton.

III. The Systematic Position of Sponges.

The opinions of different authors on this subject diverge considerably. I shall attempt to reconcile them in the following pages and to prove the correctness of the result at which I have arrived.

Aristotle first pointed out that the Sponges were not plants—a fact which seems clear enough now, but which was doubted and combated by most authors of the dismally ignorant middle ages. This we admit as proved. I agree with Häckel in dividing the organic world into the three groups—Plants, Protista, and Animals. Among the Protista there are a great majority of forms showing affinities either to animals or to plants, so that it is not unusual to split up the Protista and divide its members among the two other old established groups. For the sake of simplicity I adopt this course here.

The Animal Kingdom, in this wider sense, including the animal Protista, is naturally to be divided into Protozoa and Metazoa, of

which the former consist of similar and equal, undifferentiated, cells, which often remain isolated throughout life, whilst the latter pass through a unicellular stage of short duration only, and consist, when adult, of a number of different cells. There is a vast difference between these two groups: the Protozoa are isocellular, whilst the Metazoa are heterocellular. The Sponges are developed in the same way as all other Metazoa and pass through the same well-known embryonic stages—the Morula, Blastula, &c. They consist, when adult, of a great number of differentiated cells. There are flat epithelial cells all over the outer surface and on the canal-wall; there are collar-cells round the ciliated chambers. There are gland-cells for different purposes, muscular and nervous cells besides ordinary tissue and amœboid cells in the Mesoglœa or ground-substance, in which also the ova and spermatozoa are developed. It is therefore quite clear that the Sponges are not Protozoa, but Metazoa, and are, in fact, not similar to Protozoa in any way.

The Metazoa are naturally divided into two Groups or Grades—the Cœlentera, with a simple undivided body-cavity, all the parts of which are in direct connection with one another; and the Cœlomata, which have two distinct and entirely separated body-cavities—a gastral cavity and a cœlom or perigastric cavity. The Sponges certainly have a simple and continuous body-cavity and no trace of a cœlom, so that they must be regarded as Cœlentera.

Long before Hertwig established the cœlom theory, Leuckart had already perceived this important fact, and placed the Sponges among the Cœlentera accordingly.

Although nobody has ever attempted to regard the Sponges as Cœlomata, there has been great opposition, principally among English authors, to Leuckart's opinion. I dismiss the arguments of those who, like James Clark (284–294), Carter (166), and Saville Kent (772), regard the Sponges as Protozoa, on the ground that their idea of Protozoa does not harmonize with the generally adopted meaning of the term, for if it did, they could not, as logical thinkers, count the Sponges among them. Their idea of Protozoa comprises the whole Animal Kingdom, because they draw no distinction between isocellular and heterocellular organisms, and of course all Metazoa are, if this distinction be omitted, colonies of unicellular Protozoa. F. E. Schulze (1361) has taken the unnecessary trouble to refute Saville Kent's (772) statements in detail, and to show that the latter had been guilty not only of levity in the philosophical treatment of his work, but also of recording incorrect observations.

Some very excellent men, particularly Balfour (17), Bütschli (138), and Sollas (1440), are inclined to consider the Sponges as a separate group equal in value to our groups Metazoa and Protozoa. This arrangement was arrived at without regard to the division of the Metazoa into Cœlentera and Cœlomata. They contrast the subkingdom Porifera (Parazoa, Sollas) with the subkingdom Metazoa as a whole. With all respect to the most important opinion of Balfour, I still do not see that there is any justification for the establishment of

a special Subkingdom for the Sponges. They are evidently Metazoa, and no doubt Cœlentera in the sense given above, namely the *Grade* Cœlentera as opposed to the *Grade* Cœlomata.

I think therefore that the Sponges form part of the *Grade* Cœlentera, and I do not believe that any one will raise any objection to this statement.

Now, however, we have to approach a much more difficult task, and that is, to ascertain what position the Sponges occupy within the *Grade* Cœlentera.

In this Grade we must place, besides the Sponges, one very well-defined group of animals (the Jellyfish, Hydroids, Corals, and Ctenophora) which is not connected with other animals by any intermediate form. There can be no doubt of the comparatively close affinity of all these, and the sharp distinction between them and the Sponges. In a like manner the Sponges are an exceedingly well circumscribed group, without any transitions in any direction to other animals. The Grade Cœlentera comprises, therefore, two well-defined groups:—(1) the Mesodermalia (910) or Sponges; and (2) the Epithelaria (910) or Nematophora (Lankester), Cnidaria (Claus), Telifera (Marshall), as they are variously termed.

A. In the Mesodermalia the archenteron communicates with the outer water by numerous small pores through which the water-current enters; and by one or a few larger pores termed oscula or vents, through which the water is expelled. It consists here of a branching canal-system.

In the Epithelaria there is no branching canal-system. The anus and mouth are not distinguished, and the mouth or mouths are equivalent to all the openings of the canal-system of sponges. Only exceptionally two different kinds of pores are met with, as in certain Actiniæ with terminally open tentacles; but there is no regular current of water through these pores.

B. The gastrula of the Mesodermalia is generally produced by invagination.

The gastrula of the Epithelaria, on the other hand, is generally the result of delamination.

C. The Mesodermalia have no movable appendages wherewith to catch their prey.

The Epithelaria have such appendages.

D. The Mesodermalia are not armed with cnidoblasts or their homologues.

The Epithelaria are defended by cnidoblasts or their homologues.

Although these differences are important, yet the principal distinction between these two groups, to which I drew attention at the last meeting of the British Association (Meeting 1886), is the following:—

E. The Mesodermalia have invariably simple ectodermal and entodermal epithelia, the cells of which are always flat pavement-cells, and never converted into muscular, glandular, sexual, or sensitive elements. The muscular, connective, slime-producing glandular, skeleton-producing glandular, sexual, sensitive, ganglionic and amœ-

boid cells met with in the Sponges are invariably modified cells of the mesoglœa. This is particularly striking and important in the case of the muscular and sensitive elements.

The Epithelaria, on the other hand, have a mesoglœa the cells of which remain more or less amœboid and are not differentiated to any extent. The muscular, glandular, sexual, sensitive, ganglionic and defensive nettle-cells are produced in the epithelia, they sink below the outer cell-layer with advancing development and lie on the surface of the mesoglœa or supporting lamella.

By a process of folding and subsequent coalescing of the fold-margins, bundles of muscular cells may become immersed in the mesoglœa, and so form a mesodermal structure, which, however, must be considered a secondary mesoderm, as compared to the primary mesoderm represented by the mesoglœa and its cells. But they are invariably produced first from the epithelia and immersed afterwards, and always retain their epithelial character in clothing the walls of tubular cavities in the mesoglœa. Single muscular cells are never surrounded on all sides by the mesoglœa. Solid bundles of muscular cells do not occur. Exceptionally nettle-cells (*Crambessa*) may be found in the mesoglœa, which is also here and there traversed by nerve-fibres (*Cycloneurous Medusæ*).

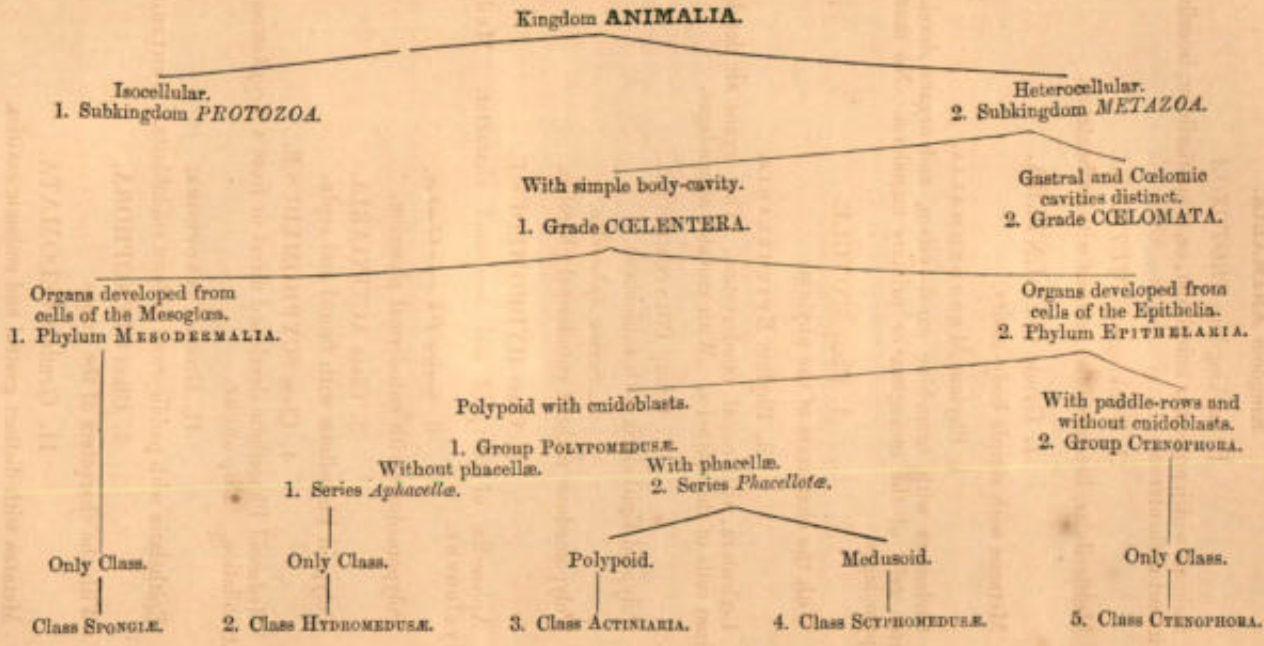
From a common sac-shaped ancestral form with simple ectoderm, simple entoderm, and undifferentiated cells in the intervening mesoglœa, representing the type of the Cœlentera, both Mesodermalia and Epithelaria have been developed. In the case of the Mesodermalia the cells of the mesoglœa became differentiated, and produced the organs, whilst the epithelia remained simple. In the case of the Epithelaria the cells of the mesoglœa remained unchanged and the organs were produced by the epithelia. I regard this as the principal difference dividing the two groups, and have therefore established the term Epithelaria in contradistinction to Mesodermalia (*l. c.*).

Having thus described the points of distinction, it remains that we should ascertain their phylogenetic value. There are only two alternatives with regard to the value we may attach to the Sponges as a group.

Either we must assume that within the Grade Cœlentera the Phylum Mesodermalia and the Phylum Epithelaria should be distinguished; or we may say that there is only one phylum in the Grade Cœlentera, namely the Phylum Cœlentera, and that this should be divided into the two Subphyla Mesodermalia and Epithelaria. It is evident that it comes much to the same thing. In this matter I adopt F. E. Schulze's opinion (1369), and consider the Sponges a separate phylum.

The result of this critical examination is given in the accompanying tabular view.

If we express this arrangement in the usual manner, we have:—


Kingdom ANIMALIA.
Isocellular.
1. Subkingdom PROTOZOA.
Heterocellular.
2. Subkingdom METAZOA.
With simple body-cavity.
1. Grade CŒLENTERA.
Gastral and Cœlomic cavities distinct.
2. Grade CŒLOMATA.
Organs developed from cells of the Mesoglœa.
1. Phylum MESODERMALIA.
Organs developed from cells of the Epithelia.
2. Phylum EPITHELARIA.
Polypoid with cnidoblasts.
1. Group POLYPOMEDUSÆ.
With paddle-rows and without cnidoblasts.
2. Group CTENOPHORA.
Without phacellæ.
1. Series Aphacellæ.
With phacellæ.
2. Series Phacellotæ.
Only Class.
Class SPONGIÆ.
Only Class.
2. Class HYDROMEDUSÆ.
Polypoid.
3. Class ACTINIARIA.
Medusoid.
4. Class SCYPHOMEDUSÆ.
Only Class.
5. Class CTENOPHORA.

Kingdom **ANIMALIA.**

I. Subkingdom *PROTOZOA.*

Animals which are either unicellular, or, if multicellular, isocellular, without archenteron.

II. Subkingdom *METAZOA.*

Multicellular, heterocellular animals with archenteron.

I. Grade CŒLENTERA.

Metazoa with simple body-cavity.

i. Phylum MESODERMALIA.

Cœlentera with branching canal-system, and organs developed from cells of the mesogloea or primary mesoderm. No movable appendages.

1. Class SPONGIÆ.

With the characters of the phylum.

ii. Phylum EPITHELARIA.

Cœlentera with cæcal canal-system. The organs are developed from cells of the epithelia. With movable appendages.

1. Group POLYPOMEDUSÆ.

Polypoid Epithelaria with cnidoblasts.

i. Series *Aphacellæ.*

Polypomedusæ without entodermal phacellæ.

2. Class HYDROMEDUSÆ.

Aphacellæ of polypoid and medusoid character. Medusæ cycloneur.

ii. Series *Phacellotæ.*

Polypomedusæ with entodermal phacellæ.

3. Class ACTINIARIA.

Polypoid Phacellotæ with funnel and septa.

4. Class SCYPHOMEDUSÆ.

Medusoid Phacellotæ developed direct or from a *Scyphostoma* by strobilation. Toponeur.

II. Group CTENOPHORA.

Epithelaria with paddle-rows without cnidoblasts. Centroneur.

5. Class CTENOPHORA.

With the characters of the group.

II. Grade CŒLOMATA.

Metazoa with distinct gastral and cœlomic cavities.

IV. The Classification of Sponges.

Having thus ascertained the systematic position of the Sponges as a group, we now approach the second part of our work.

Every one will agree that no satisfactory classificatory system of Sponges exists at present. Spongologists are in the habit of approaching this subject with great caution, I may say with diffidence.

It is a remarkable fact that the leading spongologist of the day, my esteemed teacher Prof. F. E. Schulze, in Berlin, has not attempted to work out a classificatory system of Sponges, whilst others have made some desultory efforts in that direction. It is self-evident that the systems established by Bowerbank, O. Schmidt, Gray, and others, which date from a time when virtually nothing was known about Sponges, have now become obsolete. The most successful attempt at establishing a system of Sponges is doubtless that of Vosmaer (1550), who, however, approaches his task with great diffidence; everywhere we meet in his work with "preliminary" classifications. Some geologists, principally Zittel (1635) and Sollas (1455), have classified the Sponges in a rather high-handed manner, establishing subclasses, orders, &c., without regard to details like families and genera. Zittel particularly attached too much importance to the fossil Sponges.

In the groups themselves more satisfactory detail work has recently been done. F. E. Schulze (1369) has worked out the Hexactinellids of the 'Challenger' with results which are as valuable and useful as the material at his disposal was abundant and interesting. Zittel (1626–1629) has in a satisfactory manner dealt with the fossil Sponges belonging to the same group. The Lithistids and Tetractinellids, both fossil and recent, have been carefully investigated by Zittel (1639) and Sollas (1453). I (888) have, with the aid of the works of Häckel (627–629) and Polejaeff (1179) at my disposal, established a system of Calcareous Sponges based on my investigations of the rich Australian Sponge-fauna, which appears fairly satisfactory.

The Monactinellids have been carefully studied by Vosmaer (1545), Ridley (1261), and Ridley and Dendy (1265–1266), and I have myself devoted much labour to their investigation, and have made (870) an attempt at classifying them, which, however, was unsuccessful. The Australian Fauna is exceedingly rich in Monactinellids, and my collection, of over 300 species, has enabled me to work out the classification of some of the groups in detail.

No attempt has hitherto been made to classify the Horny Sponges excepting one, contained in a short paper of Vosmaer (1552), establishing five groups, in accordance with the views previously expressed by myself (868), and based on the result of the researches into the structure of horny sponges by F. E. Schulze (1345, 1348, 1349, 1351) and myself (868). The Australian marine fauna is exceedingly rich in horny sponges, so that I have been enabled to work out their relationships in detail.

If we review the Sponges as a whole, we shall be struck with the great fundamental difference between the Calcareous and all

the other Sponges. Grant (526) was the first to point this out, and he accordingly divided the Sponges into Calcarea and Non-Calcarea. Vosmaer (1550) agrees in this point with Grant and uses his terms. I have also (888) adopted the same view. In this paper I intend to alter the term Non-Calcarea, which is misleading, inasmuch as it might be interpreted as meaning that the group so named consisted of very heterogeneous elements, coinciding with each other only in one, and that a negative character. This is not the case. I divide the Classis Spongiæ accordingly into two *Subclasses*, I. Calcarea, and II. Silicea.

The point of distinction between these two Subclasses is, that all the *Calcarea* have a skeleton composed of spicules consisting chiefly of carbonate of lime. All the other Sponges, which I comprise under the heading *Silicea*, either have a skeleton composed of siliceous spicules or have been derived phylogenetically from siliceous Sponges, and have only recently lost their spicules or replaced them with a horny support. O. Schmidt (1305) and also myself (870) were inclined to think that *some of* the siliceous Sponges had descended from horny ones. I have, however, since abandoned this view (901), and consider that the opposite direction of development, which Vosmaer (1558) advocates, is the correct one.

We have accordingly :—

Classis SPONGIÆ.

Skeleton composed chiefly of carbonate of lime.	Skeleton originally composed of siliceous spicules.
I. Subclassis CALCAREA.	II. Subclassis SILICEA.

As mentioned above, in the critical introduction to this chapter, I have nothing to add to my system of Calcareous Sponges (888) published some time ago, and I adopt it unchanged in this paper. The Calcarea are a very much smaller group than the Silicea. In this Subclass we only distinguish one Order, the Calcispongiæ (Blainville); whilst the Silicea must be divided into several Orders, and it is here that we meet with the greatest difficulty in ascertaining the true relationship of the different forms. There are no transitions between the two subclasses. In examining the structure of a great number of Sponges belonging to this second group, the subclass Silicea, I found that they can be arranged in three Groups, which will appear as Orders in my system. These are the Hexactinellida, the Chondrospongiæ, and the Cornacuspongiæ. These groups are fairly distinct, and transitional forms connecting them are rare. The Sponges of these Orders are descended from siliceous Sponges, and show the same tendency of development within each group.

In the Hexactinellida we invariably meet with a skeleton composed of triaxial spicules; these are often attached to each other by a siliceous cement which greatly strengthens the structure.

All authors agree that the Hexactinellida form a well-defined group. The remaining Silicea, however, are a very mixed lot, and before Vosmaer, no satisfactory arrangement of them had been arrived

at. The one I propose in this paper, which is similar to that of Vosmaer, is certainly very far from being as perfect as I would like to make it; but I think that at all events it is much more likely to express the relationship of Sponges in a correct manner than any other existing arrangement.

The subclass Silicea minus the order Hexactinellida comprises the Sponges with a skeleton composed of tetraxial spicules (the Tetractinellida and Lithistidæ of Marshall and other authors), the Sponges with monaxial spicules (the Monactinellida of Zittel and other authors), the Sponges with a horny skeleton and without spicules in the supporting skeleton (the Ceraospongiæ or Keratosa of many authors), and, finally, the Sponges without any supporting skeleton at all (the Myxospongiæ of Häckel).

At first sight all these forms appear connected with each other in every direction by transitional forms to such an extent that it seems hopeless to bring order into this chaotic mass. A careful investigation of many forms shows that *all* the familiar groups Tetractinellida, Lithistidæ, Monactinellida, Ceraospongiæ, and Myxospongiæ run into each other at every point. If one, however, for years endeavours to find some constancy in the varying characters of any chaotic mass of this kind, he at last generally arrives at an idea which seems clear enough when once grasped. And then one only wonders how it was that it had not been conceived a long time ago. So it was also in this case. I found that all these Sponges could be very naturally divided into *two* Orders—the above-mentioned Chondrospongiæ and Cornacuspongiæ, the first of which comprises the Lithistids, Tetractinellida, and portions of the Monactinellida, together with most Myxospongiæ; whilst the second contains all the Ceraospongiæ, and the remainder of the Monactinellids and Myxospongiæ.

We find that the ground-substance, the mesodermal intercellular substance or Mesoglœa, as it is variously termed, is more or less hard and cartilage-like in the Chondrospongiæ, and that in these the spicules remain isolated. The spicules are either tetraxon or tylostyles, less frequently styles. The monaxon spicules are monact, thereby indicating their closer affinity with the tetraxon spicules. The necessary toughness is given to these Sponges not by a cementing of the spicules, but by a hardening of the ground-substance. In some the spicules disappear altogether, as in *Oscarella*, which is an askeletous form of *Plakina*, and in *Chondrosia*, which is an askeletous sponge belonging to the *Tethya* group.

In the Cornacuspongiæ, on the other hand, there is no tendency towards a hardening of the ground-substance discernible. The ground-substance remains soft and gelatinous, and the necessary toughness is given to the sponge by the formation of a substance not found in other Sponges, which cements the spicules together. This substance is chemically and physically comparable to silk or horn, and is known as Spongin.

The spongin may become very voluminous and the spicules scarce and small. They may finally disappear altogether, and then

we have Ceraospongiæ before us. Transitional forms between the Cornacuspongiæ with supporting spicules cemented by spongin, and Cornacuspongiæ without spicules in their fibres (horny sponges), are not unfrequent.

One whole subfamily, the Chalininæ, comprising nearly 300 species, is composed of such transitional forms. The supporting spicules met with in the Cornacuspongiæ are invariably monaxon without a swelling at one end. Besides these more or less rod-shaped supporting spicules, we also find in some of the Sponges belonging to this group so-called flesh-spicules—small, irregular curved or complicated elements scattered throughout the Mesoglœa. These occur associated with spicules in the fibrous supporting skeleton and also in those forms which have no spicules in their horny supporting skeleton. To this group also the genera *Halisarca* and *Bayalus* belong, which have no skeleton at all, and appear as askeletous forms of the Aplysillide type. The term Cornacuspongiæ was established by Vosmaer (1550), and used by him in a very similar sense to that in which it is used here. The group Chondrospongiæ, on the other hand, is in the sense given above a new one; it nearly coincides with Vosmaer's group Spiculispongiæ (1550). In a former paper (889) I had retained the group Myxospongiæ, for the sake of convenience, preliminarily only, and agreeing at the time with Sollas (1440) that it was unnatural. The manner in which I have distributed the members of the Myxospongiæ among other groups is in accordance with the view expressed by F. E. Schulze in a letter.

We have accordingly to divide the subclass Silicea into three groups in the following manner:—

Subclassis *SILICEA*, Lendenfeld.

Mesoglœa soft; supporting skeleton often strengthened with siliceous cement. Spicules triaxon.	Mesoglœa hard; toughness achieved by the hardening of the ground-substance. Spicules tetraxon, monaxon, anaxon, or absent; generally corticate.	Mesoglœa soft; supporting skeleton strengthened by spongin cement; or exclusively formed of spongin, with or without foreign bodies. Spicules monaxon, or absent.
2. Ordo HEXACTINELLIDA, O. Schmidt.	3. Ordo CHONDROSPONGIÆ, Lendenfeld.	4. Ordo CORNACUSPONGIÆ, Vosmaer.

Expressed in the usual manner, the class Spongiæ would be accordingly divided into *four* Orders in the following manner:—

Classis **SPONGIÆ**, auctorum.

Cœlentera with branching canal-system, without movable appendages; the organs of which are developed from cells of the mesoglœa. With simple epithelia.

I. Subclassis *CALCAREA*, Grant.

Spongiæ with a skeleton composed of spicules which consist chiefly of carbonate of lime.

1. Ordo CALCISPONGIÆ, Blainville.

The only Order, with the characters of the Subclassis.

II. Subclassis *SILICEA*, Lendenfeld.

Spongiæ with a skeleton composed of siliceous spicules and their descendants with horny aspiculous skeleton and askeletous forms.

2. Ordo HEXACTINELLIDA, O. Schmidt.

Silicea with soft mesogloea. Supporting skeleton often strengthened with siliceous cement. Spicules triaxon.

3. Ordo CHONDROSPONGIÆ, Lendenfeld.

Silicea in which the toughness is achieved by the mesogloea or mesodermal ground-substance becoming cartilaginous, whilst the spicules remain isolated. Spicules tetraxon, monaxon (tylostylus), or absent; generally corticate.

4. Ordo CORNACUSPONGIÆ, Vosmaer.

Silicea with soft mesogloea or mesodermal ground-substance; the supporting skeleton, composed of bundles of monaxonid not tylostyle spicules, is strengthened by spongin, which cements the spicules. These may disappear altogether, and the skeleton is then composed of spongin with or without foreign bodies. The skeleton rarely disappears altogether.

Having thus divided the Class Spongiæ into four Orders, we may proceed to the further division of the Orders into Families.

I. Ordo CALCISPONGIÆ, Blainville.

This Order has been divided by Häckel (627-629) into the well-known three families Ascones, Leucones, and Sycones, with seven genera in each. Poléjaeff (1179) has divided the group into two Suborders and replaced Häckel's genera by the older and wider genera of Grant and others. I (888) have tried to combine Häckel's and Poléjaeff's classifications, and have added three new families to the existing ones.

I have retained Poléjaeff's terms for the two Suborders, but have altered their meaning. In some Calcareous Sponges the whole of the entoderm consists of collar-cells. There are no entodermal pavement-cells in these forms. These constitute my first Suborder Homocœla. In others the collar-cells are found in the ciliated chambers only, while the central gastral cavity is clothed with entodermal pavement-cells. I combine these forms in the Suborder Heterocœla.

To the Homocœla belong besides Häckel's Asconidæ, my families Homodermidæ and Leucopsidæ. I acknowledge Häckel's seven genera of the Asconidæ.

In the Heterocœla, Häckel's families Leuconidæ and Syconidæ together with Carter's Teichonidæ and my family Sycileibidæ are placed.

II. Ordo HEXACTINELLIDA, O. Schmidt.

Schulze (1369) divides the living Hexactinellida into the two Suborders Lyssacina and Dictyonina of Zittel. In the first, the spicules remain isolated or coalesce secondarily in an irregular manner; in the second, the main spicules coalesce to begin with in a very regular manner, so as to form a continuous scaffolding. In the first suborder Lyssacina, the families Euplectellidæ, Gray, Asconematidæ, F. E. Schulze, Rossellidæ, F. E. Schulze, and Hyalonematidæ, Gray, are placed. The second suborder, Dictyonina, comprises the families Farreidæ, Gray, Euretidæ, F. E. Schulze, Melittionidæ, Zittel, Coscinoporidæ, Zittel, and Meandrospongidæ, Zittel. To these the fossil families Ventriculitidæ, Staurodermidæ, Callodictyonidæ, Cœloptychidæ, Receptaculitidæ, and Monakidæ must be added.

In the classificatory scheme below, Schulze's diagnoses are translated.

III. Ordo CHONDROSPONGIÆ, Lendenfeld.

As mentioned above, this Order coincides nearly with Vosmaer's (1550) order Spiculispongiæ. I divide it into the two groups, Tetraxonia and Monaxonia. The former comprises the Sponges with tetraxon spicules, Tetractinellids and Lithistids; and the latter those forms which have monaxon spicules, or which have no spicules at all.

Sollas (1453) divides the Tetraxonia into two groups:—Choristida, Sollas, without lithistid sclerites; and Lithistida, Zittel, with lithistid sclerites. In the first group the families Plakinidæ, Pachastrellidæ, Corticidæ, Tetillidæ, Theneidæ, Stellettidæ, and Geodinæ are distinguished.

Vosmaer (1550) divides the Lithistidæ, in accordance with Zittel (1639) and O. Schmidt (1306, 1322), into the families Rhizomorinidæ, Megamorinidæ, Anomacladinidæ, Tetracladinidæ.

The Monaxonia comprise the families Suberitidæ, Spirastrellidæ, Tethydæ, and Chondrosidæ. The Clavulina and portion of the Oligosilicina of Vosmaer.

IV. Ordo CORNACUSPONGIÆ.

I divide the Cornacuspongiæ into the two suborders Halichondrina with, and Ceraospongiæ without, proper spicules in the supporting skeleton.

The Halichondrina comprise the three families Homorhaphidæ, Heterorhaphidæ, and Desmacidonidæ of Ridley and Dendy (1265, 1266).

The Ceraospongiæ are divided by me into two groups—Macrocameræ with large, and Microcameræ with small, ciliated chambers. To the former belong the families Aplysillidæ and Spongelidæ, and to the latter the Spongidæ, Aplysinidæ, and Hircinidæ.

After this general view of the Classification of Sponges, I shall proceed to give a "system" of Sponges down to subfamilies, mentioning the principal genera in each group.

Classis SPONGIÆ, auctorum.

Cœlenterata with branching canal-system, the organs of which are developed from cells of the mesogloea or primary mesoderm. With simple epithelia, with entodermal collar-cells, and without movable appendages and cnidoblasts.

I. Subclassis *CALCAREA*, Grant.

Sponges with a skeleton composed of calcareous spicules.

I. Ordo CALCISPONGIÆ, Blainville.

The only order, with the characters of the subclass.

1. Subordo HOMOCŒLA, Polejaeff, emend.

The entodermal epithelium consists exclusively of collar-cells.

1. Familia ASCONIDÆ, Häckel.

Simple sac-shaped gastral cavity with smooth surface.

Leucosolenia, Polejaeff, *Ascetta*, *Ascissa*, *Ascilla*, *Ascaltis*, *Ascortis*, *Asculmis*, *Ascandra*, Häckel.

2. Familia HOMODERMIDÆ, Lendenfeld.

The gastral cavity forms cæcal outgrowths, which resemble the tubes of Syconidæ.

Ascaltis canariensis, Häckel, *Ascaltis lamarckii*, Häckel, and *Homoderma sycandra*, Lendenfeld.

3. Familia LEUCOPSIDÆ, Lendenfeld.

A colony of Ascon-persons which are imbedded in the thick mesogloea. There are narrow inhalant pores and wider exhalant ones. The latter lead into a pseudogaster.

Leucopsis, Lendenfeld, and some species of *Pseudonardorus-forms*.

II. Subordo HETEROCŒLA, Polejaeff, emend.

The entodermal epithelium is differentiated into collar-cells, which are found in the walls of the ciliated chambers only, and into flat pavement-cells, which clothe the walls of the exhalant canals and gastral cavity.

4. Familia SYCONIDÆ, Häckel.

With regular, radially disposed cylindrical ciliated chambers, which open direct into the sac-shaped gastral cavity.

1. Subfamilia *Syconinæ*, Lendenfeld.

The unbranched ciliated chambers remain isolated in their distal part.

Sycon, Polejaeff, the subgenera of Häckel's Syconidæ which terminate with the syllable "*aga*." I divide this subfamily according to Häckel's scheme into the seven genera *Sycetta*, *Sycissa*, *Sycilla*, *Sycaltis*, *Sycortis*, *Syculmis*, and *Sycandra*.

2. Subfamilia *Uteinæ*, Lendenfeld.

With simple unbranched ciliated chambers, the distal ends of which are imbedded in a continuous cortex. *Grantessa*, Lendenfeld, *Ute*, Poléjaeff, and *Amphoriscus*, Poléjaeff, and those subgenera of the Syconidæ in Häckel's system which terminate with the syllable "*usa*."

3. Subfamilia *Grantinæ*, Lendenfeld.

With branched ciliated chambers.
Grantia, *Heteropegma*, and *Anamixilla*, Poléjaeff.

5. Familia Sylleibidæ, Lendenfeld.

With complicated exhalant canals, leading from the cylindrical ciliated chambers into the gastral cavity.

1. Subfamilia *Vosmaerinæ*, Lendenfeld.

The ciliated chambers are radially situated, and form a regularly cylindrical zone. They are connected with the gastral cavity by a network of anastomosing exhalant canals.
Vosmaeria, Lendenfeld, and *Leucetta*, Poléjaeff.

2. Subfamilia *Polejnæ*, Lendenfeld.

The ciliated chambers form a much-folded layer. The exhalant canals are wide, and do not anastomose to form a reticulation.
The genera *Polejna*, Lendenfeld, and *Leucilla*, Poléjaeff, constitute this group.

6. Familia Leuconidæ, Häckel.

Heterocœla with ramified canal-system and spherical ciliated chambers.
Leucetta, *Leucissa*, *Leucaltis*, *Leucortis*, *Leuculmis*, and *Leucandra*, Häckel, *Leuconia*, auctorum, and *Leuconia* and *Pericharax*, Poléjaeff.

7. Familia Teichonidæ, Carter.

Heterocœla without gastral cavity. The inhalant pores are situated on the one, and the exhalant on the other side of the lamellar sponge; with spherical ciliated chambers.
Teichonella, Carter, and *Eilhardia*, Poléjaeff.

II. Subclassis *SILICEA*, nov.

Sponges with a skeleton composed of siliceous spicules and their derivatives; possessing a horny skeleton or no skeleton at all, but never supported by calcareous spicules.
Comprises the Non-Calcarea of Grant and other authors.

I. Ordo HEXACTINELLIDA, O. Schmidt.

Silicea with triaxon spicules and soft mesoglœa. Strengthened by siliceous cement, generally joining the spicules.

I. Subordo LYSSACINA, Zittel.

The spicules remain isolated or are subsequently cemented together irregularly.

i. Tribus *Hexasterophora*, F. E. Schulze.

Hexaster always found in the mesoglœa; chambers distinct, thimble-shaped.

1. Familia EUPLECTELLIDÆ, F. E. Schulze.

Thin-walled tubes or sacs with sword-shaped hexact hypodermalia, the centripetal rays of which are the longest.

1. Subfamilia *Euplectellinæ*, F. E. Schulze.

Tubular, with terminal sieve-plates. The wall regularly perforated. To the centrifugal ray of each hypodermal a floricome is attached.

Euplectella, Owen, and *Regadrella*, O. Schmidt.

2. Subfamilia *Holascinæ*, F. E. Schulze.

Tubular, wall without perforations, without superficial floricomes.

Holascus and *Malacosaccus* of F. E. Schulze.

3. Subfamilia *Taegerinæ*, F. E. Schulze.

Tubular or sac-shaped, wall irregularly perforated. Principalia partially cemented, forming an irregular network. To the distal ray of each hypodermal sword-shaped hexact a floricome is attached.

Taegeria and *Walteria* of F. E. Schulze.

2. Familia ASCONEMATIDÆ, F. E. Schulze.

Pentact or hexact pinnulæ in the dermal and gastral surfaces. Hypodermalia and hypogastralia pentact. Discohexaster in the interior.

1. Subfamilia *Asconematinæ*, F. E. Schulze.

Sessile, sac-shaped, or tubular, with thin soft wall.

Asconema, Sav. Kent, and *Aulascus*, F. E. Schulze.

2. Subfamilia *Sympagellinæ*, O. Schmidt.

Pedunculate, cup-shaped. Principalia hexact and diact. Discohexaster in the interior.

Sympagella, O. Schmidt, *Polyrhabdus*, F. E. Schulze, and *Balanites*, F. E. Schulze.

3. Subfamilia *Caulophacinæ*, F. E. Schulze.

Mushroom-shaped, with long cylindrical hollow peduncle.

Caulophacus and *Trachycaulus* of F. E. Schulze.

3. Familia Rossellidæ, F. E. Schulze.

The dermalia have no centripetal ray.

Lanuginella, O. Schmidt; *Polylophus*, F. E. Schulze; *Rossella*, Carter; *Acanthascus*, *Bathydorus*, *Rhabdocalyptus*, *Crateromorpha*, *Aulochone*, *Caulocalyx*, and *Aulocalyx*, F. E. Schulze.

ii. Tribus *Amphidiscophora*, F. E. Schulze.

Amphidiscs in the limiting membranes. Hexaster absent in the interior. A basal tuft is always present. The ciliated chambers appear as somewhat irregular sac-shaped extensions of the membrana reticularis.

4. Familia Hyalonematidæ, Gray.

Numerous pentact pinnulæ in the dermal and gastral surfaces.

1. Subfamilia *Hyalonematinæ*, F. E. Schulze.

Calyculate, with a well defined oscula-area on the upper surface.

Hyalonema, Gray; *Stylocalyx*, F. E. Schulze; *Pheronema*, Leidy; and *Poliopogon*, Wyville Thomson.

2. Subfamilia *Semperellinæ*, F. E. Schulze.

Without gastral cavity and terminal oscula-area, with root-tuft.

Semperella, Gray.

To this Subordo the fossil families Receptaculitidæ and Monakidæ belong.

ii. Subordo Dictyonina, Zittel.

The parenchymal hexacts early coalesce in a regular manner, so as to form a firm skeleton.

i. Tribus *Uncinataria*, F. E. Schulze.

With uncinates.

i. Subtribus *Clavularia*, F. E. Schulze.

With radially situated clavulæ.

1. Familia Farreidæ, F. E. Schulze.

The skeleton forms a single layer; from the joining points conical extensions arise, in a direction vertical to the surface of the network.

Farrea, Bowerbank.

2. Subtribus *Scopularia*, F. E. Schulze.

With radially situated scopulæ.

2. Familia Euretidæ, F. E. Schulze.

Branched and anastomosing tubes. The skeleton-net forms several layers.

Eurete, Carter; *Periphragella*, Marshall; and *Lefroyella*, Wyville Thomson.

3. Familia Melittionidæ, Zittel.

Forms branched tubes or calyculate structures. Skeleton honeycombed. Cavities traversed by the reticular membrane. The gastral skeleton without scopulæ.

Aphrocallistes, Gray.

4. Familia Coscinoporidæ, Zittel.

The wall of the calyculate or expanded sponge is traversed by funnel-shaped straight canals, which open alternately on the one or the other surface. Covered only by the perforated limiting membrane.

Chonelasma, F. E. Schulze; and the fossil genera *Leptophragma*, Zittel, *Guettardia*, Michelin, and *Coscinopora*, Goldfuss.

5. Familia Tretodictyidæ, F. E. Schulze.

With irregular inhalant and exhalant canals, which do not traverse the body transversely, but pass the dense dictyonal skeleton obliquely or longitudinally.

