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# PROCEEDINGS

OF THE

SCIENTIFIC MEETINGS

OF THE

# ZOOLOGICAL SOCIETY

# OF LONDON

FOR THE YEAR

## 1890.

(PLATES.)

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AND SOLD AT THEIR HOUSE IN HANOVER SQUARE.

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# PROCEEDINGS

OF THE

# SCIENTIFIC MEETINGS

OF THE

# ZOOLOGICAL SOCIETY OF LONDON.

January 14, 1890.

Prof. Alfred Newton, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of December 1889:—

The registered additions to the Society's Menagerie during the month of December 1889 were 45 in number. Of these 28 were acquired by presentation, 2 by purchase, 1 by exchange, 1 was born in the Gardens, and 13 were received on deposit. The total number of departures during the same period, by death and removals, was 79.

---

Mr. Sclater exhibited a specimen of a very singular Duck, apparently of the genus *Tadorna*, transmitted to him for determination by Dr. Chr. F. Lütken, of Copenhagen, F.M.Z.S. The specimen had been obtained near Wladivostok, N.E. Asia, in April 1877, by Lieutenant Fr. Irminger, then in the service of the Great Northern Telegraph Company. After careful examination Mr. Sclater had come to the conclusion that it was a hybrid, probably between the Ruddy Sheldrake (*Tadorna casarca*) and the Falcated Teal (*Querquedula falcata*). It was described as follows:—

TADORNA CASARCA × QUERQUEDULA FALCATA (?). (Plate I.)

Front, face, space behind the eyes, and neck all round white; top and back of head, long crested nape, and line beneath the eye black; back brownish grey, with numerous narrow white cross-bars; wing-coverts all pure white; primaries black; inner secondaries

bronzy green; outer secondaries grey, with a large blotch of brownish chestnut on their outer webs; tail black; breast and belly dark grey, with numerous white cross-bars; crissum rufous; under tail-coverts white; bill brown; feet yellowish: whole length 18 inches, wing 11·8, tail 4·4, tarsus 2.

---

A set of small Birds' bones, obtained from beneath the deposits of nitrate in Southern Peru, transmitted to the Society by Prof. W. Nation, C.M.Z.S., of Lima, Peru, was exhibited previously to being sent to the British Museum in accordance with Prof. Nation's instructions.

---

Mr. D. Wilson Barker, F.Z.S., exhibited some specimens of Teredos taken from submarine telegraph-cables off the Brazilian coast, and made the following remarks:—

"The presence of the Teredo in submarine telegraph-cables is well known to electricians, but, so far as I am aware, the attention of zoologists has not been drawn to it. With the permission of Major Wood (Managing Director of the Western and Brazilian Telegraph Company), I am able to lay these specimens before the Society this evening. They were taken out of the cable between Rio de Janeiro and Bahia, in latitude 22° 11′ S., longitude 40° 22′ W., from a depth of 20 fathoms.

"The nature of the 'faults' caused by these mollusks makes them very difficult to locate, so much so, that on this particular occasion we hove in the cable a mile past them, and only discovered their presence by cutting the cable in several places, as there was no sign on the outside of the cable to show their presence inside. The specimens of cable exhibited illustrate exactly the position of the Teredos in it, and it will be observed that they must have penetrated the sheathing-wires when in the embryonic stage, and then planted themselves on the jute, into which they afterwards bored. The jute is tanned before it is laid on the internal core by a special process, and it is therefore a remarkable thing that these mollusks should be able first to bore through this tough and yielding material impregnated with a chemical solution, and then scoop out pieces in the gutta-percha sheathing of the conductor. With the Teredo was another bivalve, and the minute hole in one of the teredo-valves shows the presence of a boring mollusk.

"I may also mention I have found specimens of a small *Pholas* in another cable, but the sheathing-wires in this case had been bird-caged out, and freely admitted water to the jute sheathing.

"Apart from the interest there is in finding the Teredo adapting itself to bore into such intractable substances as jute and gutta-percha in close contact, it is a matter of serious import to the owners of cables, and the discovery of a method of preventing their attacks would be very valuable."

---

Prof. F. Jeffrey Bell, F.Z.S., exhibited some living specimens of *Bipalium*, and made the following remarks:—

"I was at first inclined to regard the *Bipalium* which Mr. Fisk sent to our Gardens [1] as distinct from *B. kewense*, Moseley, for the specimen I examined was smaller, proportionately thinner, much greener in hue, and without the well-marked longitudinal lines which have been described by Moseley and figured by myself. On examining, however, several specimens, I found that the worms varied a good deal in hue, and in the extent to which the stripes are obvious, and at last I found a small specimen which agreed exactly with my idea of what *B. kewense* ought to look like."

---

The following papers were read:—

## 1. On a new Species of Otter from the Lower Pliocene of Eppelsheim. By R. Lydekker, B.A., F.Z.S.

[Received November 15, 1889.]

In cataloguing the fossil Mammals in the British Museum [2] I entered under the heading of *Lutra dubia*, Blainville, part of the right mandibular ramus of a rather large Otter, which is stated to have been obtained from the Lower Pliocene (Upper Miocene of some authorities) sands of Eppelsheim, in Hesse-Darmstadt. My reason for thus naming the specimen was that it appeared to correspond with Blainville's figure of the type of *L. dubia* from the Middle Miocene of Sansan. Mr. E. T. Newton has, however, been good enough to show me a cast of the type specimen of the latter, which at once indicates that the Eppelsheim specimen belongs to a totally different form. The mandible of *L. dubia* is characterized by the very small size of the inner cusp of the blade of the lower carnassial, in which respect it approximates to *Lutra* (*Potamotherium*) *valetoni* of the Lower Miocene. According to Dr. Schlosser [3] this species is moreover closely allied to those Mustelines described by Meyer as *Trochictis*, which appear to connect *Lutra* with *Mustela*, and should not improbably be referred to the same genus.