Tretodictyum, F. E. Schulze; *Euriplegma*, F. E. Schulze; *Cyrtaulon*, F. E. Schulze; *Fieldingia*, Sav. Kent; and *Scleracthamnus*, Marshall.

ii. Tribus *Inermia*, F. E. Schulze.

Without uncinates and scopulæ.

6. Familia Meandrospongidæ, Zittel.

The body consists of winding tubes of uniform width. The interstices of the tubes form a vestibule space.

Dactylocalyx, Stutchbury; *Scleroplegma*, O. Schmidt; *Margaritella*, O. Schmidt; *Myliusia*, Gray; and *Aulocystis*, F. E. Schulze; and the fossil genera:—*Placoscyphia*, Reuss; *Tremabolites*, Zittel; *Etheridgia*, Tate; *Cystispongia*, Roemer; *Toulminia*, Zittel; and *Camerospongia*, d'Orb.

To this Subordo belong the fossil families Ventriculitidæ, Staurodermidæ, Callodictyonidæ, and Cœloptychidæ.

II. Ordo CHONDROSPONGIÆ, nov.

Silicea in which the toughness is caused by the mesoglœa or mesodermal ground-substance becoming cartilaginous, whilst the spicules remain isolated. Spicules tetraxon, monaxon (tylostylus or stylus), or absent. With spherical ciliated chambers. Sponge generally corticate.

Comprises the Spiculispongiæ of Vosmaer, with the exception of the genus *Halisarca*, Vosmaer.

i. Subordo Tetraxonia, Vosmaer.

With tetraxon spicules.

1. Group LITHISTIDA, Zittel.

Body stony, with a central gastral cavity or numerous vertical tubes. Spicules more or less clearly tetraxon, often branched. Besides these, sometimes monaxon spicules and flesh-spicules. The skeleton-spicules are interwoven so as to form a dense skeleton.

1. Familia RHIZOMORINIDÆ, Zittel.

Spicules irregularly branched; form irregular fibres, or are loosely interwoven. Forked anchors always present.

Arabescula, Carter; *Corallistes*, Schmidt; *Heterophymia*, Pomel; *Seliscothon*, Zittel; *MacAndrewia*, Gray; *Azorica*, Carter; *Leiodermatium*, Schmidt; and the fossil genera:—*Cnemidiastrum*, *Corallidium*, *Hyalotragos*, *Pyrgochonia*, *Discostroma*, *Leiodorella*, *Epistomella*, *Platychonia*, *Bolidium*, *Astrobolia*, and *Chonella* of Zittel; *Plococonia*, Pomel; *Chenendopora*, Lamouroux; *Verruculina*, Zittel; *Amphithelion*, Zittel; *Stychophyma*, Pomel; *Allomera*, Pomel; *Pleuromera*, Pomel; *Perimera*, Pomel; *Meta*, Pomel; *Marisca*, Pomel; *Pomelia*, Zittel; *Jereica*, Zittel; *Cœlocorypha*, Zittel; *Scytalia*, Zittel; *Stachyspongia*, Zittel; *Pachinion*, Zittel.

2. Familia ANOMOCLADINIDÆ, Zittel.

Spicules rod-shaped with terminal tufts of branches. The approximating ends of the spicules coalesce and form knots. In this way a regular triaxial network is formed.

Vetulina, Schmidt; and the fossil genera *Mastosia*, *Cylindrophyma*, *Melonella*, and *Protachilleum*, Zittel, and *Palæomanon* and *Astylospongia*, Roemer.

3. Familia TETRACLADINIDÆ, Zittel.

Spicules tetractinellid with terminal branches.

Theonella, Gray; *Rhacodiscula*, Zittel; *Discodermia*, Bocage; *Kaliapsis*, Bowerbank; *Collectella*, Schmidt; *Collinella*, Schmidt; and the fossil genera:—*Aulocopium*, Oswald; *Phymatella*, *Aulaxinia*, *Callopegma*, and *Trachysycon*, Zittel; *Siphonia*, Parkinson; *Hallirhoa*, *Jerea*, Lamouroux; *Marginospongia*, d'Orbigny; *Nelumbia*, Pomel; *Polyjerea*, Fromentel; *Astrocladia*, Zittel; *Bolospongia*, Hinde; *Thecosiphonia*, Zittel; *Calymmatina*, Zittel; *Turonia*, Michelin; *Kalpinella*, *Thamnospongia*, and *Pholidocladia*, Hinde; *Ragadinia*, Zittel; *Plinthosella*, Zittel; *Spongodiscus*, Zittel; *Phymaplectia*, Hinde; *Rhopalospongia*, Hinde.

To this Subordo also the fossil family Megamorinidæ belongs.

II. Group CHORISTIDA, Sollas.

With tetraxon spicules of regular shape.

i. Tribus *Tetradina*, Sollas.

The chief spicules are tetract, with equal rays and candelabras.

i. Subtribus *Microcameræ*, nov.

With small chambers.

4. Familia Corticidæ, Vosmaer.

With candelabras.
Corticium, Schmidt, and *Thrombus*, Sollas.

5. Familia Pachastrellidæ, Sollas.

With simple tetracts, irregularly scattered.
Pachastrella, Schmidt, *Battersbya*, Bowerbank, and *Dercitus*, Gray.

ii. Subtribus *Macrocameræ*, nov.

With large chambers.

6. Familia Plakinidæ, F. E. Schulze.

With scattered diact, triact, and tetract spicules.
Plakina, *Plakinastrella*, and *Plakortis*, F. E. Schulze, and *Eupalax*, Sollas.

7. Familia Oscarellidæ, Lendenfeld.

Without spicules.
Oscarella, Vosmaer.

ii. Tribus *Trianina*, Sollas.

The centres of the tetraxon spicules with one differentiated ray lie in the surface, in which the equal rays extend tangentially.

8. Familia Geodidæ, Sollas.

A cortex of globate spicules. Chambers small, with small outlets.
Erylus, Gray; *Caminus*, Schmidt; *Cydonium*, Müller; *Synops*, Vosmaer; *Isops*, Sollas; *Geodia*, Lamarck; and *Geodissa*, Lendenfeld.

9. Familia Stellettidæ, Sollas.

With stellate flesh-spicules usually in the cortex.

1. Subfamilia *Psammasterina*, Sollas.

With stellates and spined rods.
Psammastra, Sollas.

2. Subfamilia *Stryphnina*, Sollas.

With stellates and amphiastrellæ.
Stryphnus, Sollas.

3. Subfamilia *Sanidasterina*, Sollas.

With stellate and sanidaster (?) spicules.
Tribrachium, Weltner, and *Tethyopsis*, Stewart.

4. Subfamilia *Stellettina*, Sollas.

With two kinds of stellate flesh-spicules.
Antrastra, *Dragmastra*, Sollas; *Stelletta*, Schmidt.

5. Subfamilia *Homasterina*, Sollas.

With one kind of stellate flesh-spicules.
Myriastra, Sollas; *Asterella*, Sollas; *Pilochrata*, Sollas.

10. Familia THENEIDÆ, Sollas.

With large outlets to the ciliated chambers, and spirastrellid spicules.

Thenea, Gray (*Tisiphonia*, Wyville Thomson, *Dorvillia*, Sav. Kent, *Wyville-Thomsonia*, Wright); *Normania*, *Vulcanella*, and *Characella*, Sollas.

11. Familia TETILLIDÆ, Sollas.

With flesh-spicules which are hamate, spiral, or rod-shaped.

Spiretta, Lendenfeld; *Tetilla*, Schmidt; *Craniella*, Schmidt; *Chrotella*, Sollas; *Papirula*, Schmidt; *Thalassomora*, Lendenfeld.

12. Familia TETHYOPSILLIDÆ, nov.

Spherical sponges supported by dense masses of large radial monaxonid spicules. A few tetraxonid grapnels are inserted in the surface.

Tethyopsilla, Lendenfeld, and *Protoleia*, Dendy and Ridley.

II. Subordo MONAXONIDA.

III. Group CLAVULINA, Vosmaer, emend.

With monaxonid spicules or without supporting skeleton.

Supporting spicules tylostyle, usually radially situated. (Includes the *Pseudotetraxonia*, Vosmaer.)

1. Familia TETHYDÆ, Vosmaer.

More or less spherical sponges, with regular subdermal cavities between the thick distally extending radial bundles of spicules.

1. Subfamilia *Tethynæ*, nov.

With stellate flesh-spicules.

Tethya, Lamarck; *Tuberella*, Keller (*Tethiophæna*, Schmidt); *Tethiosphæra*, Lendenfeld; *Mastigophora*, Lendenfeld; *Thalassodactylus*, Lendenfeld.

2. Subfamilia *Tethiopsamminæ*, nov.

With a sand cortex.

Tethiopsamma, Lendenfeld, MS.

3. Subfamilia *Tethyorhaphinæ*, nov.

With rod-shaped flesh-spicules, without stellates.

Tethyorhaphis, Lendenfeld.

4. Subfamilia *Tethyamatinæ*, nov.

With hamate flesh-spicules (sigmata) without stellates.

Tethyamata, Lendenfeld.

2. Familia Sollasellidæ, Lendenfeld.

Digitate forms with radiating spicule-bundles, and distinct ecto- and endochonæ.
Sollasella, Lendenfeld.

3. Familia Spirastrellidæ, Ridley and Dendy.

With spirastrellid flesh-spicules.
Spirastrella, Ridley; *Raphyrus*, Bowerbank; *Papillina*, Schmidt; *Cheirella*, Lendenfeld; *Axos*, Gray; and *Suberocorona*, Lendenfeld. Coincides with the family Cheirellidæ, Lendenfeld.

4. Familia Suberamatidæ, nov.

With hamate flesh-spicules (sigmata).
Suberamata, Lendenfeld.

5. Familia Suberitidæ, Vosmaer, emend.

Without flesh-spicules.
Suberitella, Lendenfeld; *Suberites*, Nardo; *Suberopetros*, Lendenfeld; *Plectodendron*, Lendenfeld; *Polymastia*, Bowerbank; *Trichostemma*, M. Sars; *Tentorium*, Vosmaer (*Thecaphora*, O. Schmidt); *Stylocordyle*, Wyv. Thomson; *Quasillina*, Norman; *Cliona*, Grant; and *Poterion*, Schlegel.

iv. Subordo Oligosilicina, Lendenfeld.

Without supporting skeleton. Flesh-spicules, when present, anaxon polyactinellid. Chambers small, with narrow outlet.

1. Familia Chondrillidæ, Lendenfeld.

With polyactinellid flesh-spicules. Comprises the genus *Chondrilla*, O. Schmidt.

2. Familia Chondrosidæ, Lendenfeld.

Without flesh-spicules. Comprises the genus *Chondrosia*, Nardo.

III. Ordo CORNACUSPONGIÆ, Vosmaer, emend.

Silicea with soft mesoglœa, or mesodermal ground-substance. The supporting skeleton is composed of bundles of monaxonids, which are never tylostyle spicules. The skeleton is strengthened by spongin, which cements the spicules. These may disappear altogether, and the skeleton is then composed of spongin, with or without foreign bodies. Exceptionally, also, this horny skeleton disappears. The ciliated chambers have large outlets.

i. Subordo Halichondrina, Vosmaer.

With siliceous spicules in the supporting skeleton.

1. Familia Spongillidæ, Carter.

Freshwater sponges with gemmulæ.
Spongilla, Lamarck; *Ephydatia*, Lamouroux; *Tubella*, Carter;

Uruguaya, Carter; *Parmula*, Carter; *Meyenia*, Bowerbank; *Heteromeyenia*, Potts; *Lubomirskya*, Dybovsky; *Lessepsia*, Keller; *Potamolepis*, Marshall.

2. Familia HOMORHAPHIDÆ, Ridley and Dendy.

Megasclera oxea or strongyla; no differentiated microsclera except toxia. Marine sponges without gemmulæ.

1. Subfamilia *Renierinæ*, auct.

Spicules never completely enveloped in horny fibre.

Halichondria, Fleming; *Petrosia*, Vosmaer, =*Schmidtia* Balsamo Crivelli; *Reniera*, Nardo.

2. Subfamilia *Chalininæ*, Ridley and Dendy.

A considerable amount of spongin present, forming distinct horny fibres, in which spicules are contained.

1. Group *Chalinorhaphinæ*, Lendenfeld.

With abundant gigantic spicules axially situated.

Chalinorhaphis, Lendenfeld.

2. Group *Hoplochalininæ*, Lendenfeld.

With abundant gigantic spicules obliquely situated, and protruding beyond the fibre-surface.

Hoplochalina, Lendenfeld.

3. Group *Cacochalininæ*, Lendenfeld.

Irregular forms with slender spicules.

Cacochalina, Schmidt; *Cladochalina*, Lendenfeld; *Chalinopora*, Lendenfeld; *Chalinella*, Lendenfeld; *Chalinopsis*, Schmidt.

4. Group *Pachychalininæ*, Lendenfeld.

Irregular, digitate, lamellar forms with stout spicules, oxystrongylus.

Chalinissa, Lendenfeld; *Pachychalina*, Schmidt; and *Ceraochalina*, Lendenfeld.

5. Group *Plakochalininæ*, Lendenfeld.

Frondose, lamellar forms with stout spicules.

Plakochalina, *Euplakella*, and *Antherochalina*, Lendenfeld; *Cribrochalina*, Schmidt; *Tragosia*, Gray; *Platychalina*, Ehlers.

6. Group *Siphonochalininæ*, Lendenfeld.

Tubular, pseudogaster with stout spicules.

Spinosella, Vosmaer; *Siphonochalina*, Schmidt; *Tuba*, Duchassaing and Michelotti; *Sclerochalina*, Ridley; *Toxochalina*, Ridley; *Phylosiphonia*, Lendenfeld; *Tubulodigitus*, Carter; *Patulascula*, Carter; and *Siphonella*, Lendenfeld.

7. Group *Arenochalininæ*, Lendenfeld.

With spicules in the connecting and sand in the main fibres.

Arenochalina, Lendenfeld.

8. Group *Euchalininæ*, Lendenfeld.

Slender, regularly digitate forms with a fine-meshed network and slender spicules.

Chalina, auctorum, and *Dactylochalina*, *Euchalina*, *Euchalinopsis*, and *Chalinodendron*, Lendenfeld.

3. Familia HETERORHAPHIDÆ, Ridley and Dendy.

Megasclera of various forms; microsclera commonly present, but never chelæ. Marine sponges, without gemmulæ.

1. Subfamilia *Phlœodictyinæ*, Carter.

Sponge divisible into body and fistulæ, with a strong spicular rind. Megasclera oxea or strongyla; microsclera (when present) sigmata.

Rhizochalina, Schmidt; *Oceanapia*, Norman.

2. Subfamilia *Gelliinæ*, Ridley and Dendy.

Megasclera oxea or strongyla. Microsclera always present, viz. sigmata. No rind or fistulæ.

Gellius, Gray; *Gelliodes*, Ridley.

3. Subfamilia *Tedaniinæ*, Ridley and Dendy.

Megasclera of two forms: monactinal, styli, forming the main skeleton; and diactinal, tylota. Microsclera long, hair-like trichites.

Tedania, Gray; *Trachytedania*, Ridley.

4. Subfamilia *Desmacellinæ*, Ridley and Dendy.

Megasclera styli to tylostyli. Microsclera sigmata or toxia, or both.

Desmacella, Schmidt.

5. Subfamilia *Hamacanthinæ*, Ridley and Dendy.

Megasclera oxea or styli; microsclera diankistra, to which others may be added.

Hamacantha, Gray; *Vomerula*, Schmidt.

4. Familia DESMACIDONIDÆ, Vosmaer, auct.

Megasclera of various forms. Microsclera chelæ, to which others may be added.

1. Subfamilia *Esperellinæ*, Ridley and Dendy.

Fibre not echinated by laterally projecting spicules.

Esperia, Nardo; *Esperella*, Vosmaer; *Esperiopsis*, Carter; *Cladorhiza*, Sars; *Axoniderma*, Ridley and Dendy; *Chondrocladia*, Wyv. Thomson; *Desmacidon*, Bowerbank; *Homœodictya*, *Artemisina*, Vosmaer; *Phelloderma*, Ridley and Dendy; *Sideroderma*, Ridley and Dendy; *Iophon*, Gray; *Amphilectus*, Vosmaer; *Melonanchora*, Carter; *Guitarra*, Carter.

2. Subfamilia *Ectyoninæ*, Ridley and Dendy.

Fibre echinated by laterally projecting spicules.

Myxilla, Schmidt; *Clathria*, Schmidt; *Rhaphidophlus*, Ehlers; *Plumohalichondria*, Carter; *Acarnus*, Gray; *Echinoclathria*, Carter; *Clathrissa*, Lendenfeld; *Thalassodendron*, Lendenfeld; *Ceraospina*, Lendenfeld.

5. Familia AXINELLIDÆ, auct.

With large subdermal cavities. Skeleton non-reticulate, consisting of ascending axes of fibre, from which arise subsidiary fibres radiating to the surface pervading the subdermal cavity. Fibres plumose. Megasclera chiefly styli, to which oxea and strongyla may be added. Microsclera rarely present, never chelæ.

Dendropsis, Ridley and Dendy; *Thrinacophora*, Ridley; *Hymeniacidon*, Bowerbank; *Phakellia*, Bowerbank; *Ciocalypta*, Bowerbank; *Acanthella*, Schmidt; *Axinella*, Schmidt; *Raspailia*, Nardo; *Spirophora*, Lendenfeld.

II. Suborder KERATOSA, Bowerbank, emend.

Silicea with a supporting skeleton composed of spongin; fibre with or without foreign bodies, but always without proper spicules. Flesh-spicules may be present. Exceptionally, there is no skeleton at all.

i. Tribus *Microcameræ*, Lendenfeld.

With small spherical ciliated chambers and opaque ground-substance.

1. Familia SPONGIDÆ, F. E. Schulze.

With narrow axial thread in the horny fibres, and without filaments.

1. Subfamilia *Auleninæ*, Lendenfeld.

Reticulate sponges with vestibules, without flesh-spicules.

Halme, *Aphroditella*, *Halmopsis*, and *Aulena*, Lendenfeld; *Psammaclema*, Marshall.

2. Subfamilia *Chalinopsillinæ*, Lendenfeld.

When dry of light yellow colour, digitate, lamellar, more or less flower-shaped, imitating very closely Chalininæ, from which they appear only recently to have developed. Without flesh-spicules, with smooth surface.

Chalinopsilla and *Antheroplax*, Lendenfeld; *Dactylia*, Carter.

3. Subfamilia *Spongiæ*, Lendenfeld.

Massive, when dry dark brown, with conulated or granulated surface. Vestibules, when present, belong exclusively to the *inhalant* system. Without flesh-spicules.

Euspongia, Bronn; *Cacospongia*, Schmidt; *Hippospongia*, F. E.

Schulze; *Coscinoderma*, Carter; *Spongodendron*, Lendenfeld; and many of the species of the genus *Spongia*, auctorum.

4. Subfamilia *Spongissinæ*, Lendenfeld.

With flesh-spicules.
Spongissa, Lendenfeld, MS.

2. Familia Aplysinidæ, Lendenfeld.

The skeleton is composed of spongin-tubes, the walls of which are thinner than the diameter of the lumen, which is filled with pith.

1. Subfamilia *Aplysininæ*.

Without flesh-spicules.
Luffaria, Duchassaing and Michelotti; *Aplysina*, Nardo; *Luffarella*, Lendenfeld, MS.; *Dendrospongia*, Hyatt.

2. Subfamilia *Aplysissinæ*, Lendenfeld.

With flesh-spicules.
Aplysissa, Lendenfeld, MS.

3. Familia Hircinidæ, Lendenfeld.

With narrow axial canal in the fibres, and filaments in the ground-substance.

1. Subfamilia *Hircininæ*, Lendenfeld.

Without proper spicules.
Hircinia, Nardo; *Hircinopsis*, *Nodosina*, *Aphrotriche*, and *Styphlos*, Lendenfeld, MS.; *Stematonemia*, Bowerbank; *Filifera*, Lieberkühn; *Sarcatragus*, Schmidt; and *Polytherses*, Duchassaing and Michelotti.

2. Subfamilia *Hircinissinæ*, Lendenfeld.

With proper spicules.

1. Group *Chalinocinia*, nov.

With proper spicules in the connecting fibres.
Chalinocinia, Lendenfeld.

2. Group *Hircinissa*, nov.

Without proper spicules in the fibres; with flesh-spicules.
Hircinissa, Lendenfeld, MS.

ii. Tribus *Macrocameræ*, Lendenfeld.

With large sac-shaped ciliated chambers, and soft, transparent ground-substance.

4. Familia Spongelidæ, Lendenfeld.

The horny fibres contain slender axial thread and form a reticulated skeleton.

1. Subfamilia *Spongelinæ*, Lendenfeld.

Without flesh-spicules. The skeleton consists of distinct horny fibre containing a varying amount of foreign matter.

Spongelia, Nardo; *Dysidea*, Johnston; and *Reteplax*, Lendenfeld, MS.

2. Subfamilia *Psammininæ*, nov.

The skeleton consists of foreign bodies cemented by spongin, which, however, is not distinctly visible; without flesh-spicules.

Psammapemma, Marshall; *Psammella*, Lendenfeld, MS.; and *Holopsamma*, Carter.

3. Subfamilia *Spongelissinæ*, Lendenfeld.

The skeleton is composed of distinct horny fibres containing foreign bodies. With flesh-spicules.

Dysideissa, Lendenfeld, MS.

4. Subfamilia *Psammopessinæ*, nov.

The skeleton consists of cemented foreign bodies without distinct horny fibres. With flesh-spicules.

Psammopessa, Lendenfeld, MS.; *Phoriospongia*, Marshall; and *Haastia*, Lendenfeld, MS.

5. Familia Aplysillidæ, Lendenfeld.

The skeleton consists of spongin-tubes ramified in a dendritic fashion and filled with pith.

1. Subfamilia *Aplysillinæ*, Lendenfeld.

Cells are found in the pith of the fibres only.

Darwinella, Fritz Müller; *Aplysilla*, F. E. Schulze; *Verongia*, Bowerbank; and *Dendrilla*, Lendenfeld.

2. Subfamilia *Ianthellinæ*, nov.

Cells are found in the spongin-sheath of the fibre.

Ianthella, Gray.

6. Familia Halisarcidæ, Vosmaer.

Without skeleton.

Halisarca, Schmidt, and *Bajalus*, Lendenfeld.

V. Key to the Recent Families of Sponges.

0.	Skeleton calcareous	1.
	No calcareous skeleton	(2.)
1.	Entoderm consists exclusively of collar-cells	3.
	Entoderm consists of collar- and pavement-cells	(4.)
3.	Mesoderm thin, gastral cavity irregular	1. *Asconidæ*.
	Mesoderm thin, radial cylindrical chambers	2. *Homodermidæ*.
	Mesoderm thick, irregular chambers	3. *Leucopsidæ*.

(4.)	With cylindrical chambers	5.	
	With spherical chambers	(6.)	
5.	Chambers radial, opening direct into gastral cavity	4.	*Syconidæ*.
	Chambers opening into exhalant canals which lead into the gastral cavity	5.	*Sycettidæ*.
(6.)	Exhalants lead into oscular tubes	6.	*Leuconidæ*.
	Exhalants open direct on one side of the lamellar sponge; inhalant pores on the other side exclusively	7.	*Teichonidæ*.

(2.)	With hexact spicules and thimble-shaped chambers	7.	
	Without hexact spicules, with sac-shaped or spherical chambers	(8.)	
7.	The spicules remain isolated or partly coalesce afterwards irregularly	9.	
	The supporting spicules early coalesce in a regular Dictyonid manner	(10.)	
9.	Hexaster in the interior	11.	
	No hexasters, but amphidiscs	(12.)	
11.	Hypodermalia hexact sword-shaped, with centripetal radial ray longest; no pinnulæ	8.	*Euplectellidæ*.
	Pinnulæ in the gastral and dermal surfaces	9.	*Asconematidæ*.
	Dermalia without centripetal ray; no pinnulæ	10.	*Rossellidæ*.
(12.)	With numerous pinnulæ	11.	*Hyalonematidæ*.
(10.)	With uncinates	13.	
	Without uncinates	(14.)	
13.	With radially situated clavulæ	12.	*Ferreidæ*.
	With radially situated scopulæ	15.	
15.	Branched and anastomosing tubes; the skeleton-net forms several layers	13.	*Euretidæ*.
	Branching tubular or calyculate, honeycombed; cavities traversed by reticular membrane	14.	*Melittionidæ*.
	Calyculate or expanded, traversed transversely by funnel-shaped canals opening alternately on one or other surface	15.	*Coscinoporidæ*.
	Canals irregular, traversing the dense dictyonal skeleton obliquely or longitudinally	16.	*Tetrodictyidæ*.
(14.)	Meandrically winding tubes	17.	*Meandrospongidæ*.
(8.)	With cartilaginous ground-substance and spherical chambers. Spicules polyact, tetract, lithistid, tylostylote, or stylote, never cemented with spongin. Askeletous forms with spherical chambers	16.	
	With soft ground-substance, spherical or sac-shaped chambers. Spicules monaxon, never tylostylote, cemented with spongin. Or skeleton composed of horny fibre without proper spicules. Askeletous forms with sac-shaped chambers	(17.)	

16.	With lithistid irregular tetraxon spicules	18.
	With tetraxon spicules of irregular shape; askeletous forms with large chambers, which have large outlets	(19.)
	With monaxon tylostylote spicules	(20.)
	Without supporting spicules; flesh-spicules when present polyact, with small chambers which have narrow outlets	(21.)
18.	Spicules quite irregular	18. *Rhizomorinidæ.*
	Spicules rod-shaped, with terminal tufts of branches	19. *Anomocladinidæ.*
	Spicules tetractin, with terminal branches	20. *Tetracladinidæ.*

(19.)	The spicules are chiefly tetracts with equal rays and candelabras	22.
	There are large tetract spicules with three equal rays lying tangentially in or beyond the surface, and one differentiated, radial ray	(23.)
22.	With small inconspicuous ciliated chambers with small outlets	24.
	With large conspicuous ciliated chambers with wide outlets	(25.)
24.	With candelabra	21. *Corticidæ.*
	With simple tetracts	22. *Pachastrellidæ.*

(25.)	With scattered tetracts, triacts, diacts	23. *Plakinidæ.*
	Without spicules	24. *Oscarellidæ.*

(23.)	Tetracts with differentiated large centripetal ray and large tangential rays numerous	26.
	Tetracts with differentiated large centripetal ray rare, with small tangential rays	(27.)
26.	With spherasters	25. *Geodidæ.*
	Without spherasters	28.
28.	Flesh-spicules euaster and oxyaster	26. *Stellettidæ.*
	Flesh-spicules spirastrella	27. *Thenceidæ.*
	Flesh-spicules spirula and sigmata	28. *Tetillidæ.*

(27.)	Without flesh-spicules	29. *Tethyopsillidæ.*

(20.)	The widened distal ends of the radial spicule-bundles divide the regular subdermal cavities into ectochonæ or vestibules at the entrance of the inhalant canals	30. *Tethydæ.*
	Between the distal ends of the radial spicule-bundles ecto- and entochonæ are found	31. *Sollasellidæ.*
	The inhalant pores lead direct into the inhalant canals	29.
29.	With spirastrellid flesh-spicules	32. *Spirastrellidæ.*
	With sigmate flesh-spicules	33. *Suberamatidæ.*
	Without flesh-spicules	34. *Suberitidæ.*

(21.)	With polyact flesh-spicules	35. *Chondrillidæ.*
	Without flesh-spicules	36. *Chondrosidæ.*

(17.)	With proper spicules in the supporting skeleton.	30.
	Without proper spicules in the supporting skeleton	(31.)
30.	With uniformly distributed skeleton-reticulation and not very large subdermal cavities.	32.
	The skeleton consists of a dense axial reticulation and isolated fibres extending from this to the surface. Between these very extensive subdermal cavities are situated	(33.)
32.	With gemmulæ; living in fresh water	37. *Spongillidæ*.
	Without gemmulæ	34.
34.	Without flesh-spicules; fibres of the supporting skeleton not spined	38. *Homorhaphidæ*.
	Flesh-spicules sigmata or spiral; no chelæ	39. *Heterorhaphidæ*.
	Flesh-spicules chelæ; when absent, fibres of supporting skeleton spined	40. *Desmacidonidæ*.

(33.)	No chelæ	41. *Axinellidæ*.

(31.)	With small spherical chambers and opaque ground-substance	35.
	With large sac-shaped chambers and transparent ground-substance	(36.)
35.	Without filaments in the ground-substance	37.
	With filaments in the ground-substance	38.
37.	Skeleton-fibres with thin axial canal	42. *Spongidæ*.
	Skeleton-fibres tubular, with thick pith	43. *Aplysinidæ*.

(38.)	Skeleton-fibre with thin axial canal	44. *Hircinidæ*

(36.)	Skeleton-fibres with thin axial canal; reticulate	45. *Spongelidæ*.
	Skeleton-fibres tubular with thick pith; dendritic	46. *Aplysillidæ*.
	No skeleton	47. *Halisarcidæ*.

APPENDIX.

LIST OF PUBLICATIONS RELATING TO THE SPONGES.

(Explanations of the Abbreviations used are appended.)

1. **Ælianus, Claudius.** Περὶ ζώων. Liber 8, Cap. 16.

2. **Agassiz, Alexander.** (On Hexactinellids.) *Bull. Mus. C. Z.* 1868, p. 367 (1868).

3. **Aldrovandi, U.** De reliquis animalibus exanguibus nempe de Mollibus, Crustaceis, Testaceis et Zoophytis libri quatuor. Bononiæ, 1606. Fol. (2nd ed. 1618; 3rd ed. 1623; 4th ed. 1642.) (1606–1642.)

4. **Allman, G. J.** A new Order of Hydrozoa. *Ann. M. N. H.* ser. 4, vol. xiv. p. 237 (1874).

[5.] ——. A new Order of Hydrozoa. *Nature*, vol. x. p. 251 (1874).

6. ——. A new Order of Hydrozoa. *Tr. L. S.* vol. i. p. 61 (1875).

7. **Andrews, W.** On Irish Sponges. *Ann. M. N. H.* ser. 4, vol. i. pp. 307, 308 (1868).

8. **Aristoteles.** Περὶ ζώων ἱστορίαν. Liber 1, cap. 1; Liber 5, cap. 16; Liber 8, cap. 1.

9. ——. Περὶ ζώων μορίων. Liber 4, Cap. 5.

10. **Audouin, J. V.,** et **Milne-Edwards.** Résumé des recherches sur les animaux sans vertèbres, faites aux îles Chausey. *Ann. Sci. Nat.* tom. xv. p. 5 (1828).

11. ——, ——. Recherches pour servir à l'histoire naturelle du Littoral de la France, ou recueil de mémoires sur l'anatomie, la physiologie, la classification et les mœurs des animaux de nos côtes. Tom. 1. Paris (1832).

12. **Austin, T.** Note on Mr. Bowerbank's paper on the genus *Dunstervillia* (Bwk.), with remarks on the *Ischadites konigii*, the *Tentaculites*, and the *Conularia*. *Ann. M. N. H.* ser. 1, vol. xv. p. 406 (1845).

13. **Badock, T.** Red flints in the Chalk. *Nature*, vol. xxv. p. 529 (1882).

14. **Baier, J. J.** Oryctographia Norica, sive rerum fossilium et ad minerals regnum pertinentium in territorio Norimbergensi ejusque vicinia observatarum succincta descriptio. (1708.)

15. ——. Monumenta rerum petrif. Norimbergæ (1757).

16. **Baird, S. F.** American Sponges. United States Commission of Fish and Fisheries. Part 1. (1873.)

17. **Balfour, F. M.** The Morphology and Systematic Position of the Spongida. *J. R. Micr. Sci.* n. s. vol. xix. pp. 103–109 (1879).

[18.] ——. Sur la morphologie et la position systématique des Éponges. (Extr.) *Arch. Z. Expér.* tom. viii. pp. 5–8 (1880).

19. ——. Treatise on Comparative Embryology, vol. i. p. 18 (1880).

20. ——. On the structure and homologies of the germinal layers of the Embryo. *Q. J. Micr. Sci.* vol. xx. p. 247 (1880).

21. ——. Larval Forms. *Q. J. Micr. Sci.* vol. xx. p. 381 (1880).

22. **Balsamo-Crivelli, G.** Memoria di alcuni Spongiari del golfo di Napoli. *Atti Soc. Ital.* vol. v. pp. 284–302 (1863).

23. ——. Di alcuni organi speciali osservati in una Spugna. *Rendic. Ist. Lomb.* vol. iii. pp. 333–336 (1866).

24. **Barrois, C.** Spongiaires des sables d'Ostricourt et observations sur la phylogénie des Éponges. *Ann. Soc. Géol. Nord*, p. 71 (1875).

25. ——. Recherches sur le Terrain crétacé supérieur de l'Angleterre et de l'Irlande. (1876.)

26. ——. Mémoire sur l'Embryologie de quelques Éponges de la Manche (*Sycandra, Halisarca, Verongia, Isodictya, Dermacidon*). *Ann. Sci. Nat.* sér. 6, tom. iii. (1876).

[27.] ——. Embryologie de quelques Éponges de la Manche. (Extr.) *J. l'Anat. Phys.* tom. xii. pp. 656–661 (1876).

[28.] ——. On the development of Sponges. (Abstr.) *Monthl. Micr. J.* vol. xvi. pp. 254–256 (1876).

[29.] ——. Embryologie de quelques Éponges de la Manche. (Extr.) *Bull. Scient. du dép. du Nord*, tom. viii. pp. 151–155 (1877).

30. ——. Sur les Dictyospongidæ des Psammites des Chondros. *Ann. Soc. Géol. Nord*, tom. xi. p. 80 (1883).

31. **Bauhin, J.** Hist. fontis Bollensis. Montisbelgardi (1598).
32. **Bauhin, J.**, et **Cherler, J. H.** Hist. plant. Ebroduni (1651).
33. **Bauhin, K.** Pinax Theatri Botanici. Basileæ, Helvet. (1623).
34. **Bell, T.** Remarks on the animal nature of Sponges. *Zool. Journ.* vol. i. p. 202 (1824).
35. **Bellamy, J. C.** Natural History of South Devon. London (1840).
36. **Belon, A.** De aquatilibus. Liber ii. Parisiis (1553).
37. **Beltremieux.** Faune du département de la Charente-Inférieur. (1860.)
38. **Beneaume.** Spongia fluviatilis fragilis et piscem olens. *Mém. Acad. Sci. Paris*, p. 231 (1814).
39. **Beneden, E. Van.** Die Cœlenteraten-Natur der Spongien. *Ber. Vers. Nat. Hannover*, p. 263 (1864).
40. **Benett, E.** Catalogue of the organic remains of the county of Wilts. Warminster (1831).
41. **Bennett, George.** On the *Euplectella aspergillum*, Owen, or "Venus's Flower-Basket." *Proc. R. Soc. Tasm.* pp. 59–65 (1875).
42. **Bertolini, A.** Rariorum Italiæ plantarum dec. 3 accedit specim. zoophyt. Portus Lunæ. Pisæ (1810).
43. ——. Sopra alcuni paradox nat. (Spongitarii) nel golfo della Spezia. Modena (1832).
44. **Bianchi, G.** De conchis minus notis. Ed. ii. Romæ (1760).
45. **Bianconi, G. G.** Sopra alcuni Zoofiti descriti sotto i nomi di *Cliona celata*, etc. *Nuovi Ann. Sci. Nat.* vol. vi. p. 455 (1841).
46. **Bigsby, J. J.** Thesaurus Siluricus. London (1868).
47. ——. Thesaurus Devonico-Carboniferus. London (1878).
48. **Billings, E.** Palæozoic fossils. *Geol. Surv. Canada*, Fasc. i. 1–5. Montreal (1861–1865).
49. ——. On some new or little-known Fossils from the Silurian and Devonian Rocks of Ontario. *Canadian Nat. and Geol.* n.s. vol. vii. (1875).
50. **Blainville, M. H. D. de.** Planches. ii. Partie, Zoologie, Vers et Zoophytes. *Dictionnaire Sci. Nat.*, Paris et Strasbourg (1816–1839).
51. ——. Éponges. *Dictionnaire Sci. Nat.* tom. xv. p. 93 (1819).
52. ——. Zoophytes. *Dictionnaire Sci. Nat.* tom. lx. p. 1 (1830).
53. ——. Manuel d'Actinologie et de Zoophytologie. Paris (1834–1837).
54. **Barboza du Bocage, J. V.** Note sur la découverte d'un Zoophyte de la famille Hyalochætides sur la côte du Portugal. *P. Z. S.* 1864, pp. 265–269 (1864).
55. ——. Sur l'habitat du *Hyalonema lusitanicum*. *P. Z. S.* 1865, pp. 662–663 (1865).
56. ——. On *Hyalonema lusitanicum*. *Ann. M. N. H.* ser. 3, vol. xx. pp. 123–127 (1867).
57. ——. Notes on *Hyalonema boreale* and a new Genus of Sponges. *Ann. M. N. H.* ser. 4, vol. ii. pp. 36–38 (1868).
58. ——. Éponges siliceuses nouvelles de Portugal et de l'île St. Jago: *Podospongia lovenii*, *Reniera* (?) *grayi*, *Discodermia polydiscus*, *Latrunculia cratera*. *J. Sci. Lisb.* tom. ii. pp. 159–161 (1870).
59. ——. Sur l'existence de la *Holtenia carpenteri*, Wyville Thomson, dans les côtes du Portugal. *J. Sci. Lisb.* tom. iii. pp. 69–70 (1870).
60. **Boerhave, H.** Index alter. plant. hort. Lugd. Batav. (1720).
61. **Bosc, L. A. G.** Histoire Naturelle des Vers. Paris, tom. iii. (1802).
62. ——. Histoire Naturelle des Vers. Paris, tom. iii. 2nd. edit. (1827).
63. **Bourguet, L.**, et **Cortier, P.** Traité des pétrefactions. Paris (1742).

64. **Bowerbank, J. S.** On the Keratose or Horny Sponge of commerce. *Micr. J.* vol. i. pp. 8–11 (1841).

65. ——. Descriptions of three species of Sponge containing some new forms of organization. *Micr. J.* vol. i. pp. 161–162 (1841).

66. ——. Observations on a Keratose Sponge from Australia. *Ann. M. N. H.* ser. 1, vol. vii. p. 129 (1841).

[67.] ——. Sur les Kératoses ou Éponges cornées du commerce. (Trad.) *L'Institut*, tom. ix. no. 382, p. 137 (1841).

68. ——. On the spongeous origin of Mossagates and other siliceous bodies. *Ann. M. N. H.* ser. 1, vol. x. p. 9 (1842).

69. ——. On the spongeous origin of Mossagates and other siliceous bodies. *Ann. M. N. H.* ser. 1, vol. x. p. 84 (1842).

70. ——. On the Keratose or Horny Sponges of commerce. *Tr. R. Micr. Soc.* vol. i. pp. 32–39 (1844).

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1628. ——. Studies on Fossil Sponges. I. *Hexactinellidæ*. *Ann. M. N. H.* ser. 4, vol. xx. pp. 405–424 (1877).

1629. ——. Studies on Fossil Sponges. I. *Hexactinellidæ*. *Ann. M. N. H.* ser. 4, vol. xx. pp. 501–517 (1877).

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1641. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 235–248 (1878).

1642. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 324–341 (1878).

1643. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 385–394 (1878).

1644. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 467–482 (1878).

1645. ——. Studien über fossile Spongien. III. *Monactinellidæ*, *Tetractinellidæ*, und *Calcispongiæ*. *Abh. bayer. Ak.* vol. xiii. pt. 2, pp. 1–48 (1879).

1646. ——. Studies on Fossil Sponges. III. *Monactinellidæ*; IV. *Tetractinellidæ*; V. *Calcispongiæ*. *Ann. M. N. H.* ser. 5, vol. iii. pp. 304–313 (1879).

1647. ——. Beiträge zur Systematik der fossilen Spongien. *Neues Jahrb. Mineral. Geol.* 1879, pp. 1–40 (1879).

1648. **Zittel, K. A.** Studies on Fossil Sponges. V. *Calcispongiæ*. *Ann. M. N. H.* ser. 5, vol. iii. pp. 364–379 (1879).

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1654. **Zoholka, C.** Ueber *Isoraphinia texta*, Rœm. sp., und *Scytalia pertusa*, Reuss, sp., aus der Umgebung von Raudnitz an der Elbe, Böhmen. *SB. Ak. Wien*, Bd. iv. pp. 647–652 (1886).

LIST OF THE PRINCIPAL ABBREVIATIONS USED IN THE LIST OF PUBLICATIONS.

Abh. Ak. Berl.—Abhandlungen der königlichen preussischen Akademie der Wissenschaften zu Berlin.

Abh. bayer. Ak.—Abhandlungen der mathematisch-physikalischen Classe der k bayerischen Akademie der Wissenschaften. (München.)

Abh. kgl. Ges. Wiss. Prag.—Abhandlungen der königlichen Gesellschaft der Wissenschaften zu Prag.

Actes Soc. Jura. d'Emul. Porren.—Actes de la Société Jurassienne d'Emulation. (Porrentruy.)

Act. Soc. Lin. Bordeaux.—Actes de la Société Linnéenne de Bordeaux.

Am. J. Sci.—American Journal of Science and Art. (New Haven.)

Am. Micr. J.—American Monthly Microscopical Journal. (New York.)

Am. Nat.—American Naturalist.

Ann. Chemie Physik.—Annales de Chemie et Physique.

Ann. du Mus.—Annales du Muséum d'histoire Naturelle de Paris.

Ann. Lyceum N. H. New York.—Annals of the Lyceum of Natural History of New York.

Ann. M. N. H.—Annals and Magazine of Natural History. (London.)

Ann. of Philos.—Annals of Philosophy, or Magazine of Chemistry, Mineralogy, &c. (London.)

Ann. regno Lomb.-Venet.—Annali di Scienze regno Lombardo-Venetiana.

Ann. Sci. Nat.—Annales des Sciences Naturelles. (Paris.)

Ann. Soc. géol. Nord.—Annales de la Société géologique du Nord. (Lille.)

Ann. Soc. mal. Belg.—Annales de la Société malacologique de Belgique. (Brussels.)

Annual Rep. State Cabinet Nat. Hist. New York.—Annual Report of the Regents University of New York on the condition of the State Cabinet. (New York.)

Arb. nat. Ges. Univ. Charkow.—Arbeiten der naturforschenden Gesellschaft der Universität Charkow. (Charkow.)

Arb. Petersb. Ges.—Arbeiten der St. Petersburger naturforschenden Gesellschaft.

Arb. z. Inst. Wien.—Arbeiten aus dem zoologischen Institute der Universität Wien. (Vienna.)

Arch. Anat. Phys.—Archiv für Anatomie und Physiologie. (Liepzig.)

Arch. f. Nat.—Archiv für Naturgeschichte. (Berlin &c.)

Arch. mikr. Anat.—Archiv für mikroskopische Anatomie. (Bonn.)

Arch. Néerl.—Archives Néerlandaises des Sciences exactes et naturelles. (The Hague.)

Arch. nouv. Mus.—Archives nouvelles du Muséum. (Paris.)

Arch. Sci. Nat.—Archives des Sciences Naturelles. (Paris.)

Arch. Slav. Biol.—Archives Slaves de Biologie.

Arch. Ver. Mecklenburg.—Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg. (Neu Brandenburg.)

Arch. Z. expér.—Archives de Zoologie expérimentale et générale. (Paris.)

Assoc. franç. Av. Sci.—Association français pour l'avancement des Sciences. (Paris.)

Atti Ac. Rom.—Atti della R. Accademia delle Scienze. (Rome).

Atti Ist. Venet.—Atti dell' I. R. Istituto Veneto di Scienze, Lettere ed Arti. (Venice.)

Atti Soc. Ital.—Atti della Società Italiana di Scienze naturali. (Modena &c.)

Atti Soc. Tosc.—Atti della Società Toscana di Scienze naturali, residente in Pisa.

Beitr. balt. Wochens.—Beiträge zur baltischen Wochenschrift.

Belfast Nat. Hist. Field-Club Report.—Reports of the Belfast Natural-History Field-Club.

Ber. Com. wiss. Unters. deutsch. Meere, Kiel.—Bericht der Commission zur Untersuchung der deutschen Meere. (Kiel.)

Ber. Vers. Nat.—Amtlicher Bericht deutscher Naturforscher und Ärzte.

Berl. Monatsh.—Berliner Monatshefte.

Bibl. Hautes Etud.—Bibliothèque de l'école des Hautes Études. (Paris.)

Bih. Sv. Ak. Handl.—Bihang till Kongl. Svenska Vetenskaps-Akademiens Handlingar. (Stockholm.)

Bijdr. Dierk.—Bijdragen tot de Dierkunde. (Amsterdam.)

Biol. Centralbl.—Biologisches Centralblatt. (Erlangen.)

Brit. Mus.—British Museum Catalogue. (London.)

Bull. Ac. Belg.—Bulletin de l'Académie Royale des Sciences de Belgique. (Brussels.)

Bull. Ac. Pétersb.—Bulletin de la classe physico-mathématique de l'Académie Impériale des Sciences de St. Pétersbourg.

Bull. Am. Mus. Nat. Hist.—Bulletin of the American Museum of Natural History. (New York.)

Bull. Buff. Nat. Club.—Bulletin of the Buffalo Naturalists' Club. (Buffalo, N. Y.)

Bull. Mosc.—Bulletin de la Société Impériale des Naturalistes de Moscou.

Bull. Mus. C. Z.—Bulletin of the Museum of Comparative Zoology. (Cambridge, U.S.A.)

Bull. Scient.—Bulletin Scientifique du département du Nord.

Bull. Soc. Acclim.—Bulletin de la Société d'Acclimatation. (Paris.)

Bull. Soc. Adriat.—Bulletin de la Société Adriatique.

Bull. Soc. Linn. Normandie.—Bulletin de la Société Linnéenne de Normandie. (Caen.)

Bull. Soc. Géol.—Bulletin de la Société géologique de France. (Paris.)

Bull. Soc. Vaudoise.—Bull. de la Société Vaudoise.

Bull. Soc. Sci. Nat. Neuchâtel.—Bulletin de la Société des Sciences Naturelles. (Neuchâtel.)

Bull. Soc. Zool. Fr.—Bulletin de la Société Zoologique de France. (Paris.)

Canadian Nat. and Geol.—Canadian Naturalist and Geologist.

Can. Nat.—Canadian Naturalist.

Centralbl. med. Wiss.—Centralblatt für die medicinischen Wissenschaften. (Berlin.)

Comm. Akad. Petropol.—Commentarii Academiæ Scientiarum Imperialis Petropolitanæ. Académie Impériale des Sciences. (Petersburg.)

C. R.—Comptes rendus des Séances hebdomadaires de l'Académie des Sciences. (Paris.)

C. R. Soc. Biol.—Comptes rendus des Séances et Mémoires de la Société de Biologie. (Paris.)

Denk. Ak. Wien.—Denkschriften der k. Akademie der Wissenschaften zu Wien. (Vienna.)

Dictionnaires Sci. Nat.—Dictionnaires des Sciences Naturelles. (Paris.)

D. Litt. Zeit.—Deutsche Litteratur Zeitung.

Edinb. New Phil. Journ.—Edinburgh New Philosophical Journal. (Edinburgh.)

Edinb. Phil. Journ.—Edinburgh Philosophical Journal. (Edinburgh.)

Encyclop. méth.—Encyclopédie méthodique des sciences. (Paris.)

Férus. Bull. Sc. Nat.—Bulletin des Sciences Naturelles et de Géologie publié par M. le Baron de Férussac. (Paris.)

Fror. Notizen.—Notizen aus dem Gebeite der Natur- und Heilkunde (Froriep). (Erfurt.)

Geol. Mag.—Geological Magazine. (London.)

Geol. Surv. Canada.—Geological Survey of Canada.

Gr. Arch. mikr. Anat.—Grenacher's Archiv für mikroskopisch Anatomie.

Hist. Berw. Nat. Club.—Berwickshire Naturalists' Club.

Hist. et Mém. Acad. Paris.—Histoires et Mémoires de l'Académie des Sciences. (Paris.)

Ill. d. Monatshefte.—Illustrierte deutsche Monatshefte.

J. Ac. Philad.—Journal of the Academy of Natural Sciences, Philadelphia.

Jahrb. Mineral.—Jahrbuch für Mineralogie, Geognosie, Geologie, &c. (Stuttgart.)

J. Bombay Branch R. Asiatic Soc.—Journal of the Bombay Branch of the Royal Asiatic Society.

JB. schles. Ges.—Jahresberichte des schlesischen Gesellschaft für vaterländische Cultur. (Breslau.)

JB. schlesw. Gesell.—Jahresbericht der naturwissenschaftlichen Gesellschaft in Schleswig.

J. Chim. expérim.—Journal de la Chimie expérimentale.

J. Cincinnati Soc. Nat. Hist.—Journal of the Cincinnati Society of Natural History.

J. d. Zool.—Journal de Zoologie. (Paris.)

Jen. Z. Nat.—Jenaische Zeitschrift für Naturwissenschaften, herausgegeben von der medicinisch-naturwissenschaftlichen Gesellschaft zu Jena.

J. G. Soc.—Quarterly Journal of the Geological Society. (London.)

JH. Ver. Württ.—Jahreshefte des Vereins für vaterländische Naturkunde in Württemburg. (Stuttgart.)

J. l'Anat. Phys.—Journal de l'Anatomie et de la Physiologie. (Paris.)

J. L. S.—Journal of the Linnean Society (Zoology). (London.)

J. Microgr.—Journal de Micrographie. (Paris.)

J. N. York Micr. Soc.—Journal of the New York Microscopical Society.

J. of Conch.—Journal of Conchology.

J. prakt. Chem.—Journal für praktische Chemie. (Leipzig.)

J. Quek. Club.—Journal of the Quekett Microscopical Club. (London.)

J. R. Micr. Soc.—Journal of the Royal Microscopical Society. (London.)

J. Sci. Lisb.—Jornal de Sciencias da Academia de Lisboa. (Lisbon.)

Kgl. Svenska Vetensk.-Akad. Handlingar.—Kongliga Svenska Vetenskaps-Aakademiens Handlingar. (Stockholm.)

L'Institut.—L'Institut de France.

Mag. N. H.—Magazine of Natural History (Charlesworth). (London.)

Mag. Zool. Bot.—Magazine of Zoology and Botany. (London.)

Manual of Nat. Hist. &c. of Greenland.—Manual of the Natural History of Greenland.

Math.-nat. Ber. Ungarn.—Berichte des Ungarischen mathematisch-naturwissenschaftlichen Gesellschaft.

MB. Ak. Berl.—Monatsberichte der k. preussischen Akademie der Wissenschaften zu Berlin.

Meddel. af Soc. pro Fauna et Flora Fennica.—Meddelingen af Societat pro Fauna et Flora Fennica.

Mél. Biol. Pétersb.—Mélanges Biologiques tirés du Bulletin de la classe physico-mathématique de l'Académie Imp. des Sciences de St. Pétersbourg.

Mém. Ac. Pétersb.—Mémoires de l'Académie impériale des Sciences de St. Pétersbourg.

Mém. Acad. Sci. Paris.—Mémoires de l'Académie des Sciences. (Paris.)

Mem. Acc. Tor.—Memorie della Reale Accademia delle Scienze. (Turin.)

Mem. Bost. Soc.—Memoirs of the Boston Society of Natural History.

Mém. d. Mus.—Mémoires du Muséum d'Histoire Naturelle. (Paris.)

Mém. Soc. Géol. France.—Mémoires de la Société Géologique de France.

Mém. Soc. Helvétique Sci. Nat.—Mémoires de la Société Helvétique des Sciences Naturelles. (Lausanne.)

Mém. Soc. Hist. Nat. Paris.—Mémoires de la Société des Sciences Naturelles de France. (Paris.)

Mém. Soc. Imp. Sci. Nat. Cherbourg.—Mémoires de la Société des Sciences Naturelles. (Cherbourg.)

Mém. Soc. Jura. d'Emul. Départ. du Doubs.—Mémoires de la Société Jurassienne d'Emulation Département du Doubs.

Mém. Soc. nouv. Russ.—Mémoires de la Société nouvelle de la Russie.

Mem. Wern. Soc.—Memoirs of the Wernerian Natural-History Society. (Edinburgh.)

Micr. J.—The Microscopical Journal and Structural Record. (London.)

Monthl. Micr. J.—Monthly Microscopical Journal. (London.)

Morph. Jahrb.—Morphologisches Jahrbuch: eine Zeitschrift für Anatomie und Entwickelungsgeschichte. (Leipzig.)

MT. Ges. Bern.—Mittheilungen der naturforschenden Gesellschaft in Bern.

MT. JB. geol. Anst. Budapest.—Mittheilungen aus dem Jahrbuche der königlich-ungarischen geologischen Anstalt. Budapest.

MT. Mus. Dresden.—Mittheilungen aus dem k. zoologischen Museum zu Dresden.

MT. Ver. Steierm.—Mittheilungen des naturwissenschaftlichen Vereins für Steiermark. (Graz.)

MT. z. Stat. Neap.—Mittheilungen der zoologischen Station in Neapel. (Leipzig.)

Naturf.—Naturforscher.

Naturk. Verh. Utrecht.—Natuurkundige Verhandelingen Provincinal Utregtsch Genootschap van Kunsten en Wetenschappen. (Utrecht.)

Natuurk. Tijdschrift voor Nederlandsch Indië.—Natuurkundig Tijdschrift voor Nederlandsch Indië. (Batavia.)

Nederl. Staatscourant.—Nederlandsch Staatscourant.

Neues Jahrb. Mineral. Geol.—Neues Jahrbuch für Mineralogie, Geologie und Petrefaktenkunde. (Heidelberg, Stuttgart, &c.)

New Russian Nat. Hist.—Transactions of the New Russian Society of Natural History. (Russian.)

New Z. J. Sci.—The New Zealand Journal of Sciences. (Dunedin.)

Niederl. Arch. Zool.—Niederländisches Archiv für Zoologie. (Haarlem.)

Nors. Vid. Selsk. Skrifter.—Kongliga Norske Videnskabers Selskabs Skrifter. (Trondjem.)

Notes Leyd. Mus.—Notes from the Royal Zoological Museum of the Netherlands at Leyden.

Nouveaux Mém. de la S. Helvétique Sc. Nat.—Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles. (Lausanne.)

Nova Acta natur. curios.—Nova Acta naturæ curiosorum.

Nuovi Ann. Sci. nat.—Nuovi Annali delle Scienze naturali Bologna.

Öfv. Vet.-Ak. Förh.—Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar. (Stockholm.)

P. Ac. Philad.—Proceedings of the Academy of Natural Sciences of Philadelphia.

Pal.—Paleontographica.

P. Am. Assoc.—Proceedings of the American Association.

P. Belf. Soc.—Proceedings of the Belfast Natural History and Philosophical Society.

P. Bost. Soc.—Proceedings of the Boston Society of Natural History.

P. Bristol Nat. Soc.—Proceedings of the Bristol Natural History Society.

P. Cambridge Phil. Soc.—Proceedings of the Cambridge Philosophical Society.

P. Geol. Assoc.—Proceedings of the Geologists' Association.

Phil. Mag.—Philosophical Magazine. (London.)

Phil. Tr.—Philosophical Transactions of the Royal Society. (London.)

Pop. Sci. Review.—Popular Science Review.

P. Linn. Soc.—Proceedings of the Linnean Society of London.

P. Linn. Soc. N. S. W.—Proceedings of the Linnean Society of New South Wales. (Sydney.)

P. Liverp. Soc.—Proceedings of the Literary and Philosophical Society and Natural History Society of Liverpool.

P. Med. Soc. Edinburgh.—Proceedings of the Medical Society of Edinburgh.

P. R. Irish Ac.—Proceedings of the Royal Irish Academy. (Dublin.)

Proc. Lit. Liverpool.—Proceedings of the Literary and Philosophical Society of Liverpool.

Proc. Yorkshire Phil. Soc.—Proceedings of the Yorkshire Philosophical Society. (York.)

P. R. Soc.—Proceedings of the Royal Society. (London.)

P. R. Soc. Edinburgh.—Proceedings of the Royal Society of Edinburgh.

P. R. Soc. Tasm.—Papers and Proceedings and Reports of the Royal Society of Tasmania.

P. U. S. Nat. Mus.—Proceedings of the United States National Museum. (Washington.)

P. Z. S.—Proceedings of the Zoological Society. (London.)

Q. J. Micr. Sci.—Quarterly Journal of Microscopical Science. (London.)

Rendic. Accad. Sc. Napoli.—Rendiconti della R. Accademia delle Scienze di Napoli. (Naples.)

Rendic. Ist. Lomb.—Rendiconti del R. Istituto Lombardo di Scienze. (Milan.)

Rep. Brit. Assoc.—Reports of the British Association for the Advancement of Science.

Rep. R. Polytechnical Soc. Cornwall.—Reports of the Royal Polytechnical Society of Cornwall.

Rep. U. S. Fish Comm.—Report of the Commissioner, United States Commission of Fish and Fisheries. (Washington.)

Revue Zool.—Revue Zoologique. (Paris.)

Rozpr. i Spraw. Akad. umieg. af Krakowie.—Proceedings of the Cracow Academy.

SB. Ak. Berlin.—Sitzungsberichte der königlich-preussischen Akademie der Wissenschaften zu Berlin.

SB. Ak. Wien.—Sitzungsberichte der mathematisch-naturwissenschaftliche Classe der k. Akademie der Wissenschaften. (Vienna.)

SB. böhm. Ges.—Sitzungsberichte der k. böhmischen Gesellschaft der Wissenschaften. (Prague.)

SB. Dresden.—Sitzungsberichte der naturwissenschaftlichen Gesellschaft Isis in Dresden.

SB. Ges. Dorp.—Sitzungsberichte der Dorpater Naturforscher Gesellschaft. (Dorpat.)

SB. Ges. Leipzig.—Sitzungsberichte der königlich sächsischen Gesellschaft der Wissenschaften. (Leipzig.)

SB. nat. Fr.—Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin.

SB. niederrhein. Ges.—Sitzungsberichte des niederrheinischen Gesellschaft für Natur- und Heilkunde. (Bonn.)

SB. Soc. Erlangen.—Sitzungsberichte der physikalisch-medicinischen Societät zu Erlangen.

Schrift. Dronth. Ges.—Schriften der Drontheimer Gesellschaft.

Schrift. Gesell. Bef. Naturwissens. Marburg.—Schriften der Gesellschaft zur Beförderung der Naturwissenschaften in Marburg.

Schr. Ges. Danz.—Schriften der naturforschenden Gesellschaft zu Danzig.

Sci. Gos.—Science Gossip.

Skrifter Naturhist. Selsk.—Det Kongelige Danske Videnskabernes Selskabs Skrifter. (Copenhagen.)

Sm. Misc. Coll.—Smithsonian Miscellaneous Collections. (Washington.)

Sm. Misc. Contrib.—Smithsonian Miscellaneous Contributions to Knowledge. (Washington.)

Soc. Philom. Paris.—Rapports Généraux des Travaux de la Société Philomatique. (Paris.)

Tijdschr. Nederl. Dierk. Vereen.—Tijdschrift der Nederlandsche Dierkundige Vereeniging. (Leiden.)

Todd's Cyclop. Anat.—Todd's Cyclopædia of Anatomy.

T. R. Irish Ac.—Transactions of the Royal Irish Academy. (Dublin.)

Tr. Albany Inst.—Transactions of the Albany Institute.

Tr. Birmingham Soc.—Transactions of the Birmingham Society.

Tr. Connecticut Ac. Sci.—Transactions of the Connecticut Academy of Science.

Tr. Devon. Assoc.—Report and Transactions of the Devonshire Association for the Advancement of Science, &c. (Plymouth.)

Tr. Geol. Soc.—Transactions of the Geological Society of London.

Tr. L. S.—Transactions of the Linnean Society of London.

Tr. Newbury District Field-Club.—Transactions of the Newbury District Field-Club.

Tr. new Russian N. H. Soc.—Transactions (Trapiski) of the new Russian Natural History Society.

Tr. North. Durh.—Natural History Transactions of Northumberland and Durham. (Newcastle-on-Tyne.)

Tr. R. Asiatic Soc. Japan.—Transactions of the Royal Asiatic Society. Japan Branch.

Tr. R. Dublin Soc.—Transactions of the Royal Society of Dublin.

Tr. R. Micr. Soc.—Transactions of the Royal Microscopical Society of London.

Tr. R. Soc. Edinb.—Transactions of the Royal Society of Edinburgh.

Tr. Tynes. N. Club.—Transactions of the Tyneside Naturalists' Field-Club. (Newcastle-upon-Tyne.)

Tr. Z. S.—Transactions of the Zoological Society of London.

Uebers. Arb. schles. Ges. Breslau.—Uebersicht der Arbeiten und Verhandlungen des schlesischen naturwissenschaftlichen Gesellschaft in Breslau.

Unters. Phys. Inst. Heidelb.—Untersuchungen aus dem physiologischen Institut der Universität Heidelberg.

Vergl. phys. Studien.—Vergleichend physiologische Studien.

Verh. d. Akad. Wetensch.—Verhandelingen der Akademie van Wetenschappen.

Verh. geol. Reichsans.—Verhandlungen der k.-k. geologischen Reichsanstalt. (Vienna.)

Verh. naturf. Gesell. Zürich.—Verhandlungen der naturforschenden Gesellschaft in Zürich.

Verh. naturh. Ver. Heidelb.—Verhandlungen des naturhistorisch-medicinischen Vereins zu Heidelberg.

Verh. naturh. Ver. Rheinl.—Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande und Westfalens. (Bonn.)

Verh. phys. Ges. Berlin.—Verhandlungen der physikalischen Gesellschaft zu Berlin.

Verh. phys.-med. Gesell. Würzb.—Verhandlungen der physikalisch-medicinischen Gesellschaft in Würzburg.

Verh. z.-b. Wien.—Verhandlungen der zoologisch-botanischen Gesellschaft in Wien. (Vienna.)

Würzb. naturw. Zeitschr.—Würzburger naturwissenschaftliche Zeitschrift.

Z. geol. Ges.—Zeitschrift der deutschen geologischen Gesellschaft. (Berlin.)

Z. ges. Naturw.—Zeitschrift für die gesammten Naturwissenschaften. (Berlin.)

Zool. Anz.—Zoologischer Anzeiger. (Leipzig.)

Zool. Jahrb.—Zoologische Jahrbücher. Zeitschrift für Systematik, Geographie und Biologie der Thiere. (Jena.)

Zool. Journ.—The Zoological Journal. (London.)

Z. wiss. Zool.—Zeitschrift für wissenschaftliche Zoologie. (Leipzig.)

3. On Indian Earthworms.—Part I. Preliminary Notice of Earthworms from the Nilgiris and Shevaroys.

By Alfred Gibbs Bourne, D.Sc. (Lond.), F.L.S., Fell. Univ. Coll. Lond., Fell. Madras Univ., Professor of Biology in the Presidency College, Madras. (Communicated by Prof. Ray Lankester, F.Z.S.)

[Received November 16, 1886.]

When I commenced to find out what Earthworms were to be found here for the purposes of class-study, I was totally unprepared for the immense variety of forms which seem to occur in the country. I have at present examined a very few localities only, and as every locality yields new forms and I have already found more than twenty different species, all of which were hitherto unknown, the field may be pronounced to be fairly extensive.

I came across very few worms in my garden in Madras during the hot weather, but then I made no special search for them; those I did find belonged to the genus *Perichæta*, but seemed to be new species (I have since determined that they are new); I have found up to the present at least three species of *Perichæta* in Madras town, but have reserved them for subsequent description.

In May I went up to the Nilgiris for some weeks, and there I found numerous forms, and these always differed in different localities. In October I spent about a week on the Shevaroy Hills, and found in that short time five different forms, all markedly differing from those from the Nilgiris.

I regret that in some cases I was unable to render my observations complete, owing to want of sufficient material. It seems, however, desirable to publish this preliminary note even though it is in some cases incomplete, as more thorough investigations in any particular locality may be considerably delayed. The greater number of forms belong to the genera *Perichæta* and *Moniligaster*, and for the present I deal with these only. I have found, in addition to these, two species of *Lumbricus* at great elevations at Ootacamund and Coonoor. One of these presents a clitellum extending over somites xxvii.–xxxiv., and the other over somites xxx.–xxxiv. I refrain from naming these until I can characterize them more fully. I have also some worms belonging to other genera, but with the scanty literature to which I have access I cannot say whether they are new genera or not.

Had it not been for Mr. Benham's[1] most useful *résumé* of known Earthworms, I should have been able to do far less than I have done. Where I have given measurements or counted the somites I have chosen the largest individual I could find.

Perichætidæ.

The Perichætidæ are characterized by the fact that each somite bears numerous setæ arranged in a more or less complete ring.

The genera which are at present included in the group are:—*Perichæta*, Schm.; *Megascolex*, Temp. (*Pleurochæta*, Bedd.); *Perionyx*, E.P.; and *Rhodopis*, Kinb.

These genera are at present distinguished one from the others, thus:—

Perichæta presents a clitellum in somites xiv., xv., and xvi., a pair of laterally-placed male pores in somite xviii., and very numerous equidistant setæ.

Megascolex presents 100 setæ arranged in a ring, but with a dorsal break.

Perionyx presents a clitellum in somites xiii., xiv., xv., xvi., and xvii., a pair of male pores placed in a median pit in somite xviii., and 30 equidistant setæ.

Rhodopis presents a clitellum in somites xii. and xiii., a pair of male pores between somites xiv. and xv., and 50 to 60 equidistant setæ.

Now let us consider these characters in relation to the worms described below. Among these we find that there are numerous intermediate conditions, in respect to the arrangement of the setæ, between an *almost* equidistant series and a series presenting considerable dorsal and ventral gaps[2]. Secondly, in one form there are two pairs of male pores (*P. stuarti*). Lastly, with regard to the extent of the clitellum, in the form which I have referred to Perrier's genus *Perionyx* it extends over three somites instead of five, while among the

[1] Quart. Journ. Microsc. Sci. vol. xxvi. n. s.

[2] By the terms ventral and dorsal gaps I mean the space between the two most ventral and dorsal setæ respectively. An ordinary gap is the space between any other two contiguous setæ.

numerous forms which I have called *Perichæta* it extends in many forms (as in *P. armata*, Bedd.) over four somites, and in one form over five somites instead of three.

So, as they stand, these generic distinctions seem to me to be of little value. I am, however, inclined to hope that a careful anatomical study in the fresh state of the large variety of forms which I have already discovered (I have, moreover, every reason to believe that the field is as yet by no means exhausted[1]) will enable me to group these very interesting forms in a more rational manner. I do not think that the classification suggested by Benham[2] will turn out to be a very natural one. I refrain, however, from making any suggestions myself in this preliminary note, as I expect that the natural classification will have to be based upon the result of very careful examination of a very large number of fresh forms. I shall doubtless be able ere long to go to Ceylon, Burmah, Java, and other places, and compare fresh specimens of the forms which have been described from these regions with my Indian species.

I have in the present note spoken of all the forms as *Perichæta*, with the exception of *Perionyx saltans*, although I believe that the differences have in many cases a full generic value. A glance at my tabular statement (p. 665) will show what great differences exist.

PERICHÆTA LAWSONI, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., but is very slightly marked. Even in adult specimens it requires careful examination to detect any external difference between these somites and the ordinary somites of the body. There is, however, no doubt as to its existence and extent in either this or the following species, *P. bivaginata*.

The male pores are placed on somite xviii. There are no papillæ. The oviducts open separately, although very near the median line, in somite xiv. There are two pairs of spermathecæ; these are placed in somites viii. and ix. The spermathecal pores open between somites vii. and viii., and viii. and ix., respectively. I have found no nephridia. The gizzard is situated in somite x. Intestinal cæca are present in somite xxvi. and run forward to somite xxiii.

There are from 30–35 setæ in each somite, which are arranged so as to leave small gaps in the median, dorsal, and ventral line. The ventral gap is equivalent to about two ordinary gaps, and the dorsal gap to about three ordinary gaps. The setæ are present on the clitellar somites and are arranged as in the other somites. No modified genital setæ were observed.

Length 250 millim., circumference 7 mm.; number of somites 119.

Hab. Ootacamund, Nilgiris, at an elevation of about 7000 feet.

[1] In the one week which I recently spent in the Salem and Yercaud district, it will be seen that I discovered three new species of *Perichæta*, besides other forms.

[2] Quart. Journ. Microsc. Sci. vol. xxvi. n. s. p. 225.

CHARACTERS OF THE SPECIES OF *Perichæta* AND *Perionyx* HERE DESCRIBED.

Species.	Clitellar Somites.	Male pores.	Female pore.	Position of Spermathecæ.	Character of Spermathecæ.	Copulatory setæ.	Gizzard.	Intestinal cæca.	Number of setæ per somite.	Arrangement of setæ.	Number of somites.	Length and circumference.	Habitat.	Elevation.
												mm.		ft.
Perichæta lawsoni.	xiv., xv., xvi., xvii., very slightly marked.	xviii.; no papillæ.	xiv., paired.	viii., ix.	?	Not seen.	x.	xxvi.	30–35	Present on clitellum; small dorsal and ventral gaps.	119	250 7	Nilgiris (Ootacamund and Naduvatam).	6500 to 7500
P. bivaginata ...	xiv., xv., xvi., xvii., very slightly marked.	xviii.	xiv., paired.	vii., viii., ix.	With two minute appendices.	At least three pairs in xviii.	vi.	Absent.	56	Present on clitellum; small dorsal and ventral gaps.	162	140 8	Salem.	1000
P. gracilis	xiv., xv., xvi., xvii., xviii.	xviii., in clitellum.	xiv., paired.	viii., ix. (?)	Not seen.	Not seen.	vii.?	?	?	Present on clitellum; large dorsal and ventral gaps.	332	400 8	Nilgiris (Naduvatam).	6000
P. stuarti	xiv., xv., xvi.	xvii., xix., four in number.	xiv., single.	vii., viii.	Frill at base.	Special setæ in viii.	x.	4 pairs, about xxiii. to xxvi.	52	Present on clitellum; small gaps.	111	140 15	Shevaroys (Salem and Yercaud).	1000 to 5000
P. burliarensis	xiv., xv., xvi., xvii.	xviii.	xiv., single.	vi., vii., viii., ix.	With a long small appendix.	Special setæ in vii. & in viii.	x.	xxvi.	38–40	Absent on clitellum; ventral gaps unequal.	123	100 9	Nilgiris (Burliar).	2000 to 3000
P. hulikalensis	xiv., xv., xvi., xvii.	xviii.	xiv., single.	vii., viii.	With long thin appendix.	Absent.	?	I think present in xxvi.	42	Present on clitellum; large gaps.	209	200 9	Nilgiris (Hulikal-drug).	6000
P. mirabilis ...	xiv., xv., xvi.	xviii.	xiv., single.	vi., vii., viii., ix.	With long pouch-like appendix.	No observation.	x.	xxvi.	39	No gaps.	114	130 8	Nilgiris (Naduvatam).	6000
P. salettensis ...	xiv., xv., xvi., xvii.	xviii.	xiv., single.	vii., viii., ix.	Two small appendices.	Absent.	vi.	No observation.	?	?	112	70 9	Salem.	1000
Perionyx saltans.	xiv., xv., xvi.	xviii., in median pit.	xiv., single.	vi., vii., viii.	Two small appendices. Apert, near median line.	Absent.	?	No observation.	45–54	Present on clitellum; no gaps.	61	60 6	Nilgiris (Ootacamund, Naduvatam).	6500 to 7500

PERICHÆTA BIVAGINATA, sp. n.

This species resembles *P. lawsoni* in the condition of the clitellum and in having separate oviducal pores.

The clitellum extends over somites xiv., xv., xvi., and xvii., but is very slightly marked.

The male pores are placed on somite xviii., they are inconspicuous; there are no papillæ, although special penial setæ are present.

The oviducts open separately, very near together, in somite xiv., ventrad of the ventral setæ.

There are three pairs of spermathecæ; these are placed in somites vii., viii., and ix. The spermathecal pores open between somites vi. and vii., vii. and viii., viii. and ix., respectively. Each spermatheca possesses a pair of small diverticula at its base. Nephridia are present in most somites, if not all, and are very large and present rosettes of tubules in certain anterior somites, I think in v., vii., and ix. The nephridiopores I have not observed.

The gizzard is situated in somite vi. Intestinal cæca are absent.

There are about 56 setæ in each somite, which are arranged so as to leave small dorsal and ventral gaps, as in *P. lawsoni*. The setæ are also present on the clitellar somites.

There are a pair of small sacs in somite xviii. containing long, thin, curved, ornamented setæ, as in *P. armata*, Beddard [1]. Each sac contains at least 3 setæ.

Length 140 millim., circumference 8 mm.; number of somites 162.

Hab. Salem (about 1000 ft.), in wet ground.

PERICHÆTA (PLEUROCHÆTA?) GRACILIS, sp. n.

The clitellum extends over somites xiv., xv., xvi., xvii., and xviii., and is very well marked.

The male pores are placed in xviii.; there are no papillæ.

The oviducts open separately, very near together, in somite xiv.

I think that there are two pairs of spermathecæ in somites viii. and ix., respectively, but am a little doubtful about it.

The gizzard seemed to be in somite vii., but possibly this is a mistake for vi.

There are two pairs of groups of small nephridia opening on the posterior edges of somites vii. and viii., respectively, a little nearer the ventral line than the spermathecal pores, which occur between somites vii. and viii., and viii. and ix., respectively. I have not ascertained the number of setæ per somite, but there are large dorsal and ventral gaps.

I have found no specially modified genital setæ.

Length 400 millim., circumference 8 mm.; number of somites 332.

Hab. Naduvatam, at an elevation of about 6000 feet, in very wet ground.

I only obtained a single specimen of this very interesting worm, for which I shall make a special search on a future occasion.

[1] Ann. & Mag. Nat. Hist., Oct. 1883, p. 217.

PERICHÆTA STUARTI, sp. n.

The clitellum extends over somites xiv., xv., and xvi.; it is very well marked.

There are two pairs of male pores in somites xvii. and xix., respectively; these are all four placed upon a whitish, slightly depressed patch, which thus extends over the greater portion of somite xvii., the whole of somite xviii., and the greater portion of somite xix. Connected with each of these pores is a large coiled prostatic gland, which extends backwards in each case through some 8 or 9 somites.

There is a single median oviducal pore in the anterior portion of somite xiv.

There are two pairs of spermathecæ, situated in somites vii. and viii., respectively. They do not possess any appendages, but present a sort of frilled appearance around the base.

The gizzard is situated in somite x.

In somites xxiii.–xxvi. (?) there are four pairs of special diverticula on the dorso-lateral portions of the intestine.

I have not observed any nephridia.

There are about 52 setæ in each somite arranged with small dorsal and ventral gaps; setæ are present on the clitellum.

There are no special setæ in somite xviii., but in the anterior portion of somite viii. (*i. e.* between the anterior and posterior pair of spermathecæ) there are two groups of large modified setæ. Where these project on the surface, there is a papilla which in some specimens becomes very well marked.