Now the lower carnassial of the Eppelsheim Otter (as is well shown in the accompanying drawing, see p. 5) is remarkable for the very large size of the inner cusp of the blade, and is thereby at once distinguished from *L. dubia*. Moreover, in going through the list of the Tertiary species of Otters given by Dr. Schlosser on pp. 345–349 of the volume cited, it is apparent that the specimen under consideration is specifically distinct from all the named species, with the possible exception of *Lutra franconica*, Quenstedt, and the lower jaw from Steinheim described by Dr. O. Fraas as *L. valetoni*, but which,

[1] See P. Z. S. 1889, p. 586.
[2] Cat. Foss. Mamm. Brit. Mus. pt. i. pp. 191, 192, No. 2748 δ.
[3] Beitr. Pal. Œster.-Ung. vol. vii. p. 349.

as Dr. Schlosser points out, certainly does not belong to that species. With regard to *L. franconica*, it may be observed that this species was founded on limb-bones, of which the age is unknown, and which may be referable to one of the earlier named species, if indeed it really belongs to *Lutra* at all. The species represented by the mandible described as *L. valetoni*, if distinct from all the other forms, requires a new name. The Siwalik jaw, upon the evidence of which I have founded the species *L. bathygnathus*[1], is at once distinguished by the great relative depth of the mandible; while *L. palæindica*[2], of the same deposits, is a smaller form closely allied to *L. sumatrana*[3]. Assuming its distinctness from all recent Otters, there accordingly appears to be good evidence that the Eppelsheim mandible indicates a new species, for which I propose the name of *Lutra hessica*.

In attempting to define this species from the characters of the lower jaw only, I am fully aware how extremely difficult it would be to distinguish the existing species of Otters upon such evidence alone; but since the named fossil forms are very few in number, the objection does not apply so forcibly in this case. If, indeed, we examine the lower jaws of existing Otters, we shall find that it is possible to distinguish a large number of them by the characters of the mandible; some of the most important features being the relative length of the lower carnassial to that of the last premolar, and the proportionate size of the inner cusp of the former tooth. Thus in the large *L. brasiliensis* the carnassial is comparatively small in proportion to pm. 4; in *L. ellioti*[4] (B of woodcut) it is considerably larger; while in *L. cinerea* (D of woodcut) the proportionate size of the carnassial attains its greatest development. Again, while the inner cusp of the carnassial is very large in *L. cinerea*, *L. paranensis*, and *L. brasiliensis*, it becomes somewhat smaller in *L. vulgaris*, and still more so in *L. sumatrana*, where the entire crown of this tooth becomes very narrow. The carnassial is also narrow, with a rather smaller inner cusp, in the S. American *L. felina*.

Now *L. hessica* is an Otter of slightly larger size than the Oriental *L. ellioti*, but with very similar proportions in the length of the carnassial and pm. 4; the inner cusp of the blade of the carnassial is, however, decidedly larger than in the existing form, in which respect it agrees better with the larger *L. brasiliensis*. The cingulum on the inner side of the carnassial is more distinct than in *L. ellioti*, and the inner wall of the talon somewhat higher. The dimensions of the lower teeth of the two forms are as follows, in millimetres:—

| | *L. hessica.* | *L. ellioti.* |
|---|---|---|
| Length of pm. 4 + m. 1 ..... | 26 | 24 |
| „ pm. 4 ..... ...(?) | 10 | 9·5 |
| „ m. 1 ..... | 16 | 15·5 |

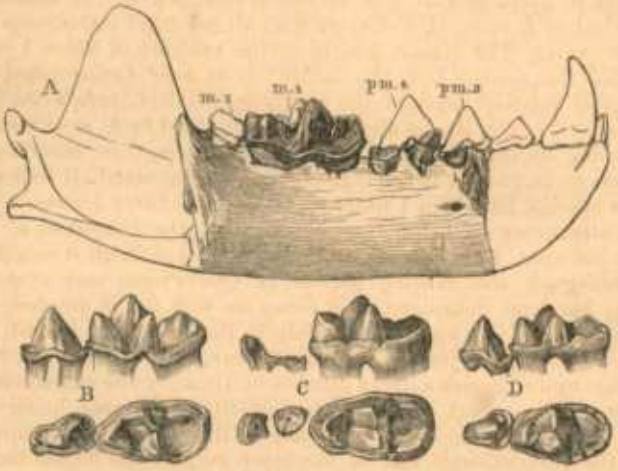
[1] Pal. Ind. ser. 10, vol. ii. pl. xxvii. fig. 3.

[2] *Op. cit.* fig. 2.

[3] See Thomas, Proc. Zool. Soc. 1889, p. 193, note 1.

[4] I provisionally follow Mr. W. T. Blanford in employing the name *L. ellioti* for the Otter in question, since there seems considerable doubt whether Mr. O. Thomas's proposal to substitute the name *L. barang* will meet with acceptation.

*L. hessica* may therefore be provisionally defined as an Otter of the approximate size of *L. elliоti*, with a somewhat larger inner cusp and cingulum to the lower carnassial, in which the inner wall of the talon is also rather higher.




A. Outer view of restored mandible of *Lutra hessica*. B. Inner and oral views of m. 1 and pm. 4 of *L. elliоti*. C. Ditto of *L. hessica*. D. Ditto of *L. cinerea*.

I may add that the matrix adhering to the specimen as well as the characters of the bone itself agree with those of other Eppelsheim fossils, so that I have no doubt as to the correctness of the locality assigned to this fossil.

## 2. On some Cranial and Dental Characters of the Domestic Dog. By Bertram C. A. Windle, M.A., M.D., Professor of Anatomy in the Queen's College, Birmingham, and John Humphreys, L.D.S., Lecturer on Dental Anatomy and Physiology in the same College.

[Received November 19, 1889.]

The observations upon which the following remarks are based were commenced more than three years ago. After they had been carried on for some time we became aware of Professor Huxley's paper "On the Cranial and Dental Characters of the *Canidæ*" [1], the remark at the end of which, that the author "deferred the consideration of the origin and relations of the domestic dogs until the evidence which he was collecting was more complete," would have

[1] Proc. Zool. Soc. 1880, p. 238.

deterred us from proceeding further in our enquiry had not the Professor courteously and kindly encouraged us to pursue our investigations. Besides a number of skulls which we have procured ourselves we have examined those in the following collections:—The Natural History Department of the British Museum; the Royal College of Surgeons, London; the Universities of Oxford, Cambridge, and Dublin; and the Museum of Science and Art in the last-named city. We have to express our thanks to the following gentlemen for their kind assistance in this matter:—Mr. Oldfield Thomas, Professor Charles Stewart, Dr. Arthur Thomson; Professors Alexander Macalister, H. W. Macintosh, and A. C. Haddon. It is right to mention that the very numerous calculations required for the preparation of the tables have been worked out by Mrs. Windle.

---

In dealing with our subject we have been confronted with two chief difficulties. In the first place, it was originally our hope and intention to have dealt with the origin of the races of the domestic dog, but a short experience of the literature of the subject showed this to be an impossibility on this occasion at least. The literature of the subject would require the devotion of years before any satisfactory results could be hoped for. We have therefore been regretfully obliged to confine ourselves to some scattered references to the opinions of the chief writers on the subject, whether as regards the derivation of the race as a whole or of certain varieties from one another.