Length 148 millim., circumference 15 mm.; number of somites 111.

Hab. Yercaud, at an elevation of about 5000 feet, and also down the ghaut as low as Salem (1000 ft.). I have specimens from Salem.

This is an exceedingly common worm in this region. It occurs in dry ground, and often under large stones.

PERICHÆTA BURLIARENSIS, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., and is well marked.

The male pores are situated in somite xviii.; segments xix., xx., xxi., and xxii. bear papillæ (apertures ?).

The oviducts open in somite xiv. by a single median pore.

The spermathecæ are placed in somites vi., vii., viii., and ix.; they present a single appendage. I am unable at present to say anything about nephridia.

The gizzard is situated in somite x. There are a single pair of intestinal cæca in somite xxvi., reaching forwards to somite xxiv. There are 38 to 40 setæ per somite. Setæ are entirely absent from the clitellum. I find no special setæ in somite xviii., but there are two pairs of groups of enlarged setæ in somites vii. and viii., respectively.

There is a large ventral gap, especially in the somites immediately following the male pores, where the most ventrally placed setæ are larger than the others.

Length 100 millim., circumference 9 mm.; number of somites 123.
Hab. Burliar, 2000–3000 ft.

PERICHÆTA HULIKALENSIS, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., and is well marked.

The male pores are situated in somite xviii., and are rather near together, and placed upon slight papillæ.

The oviducts open by a single median pore in somite xiv.

The spermathecæ are placed in somites vii. and viii.; they present a single filiform appendage.

No nephridia were observed.

I believe intestinal diverticula are present in the usual position.

There are about 42 setæ per somite. The ventral gap is equal to 4 ordinary gaps, and the dorsal gap to 7 ordinary gaps. Setæ are present on the clitellum.

No special setæ were observed.

Length 200 millim., circumference 9 mm.; number of somites 209.
Hab. Hulikal-drug, Nilgiris. Elevation about 6000 ft.

PERICHÆTA MIRABILIS, sp. n.

The clitellum extends over somites xiv., xv., and xvi., and is well marked.

The male pores are widely separated, and situated on low papillæ in somite xviii.

The oviducts open by a median pore in somite xiv.

The spermathecæ are situated in somites vi., vii., viii., and ix.; they present a single appendage. They open, as is usually the case, exactly between the somite in which they lie and the preceding somite.

The gizzard is situated in somite x.

Intestinal cæca are present in somite xxvi., and run forwards.

Nephridia seem to be present in certain anterior somites only, as in *P. gracilis*.

There are four pairs of groups of small nephridia in the posterior portions of somites v., vi., vii., and viii., respectively, and these open on minute circular papillæ which are placed in diamond-shaped depressions lying in the posterior portion of the somites, in which the nephridial groups lie, and just ventrad of the nephridiopore which lies between each of the somites and the succeeding somite.

There are further two pairs of groups of nephridia lying in somites vii. and viii., respectively, and opening on similar papillæ placed ventrad of those above described, and just anterior to the seta-ring in each somite. The further details with regard to this remarkable arrangement I hope to work out on a future occasion. I may mention here that I at first mistook these nephridiopore-bearing papillæ for the pores of the spermathecæ, and it is quite possible that previous observers have done the same thing in other species of *Perichæta*. It needs the most careful and repeated observation to make out the exact arrangement. There 39 setæ per somite, with no gap either dorsally or ventrally. It is always possible, however, to recognize the median ventral or dorsal lines, as both ventral and dorsal

setæ point forwards and away from the middle line, while the lateral setæ point straight forwards. I lay no stress on this arrangement at present; it may be caused by my method of flattening out the body-wall after a median dorsal incision. I have no observations with regard to penial setæ.

Length 130 millim., circumference 8 mm.; number of somites about 114.

Hab. Naduvatam, Nilgiris. Found along with *P. gracilis*.

I hope to make some special observations at a later period with regard to the distribution of these worms, but I may point out now that the only two species presenting this remarkable arrangement of nephridia, while differing in almost all other essentials, were found together.

PERICHÆTA SALETTENSIS, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., and is well marked.

The male pores are situated on somite xviii., without much ridge around them.

The oviducts open by a median pore in somite xiv.

The spermathecæ lie in somites vii., viii., and ix.; they present a pair of small appendages.

The gizzard is situated in somite vi.

I have no observation regarding intestinal cæca.

The nephridia occur in, at any rate, most of the somites; they are very large and present rosettes of tubules in certain anterior somites.

The setæ present a dorsal gap equal to about three ordinary gaps, and a ventral gap equal to about five ordinary gaps. There seem to be no modified penial setæ.

Length 70 millim., circumference 9 mm.; number of somites 112.

Hab. Salem, elevation about 1000 feet, in wet ground together with *P. bivaginata*; I only found two specimens.

PERIONYX SALTANS, sp. n.

The clitellum extends over somites xiv., xv., and xvi. In the hitherto known species of *Perionyx*, *P. excavatus*, E. P.[1], and *P. macintoshii*, Bedd.[2], the clitellum extends over somites xiii., xiv., xv., xvi., and xvii.

The male pores are situated on papillæ in a median pit in somite xviii.

The oviducts open by a single median pore in somite xiv.

There are three pairs of spermathecæ; these are placed in somites vi., vii., and viii. The spermathecal pores are placed between somites vi., and vii., vii. and viii., viii. and ix. This is an unusual arrangement, the spermatheca generally opens between the somite in which it lies and the somite in front. Each spermatheca presents two minute appendices. The spermathecal pores are placed very near the median line; in all the *Perichæta* species they are very lateral in position.

[1] Nouv. Arch. d. Muséum, t. viii. 1872, p. 126.
[2] Ann. & Mag. Nat. Hist., Oct. 1883, p. 217.

The nephridia are small and present a unique arrangement. The nephridiopores are all placed on the anterior edge of a somite. They are placed in two rows on each side, an inner and an outer row. The inner row is about in a line with the 11th setæ. Counting from the median ventral line, the outer row is about in a line with the 17th setæ, while the spermathecal pores are in a line with the 4th setæ.

In somite iv. there is a single nephridiopore on the left-hand side, in somite v. there is a single pore on the right-hand side, in somite vi. there is a single pore on the left-hand side; these three pores all belong to the inner rows. In somite vii. I found no pore. The remaining somites each present two pores. In somites viii., x., xii., xiv., &c. the pore on the right side belongs to the outer row, and the pore on the left side to the inner row. In somites ix., xi., xiii., xv., &c. the reverse arrangement obtains, viz., the left-hand pore belongs to the outer row and the right-hand pore to the inner row.

In too many cases we do not, unfortunately, know the position of the nephridiopore: I have not access out here to the description of *Plutellus*[1], but the nephridiopores are there said to alternate in position; with this exception the arrangement is unique and bears a most interesting relation to the theory that the spermathecæ are modified nephridia. It will be noted that the distances between the outer and inner rows of nephridiopores, between the inner row of nephridiopores and the row of spermathecal pores, and, lastly, between the rows of spermathecal pores, are almost exactly equal, and the pores have exactly similar positions in the somite.

I have made no observations on the alimentary canal.

There are 45–54 setæ in each somite arranged in an almost continuous ring.

Setæ are present on the clitellum. No modified genital setæ were observed.

Length 60 millim., circumference 6 mm.; number of somites 61.

Hab. Ootacamund; Naduvatam, Nilgiris. Elevation about 6500–7500 feet.

It is a very strong little worm, and the name refers to its power of leaping into the air when touched.

Moniligastridæ.

The huge worm which is mentioned in Darwin's book as occurring on the Nilgiris turned out to be a *Moniligaster*, a form then known from Perrier's description of a single specimen which he called *M. deshayesii*. I have since received information that Mr. Beddard has described another species from Ceylon as *M. barwelli*[2].

I found, in addition to the large worm, four smaller species of *Moniligaster* on the Nilgiris, and two others on the Shevaroys or rather at Salem, at the foot of the ghaut.

I have thus recognized seven species altogether, but it is exceedingly difficult to characterize these accurately until we know their general organization better, so that I regard the following very scanty descriptions as preliminary.

[1] Arch. de Zool. Exp. t. ii. (1873).

[2] Ann. & Mag. Nat. Hist., Feb. 1886, p. 940.

Moniligaster has been described as being devoid of any clitellum. In, at any rate, one of my species the clitellum is, however, very well marked, so that this cannot be taken as a generic character.

The genus is, however, sufficiently characterized by the four pores situated in pairs between somites vii. and viii., and x. and xi., respectively, by the peculiar arrangement of the generative organs, and by the monilated gizzard. It is often exceedingly difficult to determine the exact position of the gizzard, and I believe that its position may vary by a somite in different individuals of the same species; still there is no doubt that in some cases it will serve as a specific character—e. g. *M. sapphirinaoïdes* and *M. robustus*, which resemble one another in most respects, differ markedly in the position of the gizzard.

There is a great difference in size among the species; *M. grandis* is quite as large as *Microchæta rappi*, while *M. minutus* is one of the smallest of Earthworms.

MONILIGASTER GRANDIS, sp. n.

There is no trace of clitellum.

The distance between the ventral seta rows is greater than that between the ventral rows and the lateral rows.

The gizzard extends through somites xvii.–xxi. inclusive.

The septa between v.–vi., vi.–vii., vii.–viii., and viii.–ix. are very strong and thick.

The septum between ix. and x. is absent.

I obtained this worm in May and June. In May, before the rains, I only found it deep down: I have made coolies dig pits as much as 9-10 feet deep before coming upon a single worm, although their burrows were quite obvious; then one would suddenly come upon a specimen lying in a hollow which seemed to exactly fit its body, all rolled up together in a mass nearly the size of one's fist, and upon the surface of the body, crawling about in the mucous, were young individuals which in one instance were less than half an inch long, but from larger specimens I easily determined them to be young *Moniligasters*. I expect that there is something very interesting about this, and probably it is connected with the absence of clitellum and consequently of cocoons, but it seemed to be too late in the year to make any further observations.

In June at Naduvatam, after there had been some rain, I found these worms quite near the surface, even in some cases crawling about, but I never then found young ones. I never found these worms at a lower elevation than 6500 feet; at Coonoor, which is just below that altitude, and much warmer than Ootacamund, I could not find a single specimen.

MONILIGASTER UNIQUUS, sp. n.

So called because for some time I had only a single specimen, but I subsequently found a few others.

There is no clitellum.

The gizzard occupies somites xv.–xix.

The ventral seta rows are very near together, there is less distance

between them than between a ventral row and the lateral row of the same side.

It is a small weak-looking worm.

I found specimens at Ootacamund and at Naduvatam.

MONILIGASTER SAPPHIRINAOÏDES, sp. n.

This worm presents a well-marked clitellum extending over somites x., xi., xii., and xiii.

The gizzard occupies somites xvii.–xxi.

This is a very strong active worm, rather larger than a big English *Lumbricus agricola*, and presents most exquisite iridescent colours, among which a metallic bluish-green is the most marked.

I found it in immense numbers in some very wet black mud under turf near the Pykarah Waterfalls, at, I believe, an elevation of about 6000 feet. When placed in spirit it becomes olive-green in colour, while the clitellum becomes almost pinkish.

MONILIGASTER ROBUSTUS, sp. n.

The gizzard occupies somites xi.–xv.

This worm is easily recognized by its very pointed posterior extremity, just the anal somites being bright pink, while the rest of the worm is dull in colour. In other respects it resembles *M. sapphirinaoïdes*.

I found a few specimens only, crawling across a path on a drenching day, on top of one of the hills at Ootacamund.

MONILIGASTER PAPILLATUS, sp. n.

This species is characterized by long tubular papillæ in connection with the pores between somites x. and xi.

The gizzard occupies somites xvi.–xx.

I found this at Ootacamund and Coonoor.

This is a much longer worm than any of the other species, with the exception of *M. grandis*.

MONILIGASTER RUBER, sp. n.

The gizzard seemed to occupy only somites xiii. and xiv. In somites x., xi., and xii. there were soft-walled swellings of the intestine looking like gizzard, only not muscular. The worm had a thin body-wall, and the organs showing through give it a blood-red appearance. It is a small worm about 100 millim. long.

I obtained only a single specimen from Salem.

MONILIGASTER MINUTUS, sp. n.

The gizzard occupies somites xii., xiii., and xiv.

This is a small worm resembling *Perionyx saltans* in appearance, but not very active. The ovaries, or at any rate sacs containing ripe ova, occupy somites xii.–xv. at least.

I found numerous specimens in wet ground at Salem.

When I have determined more accurately the structure of the generative organs in this genus, this species will probably prove an interesting one.

APPENDIX.

LIST OF ADDITIONS TO THE SOCIETY'S MENAGERIE

DURING THE YEAR

1886.

Jan. 1. 1 Caracal (*Felis caracal*), ♂. Kalahari Desert, S. Africa. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Puff-Adder (*Vipera arietans*). Uitenhage, S. Africa. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 African Cobra (*Naia haje*). Little Namaqualand. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
3 Horned Vipers (*Vipera cornuta*). Little Namaqualand. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Hygian Snake (*Elaps hygiæ*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Smooth-bellied Snake (*Homalosoma lutrix*). Cape Town. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Rhomb-marked Snakes (*Psammophylax rhombeatus*). Worcester. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Hoary Snakes (*Coronella cana*). Little Namaqualand. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Crossed Snake (*Psammophis crucifer*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Many-marked Snake (*Rhagerrhis multimaculata*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S. See P. Z. S. 1886, p. 124.
12 Quails (*Coturnix communis*). Presented by Capt. M. P. Webster.
1 Ring-necked Parrakeet (*Palæornis torquatus*). Presented by Miss Shackthwaite.
2. 1 Greater Spotted Woodpecker (*Dendrocopus major*). Derbyshire. Presented by Mr. A. S. Hutchinson.
4. 1 Grey Ichneumon (*Herpestes griseus*), ♂. Presented by Capt. J. Cutting.
1 Yellow-crowned Troupial (*Icterus chrysocephalus*). Purchased.
8. 1 Grey Squirrel (black var.) (*Sciurus cinereus*). Presented by Mrs. C. Neck.
1 Golden Eagle (*Aquila chrysaetus*). Presented by H. V. Knox, Esq.
1 Bronze-winged Pigeon (*Phaps chalcoptera*). Presented by A. F. Spry, Esq.

Jan. 9. 1 Lesser White-nosed Monkey (*Cercopithecus petaurista*), ♂. Presented by T. Risely Griffith, Esq.
1 White-thighed Colobus (*Colobus vellerosus*). Purchased.
1 Moustache Monkey (*Cercopithecus cephus*). Purchased.
1 Hocheur Monkey (*Cercopithecus nictitans*). Purchased.
8 Grass-green Tree-Snakes (*Dryophis prasina*). Born in the Menagerie. See P. Z. S. 1886, p. 124.
1 Song-Thrush (*Turdus musicus*). British Isles. Deposited.
11. 1 Bonnet-Monkey (*Macacus sinicus*), ♂. Presented by Messrs. Phillips Bros.
4 Cirl Buntings (*Emberiza cirlus*), 3 ♂, 1 ♀. British Isles. Purchased.
2 Pied Wagtails (*Motacilla lugubris*). Purchased.
13. 1 White-throated Capuchin (*Cebus hypoleucus*), ♀. Deposited.
1 Northern Mocking-bird (*Mimus polyglottus*). Presented by F. Green, Esq.
1 Jackal Buzzard (*Buteo jacal*). Presented by the Rev. C. W. H. Reynolds.
14. 1 Jay (*Garrulus glandarius*). Presented by E. R. Collins, Esq.
15. 1 Vervet Monkey (*Cercopithecus lalandii*), ♂. Presented by Mrs. Sinclair.
1 Ring-tailed Conti (*Nasua rufa*), ♂. Presented by C. E. Dashwood, Esq.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Born in the Menagerie.
16. 3 Hoary Snakes (*Coronella cana*). Constantia, S. Africa. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
19. 1 Hybrid Macaque Monkey (between *Macacus cynomolgus* and *Cercopithecus*, sp. inc.). Ascension. Presented by Vitele de Michele, Esq.
20. 1 Common Otter (*Lutra vulgaris*). Received in Exchange.
1 Bearded Lizard (*Amphibolurus barbatus*). Purchased.
21. 1 Tree-Sparrow (*Passer montanus*). Presented by Mr. T. E. Gunn.
1 Mealy Redpoll (*Linota linaria*). Presented by Mr. T. E. Gunn.
3 Starlings (*Sturnus vulgaris*). Presented by Mr. T. E. Gunn.
23. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
2 White-billed Parakeets (*Tanygnathus albirostris*). Purchased.
26. 2 Stump-tailed Lizards (*Trachydosaurus rugosus*). Received in Exchange.
1 Great Cyclodus (*Cyclodus gigas*). Received in Exchange.
1 Diamond Snake (*Morelia spilotes*). Received in Exchange.
27. 4 Moorhens (*Gallinula chloropus*). Presented by Mr. T. E. Gunn.
28. 1 Chacma Baboon (*Cynocephalus porcarius*), ♂. Presented by Lieut.-Gen. G. W. A. Higginson, C.B.
1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♀. Presented by Lieut-Gen. G. W. A. Higginson, C.B.
1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by Mrs. J. J. Buchanan.
29. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Mr. H. M. Sherratt.
1 Hygian Snake (*Elaps hygiæ*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Hoary Snake (*Coronella cana*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.

Jan. 29. 1 Crossed Snake (*Psammophis crucifer*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Horned Viper (*Vipera cornuta*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
30. 3 Gold Pheasants (*Thaumalea picta*), 3 ♂. Presented by A. Heywood, Esq., F.Z.S.
1 Common Badger (*Meles taxus*), ♂. Presented by the Hon. Walter de Rothschild.
2 Reed-Buntings (*Emberiza schæniclus*). Purchased.

Feb. 2. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Mrs. Corbet.
1 Great Kangaroo (*Macropus giganteus*). Born in the Menagerie.
2 Alligators (*Alligator mississippiensis*). Presented by Mr. F. J. Dawe.
3. 1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♀. Deposited.
2 Black-headed Lemurs (*Lemur brunneus*), 2 ♂. Purchased.
1 Indian Otter (*Lutra nair*), ♂. Ceylon. Presented by Capt. J. C. Withers.
2 Maholi Galagos (*Galago maholi*). Presented by Mrs. Max Michaelis.
5. 1 Red-bellied Waxbill (*Estrelda rubricentris*). Presented by Mrs. S. Johnson, F.Z.S.
1 Anaconda (*Eunectes murinus*). Deposited.
1 Common Boa (*Boa constrictor*). Deposited.
1 Ring-tailed Coati (*Nasua rufa*), ♂. Presented by J. H. N. Theed, Esq., Lt. R.N.
8. 1 Pennant's Broadtail (*Platycercus pennanti*). Presented by H. Stacy Marks, Esq., R.A., F.Z.S.
3 Japanese Goldfish. Presented by Capt. H. Weighell.
9. 1 Kittiwake (*Rissa tridactyla*). Purchased.
1 Common Gull (*Larus canus*). Purchased.
1 Black-headed Gull (*Larus ridibundus*). Purchased.
13. 5 Adorned Ceratophrys (*Ceratophrys ornata*). Presented by Dr. Frederick C. Strutt. See P. Z. S. 1886, p. 137.
1 Common Chameleon (*Chamæleon vulgaris*). Presented by C. Kershaw, Esq.
15. 1 Bonnet-Monkey (*Macacus sinicus*), ♀. Presented by Miss Douglas.
1 Chacma Baboon (*Cynocephalus porcarius*), ♀. Presented by Mr. F. Radcliffe.
2 Feline Douroucoulis (*Nyctipithecus vociferans*). Purchased.
2 Lion Marmosets (*Midas rosalia*). Purchased.
1 Razor-billed Curassow (*Mitua tuberosa*). Purchased.
1 Mantled Buzzard (*Leucopternis palliata*). Purchased. See P. Z. S. 1886, p. 137.
1 Raccoon (*Procyon lotor*). Purchased.
16. 1 Orange-winged Amazon (*Chrysotis amazonica*). Presented by Mr. G. F. Richards.
17. 1 Collared Fruit-Bat (*Cynonycteris collaris*). Born in the Menagerie.
20. 1 Ring-tailed Coati (*Nasua rufa*), ♀. Presented by Miss A. Pagella.
23. 1 Macaque Monkey (*Macacus cynomolgus*), ♀. Deposited.
24. 6 Tuatera Lizards (*Sphenodon punctatus*). Presented by the Hon. Sir Julius Vogel, K.C.M.G.

Feb. 24. 6 Tuatera Lizards (*Sphenodon punctatus*). Deposited.
9 Tuatera Lizards (*Sphenodon punctatus*). Presented by Dr. J. von Haast, C.M.Z.S.
2 Yucatan Blue Jays (*Cyanocitta yucatanica*), 2 ♀. Purchased.
25. 1 Red Kangaroo (*Macropus rufus*), ♀. Born in the Menagerie.
26. 8 Viscachas (*Lagostomus trichodactylus*). Presented by E. Vere Dashwood, Esq.
1 Canadian Porcupine (*Erithizon dorsatus*), ♂. Received in Exchange.
4 American Hares (*Lepus americanus*). Presented by F. J. Thompson, Esq.
2 Great Barbets (*Megalæma virens*). Purchased.

Mar. 1. 1 Canada Goose (*Bernicla canadensis*). Presented by J. E. Kelsall, Esq.
2. 1 Rough-billed Pelican (*Pelecanus trachyrhynchus*). Purchased. See P. Z. S. 1886, p. 176.
1 Hutchin's Goose (*Berniela hutchinsi*). Purchased.
4. 1 Serval (*Felis serval*), ♂. Lamoo, East Africa. Presented by F. J. Jackson, Esq.
1 White-tailed Ichneumon (*Herpestes albicauda*). Lamoo, East Africa. Presented by F. J. Jackson, Esq. See P. Z. S. 1886, p. 176.
5. 1 Patas Monkey (*Cercopithecus patas*), ♀. Presented by Master Eric Blind.
1 Toque Monkey (*Macacus pileatus*). Presented by C. Brown, Esq.
1 Blue-and-Yellow Macaw (*Ara ararauna*). Presented by Lieut. W. H. Duffin, K. O. Regt.
8. 1 Lion Marmoset (*Midas rosalia*). Presented by Percy Bewick Bewick, Esq.
1 Black-backed Jackal (*Canis mesomelas*), ♀. Presented by Mrs. E. Thomas.
9. 1 Green Monkey (*Cercopithecus callitrichus*), ♂. Presented by Mrs. Dunn.
1 Talapoin Monkey (*Cercopithecus talapoin*), ♀. Received in Exchange.
11. 1 Grey Ichneumon (*Herpestes griseus*). Presented by W. A. Roofe, Esq.
12. 1 White-crowned Mangabey (*Cercocebus æthiops*), ♀. Presented by N. King, Esq.
13. 1 Grey Ichneumon (*Herpestes griseus*), ♀. Presented by T. W. Proger, Esq.
1 Demoiselle Crane (*Grus virgo*). Presented by T. W. Proger, Esq.
1 Common Gull (*Larus canus*). Purchased.
2 Changeable Lizards (*Calotes versicolor*). Deposited.
3 Gleadow's Geckos (*Hemidactylus gleadovii*). Deposited.
2 Cocteau's Geckos (*Hemidactylus coctæi*). Deposited.
15. 3 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.
16. 1 Green-billed Toucan (*Rhamphastos dicolorus*). Purchased.
1 Thunder-fish (*Misgurnus fossilis*). Presented by Alban Doran, Esq., F.R.C.S.
1 Ground-Loach (*Cobitis tænia*). Presented by Alban Doran, Esq., F.R.C.S.
17. 1 Bay Antelope (*Cephalophus dorsalis*), ♂. Purchased.

Mar. 18. 1 Thick-necked Tree-Boa (*Epicrates cenchria*). Purchased.
1 Sun-Bittern (*Eurypyga helias*). Purchased.
1 Yellow-lored Amazon (*Chrysotis xantholora*). Purchased.
19. 2 Tasmanian Wolves (*Thylacinus cynocephalus*), ♂ ♀. Deposited.
2 Red Kangaroos (*Macropus rufus*), ♂ ♀. Deposited.
1 Great Kangaroo (*Macropus giganteus*). Deposited.
1 Yellow-footed Rock-Kangaroo (*Petrogale xanthopus*). Deposited.
2 Hairy-nosed Wombats (*Phascolomys latifrons*), ♂ ♀. Deposited.
2 Vulpine Phalangers (*Phalangista vulpina*, white var.). Deposited.
2 King Parrakeets (*Aprosmictus scapulatus*), 2 ♂. Deposited.
1 Bauer's Broadtail (*Platycercus zonarius*). Deposited.
2 Swainson's Lorikeets (*Trichoglossus swainsoni*). Deposited.
1 Roseate Cockatoo (*Cacatua roseicapilla*). Deposited.
20. 2 Azara's Opossums (*Didelphys azaræ*), ♂ ♀. Rosario, La Plata. Presented by Capt. G. W. Freeman.
1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by L. H. G. Morgan, Esq.
21. 3 Striated Finches (*Munia striata*). Presented by L. B. Lewis, Esq.
1 Nutmeg-Finch (*Munia punctularia*). Presented by L. B. Lewis, Esq.
2 Black-headed Finches (*Munia malacca*). Presented by L. B. Lewis, Esq.
22. 1 Ring-tailed Lemur (*Lemur catta*), ♂. Presented by Alfred Best, Esq.
1 Thunder-fish (*Miegurnus fossilis*). Presented by Alban Doran, Esq., F.R.C.S.
1 Umbre-fish (*Umbra krameri*). Presented by Alban Doran, Esq., F.R.C.S.
23. 1 Bonnet-Monkey (*Macacus sinicus*), ♀. Presented by Dr. E. Weakes.
24. 1 Sharp-nosed Crocodile (*Crocodilus acutus*). Deposited.
2 Common Boas (*Boa constrictor*). Presented by Daniel Nicols, Esq.
1 West-African Python (*Python sebæ*). Presented by Daniel Nicols, Esq.
1 Mountain Ka-Ka (*Nestor notabilis*). Presented by James Ellis, Esq., F.S.A., Scot.
25. 1 White-fronted Lemur (*Lemur albifrons*). Born in the Menagerie.
4 Leopard Tortoises (*Testudo pardalis*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Geometric Tortoises (*Testudo geometrica*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Tent Tortoise (*Testudo tentoria*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
11 Angulated Tortoises (*Chersina angulata*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Areolated Tortoise (*Homopus areolatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Infernal Snakes (*Boodon infernalis*). Robben Island, S. Africa. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Robben-Island Snake (*Coronella phocarum*). Robben Island, S. Africa. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.

Mar. 26. 2 Golden Plovers (*Charadrius pluvialis*). Purchased.
2 Umbre-fish (*Umbra krameri*). Presented by Messrs. Paul & Co.
27. 3 Wheatears (*Saxicola œnanthe*). Purchased.
29. 1 Kingfisher (*Alcedo ispida*). Presented by Cuthbert Johnson, Esq.
1 Roseate Cockatoo (*Cacuta roseicapilla*). Deposited.
30. 1 Black Lemur (*Lemur macaco*). Born in the Menagerie.
17 Tuatera Lizards (*Sphenodon punctatus*). Deposited.
31. 1 Dingo (*Canis dingo*). Deposited.
1 Domestic Sheep (*Ovis aries*), ♂. Presented by Hugh J. Tweedy, Esq.

Apr. 1. 1 White-fronted Capuchin (*Cebus albifrons*), ♂. Presented by Mr. Mathew.
1 Axis Deer (*Cervus axis*), ♂. Born in the Menagerie.
2. 1 Ring-tailed Coati (*Nasua rufa*). Presented by Miss Agnes Thomson.
2 Sonnerat's Jungle-fowl (*Gallus sonnerati*), ♂ ♀. Deposited.
2 White-eared Scops Owls (*Scops leucotis*). Purchased.
3. 2 Cambayan Turtle-Doves (*Turtur senegalensis*), ♂ ♀. Presented by Mons. J. M. Cornély, C.M.Z.S.
2 Geoffroy's Doves (*Peristera geoffroii*), ♂ ♀. Received in Exchange.
2 Blood-breasted Pigeons (*Phlogœnas cruentata*), ♂ ♀. Received in Exchange.
1 Chinese Mynah (*Acridotheres cristatellus*). Presented by T. Douglas Murray, Esq., F.Z.S.
1 Red-and-Black Lizard (*Ctenosaura erythromelas*). Purchased. See P. Z. S. 1886, p. 266.
5. 1 Crested Porcupine (*Hystrix cristata*). Presented by Miss C. S. Simpson.
1 Herring-Gull (*Larus argentatus*). Presented by Capt. H. J. Alexander.
6. 1 Macaque Monkey (*Macacus cynomolgus*), ♀. Presented by Mrs. Carter
1 Black-eared Marmoset (*Hapale penicillata*). Presented by A. Evershed, Esq.
2 Three-toed Sloths (*Bradypus tridactylus*). Presented by Capt. Hicks.
1 Burchell's Zebra (*Equus burchelli*), ♂. Deposited.
7. 1 Eland (*Oreas canna*), ♂. Born in the Menagerie.
1 Lesser Koodoo (*Strepsiceros imberbis*), ♂. Somali Land. Received in Exchange. See P. Z. S. 1886, p. 266.
8. 1 Crested Porcupine (*Hystrix cristata*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Black-backed Jackal (*Canis mesomelas*). Presented by Capt. John Hewat, C.M.Z.S.
1 Indian Antelope (*Antilope cervicapra*). Presented by Capt. J. C. Robinson.
9. 2 Black-footed Penguins (*Spheniscus demersus*). Purchased.
2 Globose Curassows (*Crax globicera*), 2 ♀. Deposited.
10. 2 Black-backed Jackals (*Canis mesomelas*). Born in the Menagerie.
1 Ceylonese Hanging-Parrakeet (*Loriculus asiaticus*). Presented by C. W. Rosset, Esq.
1 Ruddy Sheldrake (*Tadorna casarca*), ♀. Received in Exchange.

Apr. 12. 1 Great Kangaroo (*Macropus giganteus*), ♂. Purchased.
13. 1 Eroded Cinixys (*Cinixys erosa*). Purchased.
1 Merrem's Snake (*Liophis merremi*). Purchased.
14. 1 Axis Deer (*Cervus axis*), ♂. Born in the Menagerie.
1 Greater Sulphur-crested Cockatoo (*Cacatua galerita*). Presented by W. Woods, Esq.
1 Greater Sulphur-crested Cockatoo (*Cacatua galerita*). Presented by the Lord Braybrooke, F.Z.S.
1 Barnard's Parrakeet (*Platycercus barnardi*). Presented by the Lord Braybrooke, F.Z.S.
6 Field-Frogs (*Rana arvalis*). Presented by G. A. Boulenger, Esq., F.Z.S.
15. 1 Scarlet Ibis (*Eudocimus ruber*). Deposited.
16. 2 Bronze-winged Pigeons (*Phaps chalcoptera*), ♂ ♀. Received in Exchange.
17. 1 Pudu Deer (*Pudua humilis*), ♂. Chili. Presented by Harry Berkeley James, Esq., F.Z.S.
5 Chilian Sea-Eagles (*Geranoaëtus melanoleucus*). Chili. Presented by Harry Berkeley James, Esq., F.Z.S.
2 Barn-Owls (*Strix flammea*). Presented by Harry Berkeley James, Esq., F.Z.S.
2 Black-chinned Siskins (*Chrysomitris barbata*). Presented by Harry Berkeley James, Esq., F.Z.S.
1 Diuca Finch (*Diuca grisea*). Presented by Harry Berkeley James, Esq., F.Z.S.
2 Auriculated Doves (*Zenaida auriculata*). Presented by Harry Berkeley James, Esq., F.Z.S.
5 Capoeira Partridges (*Odontophorus dentatus*). Presented by Harry Berkeley James, Esq., F.Z.S.
1 Antarctic Skua (*Stercorarius antarcticus*). Presented by Harry Berkeley James, Esq., F.Z.S.
1 White-tailed Buzzard (*Buteo albicaudatus*). Presented by Harry Berkeley James, Esq., F.Z.S.
1 King Vulture (*Gypagus papa*). Deposited.
2 Capoeira Partridges (*Odontophorus dentatus*), ♂ ♀. Deposited.
4 Californian Quails (*Callipepla californica*), 3 ♂, 1 ♀. Deposited.
19. 1 Pale-headed Tree-Boa (*Epicrates angulifer*). Hayti. Presented by Miss Maysie Hunt.
20. 1 Rose-crested Cockatoo (*Cacatua moluccensis*). Deposited.
21. 1 Garnett's Galago (*Galago garnetti*). Presented by the Rev. W. C. Porter.
1 Grey Ichneumon (*Herpestes griseus*), ♀. Presented by James B. Bevington, Esq.
1 Ogilby's Rat-Kangaroo (*Hypsiprimnus ogilbyi*), ♀. Purchased.
22. 1 Common Badger (*Meles taxus*). Presented by E. Gully, Esq.
2 Poë Honey-eaters (*Prosthemadera novæ-zealandiæ*). Deposited.
1 Poë Honey-eater (*Prosthemadera novæ-zelandiæ*). Presented by Dr. W. L. Buller, F.R.S., C.M.Z.S.
3 Australian Gannets (*Sula serrator*). Deposited.
2 Australian Gannets (*Sula serrator*). Presented by Dr. W. L. Buller, F.R.S., C.M.Z.S.
1 Huia Bird (*Heterolocha gouldi*). Deposited.
23. 2 Collared Fruit-Bats (*Cynonycteris collaris*). Born in the Menagerie.
1 Kestrel (*Tinnunculus alaudarius*). Presented by G. Bateson-de-Yarburgh, Esq.

Apr. 23. 1 Robben-Island Snake (*Coronella phocarum*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
24. 6 Barbary Turtle-Doves (*Turtur risorius*). Presented by R. Seyd, Esq., F.Z.S.
26. 20 Palmated Newts (*Molge palmata*). Epping Forest. Presented by G. A. Boulenger, Esq., F.Z.S.
27. 1 Pudu Deer (*Pudua humilis*), ♀. Purchased.
2 Short-eared Owls (*Asio brachyotus*). Purchased.
1 Magellanic Eagle-Owl (*Bubo magellanicus*). Purchased.
1 Hairy-eared Rhinoceros (*Rhinoceros lasiotis*), ♂. Received in Exchange. See P. Z. S. 1886, p. 266.
1 Asiatic Wild Ass (*Equus onager*), ♂. Deposited.
28. 1 Ludio Monkey (*Cercopithecus ludio*), ♀. Purchased.
A Collection of Sea-Anemones, &c. Presented by W. L. Sclater, Esq., F.Z.S.
29. 1 Common Squirrel (*Sciurus vulgaris*), ♂. Deposited.
3 Red-crested Finches (*Coryphospingus cristatus*). Purchased.
2 Rosy-faced Love-birds (*Agapornis roseicollis*). Purchased.
1 Shining Parrakeet (*Pyrrhulopsis splendens*). Purchased.
1 Red-collared Conure (*Conurus rubritorquis*). Purchased. See P. Z. S. 1886, p. 538, pl. lvi.
1 Vinaceous Amazon (*Chrysotis vinacea*). Purchased.
2 Punjab Wild Sheep (*Ovis cycloceros*). Received in Exchange.
2 Military Macaws (*Ara militaris*). Presented by C. Clifton, Esq., F.Z.S.
1 Red-and-Yellow Macaw (*Ara chloroptera*). Presented by C. Clifton, Esq., F.Z.S.
2 Ring-Doves (*Columba palumbus*). Presented by Lord Arthur Russell, F.Z.S.
1 Green Lizard (*Lacerta viridis*). Presented by Alban Doran, Esq., F.R.C.S.
30. 1 Jay (*Garrulus glandarius*). Presented by R. Humphreys, Esq.

May 1. 2 Ring-tailed Lemurs (*Lemur catta*), ♂ ♀. Deposited.
1 Redstart (*Ruticilla phœnicurus*), ♂. Purchased.
2 Spanish Terrapins (*Clemmys leprosa*, jr.). Presented by Alban Doran, Esq., F.R.C.S.
1 Spotted Salamander (*Salamandra maculosa*). Presented by Alban Doran, Esq., F.R.C.S.
6 Young Axolotls (*Siredon mexicanus*). Presented by Alban Doran, Esq., F.R.C.S.
1 Fire-bellied Toad (*Bombinator igneus*). Presented by Alban Doran, Esq., F.R.C.S.
2 Edible Frogs (*Rana esculenta*). Presented by Alban Doran, Esq., F.R.C.S.
3. 1 Brazilian Tree-Porcupine (*Sphingurus prehensilis*). Presented by J. E. Wolfe, Esq.
2 Sloth-Bears (*Melursus ursinus*), ♂ ♀. Presented by H. Mainwaring, Esq.
1 Naked-necked Iguana (*Iguana delicatissima*). Presented by D. Morris, Esq.
7 European Tree-Frogs (*Hyla arborea*). Presented by Thompson Hudson, Esq.
4. 1 West-Indian Agouti (*Dasyprocta cristata*). Presented by Dr. A. Boon, F.R.C.S.
1 Dark-backed Squirrel (*Sciurus atrodorsalis*). Burmah. Presented by C. Crofton Black, Esq.

May 4. 1 Californian Quail (*Callipepla californica*), ♂. Presented by Miss Hodge.
1 Herring-Gull (*Larus argentatus*). Presented by Miss Hodge.
1 Common Viper (*Vipera berus*). Presented by Mrs. Mowatt.
3 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.
5. 4 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.
1 Orange-thighed Falcon (*Falco fusco-cærulescens*). Presented by R. J. Jones, Esq. See P. Z. S. 1886, p. 318.
6. 1 Two-banded Monitor (*Varanus salvator*). Presented by Mr. Carl Hagenbeck.
1 Changeable Lizard (*Calotes versicolor*). Presented by Mr. Carl Hagenbeck.
1 Long-snouted Snake (*Passerita mycterizans*). Presented by Mr. Carl Hagenbeck.
1 Painted Tree-Snake (*Dendrophis picta*). Presented by Mr. Carl Hagenbeck.
2 Rat-Snakes (*Ptyas mucosa*). Presented by Mr. Carl Hagenbeck.
1 Indian Cobra (*Naia tripudians*). Presented by Mr. Carl Hagenbeck.
7. 1 Purple-faced Monkey (*Semnopithecus leucoprymnus*), ♀. Presented by Mrs. Larkins.
2 Kestrels (*Tinnunculus alaudarius*). Presented by J. S. Malcolm, Esq.
1 Common Toad (*Bufo vulgaris*). Presented by Alban Doran, Esq., F.R.C.S.
1 Green Toad (*Bufo viridis*). Presented by Alban Doran, Esq., F.R.C.S.
1 Common Viper (*Vipera berus*). Presented by Mrs. Mowatt.
8. 5 Senegal Parrots (*Pœocephalus senegalus*). Presented by R. B. Sheridan, Esq. See P. Z. S. 1886, p. 318.
1 Wedge-tailed Eagle (*Aquila audax*). Presented by R. B. Colvin, Esq.
2 Greek Tortoises (*Testudo græca*). Presented by Admiral Mellersh.
9. 1 Hog-Deer (*Cervus porcinus*). Born in the Menagerie.
1 Small Hill-Mynah (*Gracula religiosa*). Deposited.
10. 4 Chilian Pintail (*Dafila spinicauda*). Bred in the Gardens.
1 Indian Coucal (*Centropus rufipennis*). Purchased.
1 African Tantalus (*Pseudotantalus ibis*). Purchased.
11. 2 Shaw's Gerbilles (*Gerbillus shawi*), ♂ ♀. Presented by W. R. Ogilvie Grant, Esq.
1 Green Lizard (*Lacerta viridis*). Deposited.
12. 2 Black-backed Jackals (*Canis mesomelas*), ♂ ♀. Presented by Fredk. Mosenthal, Esq.
1 Ring-tailed Coati (*Nasua rufa*). Presented by Mr. T. P. Lymn.
13. 1 Spotted Eagle-Owl (*Bubo maculosus*). Purchased.
1 Indian Rat-Snake (*Ptyas mucosa*). Deposited.
4 Black-tailed Godwits (*Limosa ægocephala*). Purchased.
14. 2 Grey Parrots (*Psittacus erithacus*). Deposited.
15. 1 Broad-breasted Chelymys (*Chelymys latisternum*). Presented by the Rev. Albert Popham.
16. 1 Eland (*Oreas canna*), ♂. Born in the Menagerie.
1 Condor (*Sarcorhamphus gryphus*). Presented by R J. Jones, Esq.

June 7. 1 Brazilian Cormorant (*Phalacrocorax brasilianus*. Bahama Islands. Presented by Mrs. E. Blake.
1 Fugitive Snake (*Dromicus fugitivus*). Bahama Islands. Presented by Mrs. E. Blake.
4 Lineated Chalcis (*Chalcides lineatus*). Presented by J. C. Warburg, Esq.
8. 1 Orang-outang (*Simia satyrus*), ♀. Presented by H. H. Riccard, Esq.
1 White-handed Gibbon (*Hylobates lar*). Deposited.
1 White-handed Gibbon (*Hylobates lar*). Presented by Dudley Hervey, Esq.
1 Binturong (*Arctictis binturong*), ♂. Presented by Dudley Hervey, Esq.
1 White-whiskered Paradoxure (*Paradoxurus leucomystax*). Presented by Dudley Hervey, Esq.
2 Viscachas (*Lagostomus trichodactylus*), ♀. Purchased.
2 Crossed Vipers (*Craspedocephalus alternatus*). Purchased.
2 Mexican Guans (*Penelope purpurascens*). Presented by E. A. Clowes, Esq.
9. 1 South-American Flamingo (*Phœnicopterus ignipalliatus*). Purchased.
1 Harnessed Antelope (*Tragelaphus scriptus*), ♀. Purchased.
1 Porose Crocodile (*Crocodilus porosus*). Purchased.
10 Adorned Ceratophrys (*Ceratophrys ornata*). Deposited.
10. 1 Barbel Wild Sheep (*Ovis barbel*), ♂. Born in the Menagerie.
2 Lineated Kaleeges (*Euplocamus lineatus*), ♂ ♀. Purchased.
1 Roseate Spoonbill (*Platalea ajaja*). Purchased.
11. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Miss Grace Balfour.
1 Indian Civet (*Viverricula malaccensis*), ♂. Presented by Capt. Archibald Douglas, R.N.
1 Common Squirrel (*Sciurus vulgaris*). Purchased.
7 Common Vipers (*Vipera berus*). Presented by Walter Blacker, Esq.
2 Dominican Tree-Frogs (*Hyla dominicensis*). Jamaica. Presented by J. J. Lister, Esq., F.Z.S.
12. 1 Green Monkey (*Cercopithecus callitrichus*), ♂. Presented by Duncan Armstrong, Esq.
1 Bald Ouakari (*Brachyurus calvus*), ♂. Purchased. See P.Z.S. 1886, p. 417.
2 Balearic Cranes (*Balearica pavonina*). Purchased.
1 Song-Thrush (*Turdus musicus*). Presented by Master J. Locke Lathom.
1 Blackbird (*Turdus merula*). Presented by Master J. Locke Lathom.
13. 1 Puma (*Felis concolor*). Deposited.
1 Garden's Night Heron (*Nycticorax gardeni*). St. Kitt's, W. Indies. Presented by Dr. A. Boon, F.R.C.S.
14. 1 Binturong (*Arctictis binturong*). Presented by Capt. R. Hay.
15. 1 Bonnet-Monkey (*Macacus sinicus*), ♂. Presented by Mrs. Geo. Willing.
1 Balearic Crane (*Balearica pavonina*). Purchased.
16. 1 Japanese Deer (*Cervus sika*), ♀. Born in the Menagerie.
17. 2 Tcheli Monkeys (*Macacus tcheliensis*), ♂ ♀. Jung-ling Mountains, near Pekin. Presented by Dr. S. W. Bushell, C.M.Z.S. See P.Z.S. 1886, p. 417.

May 4. 1 Californian Quail (*Callipepla californica*), ♂. Presented by Miss Hodge.
1 Herring-Gull (*Larus argentatus*). Presented by Miss Hodge.
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1 Long-snouted Snake (*Passerita mycterizans*). Presented by Mr. Carl Hagenbeck.
1 Painted Tree-Snake (*Dendrophis picta*). Presented by Mr. Carl Hagenbeck.
2 Rat-Snakes (*Ptyas mucosa*). Presented by Mr. Carl Hagenbeck.
1 Indian Cobra (*Naia tripudians*). Presented by Mr. Carl Hagenbeck.
7. 1 Purple-faced Monkey (*Semnopithecus leucoprymnus*), ♀. Presented by Mrs. Larkins.
2 Kestrels (*Tinnunculus alaudarius*). Presented by J. S. Malcolm, Esq.
1 Common Toad (*Bufo vulgaris*). Presented by Alban Doran, Esq., F.R.C.S.
1 Green Toad (*Bufo viridis*). Presented by Alban Doran, Esq., F.R.C.S.
1 Common Viper (*Vipera berus*). Presented by Mrs. Mowatt.
8. 5 Senegal Parrots (*Pæocephalus senegalus*). Presented by R. B. Sheridan, Esq. See P. Z. S. 1886, p. 318.
1 Wedge-tailed Eagle (*Aquila audax*). Presented by R. B. Colvin, Esq.
2 Greek Tortoises (*Testudo græca*). Presented by Admiral Mellersh.
9. 1 Hog-Deer (*Cervus porcinus*). Born in the Menagerie.
1 Small Hill-Mynah (*Gracula religiosa*). Deposited.
10. 4 Chilian Pintail (*Dafila spinicauda*). Bred in the Gardens.
1 Indian Coucal (*Centropus rufipennis*). Purchased.
1 African Tantalus (*Pseudotantalus ibis*). Purchased.
11. 2 Shaw's Gerbilles (*Gerbillus shawi*), ♂ ♀. Presented by W. R. Ogilvie Grant, Esq.
1 Green Lizard (*Lacerta viridis*). Deposited.
12. 2 Black-backed Jackals (*Canis mesomelas*), ♂ ♀. Presented by Fredk. Mosenthal, Esq.
1 Ring-tailed Coati (*Nasua rufa*). Presented by Mr. T. P. Lymn.
13. 1 Spotted Eagle-Owl (*Bubo maculosus*). Purchased.
1 Indian Rat-Snake (*Ptyas mucosa*). Deposited.
4 Black-tailed Godwits (*Limosa ægocephala*). Purchased.
14. 2 Grey Parrots (*Psittacus erithacus*). Deposited.
15. 1 Broad-breasted Chelymys (*Chelymys latisternum*). Presented by the Rev. Albert Popham.
16. 1 Eland (*Oreas canna*), ♂. Born in the Menagerie.
1 Condor (*Sarcorhamphus gryphus*). Presented by R. J. Jones, Esq.

May 17. 3 Speckled Terrapins (*Clemmys guttata*). Presented by S. Garman, Esq., C.M.Z.S.
7 Painted Terrapins (*Clemmys picta*). Presented by S. Garman, Esq., C.M.Z.S.
1 Sculptured Terrapin (*Clemmys insculpta*). Presented by S. Garman, Esq., C.M.Z.S.
11 Striped Snakes (*Tropidonotus sirtalis*). Presented by S. Garman, Esq., C.M.Z.S.
3 Ribbon Snakes (*Tropidonotus saurita*). Presented by S. Garman, Esq., C.M.Z.S.
7 Dekay's Snakes (*Ichnognathus dekayi*). Presented by S. Garman, Esq., C.M.Z.S.
4 Grass-Snakes (*Cyclophis vernalis*). Presented by S. Garman, Esq., C.M.Z.S.
1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by Capt. Boyle.
4 Bernicle Geese (*Bernicla leucopsis*), 2 ♂, 2 ♀. Received in Exchange.

18. 2 Squirrel Monkeys (*Chrysothrix sciurea*), ♂ ♀. Presented by George Liddell, Esq., R.N.
3 Spanish Terrapins (*Clemmys leprosa*). Presented by Cuthbert Johnson, Esq.
3 Tessellated Snakes (*Tropidonotus tessellatus*). Purchased.

19. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
1 Gayal (*Bibos frontalis*), ♀. Born in the Menagerie.
2 Wild Ducks (*Anas boscas*), ♂ ♀. Presented by G. Edson, Esq.
1 Common Viper (*Vipera berus*). Presented by Percy E. Coombe, Esq.
2 Lion Marmosets (*Midas rosalia*). Purchased.
1 Spotted Cavy (*Cœlogenys paca*). Purchased.
2 Ariel Toucans (*Rhamphastos ariel*). Purchased.
1 Crested Curassow (*Crax alector*). Purchased.
2 Zenaida Doves (*Zenaida amabilis*?). Purchased.
1 Natterer's Hawk (*Asturina natterери*). Purchased.

20. 2 Ruffs (*Machetes pugnax*), 2 ♀. Purchased.
2 Spotted Hyænas (*Hyæna crocuta*), ♂ ♀. Purchased.

21. 1 African Wild Ass (*Equus tæniopus*), ♂. Born in the Menagerie.
1 Pig-tailed Monkey (*Macacus cynomolgus*), ♀. Presented by Mrs. F. E. A. Prince.

22. 1 Japanese Deer (*Cervus sika*), ♂. Born in the Menagerie.
4 Menobranchs (*Menobranchus lateralis*). Presented by Prof. Ramsay Wright, F.Z.S.
1 Quail (*Coturnix communis*), ♂. Presented by Kenneth Lawson, Esq.

25. 1 Ring-tailed Lemur (*Lemur catta*), ♂. Presented by Angus Ogilvy, Esq.
1 Smooth Snake (*Coronella lævis*). Purchased.
1 Tessellated Snake (*Tropidonotus tessellatus*). Purchased.

26. 1 Black-faced Spider-Monkey (*Ateles ater*), ♀. Deposited.
1 Rook (*Corvus frugilegus*). Presented by H. J. Peckover, Esq.
1 Common Viper (*Vipera berus*). Presented by W. H. B. Pain, Esq.

27. 2 Spotted Hyænas (*Hyæna crocuta*), ♂ ♀. Purchased.
2 Side-striped Jackals (*Canis lateralis*), ♂ ♀. Purchased.
1 Griffon Vulture (*Gyps fulvus*). Purchased.

May 27. 1 Crab-eating Raccoon (*Procyon cancrivorus*), ♂. Deposited.
1 Loggerhead Turtle (*Thalassochelys caouana*). Presented by Lieut. R. G. Fraser, R.N.
1 Indian Cobra (*Naia tripudians*). Presented by Messrs. H. Thwaites and V. A. Julius.
1 Indian Cobra (*Naia tripudians*). Presented by Stanley A. Julius, Esq.
29. 2 Black-tailed Parrakeets (*Polytelis melanura*). Presented by James Thomson, Esq.
2 Triangular-spotted Pigeons (*Columba guinea*). Bred in the Gardens.
31. 1 Nisnas Monkey (*Cercopithecus pyrrhonotus*), ♀. Presented by the Rev. W. MacGregor.
1 Golden Eagle (*Aquila chrysaetus*). Finland. Presented by Walter Holdsworth, Esq.
6 Long-eared Owls (*Asio otus*). Norfolk. Presented by George B. Burnand, Esq.
3 Ruffs (*Machetes pugnax*), 3 ♀. Deposited.

June 2. 1 Japanese Deer (*Cervus sika*), ♂. Born in the Menagerie.
6 Black-footed Penguins (*Spheniscus demersus*) Presented by Capt. John Hewat.
4 Siamese Blue Pies (*Urocissa magnirostris*). Presented by J. M. Cook, Esq., F.Z.S.
2 Small Hill-Mynahs (*Gracula religiosa*). Presented by J. M. Cook, Esq., F.Z.S.
1 Rufous-necked Weaver-bird (*Hyphantornis textor*). Presented by J. M. Cook, Esq., F.Z.S.
3. 1 Wapiti Deer (*Cervus canadensis*), ♀. Born in the Menagerie.
1 Glaucous Macaw (*Ara glauca*). Purchased. See P. Z. S. 1886, p. 417.
4 Crested Pigeons (*Ocyphaps lophotes*), 2 ♂, 2 ♀. Purchased.
4 Amherst Pheasants (*Thaumalea amherstiæ*), 2 ♂, 2 ♀. Purchased.
2 Great American Egrets (*Ardea egretta*). Purchased.
2 Strickland's Coots (*Fulica leucoptera*). La Plata. Purchased.
1 Azara's Agouti (*Dasyprocta azaræ*). Purchased.
4. 1 Common Badger (*Meles taxus*), ♂. Presented by C. A. Ross, Esq.
1 Malbrouk Monkey (*Cercopithecus cynosurus*), ♀. Deposited.
2 Lapwings (*Vanellus vulgaris*). Purchased.
5. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Mr. J. Coston.
1 Rook (*Corvus frugilegus*). Purchased.
4 Indian Tree-Ducks (*Dendrocygna javanica*). Purchased.
6. 3 American Charr (*Salmo frontinalis*). Presented by F. J. Stevenson, Esq.
7. 1 Common Genet (*Genetta vulgaris*). Presented by J. Church Dixon, Esq.
1 Herring-Gull (*Larus argentatus*). Presented by C. A. Marriott, Esq.
2 Black-billed Tree-Ducks (*Dendrocygna arborea*). Bahama Islands. Presented by Mrs. E. Blake.
1 Violaceous Night-Heron (*Nycticorax violaceus*). Bahama Islands. Presented by Mrs. E. Blake.

June 7. 1 Brazilian Cormorant (*Phalacrocorax brasilianus*. Bahama Islands. Presented by Mrs. E. Blake.
1 Fugitive Snake (*Dromicus fugitivus*). Bahama Islands. Presented by Mrs. E. Blake.
4 Lineated Chalcis (*Chalcides lineatus*). Presented by J. C. Warburg, Esq.
8. 1 Orang-outang (*Simia satyrus*), ♀. Presented by H. H. Riccard, Esq.
1 White-handed Gibbon (*Hylobates lar*). Deposited.
1 White-handed Gibbon (*Hylobates lar*). Presented by Dudley Hervey, Esq.
1 Binturong (*Arctictis binturong*), ♂. Presented by Dudley Hervey, Esq.
1 White-whiskered Paradoxure (*Paradoxurus leucomystax*). Presented by Dudley Hervey, Esq.
2 Viscachas (*Lagostomus trichodactylus*), ♀. Purchased.
2 Crossed Vipers (*Craspedocephalus alternatus*). Purchased.
2 Mexican Guans (*Penelope purpurascens*). Presented by E. A. Clowes, Esq.
9. 1 South-American Flamingo (*Phœnicopterus ignipalliatus*). Purchased.
1 Harnessed Antelope (*Tragelaphus scriptus*), ♀. Purchased.
1 Porose Crocodile (*Crocodilus porosus*). Purchased.
10 Adorned Ceratophrys (*Ceratophrys ornata*). Deposited.
10. 1 Barbel Wild Sheep (*Ovis barbel*), ♂. Born in the Menagerie.
2 Lineated Kaleeges (*Euplocamus lineatus*), ♂ ♀. Purchased.
1 Roseate Spoonbill (*Platalea ajaja*). Purchased.
11. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Miss Grace Balfour.
1 Indian Civet (*Viverricula malaccensis*), ♂. Presented by Capt. Archibald Douglas, R.N.
1 Common Squirrel (*Sciurus vulgaris*). Purchased.
7 Common Vipers (*Vipera berus*). Presented by Walter Blacker, Esq.
2 Dominican Tree-Frogs (*Hyla dominicensis*). Jamaica. Presented by J. J. Lister, Esq., F.Z.S.
12. 1 Green Monkey (*Cercopithecus callitrichus*), ♂. Presented by Duncan Armstrong, Esq.
1 Bald Ouakari (*Brachyurus calvus*), ♂. Purchased. See P. Z. S. 1886, p. 417.
2 Balearic Cranes (*Balearica pavonina*). Purchased.
1 Song-Thrush (*Turdus musicus*). Presented by Master J. Locke Lathom.
1 Blackbird (*Turdus merula*). Presented by Master J. Locke Lathom.
13. 1 Puma (*Felis concolor*). Deposited.
1 Garden's Night Heron (*Nycticorax gardeni*). St. Kitt's, W. Indies. Presented by Dr. A. Boon, F.R.C.S.
14. 1 Binturong (*Arctictis binturong*). Presented by Capt. R. Hay.
15. 1 Bonnet-Monkey (*Macacus sinicus*), ♂. Presented by Mrs. Geo. Willing.
1 Balearic Crane (*Balearica pavonina*). Purchased.
16. 1 Japanese Deer (*Cervus sika*), ♀. Born in the Menagerie.
17. 2 Tcheli Monkeys (*Macacus tcheliensis*), ♂ ♀. Jung-ling Mountains, near Pekin. Presented by Dr. S. W. Bushell, C.M.Z.S. See P. Z. S. 1886, p. 417.

June 17. 1 Tawny Eagle (*Aquila nævioides*). Cyprus. Presented by Col. E. L. Fraser.
1 Spiny-tailed Mastigure (*Uromastix acanthinurus*). Presented by A. Lasenby Liberty, Esq., F.Z.S.
1 Argus Gecko (*Sphærodactylus argus*). Bahamas. Presented by Mrs. E. Blake.
1 Tarantula Spider (*Mygale*, sp. inc.). Bahamas. Presented by Mrs. E. Blake.
1 Egyptian Goose (*Chenalopex ægyptiaca*), ♀. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Robben-Island Snake (*Coronella phocarum*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Hoary Snake (*Coronella cana*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Infernal Snake (*Boodon infernalis*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Rhomb-marked Snake (*Psammophylax rhombeatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
8 Geometric Tortoises (*Testudo geometrica*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Leopard Tortoise (*Testudo pardalis*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
3 Areolated Tortoises (*Homopus areolatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Horned Viper (*Vipera cornuta*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
18. 1 Wild Swine (*Sus scrofa*), ♀. Presented by John Brooks, Esq.
4 Sparrow-Hawks (*Accipiter nisus*, jr.). Presented by J. Rowland Ward, Esq., F.Z.S.
1 Peruvian Thicknee (*Œdicnemus superciliaris*). Deposited.
1 Tuatera Lizard (*Sphenodon punctatus*). Presented by Capt. R. Sutherland.
1 Common Viper (*Vipera berus*). Presented by W. H. B. Pain, Esq.
19. 2 White-backed Piping-Crows (*Gymnorhina leuconota*). Deposited.
A Collection of Marine Fishes. Purchased.
20. 1 Crowned Horned Lizard (*Phrynosoma coronatum*). Presented by S. Upton Robins, Esq.
21. 12 Madarin Ducks (*Æx galericulata*). Bred in the Gardens.
1 Chilian Pintail (*Dafila spinicauda*). Bred in the Gardens.
1 Red-crested Pochard (*Fuligula rufina*). Bred in the Gardens.
1 Martinique Gallinule (*Ionornis martinicus*). Presented by W. J. Rae, Esq.
4 Aldrovandi's Skinks (*Plestiodon auratus*). Presented by the Hon. Walter de Rothschild.
22. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by Mr. G. Ballantyne.
12 Black-tailed Godwits (*Limosa ægocephala*). Purchased.
23. 1 Thar (*Capra jemlaica*), ♀. Born in the Menagerie.
1 Geometric Tortoise (*Testudo geometrica*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Angulated Tortoise (*Chersina angulata*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Fisk's Tortoise (*Testudo fiski*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S. See P. Z. S. 1886, p. 542, pl. lviii.

June 23. 2 Areolated Tortoises (*Homopus areolatus*, jr.). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Ocellated Gecko (*Pachydactylus ocellatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Spotted Gecko (*Pachydactylus maculatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Dwarf Chameleon (*Chamæleon pumilus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Three-streaked Euprepes (*Euprepes tricittatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
4 Sepiform Lizards (*Plewrostrichus sepiformis*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Spotted Slow-worm (*Acontias meleagris*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Bipes (*Scelotes bipes*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Pigmy Hog (*Porcula salvania*). Born in the Menagerie.
24. 1 Macaque Monkey (*Macacus cynomolgus*). Presented by Mrs. S. M. Grove-Grady.
1 Banded Ichneumon (*Herpestes fasciatus*). Presented by G. F. Simpson, Esq.
2 Ruffs (*Machetes pugnax*). Deposited.
25. 1 Larger Hill-Mynah (*Gracula intermedia*). Presented by Miss Maud Bendall.
1 Common Viper (*Vipera berus*). Deposited.
1 Sand-Lizard (*Lacerta agilis*). Presented by Master Stanley S. Flower.
26. 2 Egyptian Geese (*Chenalopex ægyptiaca*). Presented by Col. Harris Burland.
1 Silver-backed Fox (*Canis chama*), ♀. Purchased.
2 Freshwater Fishes. Presented by Alban Doran, Esq., F.R.C.S.
8 Bitterlings (*Rhodeus amarus*). Presented by Alban Doran, Esq., F.R.C.S.
27. 1 Chimpanzee (*Anthropopithecus troglodytes*), ♀. Deposited.
28. 1 Grey Squirrel (*Sciurus cinereus*), ♀. Deposited.
1 Greater White-crested Cockatoo (*Cacatua cristata*). Deposited.
1 Bronze-winged Pigeon (*Phaps chalcoptera*). Bred in the Gardens.
2 Violaceous Night-Herons (*Nycticorax violaceus*). St. Kitts. Presented by Dr. A. Boon, F.R.C.S., C.M.Z.S.
A Collection of Freshwater Fishes. Presented by Messrs. Paul & Co.
29. 1 Prairie-Wolf (*Canis latrans*). Winnipeg. Presented by Gerald F. Talbot, Esq.
2 Mule Deer (*Cariacus macrotis*), 2 ♀. Born in the Menagerie.
2 Glass Snakes (*Pseudopus pallasi*). Purchased.
30. 1 Yak (*Poëphagus grunniens*). Born in the Menagerie.
1 Stein-bok Antelope (*Neotragus tragulus*). Presented by W. J. Robertson, Esq.
1 Quail (*Coturnix communis*). Presented by Mrs. M. A. Moore.

July 2. 6 Thirteen-striped Sousliks (*Spermophilus decemlineatus*). Purchased.
5 American Flying-Squirrels (*Sciuropterus volucella*). Purchased.
1 Mocassin Snake (*Tropidonotus fasciatus*). Purchased.
1 American Milk-Snake (*Coluber eximius*). Purchased.

July 2. 1 Bonnet-Monkey (*Macacus sinicus*). Presented by Albert Thorne, Esq.
1 Mona Monkey (*Cercopithecus mona*). Deposited.
3. 1 Macaque Monkey (*Macacus cynomolgus*). Presented by Mr. S. R. Hicks.
1 Common Fox (*Canis vulpes*). Presented by A. Browning Priestley, Esq.
1 Brown Bear (*Ursus arctos*). Presented by Capt. Asher Smith.
4. 4 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.
6. 1 Squirrel-Monkey (*Chrysothrix sciurea*), ♂. Presented by Madame G. Sangiorgi.
1 Bennett's Wallaby (*Halmaturus bennetti*), ♀. Bred in the Gardens.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Bred in the Gardens.
7. 3 Canadian Beavers (*Castor canadensis*). Bred in the Gardens.
2 Golden Eagles (*Aquila chrysaëtus*). Deposited.
1 Common Cormorant (*Phalacrocorax carbo*). Presented by O. Moulton Barrett, Esq.
8. 1 Lined Finch (*Spermophila lineola*), ♂. Deposited.
1 Lineolated Parrakeet (*Bolborhynchus lineolatus*). Purchased. See P. Z. S. 1886, p. 417.
1 Lear's Macaw (*Ara leari*). Purchased. See P. Z. S. 1886, p. 417.
2 Ostriches (*Struthio camelus*), ♂ ♀. Purchased.
9. 1 Macaque Monkey (*Macacus cynomolgus*), ♀. Presented by Mr. D. Evans.
1 Lesser Redpoll (*Linota rufescens*). Presented by Mr. C. H. Liveing.
1 Brambling (*Fringilla montifringilla*). Presented by Mr. C. H. Liveing.
10. 1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by Capt. Pitman.
12. 1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by F. W. Steward, Esq.
1 Ring-tailed Lemur (*Lemur catta*), ♀. Presented by Mrs. Collcutt.
6 Prairie-Marmots (*Cynomys ludovicianus*), 3 ♂, 3 ♀. Presented by F. J. Thompson, Esq.
13. 2 Peba Armadillos (*Tatusia peba*). Presented by Mr. J. Clements.
1 Bronze-winged Pigeon (*Phaps chalcoptera*). Bred in the Gardens.
1 Barred-shouldered Dove (*Geopelia humeralis*). Bred in the Gardens.
2 Sarus Cranes (*Grus antigone*). Purchased.
1 Common Rhea (*Rhea americana*), ♂. Presented by J. W. Bell, Esq.
14. 2 Common Foxes (*Canis vulpes*), ♂ ♀. Russia. Presented by Harrison Cripps, Esq., F.R.C.S.
2 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Gardens.
15. 4 Red-bellied Squirrels (*Sciurus variegatus*). Trinidad. Presented by R. J. Lechmere Guppy, Esq.
1 Elliot's Pheasant (*Phasianus elliotii*). Hatched from eggs laid in the Society's Gardens.

July 15. 1 Greater Black-backed Gull (*Larus marinus*). Presented by H. Stevens, Esq.
24 Sand-Lizards (*Lacerta agilis*). Presented by Mr. Sherard Schaefer.
1 Slow-worm (*Anguis fragilis*). Presented by Mr. Sherard Schaefer.
1 Common Snake (*Tropidonotus natrix*). Presented by Mr. Sherard Schaefer.
8 European Tree-Frogs (*Hyla arborea*). Purchased.
20. 1 Levaillant's Cynictis (*Cynictis penicillata*), ♂. Presented by R. A. Fairclough, Esq.
5 Suricates (*Suricata tetradactyla*), 2 ♂, 3 ♀. Presented by R. A. Fairclough, Esq.
2 Triangular-spotted Pigeons (*Columba guinea*). Presented by R. A. Fairclough, Esq.
3 Vinaceous Turtle-Doves (*Turtur vinaceus*). Presented by R. Fairclough, Esq.
2 Cape Turtle-Doves (*Turtur capicola*). Presented by R. A. Fairclough, Esq.
22. 3 Lions (*Felis leo*), 1 ♂, 2 ♀. Purchased.
5 Forster's Milvagos (*Milvago australis*). Falkland Islands. Presented by Mr. James Moore.
2 Common Toads (*Bufo vulgaris*). Presented by Mrs. F. Walker.
23. 1 Grey Squirrel (*Sciurus cinereus*, var.). Purchased.
3 Hudson's Bay Squirrels (*Sciurus hudsonius*). Purchased.
1 Mink (*Putorius vison*). Purchased.
1 Virginian Eagle-Owl (*Bubo virginianus*). Purchased.
2 Red Foxes (*Canis fulvus*), ♂ ♀. Presented by Messrs. Ensor, Weber, & Co.
24. 1 White-throated Capuchin (*Cebus hypoleucus*). Presented by Madame Sangiorgi.
1 Masked Paradoxure (*Paradoxurus larvatus*). Hongkong. Presented by J. Orange, Esq.
2 Mule Deer (*Cariacus macrotis*), ♂. Born in the Menagerie.
1 King Vulture (*Gypagus papa*). British Guiana. Presented by N. Atkinson, Esq.
1 Tawny Owl (*Syrnium aluco*). Presented by Master C. G. Gregory.
26. 2 Grey Parrots (*Psittacus erithacus*). Deposited.
1 Vociferous Sea-Eagle (*Haliaetus vocifer*). Purchased.
1 Short-eared Owl (*Asio brachyotus*). Purchased.
2 Blanding's Terrapin (*Clemmys blandingi*). Purchased.
2 Indian River-Snakes (*Tropidonotus quincunciatus*). Purchased.
1 Hyacinthine Macaw (*Ara hyacinthina*). Purchased.
27. 1 Masked Weaver-bird (*Hyphantornis personatus*), ♂. Purchased.
2 Triangular-spotted Pigeons (*Columba guinea*). Bred in the Gardens.
1 Geoffroy's Dove (*Peristera geoffroyi*). Bred in the Gardens.
28. 1 Blue-faced Amazon (*Chrysotis astiva*). Presented by Mrs. J. Fletcher.
4 Brazilian Teal (*Querquedula brasiliensis*). Bred in the Gardens.
5 Slender Ducks (*Anas gibberifrons*). Bred in the Gardens.
2 Chilian Pintail (*Dafila spinicauda*). Bred in the Gardens.

July 28. 2 Common Wild Ducks (*Anas boschas*). Bred in the Gardens.
29. 1 ¾-bred Wapiti Deer, ♂ (between male hybrid *Cervus luehdorfi* and *C. canadensis* and female *C. canadensis*). Bred in the Gardens.
1 Himalayan Monaul (*Lophophorus impeyanus*). Bred in the Gardens.
30. 1 Aldrovandi's Skink (*Plestiodon auratus*). Presented by R. M. J. Teil, Esq.

Aug. 1. 1 Malbrouck Monkey (*Cercopithecus cynosurus*). Presented by Mrs. Barrington.
2. 1 Common Fox (*Canis vulpes*), ♂. Presented by Mr. J. W. Morgan.
3. 1 Spotted Ichneumon (*Herpestes nepalensis*). Presented by Herbert W. Brown, Esq.
1 Bronze-spotted Dove (*Chalcopelia chalcospilos*). Bred in the Gardens.
1 Common Viper (*Vipera berus*). Presented by Gerald Waller, Esq., F.Z.S.
4. 1 Common Polecat (*Mustela putorius*). Presented by Wm. Buckley, Esq.
2 Hybrid Tufted Ducks (between *Fuligula cristata* and *Fuligula ferina*). Presented by — Thwaites, Esq.
4 Florida Tortoises (*Testudo polyphemus*). Presented by Hugh Bellas, Esq.
5. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
1 Bandicoot-Rat (*Mus bandicota*). Born in the Menagerie.
1 Red-crested Cardinal (*Paroaria cucullata*). Presented by W. E. Ayerst, Esq.
7. 1 Brown-coated Conure (*Conurus aruginosus*). Deposited.
1 Roseate Cockatoo (*Cacatua roseicapilla*). Deposited.
9. 8 Elliot's Pheasants (*Phasianus ellioti*). Hatched from eggs laid in the Society's Gardens. See P. Z. S. 1886, p. 418.
10. 2 Derbian Screamers (*Chauna derbiana*). Presented by Capt. H. E. Rigaud.
2 Slowworms (*Anguis fragilis*). Presented by A. Mead, Esq.
1 Black Vole (black var.) (*Arvicola pratensis*). Presented by G. T. Rope, Esq.
11. 1 Alpine Marmot (*Arctomys marmotta*). Presented by Lionel H. Hanbury, Esq., F.Z.S.
2 Tawny Owls (*Syrnium aluco*). Presented by Lionel H. Hanbury, F.Z.S.
12. 3 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.
13. 1 Golden-crowned Conure (*Conurus aureus*). Deposited.
14. 1 Arabian Baboon (*Cynocephalus hamadryas*), ♀. Presented by C. Palgrave, Esq., F.Z.S.
1 Peregrine Falcon (*Falco peregrinus*). Presented by J. H. Ward, Esq.
1 Javan Loris (*Nycticebus javanicus*). Java. Presented by Dr. F. H. Bauer, C.M.Z.S.
16. 2 Well's Doves (*Engyptila wellsi*). Grenada, W. I. Presented by Septimus Wells, Esq.
2 Ring-tailed Coatis (*Nasua rufa*). Born in the Menagerie.
17. 1 Barn-Owl (*Strix flammea*). Presented by Sir Henry Tyler.
6 Ribbon-Snakes (*Tropidonotus saurita*). Born in the Menagerie.

Aug. 18. 2 Great Eagle-Owls (*Bubo maximus*). Presented by the Viscount Hill.
3 Yellow-headed Conures (*Conurus jendaya*). Presented by C. Rudge, Esq.
19. 1 Raven (*Corvus corax*). Presented by Mrs. Tatham.
1 Common Viper (*Vipera berus*). Presented by R. B. Spalding, Esq.
4 Ruscon's Newts (*Molge rusconi*). Sardinia. Presented by Prof. H. H. Giglioli, C.M.Z.S.
20. 1 Egyptian Gazelle (*Gazella dorcas*). Presented by Capt. Robbins.
3 Black-eared Marmosets (*Hapale penicillata*). Purchased.
1 Feline Douroucouli (*Nyctipithecus vociferans*). Purchased.
2 Yarrell's Curassows (*Crax carunculata*), 2 ♂. Purchased.
2 Magpie Tanagers (*Cissopis leveriana*). Purchased.
2 Ariel Toucans (*Rhamphastos ariel*). Purchased.
2 Laughing Gulls (*Larus atricilla*). Purchased.
1 White-faced Tree-Duck (*Dendrocygna viduata*). Purchased.
2 Common Boas (*Boa constrictor*). Presented by T. H. Church, Esq.
21. 1 Martinique Gallinule (*Ionornis martinicus*). Presented by Mr. J. M. Booker.
3 Aldrovandi's Skinks (*Plestiodon auratus*). Received in Exchange.
2 Common Slowworms (*Anguis fragilis*). Received in Exchange.
23. 1 White-throated Capuchin (*Cebus hypoleucus*). Presented by H. A. Blake, Esq.
1 Ring-tailed Coati (*Nasua rufa*). Deposited.
1 Globose Curassow (*Crax globicera*), ♀. Deposited.
2 Dominican Kestrels (*Tinnunculus dominicensis*). St. Kitt's, W. I. Presented by Dr. A. Boon, F.R.C.S.
2 Green Bitterns (*Butorides virescens*). St. Kitt's, W. I. Presented by Dr. A Boon, F.R.C.S.
24. 1 Leopard (*Felis pardus*). Born in the Menagerie.
1 Clouded Iguana (*Cyclura carinata*). Bahama Islands. Presented by H. A. Blake, Esq.
1 Mississippi Alligator (*Alligator mississippiensis*). Presented by Miss Janet D. White.
26. 1 Common Gannet (*Sula bassana*). Presented by Mr. F. C. Hatfield.
27. 1 Raven (*Corvus corax*). Presented by Mrs. Robert Garland.
28. 1 Black-necked Swan (*Cygnus nigricollis*), ♀. Purchased.
30. 1 Argus Pheasant (*Argus giganteus*). Bred in the Gardens.

Sept. 1. 1 Lanner Falcon (*Falco lanarius*). Deposited.
2 Common Vipers (*Vipera berus*). Presented by W. Robertson, Esq.
1 Common Viper (*Vipera berus*). Presented by W. H. B. Pain, Esq.
2 Hawfinches (*Coccothraustes vulgaris*). Presented by W. Struth, Esq.
2. 2 Common Marmosets (*Hapale jacchus*). Deposited.
1 Mesopotamian Fallow Deer (*Dama mesopotamica*). Born in the Menagerie.
4 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.