In the second place, the difficulty of determining the limits of breeds or varieties of dogs, and still more that of deciding whether a given museum-specimen is that of a so-called "pure-bred" animal or even of absolutely defining what is a "pure-bred animal," is one which will be readily comprehended by anyone who is even superficially acquainted with the ways of canine fanciers. Anyone taking the trouble to look through the pages of 'Stonehenge,' for example, will not fail to realize that fanciers have exercised their ingenuity in many directions upon most of the commoner breeds of dogs, and by no means always on the same lines. This fact is, doubtless, sufficient to account for the striking discrepancies and differences which, as will be seen from the tables, exist amongst dogs of the same variety.

As an example, it may be stated that in few is this more the case than in that of the Bull-dogs, and yet the skulls included in this table are nearly all specially vouched for as being those of exceptionally purely-bred individuals. We can only state that, so far as we have been able, we have included in the tables only such animals as apparently might be with reason described as "pure-bred."

In the first part of this paper will be found the measurements of the various specimens examined, reduced to terms of the basi-cranial axis in each case, with averages, arranged in a tabular form.

These have been for convenience' sake placed in the order given in the article "Dog" in the last edition of the 'Encyclopædia Britannica'; but we do not desire it to be understood on that account that we pledge ourselves to that or any other of the numerous classifications extant. To the table dealing with each breed is affixed a few notes on its possible derivation[1].

The measurements have been made after the plan adopted by Professor Huxley in his paper already referred to. A few of these may be explained here, in his words, for the sake of clearness. *Basicranial Axis*: this, the standard, is "a median line drawn in the bisected skull from the hinder edge of the basioccipital bone to the junction between the presphenoid and the ethmoid in the base of the skull." The value of this is taken as 100, and the other measurements, cranial and dental, are expressed in terms of it. "When, as often happens, the skull under examination cannot be bisected, a sufficiently close approximation to the true length of the basicranial axis may be obtained by taking the distance along the median line of the base of the skull from the posterior edge of the basioccipital bone to a point opposite the middle of the distance between the optic and ethmoidal foramina. This point always lies a little behind the posterior extremity of the vomer." In the remaining columns "'total length' means the distance from the front edge of the premaxillary bones to the extremity of the occipital spine. The 'zygomatic width' is the greatest transverse distance between the outer faces of the zygomatic arches. The 'length of the bony palate' is measured from the front edge of the symphysis of the præmaxillary bones to the hinder edge of the middle of the bony palate, not taking into account the inconstant median spine which is frequently developed. The 'width of the bony palate' is the distance between the points at which the outer faces of pm.4 and m.1 meet."

The remainder of the paper after the special tables is devoted to the consideration of certain points arising out of the figures contained therein.

[1] It may be convenient here to mention the chief writers referred to, with the titles of their works and the abbreviations used in reference to them:—

Animals and Plants under Domestication. Darwin.—"D."
Encyclopædia Britannica, Ed. 9. Art. "Dog."—"E. B."
The Dog. "Stonehenge." 1879.—"S."
British Quadrupeds. "Dogs." Bell.—"B."
The Dog. W. Youatt.—"Y."
Varieties of Dogs. Gray, Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 236.—"G."
Naturalist's Library. Smith, vol. v.—"C. H. S."
Die Racen des zahmen Hundes. Fitzinger, Sitzungsb. d. mathem.-naturw. Cl. d. kaiserl. Ak. der Wissensch. lvi. Bd. i. S. 377.—"F."
Eine Studie üb. die Abstammung der Hunderassen, von A. v. Pelzeln. Zool. Jahrb.—"P."
Die Stammväter unserer Hunde-Rassen. Jeitteles. Wien, 1877.—"J."

## Group I.—Wolf-dogs.

This group contains:—(1) Esquimaux; (2) Kamtschatka dog; (3) Sheep-dog, of which there are three varieties—α. Collie, β. Southern Sheep-dog, γ. Drover's dog: (4) Newfoundland; (5) St. Bernard's dog. The last two, according to some authorities, form a group by themselves.

Table I.—*Esquimaux Dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 284·61 | 176·92 | 140·76 | 107·69 | 93·07 | 103·84 | 30·76 | 21·84 | 20·15 | 11·53 | 18·46 | 33·84 | 12·38 | ... |
| 2. | 301·47 | 168·80 | 143·28 | 102·98 | 110·44 | 113·43 | 29·85 | 20·39 | 20·11 | 11·19 | 14·92 | 35·22 | 12·96 | 6·71 |
| 3. | 318·51 | 163·76 | 152·96 | 103·14 | 121·48 | 127·62 | 32·89 | 22·22 | 22·62 | 13·48 | 18·66 | 36·29 | 13·55 | ... |
| 4. | 339·09 | 197·81 | 156·36 | 119·09 | 107·27 | 132·72 | 38·72 | 24·36 | 30·90 | 12·72 | 20·36 | 39·27 | 13·45 | ... |
| 5. | 290·65 | 158·73 | 139·68 | 100·0 | 98·41 | 107·93 | 30·15 | 20·95 | 20·34 | 10·0 | 15·07 | 34·29 | 14·29 | 9·52 |
| 6. | 290·87 | 162·50 | 143·75 | 101·56 | 101·56 | 112·5 | 29·68 | 21·09 | 20·25 | ... | 16·40 | 32·50 | 14·06 | 6·25 |
| 7. | 288·40 | 170·28 | 139·13 | 112·31 | 101·44 | 107·24 | 27·82 | 19·56 | 20·36 | 9·42 | 14·59 | 30·43 | 13·04 | 6·95 |
| 8. | 278·92 | 156·41 | 128·20 | 92·30 | 89·23 | 92·30 | 25·64 | 18·66 | 22·05 | 8·97 | 14·10 | 29·48 | 12·05 | ... |
| 9. | 320·0 | 185·71 | 157·14 | 105·71 | 97·14 | 111·42 | 31·42 | 20·71 | 27·14 | 11·14 | 17·14 | 35·71 | 15·71 | 7·85 |
| 10. | 297·22 | 179·61 | 145·83 | 106·94 | 104·16 | 111·11 | 31·94 | 20·13 | 26·38 | 11·11 | 15·95 | 34·72 | 13·88 | 6·94 |
| 11. | 300·0 | 171·42 | 150·0 | 103·57 | 111·42 | 117·14 | 31·42 | 20·0 | 25·0 | 10·71 | 15·71 | 35·71 | 12·14 | ... |
| 12. | 269·23 | 161·53 | 138·46 | 92·30 | 100·0 | 107·69 | 29·23 | 18·46 | 24·61 | 10·0 | 15·38 | 32·30 | 13·85 | 6·15 |
| Av. | 299·08 | 170·62 | 145·71 | 103·38 | 101·55 | 112·91 | 30·74 | 20·53 | 26·32 | 10·93 | 16·93 | 34·23 | 13·86 | 7·19 |

Nos. 1 & 2. Roy. Coll. Surgeons. Nos. 3, 4, 5, 6, 7. Nat. Hist. Mus. (5. Nootka Sound). No. 8. Trin. Coll. Dubl. (Disco). Nos. 9 & 10. Camb. Univ. (Arctic Exped.). Nos. 11 & 12. Oxford Univ.