Sept. 3. 1 Common Mole (*Talpa europæa*). Presented by Mr. J. Scatcherd.
3 Indian Crocodiles (*Crocodilus palustris*). Deposited.
5. 5 American Milk-Snakes (*Coluber eximius*). Born in the Menagerie.
6. 9 Red-headed Finches (*Amadina erythrocephala*), ♂ ♀. Presented by H. B. James, Esq.
2 Saffron Finches (*Sycalis flaveola*), ♂ ♀. Presented by H. B. James, Esq.
1 Leadbeater's Cockatoo (*Cacatua leadbeateri*). Presented by J. Davis, Esq.
1 Roseate Cockatoo (*Cacatua roseicapilla*). Presented by G. H. Hawtayne, Esq., C.M.Z.S.
1 Smooth Snake (*Coronella lævis*). Presented by W. H. B. Pain, Esq.
8. 1 West-African Python (*Python sebæ*). Presented by Major A. Morton Festing.
1 Leonine Monkey (*Macacus leoninus*), ♂. Deposited.
9. 1 Spring-bok (*Gazella euchore*), ♂. Presented by Capt. John Hewat, C.M.Z.S.
2 Crested Pigeons (*Ocyphaps lophotes*). Bred in the Gardens.
1 Geoffroy's Dove (*Peristera geoffroyi*). Bred in the Gardens.
1 Spot-ringed Snake (*Liophis poecilogyrus*). Rio de Janeiro, Brazil. Presented by Edgell Hunt, Esq. See P. Z. S. 1886, p. 418.
11. 2 Talapoin Monkeys (*Cercopithecus talapoin*). Presented by R. E. Dennett, Esq.
12. 1 Herring-Gull (*Larus argentatus*). Presented by E. Penton, Esq., jun., F.Z.S.
13. 1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♀. Presented by the Rev. H. K. Moolenaar.
1 Bateleur Eagle (*Helotarsus ecaudatus*). Lamoo, East Africa. Presented by Dr. W. Somerville.
1 Common Crowned Pigeon (*Goura coronata*). Bred in the Gardens.
2 Auriculated Doves (*Zenaida auriculata*). Bred in the Gardens.
14. 1 Black-backed Jackal (*Canis mesomelas*), ♀. Presented by A. T. Marsh, Esq.
1 Moorish Tortoise (*Testudo mauritanica*). Presented by A. T. Marsh, Esq.
1 Common Otter (*Lutra vulgaris*), ♂. Deposited.
2 Ariel Toucans (*Rhamphastos ariel*). Purchased.
1 Algerian Skink (*Plestiodon algeriensis*). Deposited.
15. 2 Black Rats (*Mus rattus*). Sark, Channel Islands. Presented by W. F. Collins, Esq.
1 Wild Duck (*Anas boschas*), ♂. Presented by Kenneth Lawson, Esq.
16. 2 Elegant Galidias (*Galidia elegans*). Presented by Burt C. Müller, Esq. See P. Z. S. 1886, p. 418.
17. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by Mr. Thomas Harris.
1 Common Stoat (*Mustela erminea*). Purchased.
2 Viscachas (*Lagostomus trichodactylus*). Born in the Menagerie.
18. 1 Common Marmoset (*Hapale jacchus*). Deposited.
2 Black-eared Marmosets (*Hapale penicillata*). Deposited.
1 Common Barn-Owl (*Strix flammea*). Presented by Mrs. E. Holloway.

Sept. 20. 1 Lesser White-nosed Monkey (*Cercopithecus petaurista*), ♂. Purchased.

21. 2 Golden Eagles (*Aquila chrysaëtus*). Isle of Mull, Argyllshire, Scotland. Presented by His Grace the Duke of Argyll, K.G., F.Z.S.

1 Anaconda (*Eunectes murinus*). Deposited.

22. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by Mrs. Faulkner.

1 Stock-Dove (*Columba œnas*). Presented by Chas. Whymper, Esq., F.Z.S.

23. 1 Spotted Hyæna (*Hyæna crocuta*). Born in the Menagerie.

1 Barred Dove (*Geopelia striata*). Presented by F. W. Green, Esq.

1 Maned Goose (*Bernicla jubata*), ♂. Received in Exchange.

28. 2 Moorhens (*Gallinula chloropus*). Presented by Lord Moreton, F.Z.S.

29. 1 Hairy-rumped Agouti (*Dasyprocta pyrrhnolopha*). Presented by Mrs. Otto Fell.

1 Common Hedgehog (*Erinaceus europæus*). Presented by Madame Tina Mazzoni.

1 Horned Viper (*Vipera cornuta*). Presented by C. P. Pillans, Esq.

30. 1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♂. Presented by Lionel R. Crawshay, Esq.

1 Rough Fox (*Canis rudis*), ♂. Presented by Capt. J. Smith.

Oct. 1. 1 Mona Monkey (*Cercopithecus mona*), ♀. Niger River, West Africa. Presented by W. P. Hewby, Esq.

4. 1 Yellow-footed Rock-Kangaroo (*Petrogale xanthopus*), ♀. Presented by Mr. George Langborne, s.s. 'Rome.'

5. 1 Brown Capuchin (*Cebus fatuellus*), ♀. Presented by Messrs. Kühner, Hendschel, & Co.

1 Common Chameleon (*Chamæleon vulgaris*). Presented by Charles T. Port, Esq., F.Z.S.

1 Common Squirrel (*Sciurus vulgaris*). Presented by Miss Gertrude Hudson.

6. 1 Porto-Rico Pigeon (*Columba corensis*). Bred in the Gardens.

1 Triangular-spotted Pigeon (*Columba guinea*). Bred in the Gardens.

1 Common Viper (*Vipera berus*). Presented by W. H. B. Pain, Esq.

7. 1 Macaque Monkey (*Macacus cynomolgus*), ♀. Presented by the Countess de Geloes.

2 Lanner Falcons (*Falco lanarius*). Presented by the Baron d'Eprémesnil.

9. 1 Blue-and-Yellow Macaw (*Ara ararauna*). Presented by Mrs. George Quish.

1 Gannet (*Sula bassana*). Presented by J. H. Gurney, Esq., F.Z.S.

1 Common Chameleon (*Chamæleon vulgaris*). Presented by T. H. Carlton Levick, Esq.

12. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by T. L. Brewer, Esq.

1 Yellow-grey Squirrel (*Sciurus griseoflavus*), ♂. Received in Exchange.

2 Grey Seals (*Halichœrus grypus*). Isle of Canna, N.B. Presented by R. Thom, Esq.

Oct. 12. 1 Goshawk (*Astur palumbarius*). Presented by the Baron d'Eprémesnil.
2 Black-footed Penguins (*Spheniscus demersus*). Received in Exchange.
13. 1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
14. 1 Golden Plover (*Charadrius pluvialis*). Presented by Mr. G. Smith.
1 Bonnet-Monkey (*Macacus sinicus*), ♂. Presented by Mrs. Samuel Lloyd.
10 Common Vipers (*Vipera berus*). Presented by C. F. M'Niven, Esq.
16. 1 Common Squirrel (*Sciurus vulgaris*). Presented by Miss F. Westrup.
1 Varying Hare (*Lepus variabilis*). Presented by T. West Carnie, Esq.
18. 1 Common Seal (*Phoca vitulina*), ♀. Presented by Mr. H. Overton.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Born in the Menagerie.
1 Quail (*Coturnix communis*). Presented by Dr. A. Günther, F.Z.S.
1 Asiatic Quail (*Perdicula asiatica*). Presented by Dr. A. Günther, F.Z.S.
1 Common Cormorant (*Phalacrocorax carbo*). Deposited.
19. 6 Mute Swans (*Cygnus olor*). Deposited.
20. 1 Pig-tailed Monkey (*Macacus nemestrinus*), ♂. Deposited.
1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Mrs. H. Reader.
1 Crested Porcupine (*Hystrix cristata*), ♀. Presented by Mrs. E. Dunn.
21. 1 Canadian Beaver (*Castor canadensis*), ♀. Presented by the Earl of Carnarvon.
22. 1 Green Monkey (*Cercopithecus callitrichus*), ♂. Presented by J. W. Bacon, Esq.
23. 1 Green Monkey (*Cercopithecus callitrichus*), ♀. Presented by G. D. W. Ingham, Esq.
1 Virginian Fox (*Canis virginianus*). N. America. Received in Exchange.
1 Scarlet Ibis (*Eudocimus ruber*). Received in Exchange.
1 Common Boa (*Boa constrictor*). Received in Exchange.
25. 8 Long-fronted Gerbilles (*Gerbillus longifrons*). Born in the Menagerie.
26. 4 Common Hedgehogs (*Erinaceus europæus*). Presented by W. Walkinshaw, Esq.
1 Aldrovandi's Skink (*Plestiodon auratus*). Deposited.
27. 1 African Buzzard (*Buteo desertorum*). Mogador, N. Africa. Presented by P. L. Forwood, Esq.
28. 1 Rusty-spotted Cat (*Felis rubiginosa*), ♀. Purchased.
2 Diuca Finches (*Diuca grisea*). Received in Exchange.
29. 1 Bonnet-Monkey (*Macacus sinicus*), ♀. Presented by Miss Edith Prowse.
2 Wood-Larks (*Alauda arborea*). Purchased.
1 Ring-necked Parrakeet (*Palæornis torquatus*), ♀. Presented by W. S. Bradshaw, Esq.

Nov. 2. 1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by Col. J. M. McNeile.

Nov. 2. 1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by Mrs. E. White.
1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
4. 1 Bactrian Camel (*Camelus bactrianus*), ♂. Deposited.
2 Eleonora Falcons (*Falco eleonoræ*). Deposited.
1 Hog-nosed Snake (*Heterodon platyrhinos*). Presented by Miss Catherine C. Hopley.
4 Copper-head Snakes (*Cenchris contortrix*). Presented by W. A. Conklin, Esq., C.M.Z.S.
2 Common Rattlesnakes (*Crotalus durissus*). Presented by W. A. Conklin, Esq., C.M.Z.S.
1 Hog-nosed Snake (*Heterodon platyrhinos*). Presented by W. A. Conklin, Esq., C.M.Z.S.
5. 1 Rose-crested Cockatoo (*Cacatua moluccensis*). Presented by Miss Townshend Wilson.
2 Mantchurian Crossoptilons (*Crossoptilon mantchuricum*), ♂ ♀. Purchased.
2 Bar-tailed Pheasants (*Phasianus reevesi*), ♂ ♀. Purchased.
12 Barbary Turtle-Doves (*Turtur risorius*). Presented by E. L. Armbrecht, Esq., F.Z.S.
1 Fire-bellied Toad (*Bombinator igneus*). Presented by G. A. Boulenger, Esq., F.Z.S.
6. 4 Ring-Doves (*Columba palumbus*). Bred in the Gardens.
10 Barbary Turtle-Doves (*Turtur risorius*). Bred in the Gardens.
3 Testaceous Snakes (*Ptyas testaceus*). Michigan, U.S.A. Purchased.
8. 1 Ocelot (*Felis pardalis*). Deposited.
1 Bactrian Camel (*Camelus bactrianus*), ♀. Deposited.
9. 1 Vinaceous Turtle-Dove (*Turtur vinaceus*). Bred in the Gardens.
10. 1 Woodcock (*Scolopax rusticula*). Purchased.
11. 2 White-backed Piping-Crows (*Gymnorhina leuconota*). Deposited.
2 Goshawks (*Astur palumbarius*). Presented by the Baron d'Eprémesnil.
12. 1 Patas Monkey (*Cercopithecus patas*), ♂. Presented by Mr. Thomas Bailey.
1 Hobby (*Falco subbuteo*). Captured in the Indian Ocean. Presented by Dr. R. Mead.
13. 1 Yellow Baboon (*Cynocephalus babouin*), ♀. Presented by Capt. Henderson Smith, R.N.
1 Bengal Vulture (*Gyps bengalensis*). Received in Exchange.
2 Sing-Sing Antelopes (*Cobus sing-sing*), ♂ ♀. Received in Exchange.
2 Java Sparrows (*Padda oryzivora*). Presented by Mrs. Conrad Pile.
4 St.-Helena Seed-eaters (*Crithagra butyracea*). Presented by Mrs. Conrad Pile.
15. 1 Line-tailed Souslik (*Spermophilus grammurus*). California. Presented by B. F. Russell, Esq.
3 Magpie Tanagers (*Cissopis leveriana*). Purchased.
2 Red Crested Cardinals (*Paroaria cucullata*). Purchased.
1 Red Ground-Dove (*Geotrygon montana*). Purchased.
1 Yarrell's Curassow (*Crax carunculata*), ♂. Purchased.
1 Crested Curassow (*Crax alector*). Purchased.
16. 1 Patas Monkey (*Cercopithecus patas*), ♀. Presented by Capt. T. W. Robinson.

Nov. 16. 1 Puma (*Felis concolor*), ♂. Gran Chaco, Argentine Republic. Presented by Alfred Grenfell, Esq., F.Z.S.
2 Roseate Cockatoos (*Cacatua roseicapilla*). Deposited.
10 Cockateels (*Calopsitta novæ-hollandiæ*). Deposited.
2 Red-winged Parrakeets (*Aprosmictus erythropterus*). Deposited.
4 Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*). Deposited.
5 Chestnut-eared Finches (*Amadina castanotis*). Deposited.
1 Nutmeg-bird (*Munia punctularia*). Deposited.
2 Eastern Turtle-Doves (*Turtur meena*). Deposited.

17. 1 Malayan Bear (*Ursus malayanus*), ♀. Presented by Miss A. Stewart-Savile.
4 Chukar Partridges (*Caccabis chukar*), 2 ♂, 2 ♀. Persia. Presented by Dr. J. Huntley.

19. 1 Gazelle (*Gazella dorcas*), ♂. Presented by Edw. J. Hough, Esq.

20. 3 Chestnut-eared Finches (*Amadina castanotis*). Deposited.
4 Roseate Cockatoos (*Cacatua roseicapilla*). Deposited.
7 Cockateels (*Calopsitta novæ-hollandiæ*). Deposited.
2 Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*). Deposited.
2 Peaceful Doves (*Geopelia tranquilla*). Deposited.
2 Hawfinches (*Coccothraustes vulgaris*). Purchased.
1 Common Toad (*Bufo vulgaris*?). Presented by E. N. Wroughton, Esq.

22. 2 Gambel's Partridges (*Callipepla gambelli*), ♂ ♀. Presented by W. A. Conklin, Esq., C.M.Z.S.

23. 2 Mute Swans (*Cygnus olor*). Presented by Lady Siemens.
1 Common Peafowl (*Pavo cristatus*), ♂. Presented by Lady Siemens.
1 Common Guillemot (*Lomvia troile*). Presented by J. H. Gurney, Esq., F.Z.S.

24. 5 Great Eagle-Owls (*Bubo maximus*). Presented by Philip Crowley, Esq., F.Z.S.
1 Malabar Green Bulbul (*Phyllornis aurifrons*). Received in Exchange.

25. 1 Small-footed Hedgehog (*Erinaceus micropus*). Madras. Presented by H. R. P. Carter, Esq.
2 Bullfinches (*Pyrrhula europæa*), 2 ♂. Purchased.
5 Great Titmice (*Parus major*). Purchased.
4 Blue Titmice (*Parus cæruleus*). Purchased.
1 Grey Parrot (*Psittacus erithacus*). Presented by Mrs. Greenwood.
1 Red-and-Yellow Macaw (*Ara chloroptera*). Presented by Mrs. Arthur Daunt.

26. 1 Bonnet-Monkey (*Macacus sinicus*), ♂. Presented by Miss G. M. Fisher.

29. 1 Beisa Antelope (*Oryx beisa*), ♂. Purchased.

30. 1 Red Kangaroo (*Macropus rufus*), ♀. Born in the Menagerie.
1 Poë Honey-eater (*Prosthemadera novæ-zealandiæ*). Presented by Capt. B. J. Barlow, s.s. 'Tainui.'
1 Blue-fronted Amazon (*Chrysotis æstiva*). Presented by Miss Joachim.
2 Tuatera Lizards (*Sphenodon punctatus*). Presented by Dr. E. B. Parfitt.

Dec. 1. 2 Macaque Monkeys (*Macacus cynomolgus*), ♂ ♀. Presented by the Countess Dowager of Lonsdale.
1 Domestic Sheep (*Ovis aries*, var.). Presented by Sir Albert Kaye Rollitt, F.Z.S.
2. 1 Tail-banded Snake (*Elaphis tæniurus*). Purchased.
1 Rude Fox (*Canis rudis*). Purchased.
3. 1 Mona Monkey (*Cercopithecus mona*), ♀. Presented by Miss Bashall.
4. 1 Grey-striped Mouse (*Sminthus vagus*). Tatra Mountain, Hungary. Presented by Dr. A. Wrzesniowski.
5. 1 Cerastes Viper (*Vipera cerastes*). Presented by J. H. Leech, Esq., F.Z.S.
6. 1 Spanish Terrapin (*Clemmys leprosa*). Presented by Miss Eden.
8. 18 Brown Newts (*Spelerpes fuscus*). Presented by Prof. H. H. Giglioli, C.M.Z.S.
2 Carolina Doves (*Zenaidura carolinensis*). Received in Exchange.
9. 1 Allied Saltator (*Saltator similis*). Received in Exchange.
2 Moorish Geckos (*Tarentola mauritanica*). Presented by J. C. Warburg, Esq.
10. 2 Shore-Larks (*Otocorys alpestris*). Purchased.
1 Sclater's Curassow (*Crax sclateri*), ♀. Presented by Rear-Admiral Fairfax, R.N., F.Z.S.
1 Razor-billed Curassow (*Mitua tuberosa*). Presented by Rear-Admiral Fairfax, R.N., F.Z.S.
1 Lesser Razor-billed Curassow (*Mitua tomentosa*). Presented by Rear-Admiral Fairfax, R.N., F.Z.S.
2 Peruvian Thicknees (*Œdicnemus superciliaris*). Received in Exchange.
11. 1 Common Zebra (*Equus zebra*), ♂. Purchased. See P. Z. S. 1887, p. 1.
13. 1 Macaque Monkey (*Macacus cynomolgus*), ♀. Deposited.
1 Red-handed Tamarin (*Midas rufimanus*). Presented by Mrs. Chapman.
1 Maugé's Dasyure (*Dasyurus maugei*). Presented by Mr. R. J. Hamilton.
14. 2 Common Peafowls (*Pavo cristatus*), ♂ ♀. Presented by R. Hunter, Esq.
15. 4 Herring-Gulls (*Larus argentatus*). Presented by Capt. S. T. Sargent.
16. 1 Isabelline Bear (*Ursus isabellinus*), ♂. Deposited.
2 Collared Peccaries (*Dicotyles tajaçu*). Presented by Thos. Bell, Esq.
2 Indian Crows (*Corvus splendens*). Presented by Lord Lilford, F.Z.S.
18. 1 Yarrell's Curassow (*Crax carunculata*), ♀. Presented by the Rev. Wm. Bramley Moore.
1 Razor-billed Curassow (*Mitua tuberosa*). Presented by the Rev. Wm. Bramley Moore.
1 Lesser Razor-billed Curassow (*Mitua tomentosa*). Presented by the Rev. Wm. Bramley Moore.
1 Red-billed Tree-Duck (*Dendrocygna autumnalis*). Presented by the Rev. Wm. Bramley Moore.
2 White-faced Tree-Ducks (*Dendrocygna viduata*). Presented by the Rev. Wm. Bramley Moore.
6 Spectacled Salamanders (*Salamandrina perspicillata*). Presented by Prof. H. H. Giglioli, C.M.Z.S.

Dec. 21. 10 Moorish Geckos (*Tarentola mauritanica*). South of France. Presented by J. C. Warburg, Esq.

22. 3 Zebus (*Bos indicus*). Deposited by H.R.H. the Prince of Wales, K.G.

1 Short-eared Owl (*Asio brachyotus*). Presented by the Rev. H. D. Astley, F.Z.S.

24. 1 Many-zoned Hawk (*Melierax polyzonus*). Mogador. Presented by Lord Lilford, F.Z.S.

1 Red-throated Diver (*Colymbus septentrionalis*). Presented by Lord Lilford, F.Z.S.

1 Swainson's Harrier (*Circus macrurus*). Deposited.

25. 1 Indian Rhinoceros (*Rhinoceros unicornis*), ♂. India. Presented by H.H. the Maharajah of Cooch Behar. See P. Z. S. 1887, p. 1.

1 Tiger (*Felis tigris*), ♂. Received in Exchange.

28. 1 Yellow-footed Rock-Kangaroo (*Petrogale xanthopus*), ♂. Born in the Menagerie.

30. 2 Green Lizards (*Lacerta viridis*). Presented by R. M. J. Teil, Esq.

1 Slowworm (*Anguis fragilis*). Presented by R. J. M. Teil, Esq.

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PROCEEDINGS

OF THE

SCIENTIFIC MEETINGS

OF THE

ZOOLOGICAL SOCIETY

OF LONDON

FOR THE YEAR

1886.

(PLATES.)

PRINTED FOR THE SOCIETY,
AND SOLD AT THEIR HOUSE IN HANOVER SQUARE.

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MESSRS. LONGMANS, GREEN, AND CO.,
PATERNOSTER ROW.

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1886.

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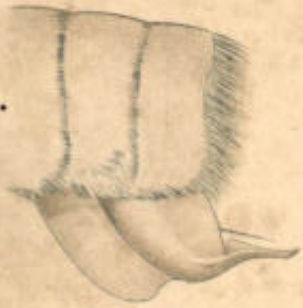

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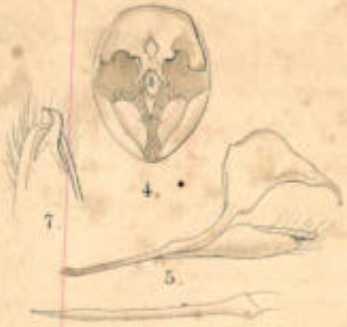

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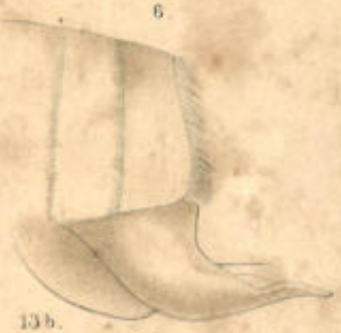

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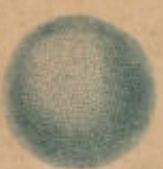

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13.

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STRUCTURE & DEVELOPMENT OF PARNASSIUS

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3.

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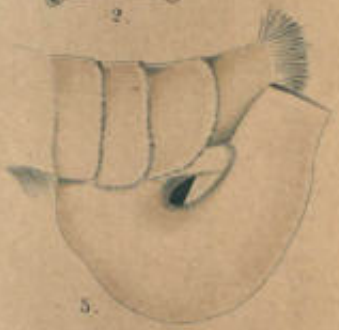

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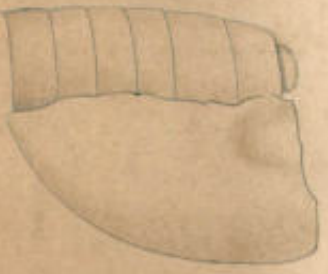

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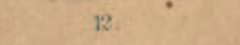

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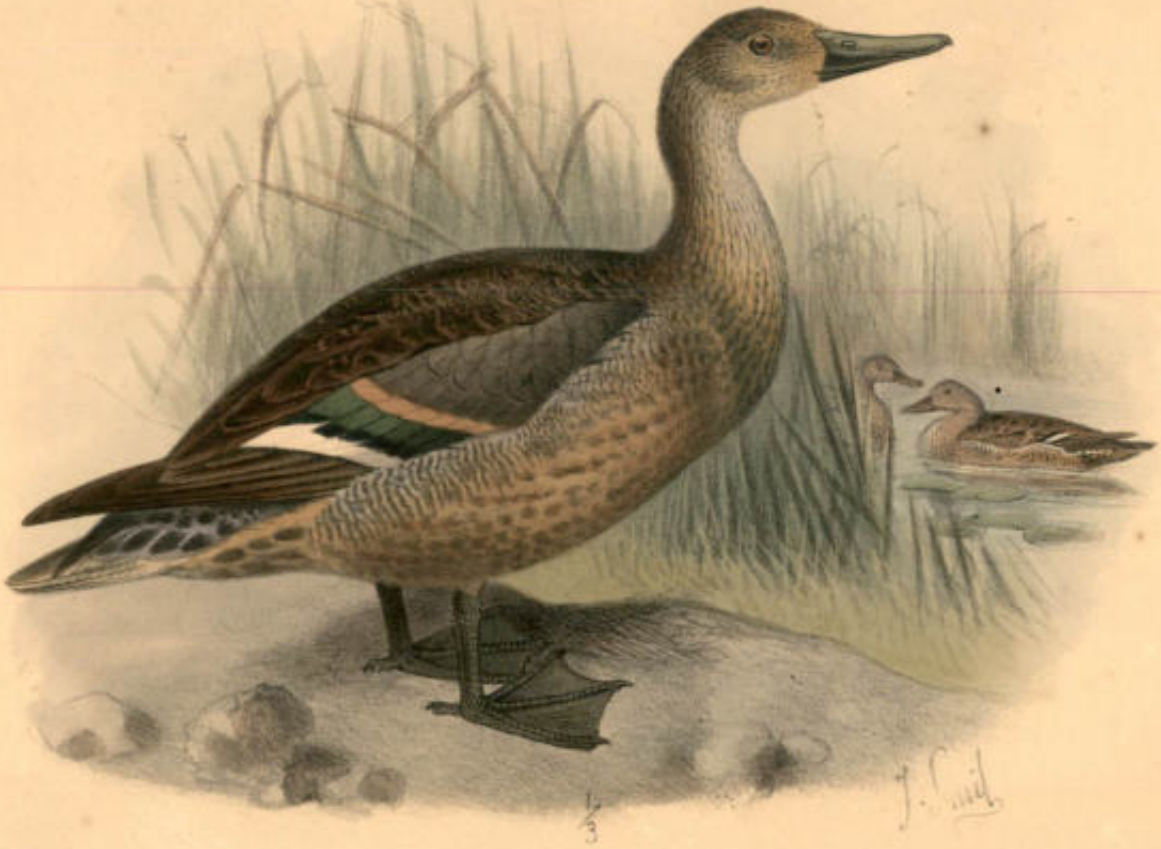
J.G. Keulemans lith. Hanhart imp.

MUS HUMII.

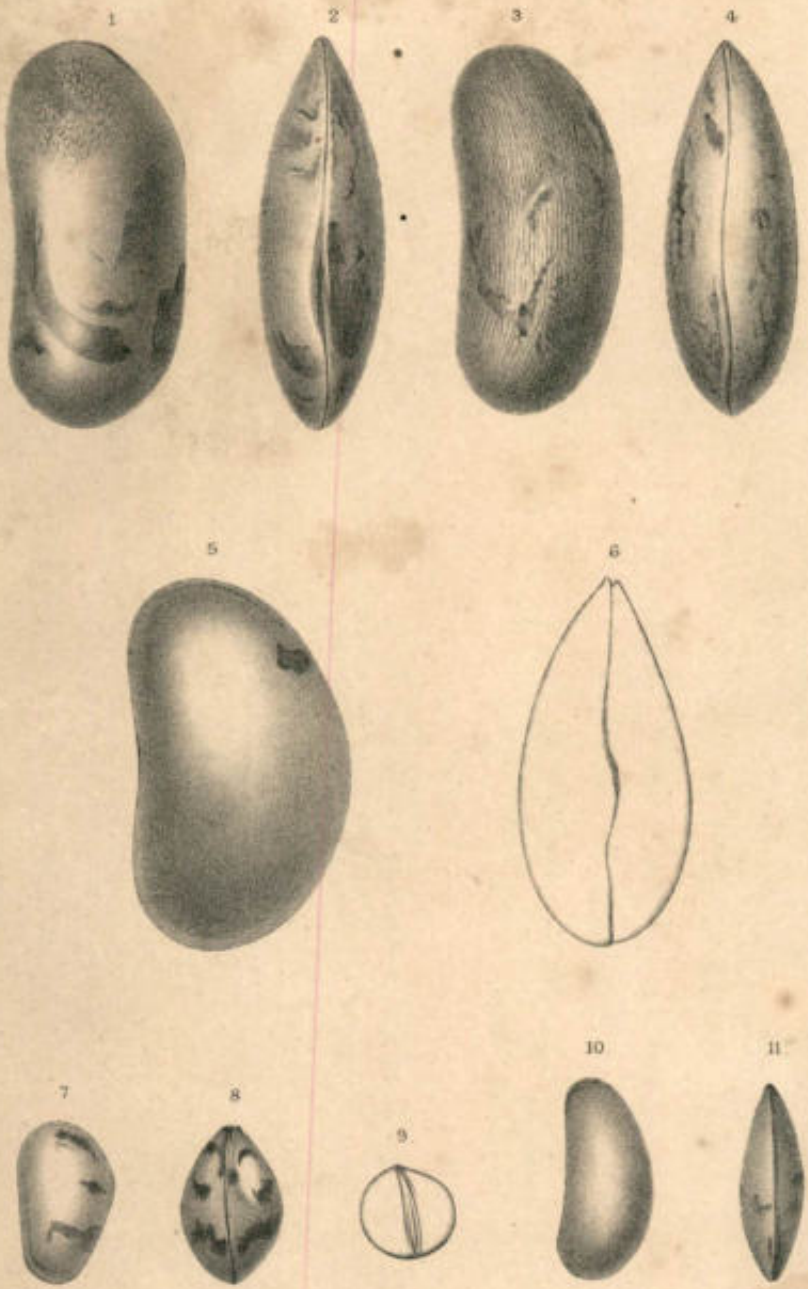
J.G.Keulemans del.

Hanhart imp

SCIUROPTERUS DAVISONI



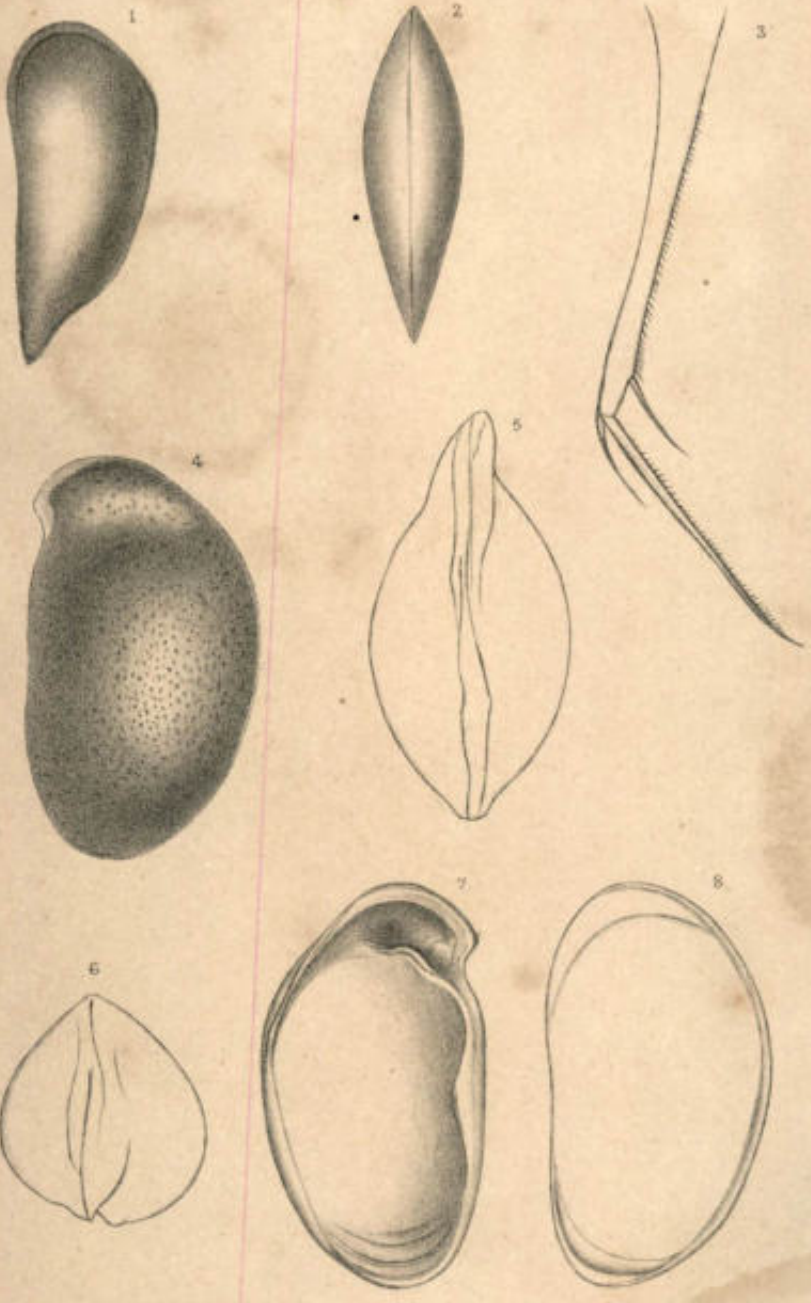
DAFILA MODESTA



G. S. B. del.

Geo. West & Sons, lith. et imp.

NEW AUSTRALIAN ENTOMOSTRACA.



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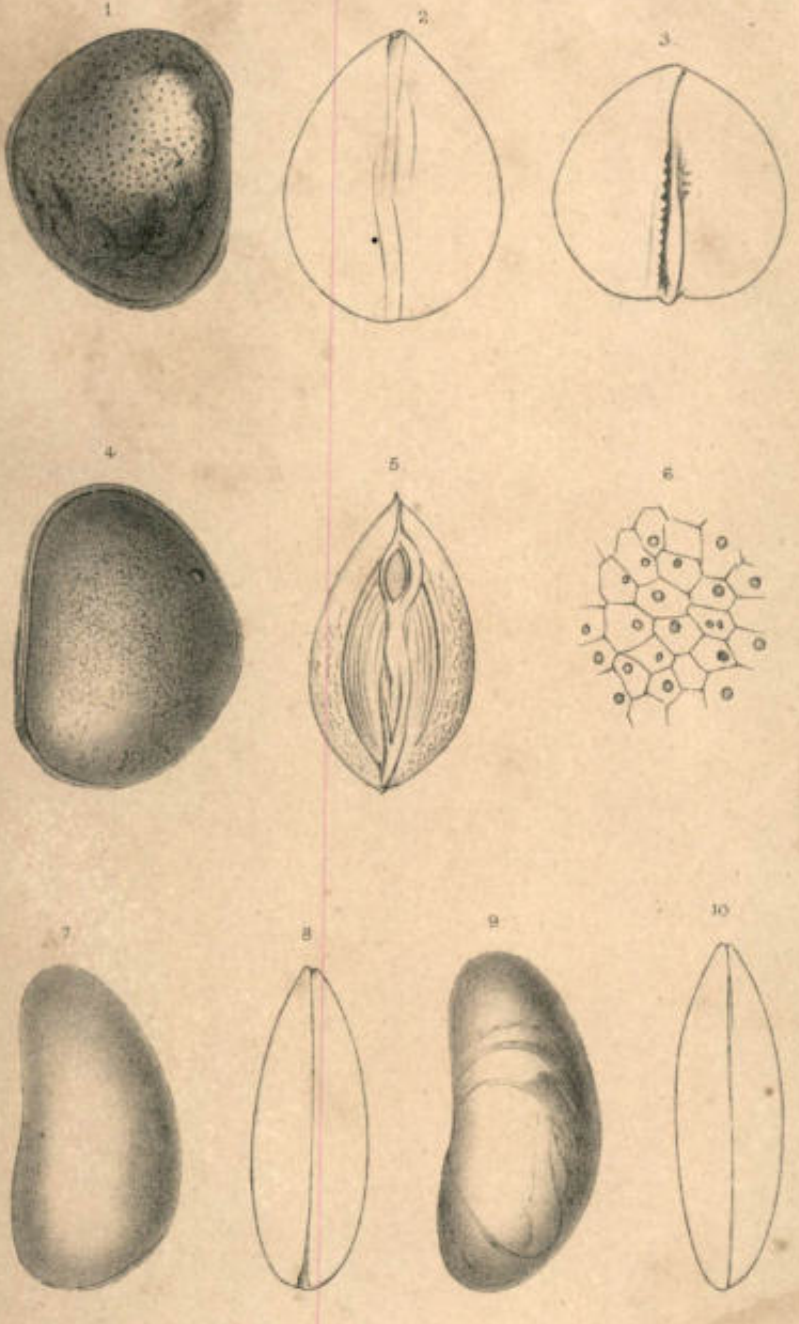

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Geo. West & Sons lith. et imp.

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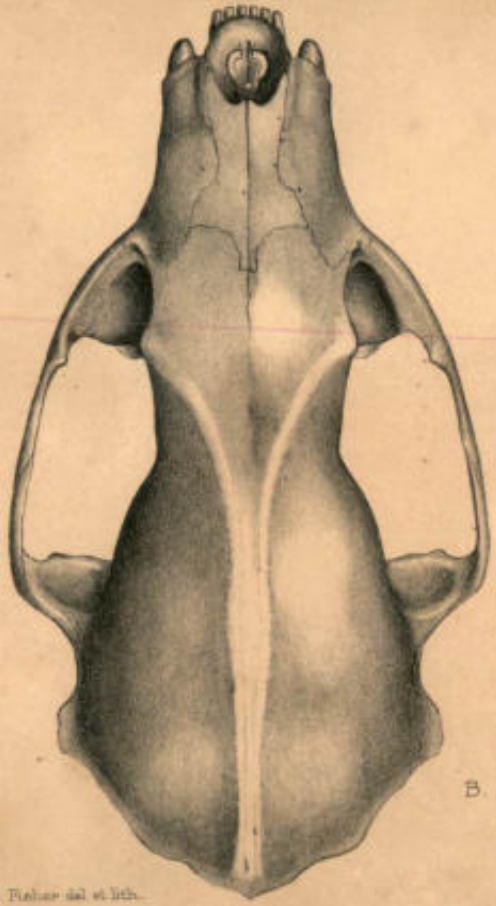

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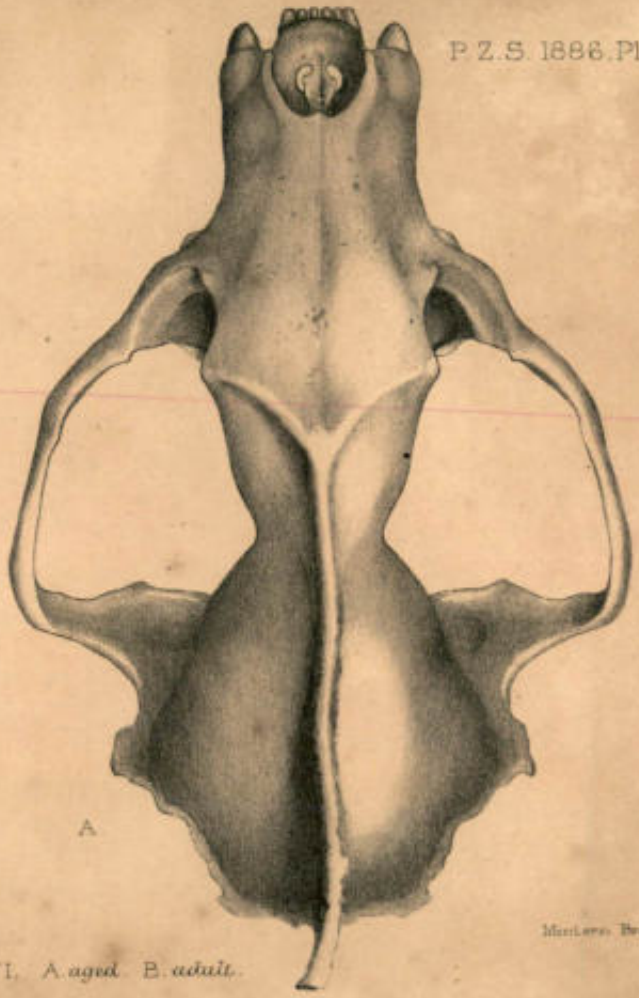
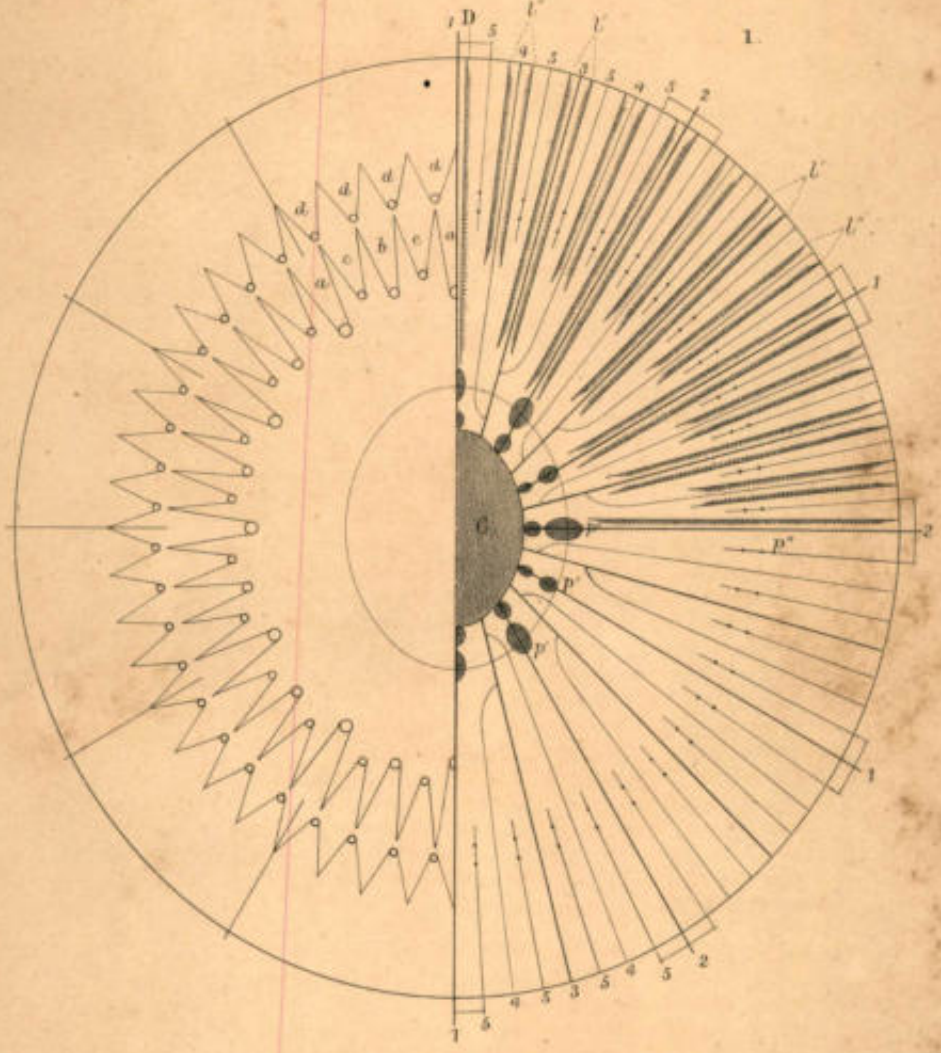


A.

M. Hoeman Fisher del. et lith.

Mintern Bros. imp.

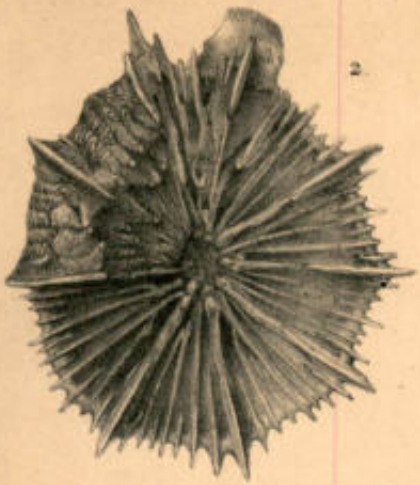
SKULLS OF MUSTELA PENNANTI. A. *aged*. B. *adult*.

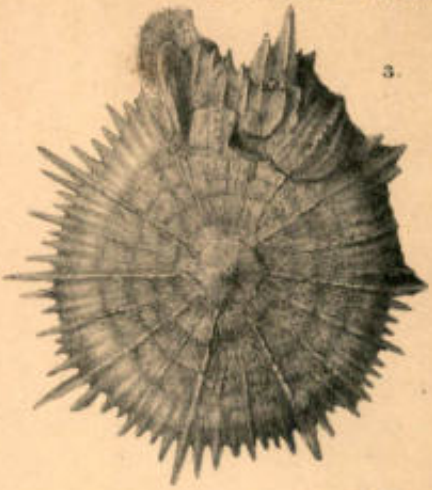


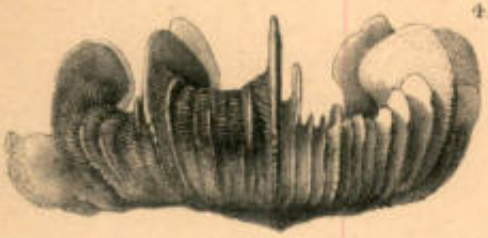
W. del. P. Smit. lith.

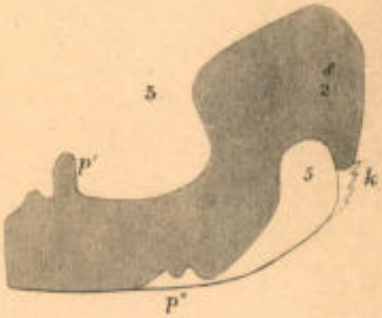
Mintern Bros. imp.

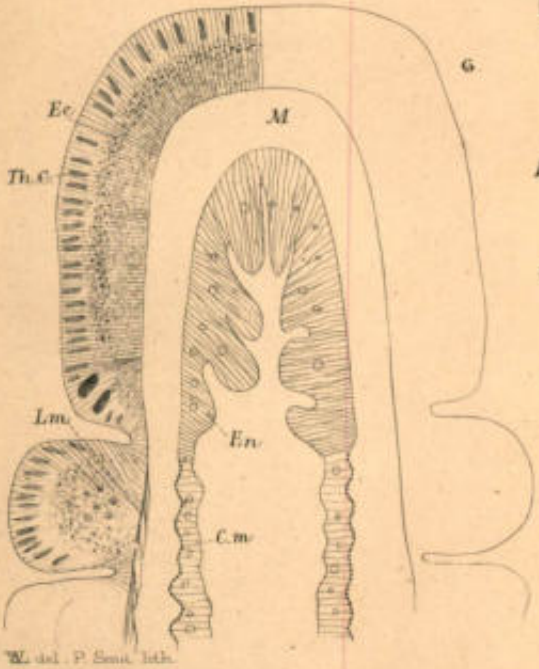
STEPHANOTROCHUS MOSELEYANUS

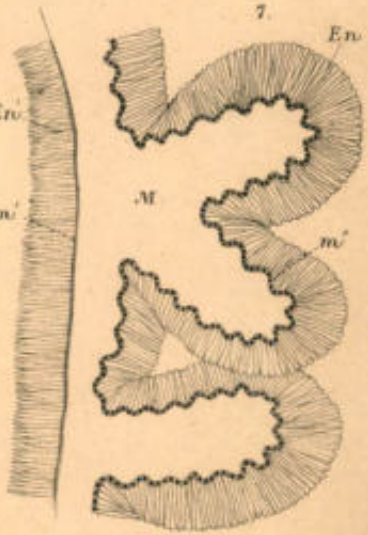






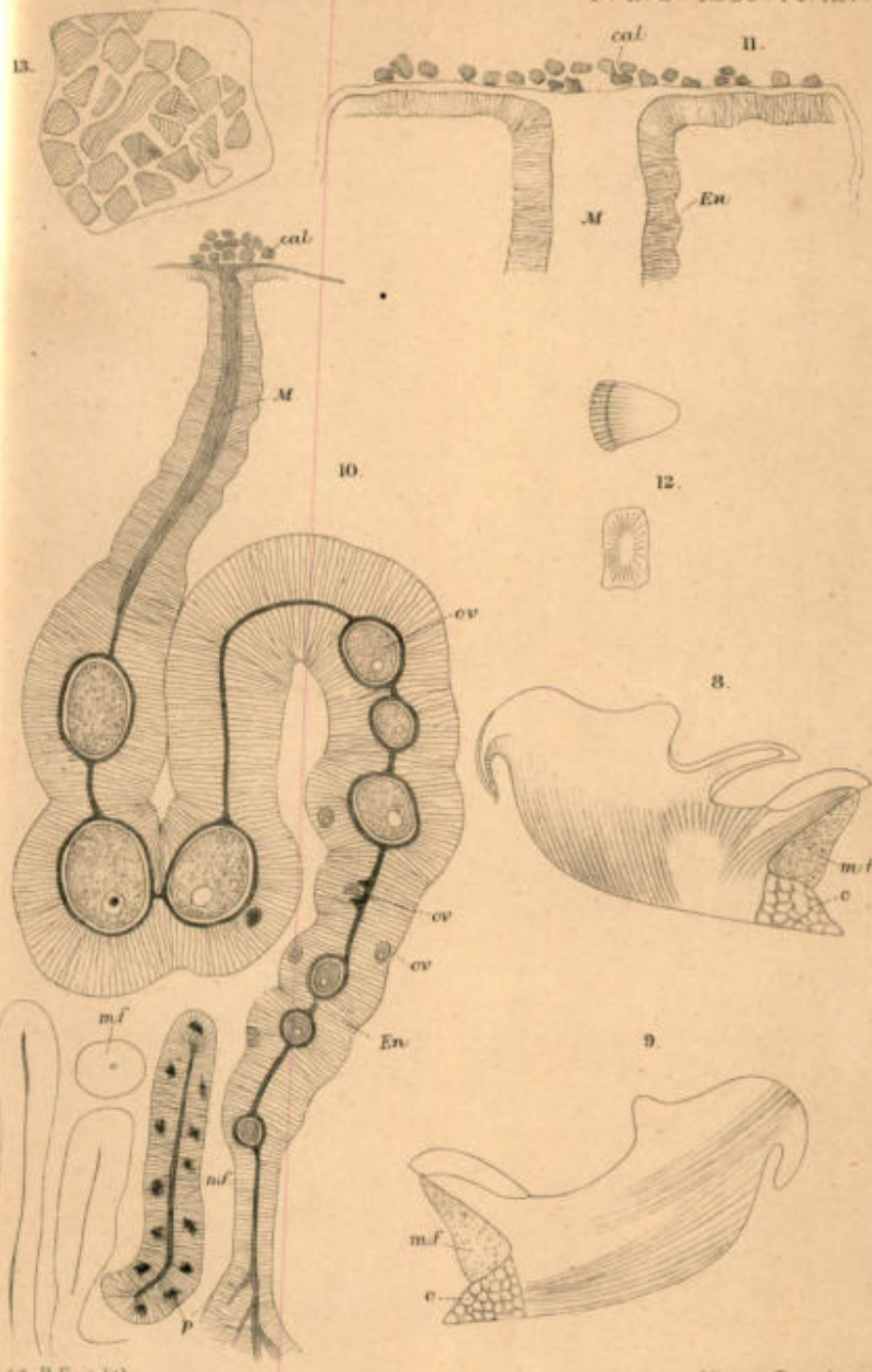






W. del. P. Smit. lith. Mintern Bros. imp.

STEPHANOTROCHUS MOSELEYANUS



W. del. P. Smit. lith.

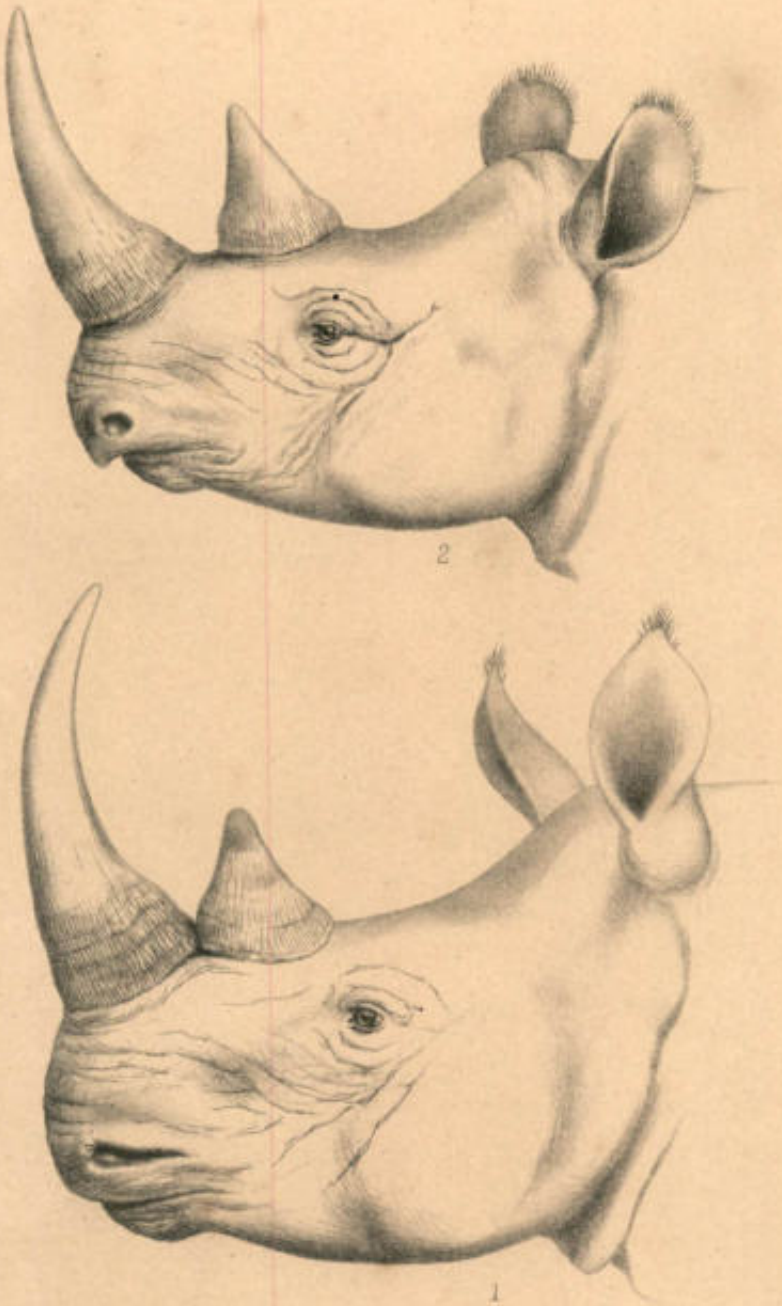
Mintern Bros. imp.

STEPHANOTROCHUS MOSELEYANUS.

J. Smit. del. et lith.

Mintern Bros. imp.

LINOPHRYNE LUCIFER.



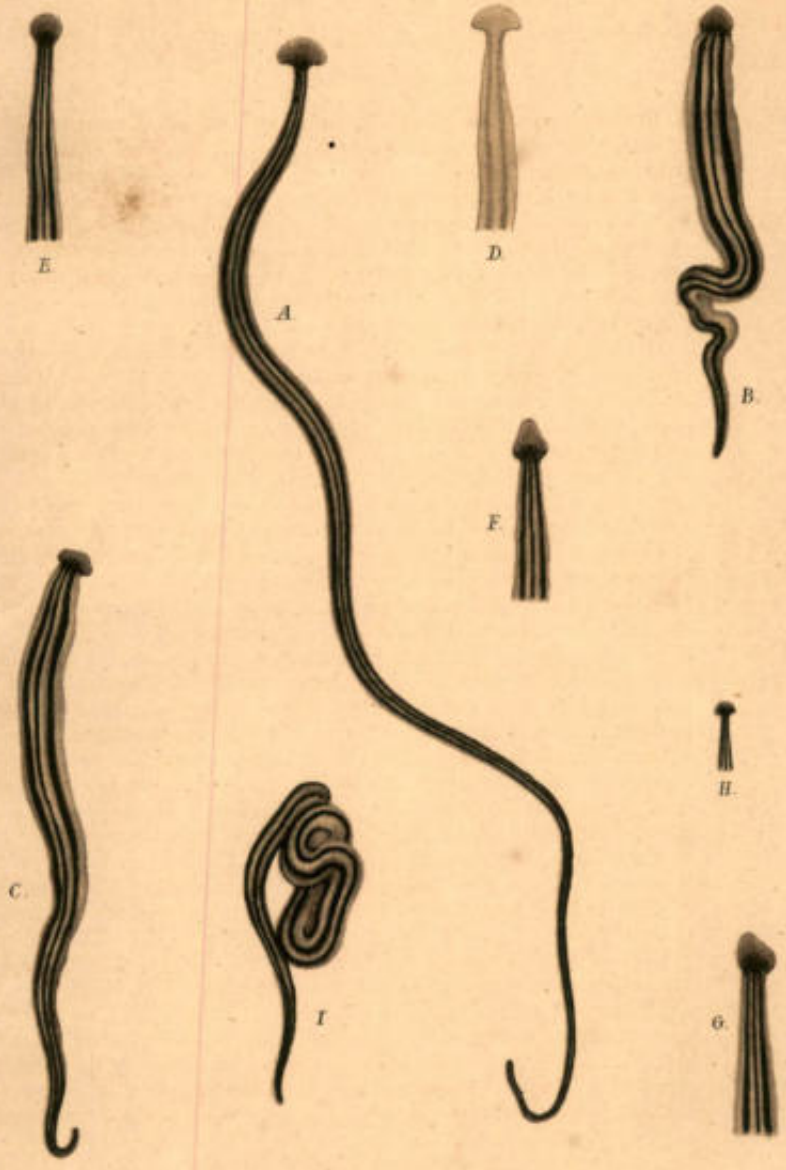
J.Smit lith.

Hanhart imp.

HEADS OF RHINOCEROS SIMUS (Fig.1) AND R.BICORNIS. (Fig.2.)

W.Purkiss lith. Hanhart imp.

NEW COLEOPTERA OF THE FAMILY ENDOMYCHIDÆ.

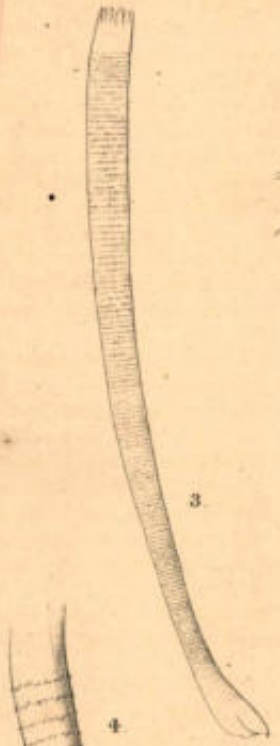


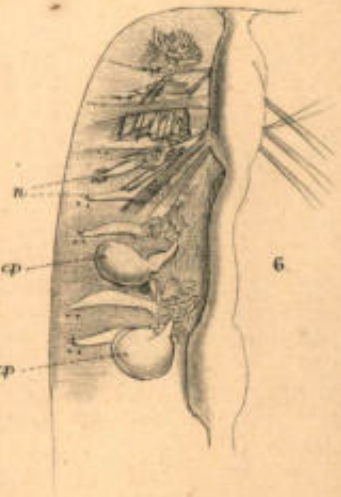
Benjeau & Highley del. et lith.

Mintern Bros. imp.

BIPALIUM KEWENSE.

IN VARIOUS STAGES OF CONTRACTION.





F.E.B. del. P. Smit lith.

Mintern Bros. imp.

ACANTHODRILUS LAYARDI.

P. Smit. lith.

Hanhart imp.

HYBODUS DUBRISIENSIS, Mackie.

J.Smit lith.

Hanhart imp.

HYBRID GROUSE BETWEEN LAGOPUS ALBUS AND TETRAO TETRIX.

J. Smit lith.

HYBRID GROUSE BETWEEN LAGOPUS ALBUS AND TETRAO TETRIX.

Hanhart imp.

F. W. Frohawk del. et lith.

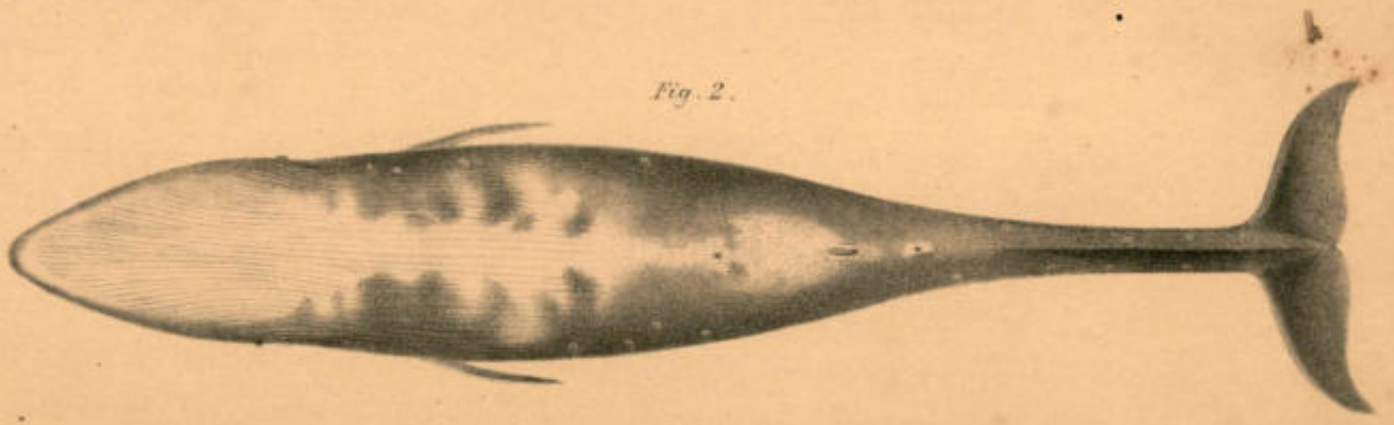
CTENOSAURA ERYTHROMELAS

Mintern Bros. imp.

RANA ARVALIS.

Fig. 1.

Fig. 2.



J. Smit lith.

Eenhart imp.

BALÆNOPTERA BOREALIS

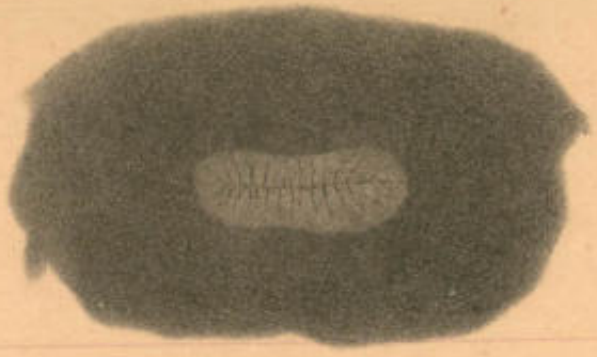


Fig. 2.

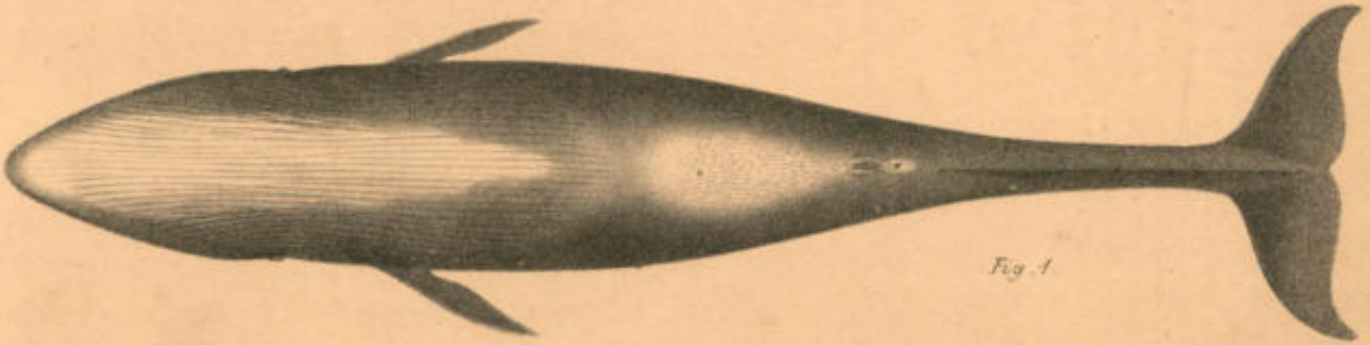


Fig. 1.

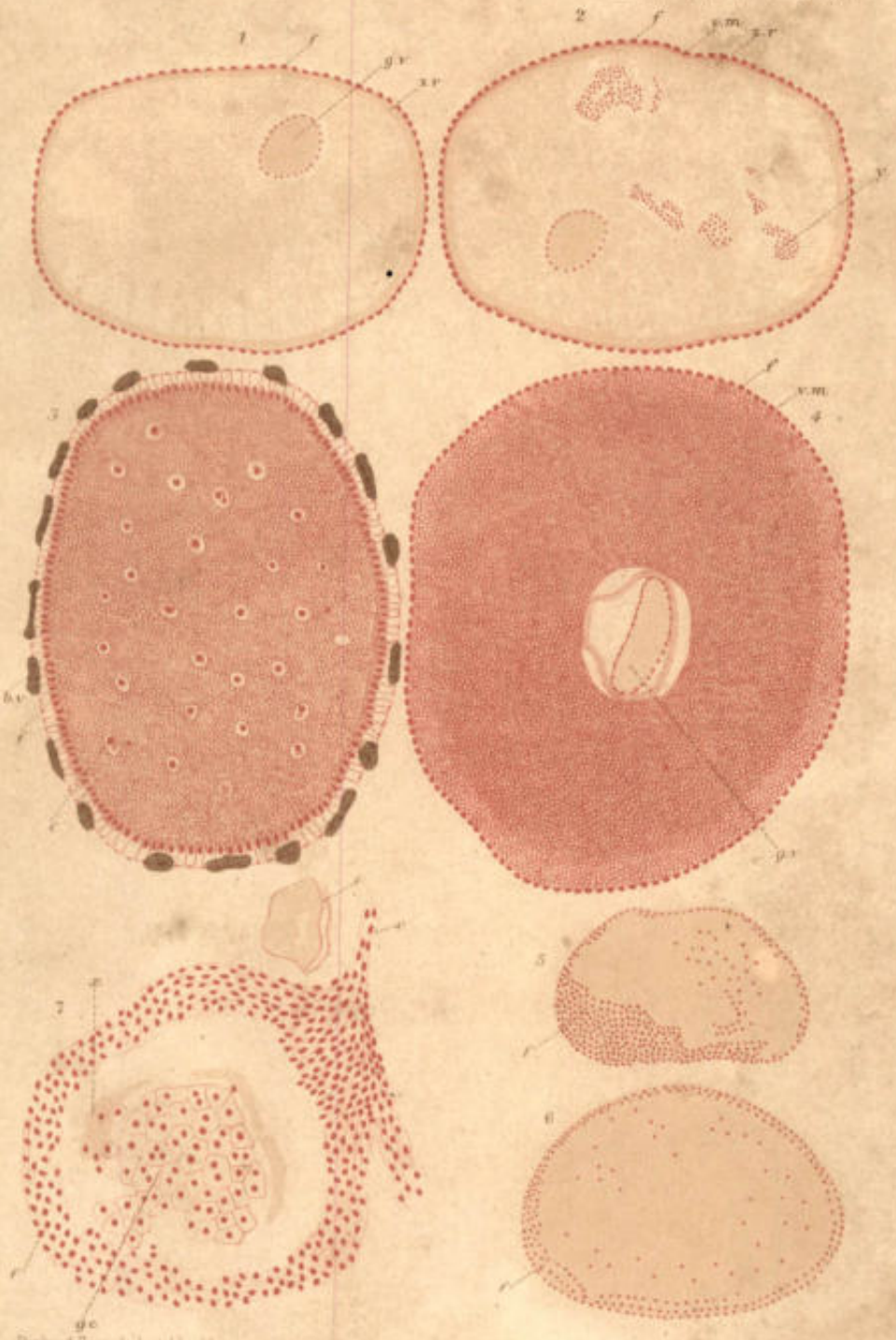
J. Smit lith.

Hanhart imp.

BALÆNOPTERA BOREALIS.

W. H. Fitzgerald del. et lith. Mintern Bros. imp.

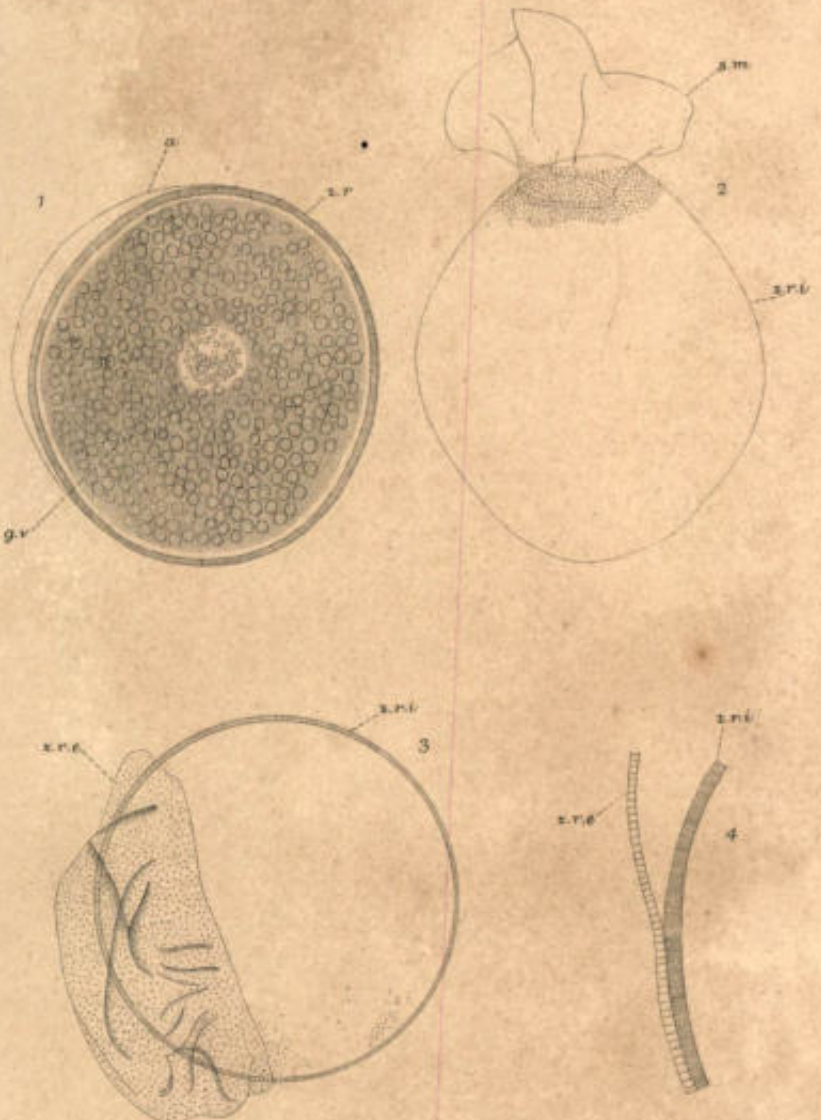
NEW OR RARE SPHINGIDÆ



Ova of Protopterus.

F. E. S. del.
Hanhart & Collingridge lith.
West, Newman & Co. imp.

Ova of Protopterus



J.T.C. del.
Parkinson & Coward lith.

West, Newman & Co. imp.

Ovum of Osmerus.

P.Smit lith. Hanhart imp.

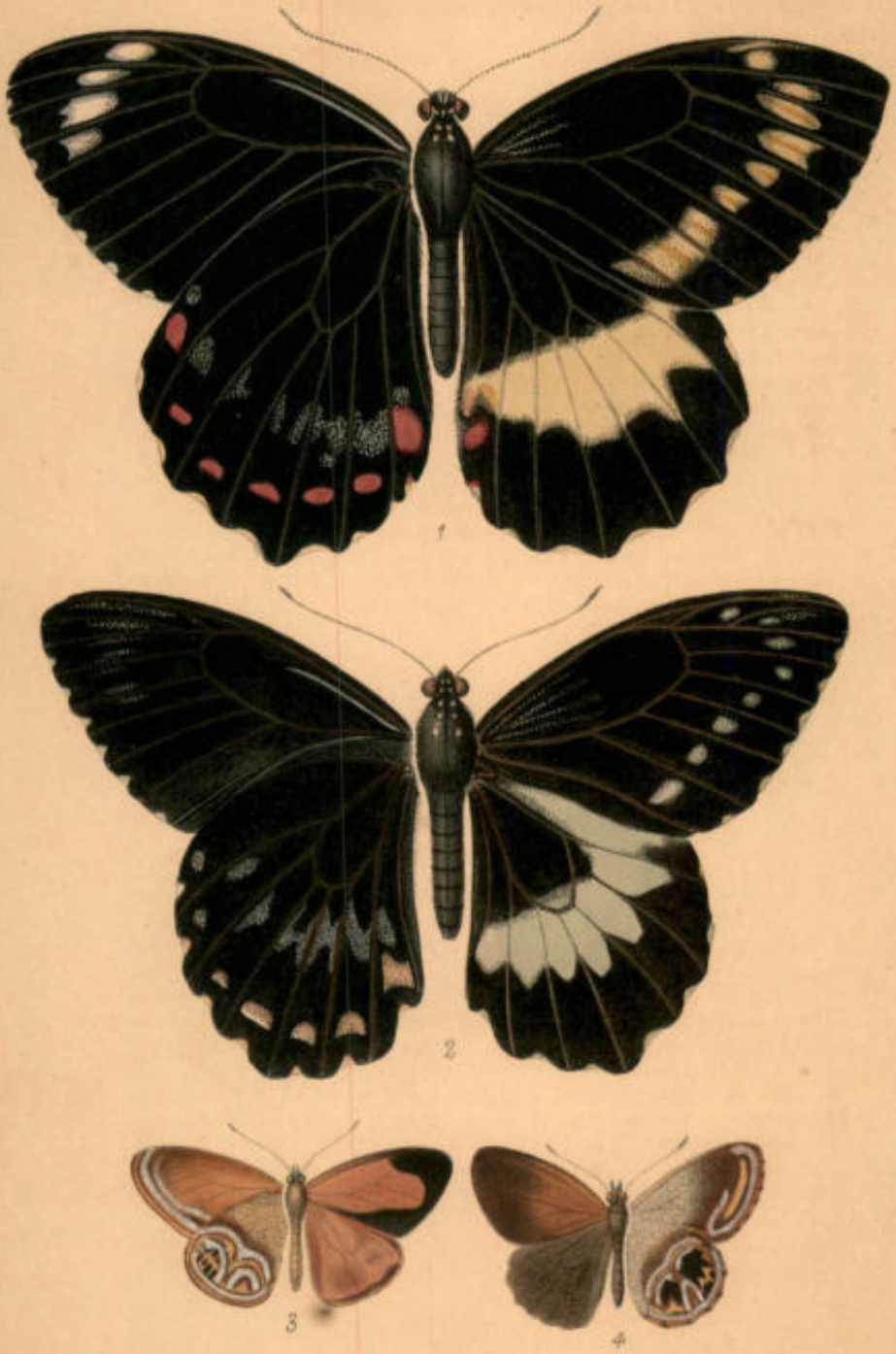
CAPRA ÆGAGRUS, ♂

P.Smit lith. Hanhart imp.