Smith considers that these dogs together with the Newfoundland breed come from the Nootka dog and are thus of Asiatic origin. Fitzinger thinks they are variations of the Sheep-dog (Haushund, *Canis domesticus*).

The object of this paper being chiefly to place on record our measurements even where they do not appear to have any particular bearing upon any theory, it may here be said, once for all, that we shall give various dimensions which we have obtained of isolated examples in such places as may appear most suitable for them. We do this in the hope that some future workers, more versed in taxonomy than ourselves, may find them of use at some time. Thus, the following are the measurements of a hybrid between the Esquimaux dog and a European wolf (Nat. Hist. Mus.).

Table II.

| Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Pm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 306·84 | 167·12 | 142·46 | 101·36 | 103·47 | 121·23 | 31·59 | 19·86 | 27·12 | 11·64 | 18·08 | 33·56 | 16·02 | 7·12 |

Table III.—*Greenland Sledge-dog* (Camb. Univ.).

| Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Pm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 301·47 | 150·0 | 132·94 | 88·23 | 123·52 | 102·35 | 28·82 | 21·32 | 25·0 | 12·50 | 11·64 | 32·82 | 14·70 | 5·88 |

This probably might have been included in Table I., but as it is catalogued under a somewhat different title we have placed it here separately.

The SHEEP-DOG is, according to Buffon, the parent-stock of all the species of dogs. Fitzinger also describes it as one of his pure races. There are, however, as has been mentioned above, at least three varieties of the breed. Moreover, as 'Stonehenge' states that "a great proportion of those in actual use are crossed with the various sporting dogs such as the Setter, which is very common" (especially in the case of the Collie, which has been crossed with the Gordon Setter), "or the Pointer, or even the Hound," the varieties of this breed within certain limits may be almost unending.

Table IV.—*Shepherd's Dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Pm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 298·43 | 173·43 | 140·62 | 100·0 | 154·68 | 128·12 | 28·59 | 20·62 | 27·34 | 10·93 | 15·0 | 34·67 | 13·28 | ... |
| 2. | 300·78 | 149·60 | 144·88 | 109·44 | 119·88 | 124·40 | 28·81 | 21·43 | 24·40 | 14·17 | 16·75 | 33·07 | 17·32 | 11·81 |
| 3. | 293·10 | 170·88 | 150·86 | 103·44 | 103·44 | 115·51 | 30·17 | 19·82 | 26·20 | 9·48 | 15·86 | 31·03 | 12·41 | 8·96 |
| 4. | 282·92 | 145·52 | 139·33 | 91·86 | 100·81 | 112·19 | 29·26 | 20·32 | 26·34 | 11·70 | 16·26 | 32·52 | 11·70 | 8·94 |
| 5. | 261·96 | 136·96 | 130·83 | 91·66 | 95·83 | 109·16 | 27·5 | 20·83 | 25·33 | 12·5 | 15·83 | 33·33 | 14·5 | 8·33 |
| 6. | 294·11 | 166·17 | 147·05 | 102·94 | 102·94 | 111·76 | 28·67 | 20·58 | 26·47 | 12·5 | 18·38 | 31·61 | 15·44 | ... |
| Av. | 288·5 | 157·01 | 141·26 | 99·89 | 112·93 | 116·86 | 28·83 | 20·6 | 26·01 | 11·88 | 16·35 | 32·68 | 14·11 | 9·51 |

Nos. 1 & 2. Roy. Coll. Surgeons. Nos. 3, 4, 5. Q. Coll. Birm.

Table V.—*Newfoundland Dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 313·3 | 176·0 | 146·6 | 108·0 | 98·0 | 109·3 | 28·20 | 20·86 | 24·6 | 12·8 | 18·0 | 34·96 | 14·6 | 9·3 |
| 2. | 321·62 | 189·18 | 156·75 | 113·51 | 97·29 | 121·62 | 27·70 | 20·27 | 22·29 | 10·81 | 14·86 | 30·67 | 13·51 | 6·08 |
| 3. | 297·14 | 157·14 | 147·14 | 100·0 | 100·0 | 142·85 | 28·57 | 20·71 | 25·0 | 12·14 | 15·0 | 32·14 | 14·28 | ... |
| 4. | 300·0 | 171·42 | 150·0 | 100·0 | 100·0 | 142·85 | 28·57 | 20·0 | 24·28 | 11·42 | 15·71 | 32·14 | 12·85 | 7·14 |
| Av. | 308·01 | 173·45 | 150·12 | 105·38 | 98·32 | 129·15 | 28·27 | 20·41 | 24·04 | 11·74 | 15·89 | 32·48 | 13·81 | 7·51 |

Nos. 1 & 2. (Franklin) Roy. Coll. Surgeons. Nos. 3 & 4. Oxford Univ.

The Dog of St. Bernard is according to Smith nearly allied to the last group. Fitzinger describes it as a cross between the great Spaniel (*Canis extrarius*) and the Mastiff (*C. molossus mastivus*).

Table VI.—*St. Bernard's Dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 319·04 | 172·02 | 150·0 | 100·0 | 97·31 | 114·28 | 25·0 | 17·5 | 20·83 | 10·71 | 15·47 | 31·06 | 13·33 | 7·73 |
| 2. | 326·25 | 167·5 | 160·0 | 102·5 | 101·25 | 120·0 | 27·12 | 19·37 | 15·87 | 10·87 | 15·25 | 32·5 | 12·5 | 8·75 |
| Av. | 322·64 | 169·76 | 155·0 | 101·25 | 99·28 | 117·14 | 26·06 | 18·43 | 18·35 | 10·79 | 15·36 | 32·03 | 12·91 | 8·24 |

No. 1. Roy. Coll. Surgeons. No. 2. Nat. Hist. Mus.

The Pomeranian breed is placed by Smith near the St. Bernard and the other Wolf-dogs. He states that there is in India "a dwindled offspring of this race now mixed with the Pariahs, but still retaining the long-haired white livery of its ancient parentage. It is most likely the residue of the quondam companions of one of the several northern invading tribes who conquered, established dominion, and were absorbed by the Hindoo race." Fitzinger believes that the Pomeranian is a climatic variety of the Sheep-dog.

Table VII.—*Pomeranian Dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 267·92 | 168·96 | 137·73 | 113·20 | 71·69 | 98·11 | 29·43 | 21·13 | 25·47 | 11·32 | 15·09 | 39·39 | 14·15 | ... |
| 2. | 256·0 | 148·0 | 128·0 | 100·0 | 100·0 | 110·0 | 27·0 | 22·0 | 27·0 | 11·0 | 17·0 | 35·0 | 16·0 | 7·0 |
| 3. | 236·66 | 130·83 | 115·0 | 90·0 | 90·0 | 100·0 | 27·50 | 18·33 | 20·66 | 10·66 | 17·5 | 31·66 | 14·16 | 7·5 |
| 4. | 253·77 | 150·94 | 132·07 | 103·77 | 94·33 | 113·20 | 30·18 | 21·69 | 30·18 | 12·26 | 21·69 | 35·84 | 15·09 | 7·54 |
| 5. | 253·84 | 159·61 | 136·53 | 99·15 | 94·23 | 105·76 | 29·80 | 20·19 | 28·84 | 11·92 | 17·30 | 39·76 | 13·46 | 7·69 |
| Av. | 253·64 | 151·23 | 129·86 | 100·43 | 90·05 | 105·41 | 28·78 | 20·67 | 27·63 | 12·63 | 17·71 | 35·33 | 14·57 | 7·43 |

## Group II.—Greyhounds.

This group includes the Irish Wolf-dog, ancient and modern, the Scotch Deerhound, the Greyhound, Italian Greyhound, Naked dog, and Lurcher. The Greyhound breed is undoubtedly one of great age, since figures of this breed have been found on monuments in Egypt at least 3000 years old. Some of these at least, however, resembled the Akaba or Bedouin Greyhound, and differed from the English and other varieties in that they possessed long brush tails.

The Old Irish Wolf-dog was originally, according to Smith, of the same origin as the Scotch, and "according to some opinions was not found in Ireland in its greatest development until the Danes began to infest its coasts." It may have been, however, he thinks, that there was an ancient race which "was crossed with the great Danish dog by the Northmen, and under favourable circumstances increased to the great stature since so much admired." It was the largest dog in Western Europe, whatever may have been its origin, and has now been extinct for nearly a century. Lambert[1] has given a description with a figure of one given to him in 1790 by Lord Altamont, who then possessed the only eight specimens in existence. The measurements of this animal will be found at the place referred to. Their make, from the figure, must have been heavier, and this especially about the head, than the ordinary greyhound type. The hair was short and smooth, the colour of some being brown and white, of others black and white. "They seem to be good tempered," he states, but "from the accounts I received are degenerated in size. They were formerly much larger, and in their make more like a greyhound."

The measurements given in the table were kindly made for us by Professor A. C. Haddon, M.A., to whom our best thanks are due for his trouble. They are from the specimens in the Museum of Science and Art, Dublin. Unfortunately in every case the inferior maxillæ were wanting.

Table VIII.—*Old Irish Wolf-dog.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 311·39 | 162·28 | 140·50 | 88·60 | 102·53 | 27·84 | 14·68 | 26·58 | 11·39 | 17·72 |
| 2. | 284·84 | 168·18 | 130·33 | 92·42 | 96·96 | 26·76 | 13·63 | 25·0 | 9·09 | 18·93 |
| 3. | 306·25 | ... | 148·75 | 93·75 | 105·0 | 28·75 | 15·0 | 22·5 | 11·25 | 16·25 |
| 4. | 311·11 | 166·66 | 158·33 | 101·38 | 109·72 | 30·55 | 19·44 | 25·0 | 12·5 | 17·36 |
| 5. | 326·66 | 176·66 | 153·33 | 105·0 | 108·33 | 30·83 | ... | 26·66 | 12·5 | 19·16 |
| 6. | 286·56 | 153·73 | 137·81 | 97·01 | 101·49 | 29·05 | 16·41 | 22·38 | ... | ... |
| Av. | 304·47 | 165·70 | 143·17 | 96·36 | 104·09 | 28·93 | 15·83 | 24·69 | 11·55 | 17·88 |

No. 1. R. I. A. a. No. 2. R. I. A. β. No. 3. Dr. Wilde 2. No. 4. Dr. Wilde 3. No. 5. Dr. Wilde 4 (Dunshaughlin). No. 6. Dr. Wilde 5 (Dunshaughlin).

[1] Trans. Linn. Soc. iii. p. 16.

The Modern Irish Wolf-dog has little in common with the above-mentioned breed except its name. According to 'Stonehenge,' "The Scotch Deerhound is taken as the stock on which to graft greater size and power, and most probably this has been done, partly by the selection of very large specimens and partly by crossing with the Mastiff, or possibly with the great Dane." The result is, of course, the production of a perfectly artificial breed.

Table IX.—*Modern Irish Wolf-dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 337·41 | 169·89 | 161·29 | 103·22 | 107·35 | 129·45 | 25·80 | 19·61 | 24·77 | 11·61 | 17·41 | 33·55 | 13·93 | ... |
| 2. | 315·78 | 152·63 | 146·65 | 96·05 | 111·57 | 121·05 | 26·31 | 19·72 | 23·68 | 11·64 | 16·44 | 31·57 | 14·47 | 5·92 |
| 3. | 304·34 | 169·56 | 153·62 | 101·44 | 105·79 | 126·86 | 29·71 | 21·73 | 20·81 | 12·75 | 16·95 | 34·05 | 13·76 | ... |
| Av. | 319·18 | 162·03 | 153·65 | 100·24 | 108·24 | 124·79 | 27·27 | 20·36 | 23·09 | 12·07 | 16·93 | 33·06 | 14·05 | 5·92 |

These specimens are from the Nat. Hist. Museum.

The following measurements are from a specimen of the Scotch Deerhound in the Museum of the Roy. Coll. Surgeons.