CAPRA SINAITICA, ♂.

Mintern Bros. imp.

DRAGON FLIES FROM N.W. INDIA.



W. Purkiss lith. Hanhart imp.

NEW BUTTERFLIES FROM THE SOLOMON ISLANDS

Mintern Bros. imp.

NEW LEPIDOPTERA FROM WESTERN INDIA.

J.G.Keulemans lith. Hanhart imp.

PHŒNICOPTERUS JAMESI.

W. Purkiss lith.

Hanhart imp.

ATTACUS ALBIDUS

W. Purkiss, lith. Hanhart, imp.

1. BUNAEA PYGELA.
2. ANTHERÆA DOLABELLA.
3. CHRYSOPOLOMA ROSEA.
4. CHRYSOPOLOMA CITRINA.

1.

2a.

2b.

1a.

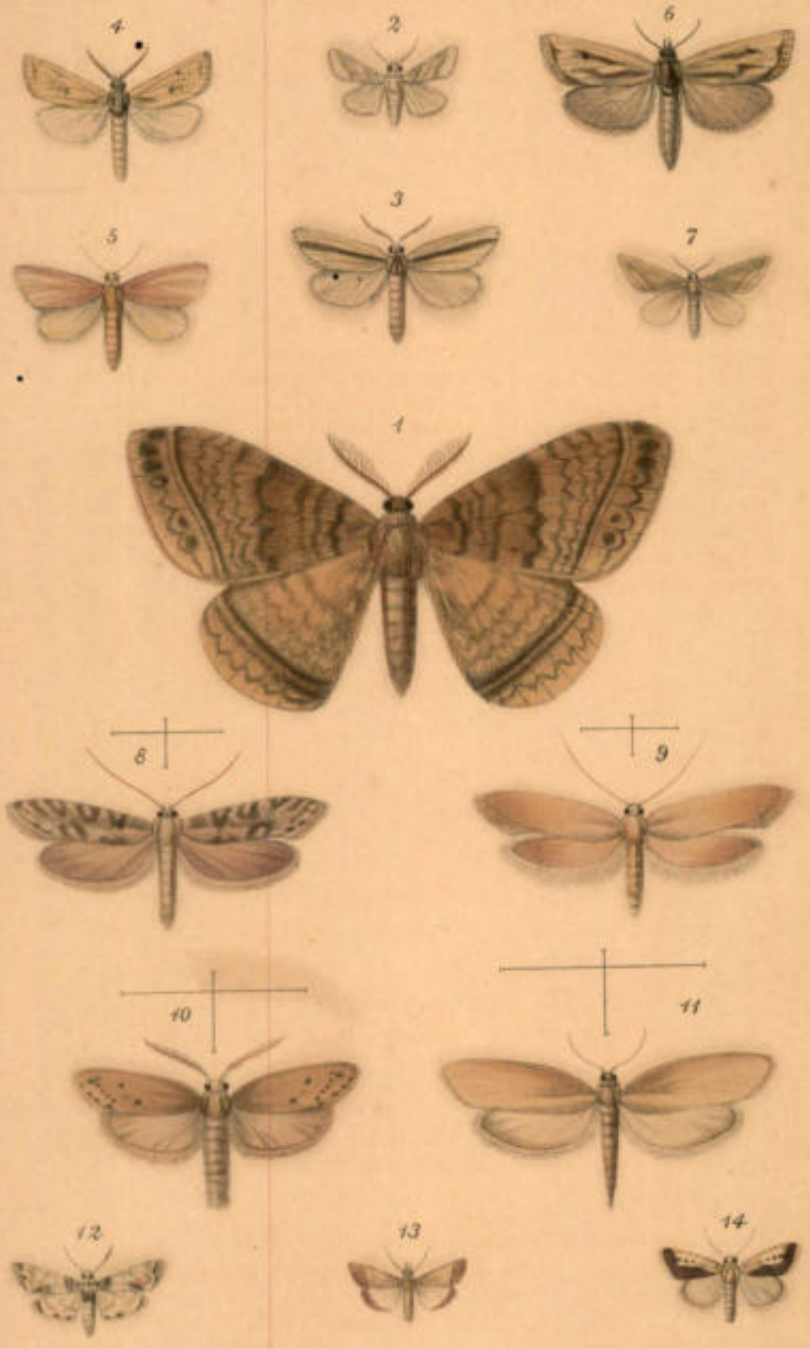
2.

P.W. Strahorn del. et lith. Minneapolis, Bros. imp.

1. IXALUS ASPER. 2. GEOMOLGE FISCHERI.

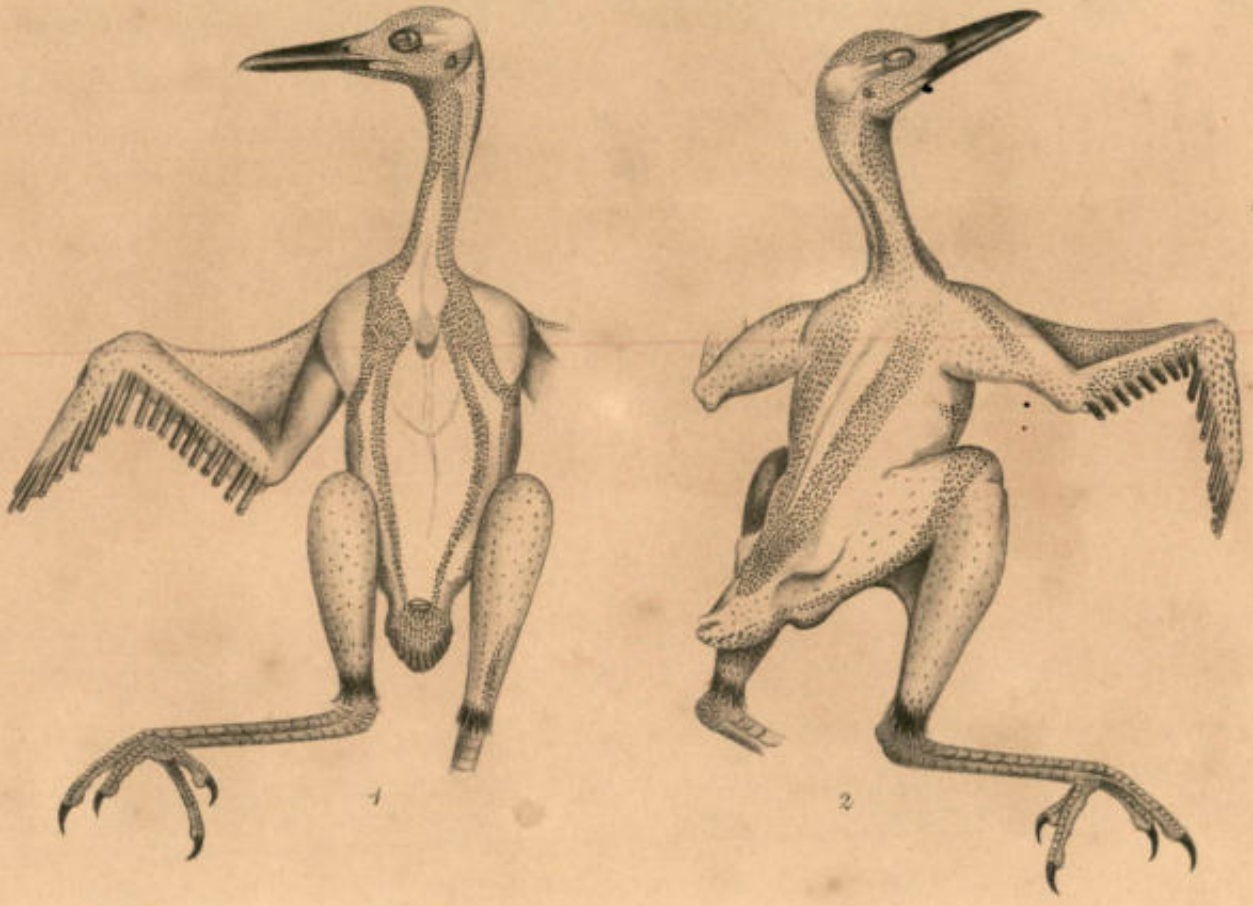
W. Purkiss lith. Hanhart imp.

NEW INDIAN LEPIDOPTERA



W. Purkiss lith. Hanhart imp.

NEW INDIAN LEPIDOPTERA.



1

2

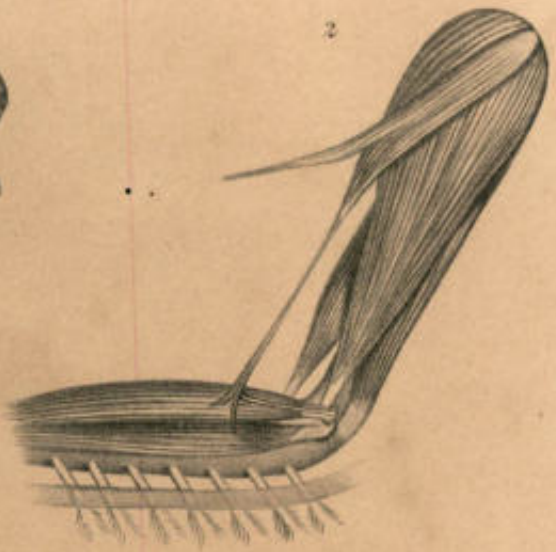
J. Smit lith.

ANATOMY OF GEOCOCCYX CALIFORNIANUS.

Hanhart imp.

1

2



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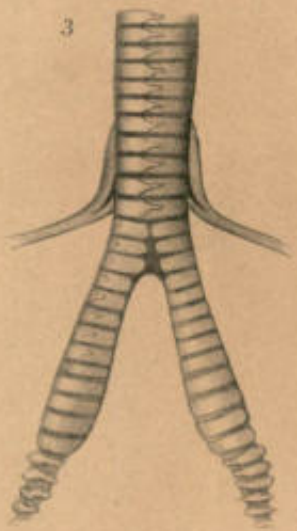

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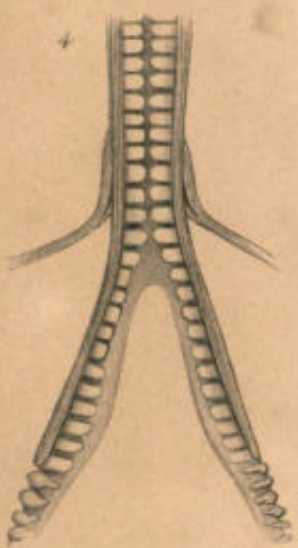
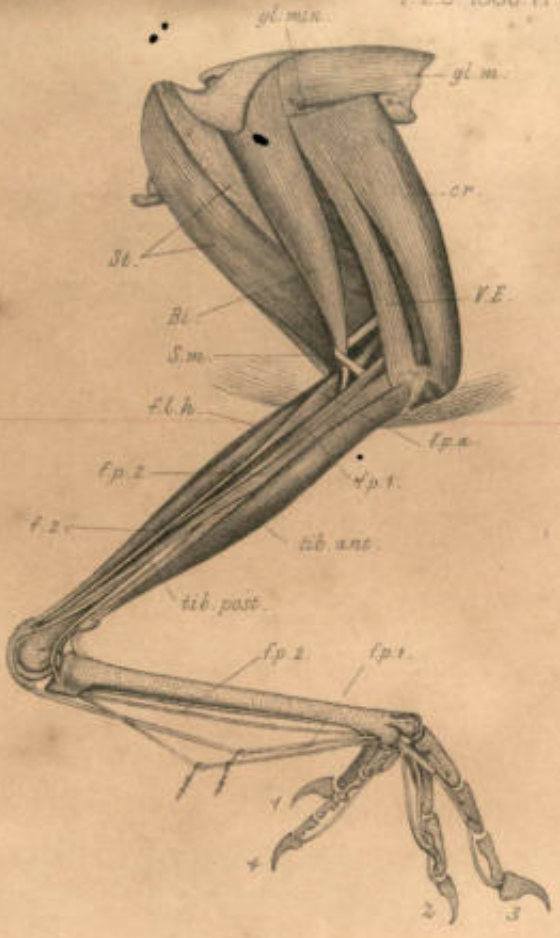


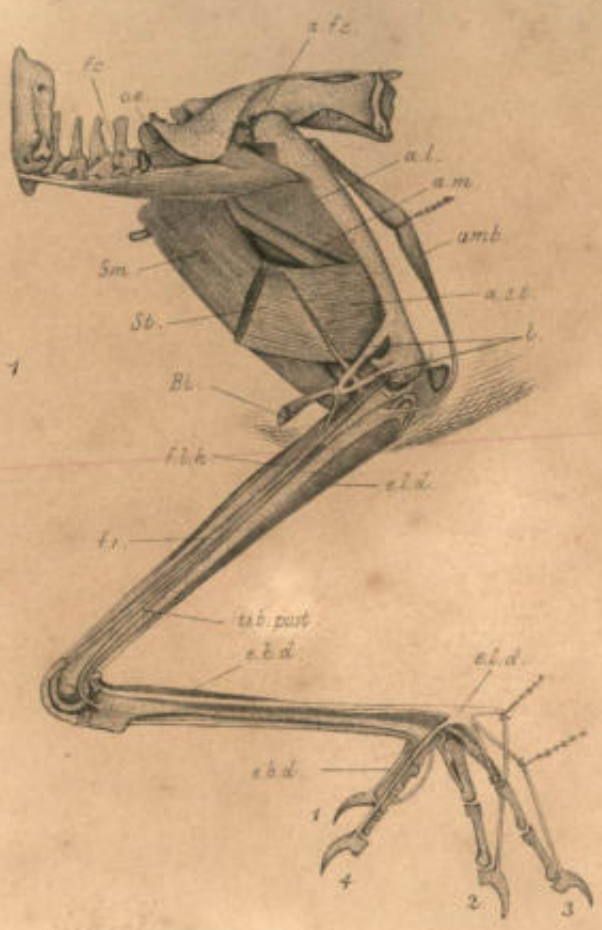
J. Smit. lith. ANATOMY OF GEOCOCCYX CALIFORNIANUS. Hanhart. imp.



J. Smit lith.

ANATOMY OF GEOCOCCYX CALIFORNIANUS.

Hanhart imp.



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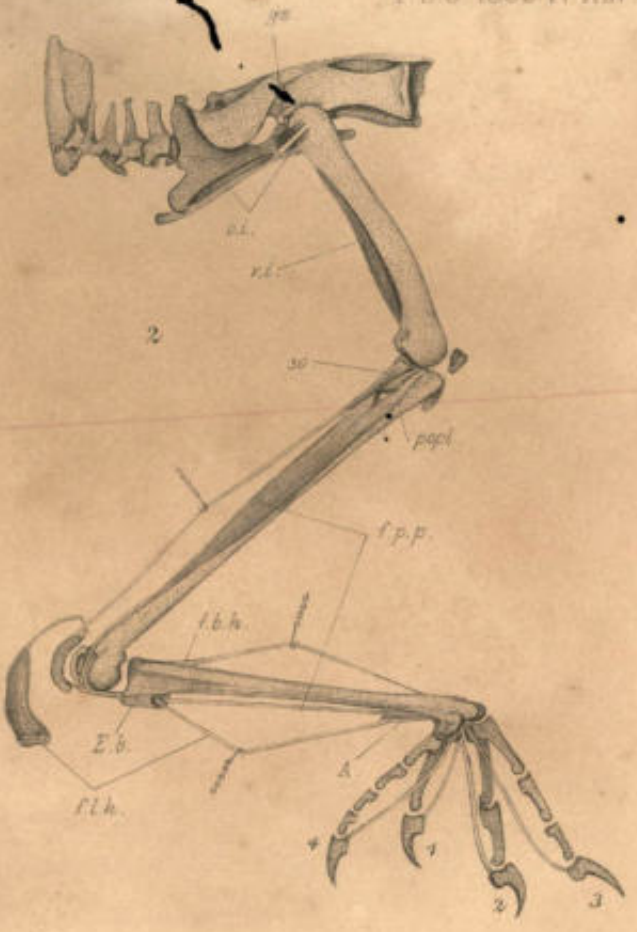
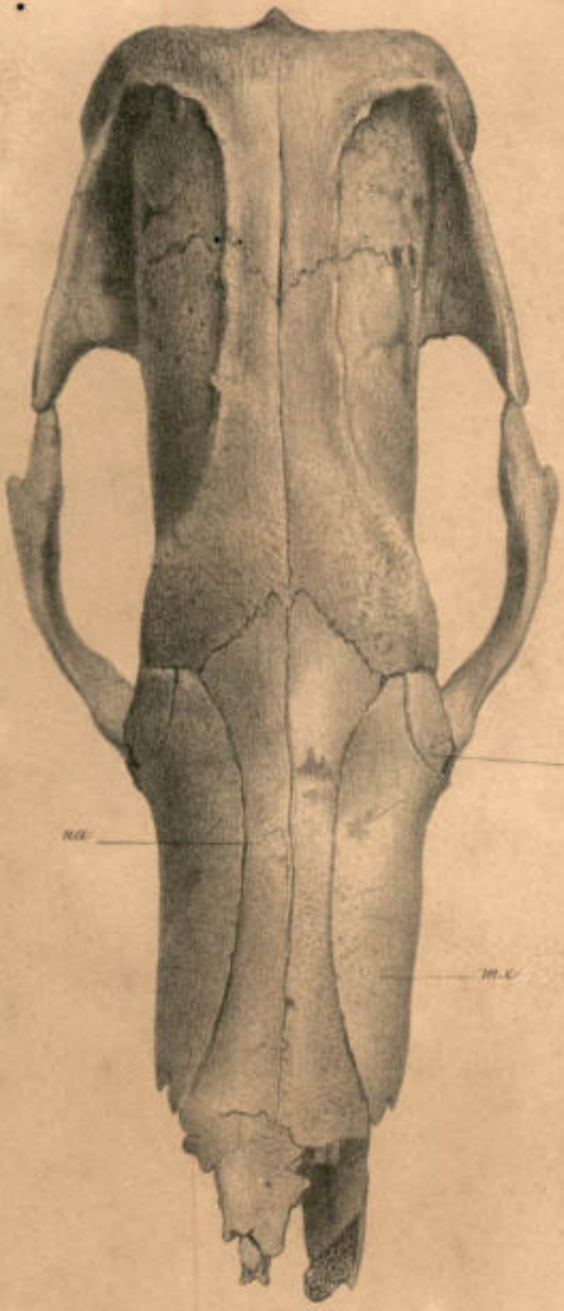


J. Smit lith.

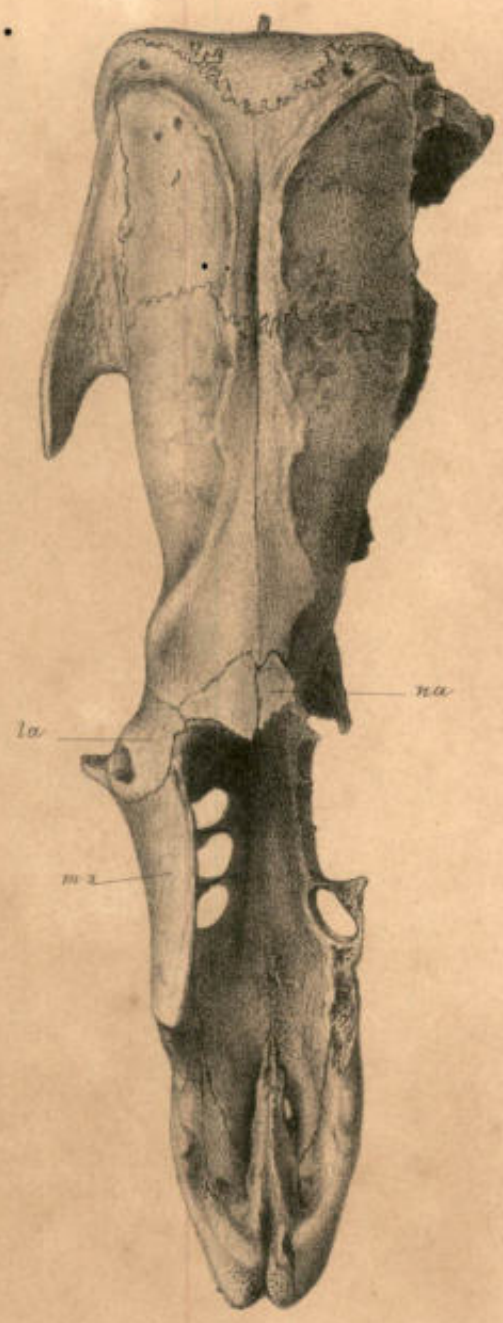
ANATOMY OF GEOCOCCYX CALIFORNIANUS.

Hanhart imp.



J. Smit. lith. Hanhart imp.

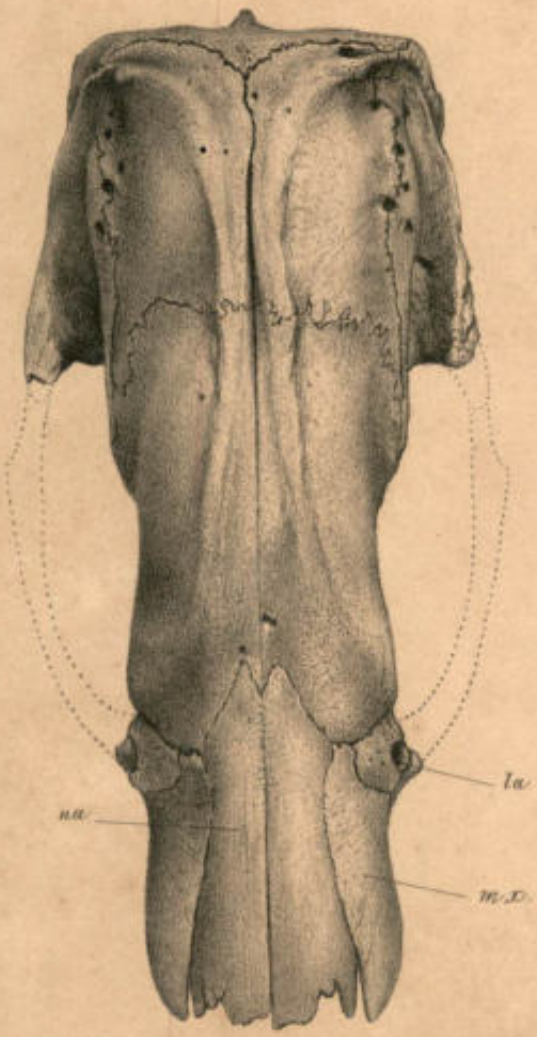
SCELIDOTHERIUM LEPTOCEPHALUM



J. Smit. lith.

Hanhart. imp.

SCELIDOTHERIUM BRAVARDI.



J. Smit lith. Hanhart imp.

SCELIDOTHERIUM CHILIENSE.

J. Smit lith.

Hanhart imp.

1 SCELIDOTHERIUM BRAVARDI.
2 " CHILIENSE.
3 " LEPTOCEPHALUM.
4 " BRAVARDI.

1. BOMBINATOR BOMBINUS.
2. BOMBINATOR IGNEUS.

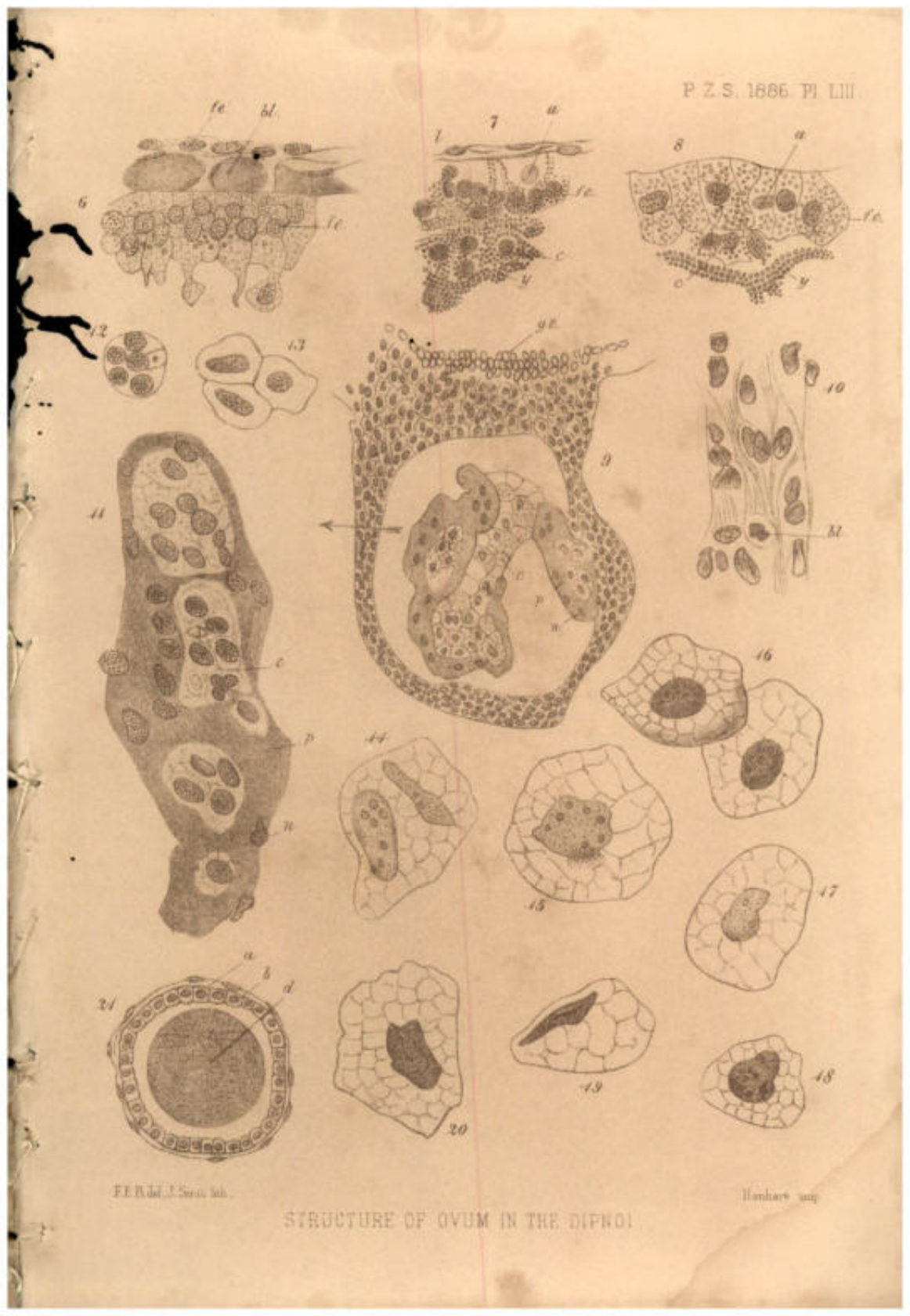
F. Nicholls lith. Benhart imp.

GAZELLA NASO.

F.E.B. del. J.Smit lith.

Hanhart imp.

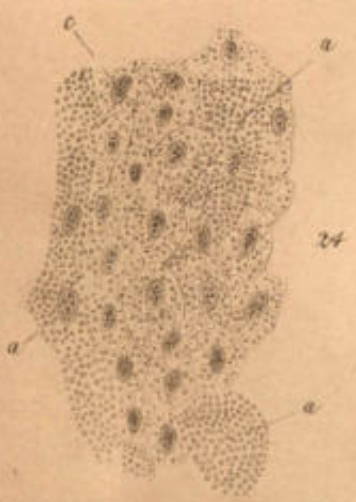
STRUCTURE OF OVUM IN THE DIPNOI

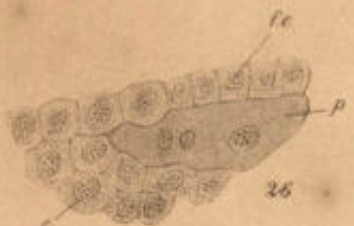


F.E.B. del. J. Smit, lith.

Hanhart imp.

STRUCTURE OF OVUM IN THE DIPNOI

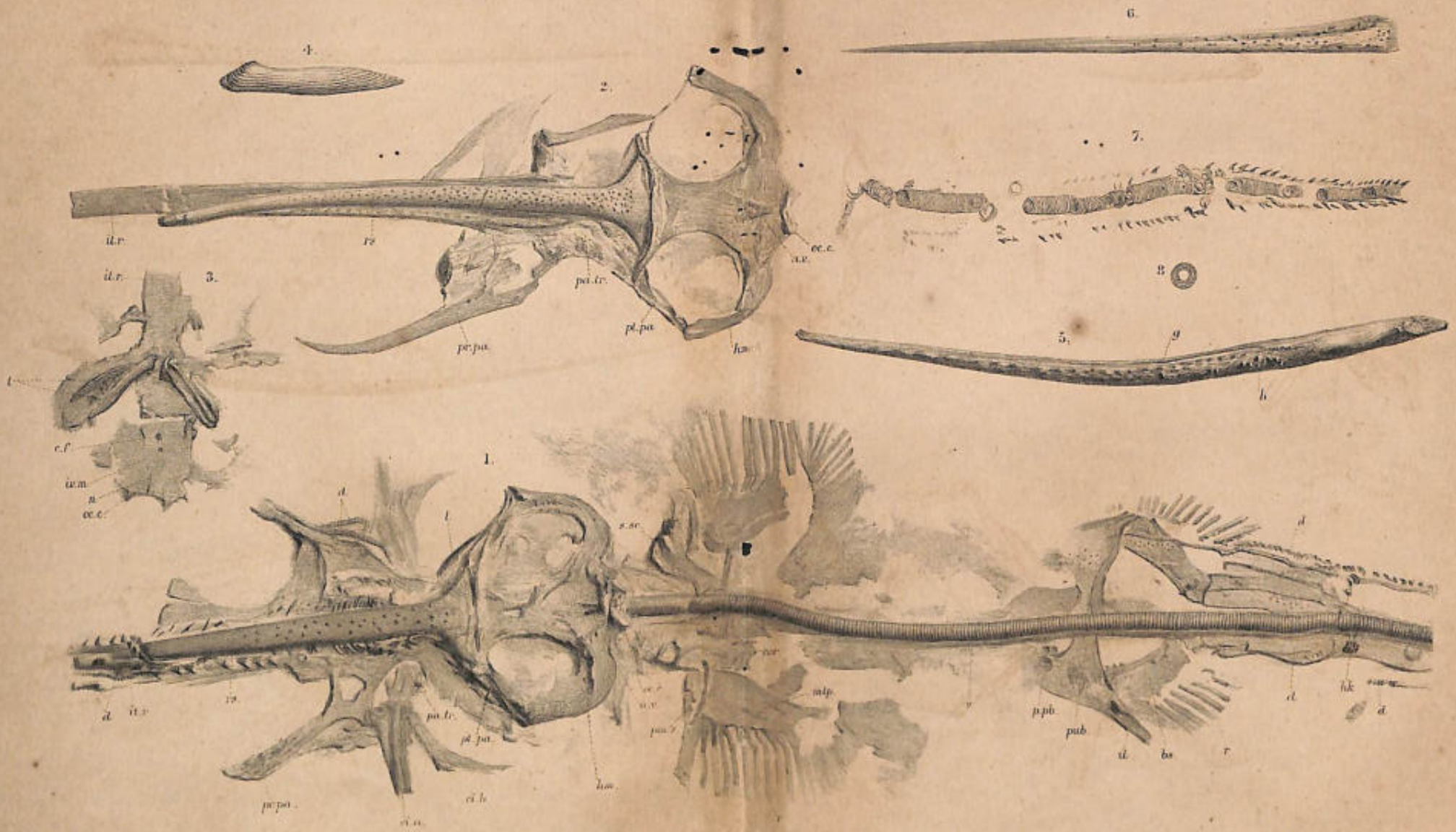




F.E.B. del. J. Smit lith.

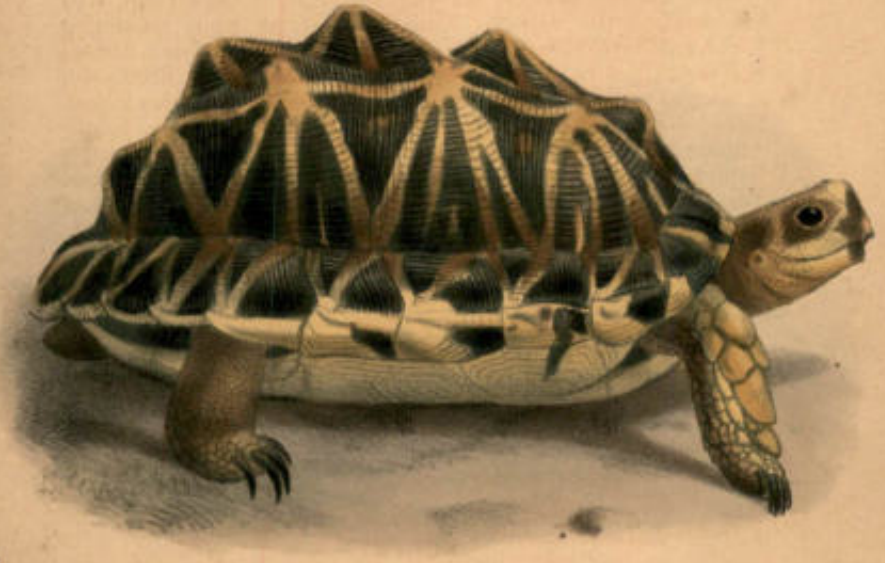
Hanhart imp.

STRUCTURE OF OVUM IN THE DIPNOI.

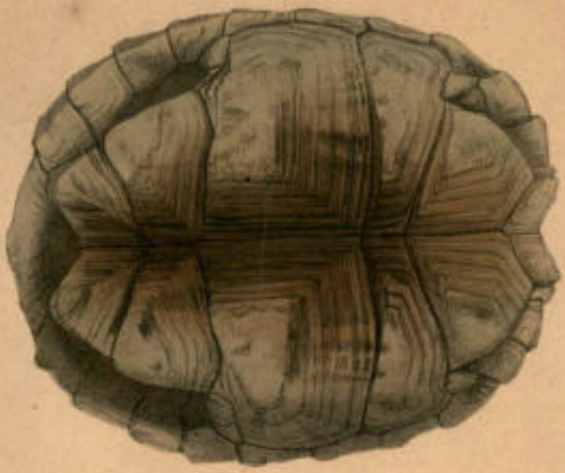

4.
2.
6.
7.
il.r.
il.r.
3.
ra
pa.tr.
pt.pa.
pa.pa.
ec.c.
a.v.
hu.
8
5.
g
h
t
c.f.
ex.m.
n.
oc.c.
1.
d
l
s.sc.
cor
scp.
p.pb.
pub
il
bs
r
hk
il.r.
ra
pa.tr.
pt.pa.
pa.pa.
ci.h.
ci.v.
hu.

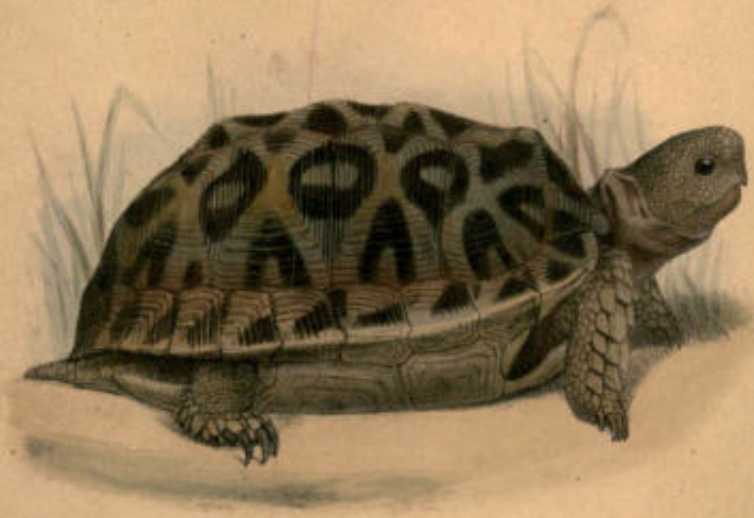
Smit lith. Hanhart imp.

CONURUS RUBRITORQUIS



TESTUDO TRIMENI.





W. Swan, del. et lith.

Mintern Bros. imp.

TESTUDO FISKI.

2.

4. 5.

10. 11.

3.

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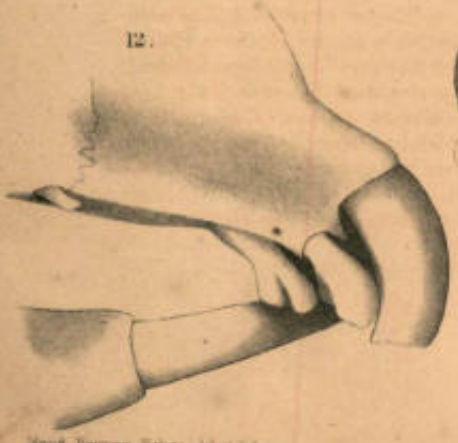
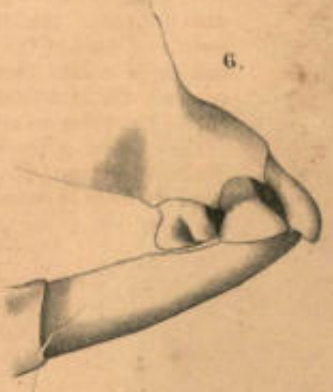
1.

9.



12.

7.



6.

Mintern Bros. imp.

LAGOSTROPHUS FASCIATUS, FIGS. 1–7.
LAGORCHESTES LEPOROIDES, FIGS. 8–12.

2

1

J. Smit del. et lith.

PHASCOLOGALE VIRGINIÆ.

Mintern Bros. imp.