Table X.—*Scotch Deerhound.*

| Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 295·36 | 140·39 | 137·74 | 85·42 | 99·33 | 115·23 | 24·50 | 15·89 | 21·45 | 9·27 | 12·56 | 29·47 | 12·18 | 6·62 |

A Chinese Wolf-dog in the same collection should perhaps find its place here.

Table XI.—*Chinese Wolf-dog.*

| Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 283·05 | 159·32 | 138·98 | 98·39 | 97·45 | 106·77 | 27·96 | 21·18 | 22·89 | 11·05 | 14·40 | 30·38 | 13·55 | 6·77 |

The Greyhound is taken by Fitzinger as one of his stem-forms, many varieties existing in different parts of the world. The first table relates to the English form.

Table XII.—*Greyhounds.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Fm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 306·34 | 161·9 | 153·96 | 92·85 | 107·93 | 113·49 | 27·7 | 18·25 | 39·3 | 11·93 | 15·07 | 31·74 | 12·69 | 7·93 |
| 2. | 331·25 | 167·18 | 151·56 | 93·75 | 111·71 | 117·96 | 28·90 | 20·31 | 25·0 | 10·93 | 17·18 | 32·03 | 14·06 | 9·37 |
| 3. | 359·70 | 143·28 | 147·76 | 91·79 | 105·97 | 119·40 | 26·26 | 19·70 | 24·62 | 11·19 | 14·92 | 32·83 | 13·43 | 8·20 |
| 4. | 291·42 | 145·71 | 150·0 | 87·85 | 104·28 | 128·57 | 28·57 | 20·71 | 25·71 | 11·42 | 16·42 | 33·57 | 14·28 | ... |
| 5. | 289·0 | 138·46 | 148·46 | 87·69 | 107·69 | 116·92 | 29·23 | 21·53 | 26·15 | 11·53 | 16·92 | 32·30 | 13·85 | 7·69 |
| Av. | 313·74 | 151·50 | 150·35 | 90·78 | 107·51 | 119·27 | 28·13 | 20·10 | 24·95 | 11·40 | 16·10 | 32·49 | 13·66 | 8·29 |

No. 1. Roy. Coll. Surgeons. Nos. 2 & 3. Nat. Hist. Mus. No. 4. Camb. Univ. No. 5. Oxford Univ.

Table XIII.—*Italian Greyhounds.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Fm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 275·05 | 157·65 | 143·52 | 89·65 | 103·65 | 120·0 | 31·29 | 20·52 | 27·05 | 10·56 | 14·56 | 38·35 | 12·70 | ... |
| 2. | 270·83 | 145·83 | 135·41 | 93·75 | 98·39 | 112·5 | 29·16 | 20·83 | 25·0 | 11·46 | 15·62 | 35·41 | 13·54 | ... |
| 3. | 268·0 | 164·0 | 140·0 | 100·0 | 104·0 | 112·0 | 28·0 | 20·0 | 24·0 | 12·0 | 16·0 | 34·0 | 14·0 | 5·0 |
| Av. | 271·29 | 155·82 | 139·64 | 94·46 | 102·68 | 114·83 | 29·48 | 21·45 | 25·35 | 11·34 | 15·39 | 35·92 | 13·41 | 5·0 |

No. 1. Nat. Hist. Mus. Nos. 2 & 3. Oxford Univ.

Two other forms of Greyhound are included in the next table, No. 1 being an Australian Greyhound used for kangaroo-hunting, No. 2 a Cabul Greyhound. Both are in the Nat. Hist. Mus.

Table XIV.

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Fm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 290·42 | 158·59 | 157·14 | 86·42 | 99·28 | 120·0 | 25·0 | 16·85 | 24·0 | 9·28 | 13·85 | 31·71 | 12·85 | 7·14 |
| 2. | 319·83 | 159·05 | 157·48 | 91·53 | 119·88 | 124·40 | 31·49 | 20·47 | 24·88 | 12·50 | 17·0 | 32·28 | 12·59 | 7·08 |

## Group III.—Spaniels.

The large Spaniel, of which, according to Fitzinger, the English Spaniel is a smaller breed, is apparently derived from Spain, and is considered by the above-named authority to be a pure breed.

Table XV.—*Spaniels.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 313·79 | 175·86 | 151·72 | 112·06 | 106·89 | 118·96 | 24·13 | 20·68 | 25·86 | 12·06 | 17·24 | 34·48 | 14·13 | 6·03 |
| 2. | 270·40 | 162·24 | 130·61 | 102·04 | 85·71 | 107·14 | 29·59 | 20·40 | 25·91 | 10·20 | 14·69 | 35·71 | 15·30 | ... |
| 3. | 307·54 | 164·15 | 139·62 | 100·0 | 113·20 | 129·24 | 31·13 | 21·69 | 27·35 | 11·32 | 17·92 | 35·84 | 17·35 | 10·37 |
| 4. | 286·12 | 157·35 | 124·19 | 100·0 | 90·32 | 103·22 | 29·35 | 20·96 | 27·41 | 10·48 | 19·0 | 35·48 | 19·35 | 5·64 |
| 5. | 288·56 | 166·09 | 142·85 | 109·52 | 99·04 | 107·61 | 27·61 | 22·25 | 25·71 | 12·76 | 16·57 | 32·38 | 15·61 | 9·52 |
| 6. | 258·18 | 154·54 | 134·04 | 103·63 | 89·09 | 112·72 | 30·0 | 22·72 | 27·27 | 10·90 | 15·45 | 34·54 | 14·54 | ... |
| 7. | 277·77 | 166·66 | 151·11 | 106·66 | ... | 117·77 | 33·33 | 22·22 | 28·88 | 13·33 | 17·77 | 37·77 | 14·40 | 6·66 |
| Av. | 283·19 | 163·82 | 139·23 | 104·81 | 97·37 | 113·81 | 29·30 | 21·56 | 26·62 | 11·58 | 16·95 | 35·17 | 15·81 | 7·64 |

Nos. 1 & 2. Roy. Coll. Surgeons. Nos. 3 & 4. Nat. Hist. Mus. (4. Water S.).
No. 5. Q. Coll. Birm. No. 6. Camb. Univ. No. 7. Oxford Univ.

In this division is also placed the King Charles Spaniel (1) and the Chinese Pug-nosed dog[1] (2), the measurements of both of which are given in the following table:—

Table XVI.

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 297·61 | 214·28 | 148·80 | 135·71 | 95·23 | 126·19 | 35·71 | 26·19 | 29·57 | 15·47 | 17·85 | 39·28 | 16·66 | ... |
| 2. | 307·69 | 189·47 | 92·10 | 110·52 | 59·21 | 68·42 | 21·05 | 16·31 | 18·94 | 9·21 | 12·36 | 27·10 | 9·21 | ... |

## Group IV.—Hounds.

This group includes the Bloodhound, Staghound, Foxhound, Harrier, Beagle, Pointer, Dalmatian, and Otter-dog.

The Bloodhound has several varieties. Thus there are two German breeds, one smaller and lighter (C. H. S.), and a Cuban breed, which is of Spanish descent and different from the English, having small pendulous ears and a more pointed nose (E. B.). It also has two spots over the eyes (C. H. S.). The following table includes four English and one from Manilla.

[1] For accounts of this breed see Gray, Proc. Zool. Soc. 1867, p. 40, and 1868, p. 509.

Table XVII.—*Bloodhounds.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Pm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 284·70 | 158·82 | 142·35 | 101·17 | 91·17 | 105·88 | 23·52 | 18·20 | 22·94 | 10·0 | 13·76 | ... | 10·58 | 6·47 |
| 2. | 303·44 | 158·62 | 143·44 | 99·31 | 100·37 | 117·24 | 27·58 | 19·03 | 24·41 | 11·44 | 16·55 | 31·72 | 13·51 | 8·27 |
| 3. | 312·92 | 171·42 | 149·65 | 104·76 | 103·40 | 114·28 | 27·21 | 18·77 | 26·25 | 11·56 | 17·95 | 31·97 | 12·92 | 7·48 |
| 4. | 348·33 | 191·66 | 171·66 | 119·33 | 106·66 | 119·16 | 30·0 | 21·16 | 24·16 | 12·5 | 15·83 | 37·0 | 14·16 | 9·16 |
| 5. | 288·57 | 154·28 | 145·71 | 90·0 | 90·0 | 114·28 | 28·42 | 17·85 | 21·42 | 10·0 | 14·28 | 31·42 | 13·57 | 8·71 |
| Av. | 307·59 | 166·96 | 150·56 | 101·71 | 98·32 | 114·17 | 26·94 | 19·01 | 23·83 | 11·10 | 17·67 | 33·27 | 12·95 | 7·42 |

No. 1. Roy. Coll. Surgeons. Nos. 2, 3, 4 (Manilla), Nat. Hist. Mus. No. 5. Oxford Univ.

The Foxhound is, according to 'Stonehenge,' generally supposed to have "been obtained by crossing the old-fashioned hound (whether Northern or Southern) with the Greyhound; but of this cross there is no record in the kennel books of our earliest Foxhound packs, which trace back for nearly or quite two hundred years. Now, success in breeding generally leads to a confession of the method by which it has been attained, as is exemplified in the case of Lord Oxford with his Bull-dog and Greyhound cross, and it is argued that if the Greyhound had been used as alleged, some record of the fact would have been handed down to us. Hence this point in the history of the Foxhound must be regarded as unsettled." It may be mentioned that Fitzinger believes it to be the produce of a cross between the English hunting-dog and the great Dane.

Table XVIII.—*Foxhounds.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | Pm. & M. L. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 284·61 | 153·84 | 153·84 | 100·0 | 98·46 | 115·38 | 28·15 | 19·23 | 20·76 | 10·0 | 14·61 | 30·76 | 12·30 | ... |
| 2. | 281·53 | 161·53 | 138·46 | 100·0 | 100·0 | 107·69 | 30·76 | 16·15 | 20·76 | 17·69 | 18·46 | 36·15 | 13·85 | ... |
| Av. | 283·07 | 157·68 | 146·15 | 100·0 | 99·23 | 111·53 | 29·45 | 17·69 | 20·76 | 13·84 | 16·53 | 33·45 | 13·07 | ... |

No. 1. Camb. Univ. No. 2. Oxford Univ.

A pure Harrier with the exception of the Welsh breeds is, according to 'Stonehenge,' very rare at the present day. The same authority states that this dog shares with the Bloodhound and Otterhound the honour of being the oldest breed of hounds now in England. It is distinguished, amongst other things, from the Fox-

hound by "being longer and narrower in the face and head, and somewhat more hollow under the eye." We cannot say to what special breed the example of which the measurements are given below belonged. It is in the Oxford University Museum.

"Between a large Welsh Harrier and an OTTER-HOUND no one but an expert could detect any difference, which, after all, will be found to exist only in the coat and feet, and then in a very slight degree." says 'Stonehenge.' For this reason we have placed the measurements of a skull of this breed, in the Oxford University Museum, in the same table.

Table XIX.—*Harrier and Otter-hound.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 289·09 | 169·09 | 136·36 | 109·09 | 101·81 | 123·63 | 30·90 | 21·81 | 28·18 | 10·90 | 16·36 | 38·18 | 13·63 | 7·27 |
| 2. | 272·72 | 163·63 | 136·18 | 100·0 | 90·90 | 112·72 | 29·09 | 20·0 | 25·45 | 10·90 | 14·54 | 30·90 | 14·54 | 7·27 |

No. 1. Harrier. No. 2. Otter-hound.

"The true BEAGLE is a miniature specimen of the old Southern hound" (*Stonehenge*). The following table gives the measurements of two specimens; No. 1 from the Natural History Museum, No. 2 from the Oxford University Museum.

Table XX.—*Beagles.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 278·15 | 162·06 | 140·22 | 103·44 | 112·64 | 126·43 | 34·48 | 25·97 | 29·88 | 13·79 | 18·39 | 38·62 | 14·25 | ... |
| 2. | 264·15 | 169·81 | 132·07 | 103·77 | 100·0 | 111·32 | 32·27 | 22·64 | 28·30 | 13·20 | 18·86 | 34·90 | 14·75 | 6·60 |
| Av. | 271·15 | 165·93 | 136·14 | 103·60 | 106·32 | 118·87 | 33·27 | 24·30 | 29·09 | 13·49 | 18·62 | 36·76 | 14·50 | 6·60 |

The POINTER possibly came from Spain, and originally Phœnicia (C. H. S.). There is, however, no proof, says 'Stonehenge,' that it originated in Spain, and the animal called the Old Spanish Pointer is now quite extinct in this country. It is possible, he proceeds to say, that the present Pointer may have been produced by careful selection from the original Spanish Pointer, but it is more probable that in all cases a cross directly with the Greyhound, or indirectly with that breed through the Foxhound, has been resorted to.

Table XXI.—*Pointers.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 278·87 | 170·42 | 138·79 | 102·81 | 90·47 | 109·85 | 24·64 | 20·42 | 22·91 | 10·70 | 15·49 | 30·42 | 13·38 | 5·63 |
| 2. | 300·0 | 165·84 | 155·55 | 100·0 | 101·58 | 111·90 | 30·95 | 20·15 | 22·69 | 9·84 | 14·28 | 33·65 | 14·60 | 8·25 |
| 3. | 252·99 | 148·68 | 128·70 | 95·72 | 99·25 | 116·23 | 27·69 | 17·94 | 24·95 | 9·57 | 15·38 | 30·76 | 12·30 | 5·98 |
| 4. | 290·76 | 169·23 | 153·84 | 100·0 | 100·0 | 110·76 | 27·69 | 19·23 | 22·30 | 11·53 | 13·85 | 30·76 | 14·61 | 10·0 |
| 5. | 277·77 | 175·92 | 148·14 | 111·11 | 97·22 | 112·96 | 30·50 | 22·22 | 28·88 | 13·88 | 18·51 | 35·18 | 16·66 | 9·25 |
| Av. | 280·08 | 166·02 | 144·99 | 101·93 | 98·70 | 112·34 | 29·29 | 19·99 | 24·33 | 11·10 | 15·50 | 32·15 | 14·31 | 7·92 |

Nos. 1 & 2. Roy. Coll. Surgeons. No. 3. Nat. Hist. Mus. No. 4. Cambridge. No. 5. Oxford.

Of the Dalmatian, which belongs to this group, we have been unable to examine a specimen.

## Group V.—Mastiffs.

A race either Mastiff or Bull-dog, or both, was, says Smith, existent in Britain before the Romans. This race is supposed to have been the progenitor of the breed of Talbot-dogs of mediæval times, and they again of the modern Mastiff, which some hold to be identical, whilst others think that the Talbot was something between a Mastiff and a Bull-dog. The typical form, according to the above-mentioned authority, is the Thibetan. The English modern Mastiff has been much crossed with the Bull-dog (S.).

The following table includes several varieties.

Table XXII.—*Mastiffs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 353·22 | 173·0 | 164·70 | 106·61 | 103·88 | 114·70 | 31·61 | 19·85 | 24·26 | 12·05 | 17·64 | 36·76 | 15·0 | 7·64 |
| 2. | 280·51 | 162·33 | 129·87 | 112·98 | 84·41 | 88·31 | 24·02 | 16·88 | 19·74 | 9·74 | 14·28 | 28·83 | 12·98 | 7·79 |
| 3. | 279·86 | 165·27 | 136·11 | 97·22 | 90·27 | 99·44 | 25·27 | 16·94 | 20·83 | 9·72 | 12·77 | 27·08 | 11·11 | 6·25 |
| 4. | 350·16 | 195·89 | 169·86 | 108·90 | 110·95 | 118·08 | 29·04 | 18·76 | 24·24 | 11·86 | 15·75 | 31·78 | 13·42 | 6·57 |
| 5. | 288·37 | 162·79 | 138·37 | 102·32 | 90·69 | 96·51 | 25·35 | 17·44 | 25·0 | 11·39 | 14·88 | 30·58 | 12·20 | 7·32 |
| 6. | 317·14 | 165·71 | 152·85 | 95·71 | 101·42 | 117·14 | 25·0 | 17·42 | 23·57 | 10·0 | 14·71 | 30·0 | 12·14 | 7·85 |
| 7. | 314·86 | 174·72 | 165·54 | 104·05 | 100·0 | 106·08 | 25·0 | 19·59 | 24·32 | 11·21 | 14·86 | 30·54 | 13·51 | ... |
| 8. | 298·52 | 172·79 | 149·38 | 100·0 | 98·52 | 111·76 | 28·67 | 21·32 | 25·29 | 10·29 | 16·91 | 32·35 | 14·70 | 5·88 |
| 9. | 306·41 | 179·48 | 151·28 | 115·38 | 106·41 | 119·87 | 27·82 | 19·48 | 24·35 | 12·17 | 16·66 | 35·33 | 15·64 | 9·97 |
| 10. | 288·13 | 203·38 | 144·06 | 105·08 | 101·69 | 122·03 | 30·58 | 21·18 | 27·96 | 12·71 | 18·64 | 33·89 | 15·25 | ... |
| Av. | 306·51 | 175·73 | 149·60 | 104·82 | 99·02 | 108·89 | 27·22 | 18·88 | 23·95 | 11·06 | 15·71 | 31·59 | 13·59 | 7·29 |

Nos. 1, 2, 3, Roy. Coll. Surgeons. No. 4 (Thibet), No. 5 (Danish), No. 6 (Bhotea, Nepál), No. 7 (Thibet), No. 8 (Scotch),—Nat. Hist. Mus. No. 9 (Irish), Trin. Coll. Dublin. No. 10. Oxford.

The BULL-DOG is an animal which has been used in numerous crosses. On account of its peculiarities one would expect that various specimens would present tolerably similar measurements, and this especially in the case of those detailed below, since in the greater number of cases the skulls are stated to have belonged to pure-bred animals. Yet, as we have already mentioned, in no breed are more striking differences to be remarked.

Table XXIII.—*Bull-dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 310·63 | 238·72 | 139·36 | 153·19 | 94·08 | 115·53 | 31·91 | 25·93 | 35·19 | 14·89 | 21·47 | 42·55 | ... | ... |
| 2. | 350·0 | 197·50 | 120·0 | 126·60 | 85·0 | 108·30 | 27·5 | 22·5 | 24·5 | 13·5 | 14·16 | 34·16 | 16·83 | 9·2 |
| 3. | 256·89 | 208·62 | 106·03 | 131·03 | 79·31 | 117·24 | 29·44 | 20·89 | 26·55 | 12·06 | 15·0 | 32·24 | 15·51 | 7·24 |
| 4. | 264·0 | 198·40 | 108·80 | 132·80 | 84·80 | 112·0 | 28·8 | 21·12 | 27·2 | 12·0 | 18·4 | 35·2 | 19·04 | ... |
| 5. | 244·80 | 177·60 | 104·0 | 121·60 | 80·0 | 120·0 | 27·2 | 21·60 | 20·4 | 9·6 | 16·32 | 32·8 | 13·6 | 5·92 |
| 6. | 292·80 | 200·0 | 120·0 | 137·60 | 78·72 | 123·20 | 28·32 | 22·40 | 24·8 | 13·6 | 16·0 | 36·0 | 14·4 | 7·2 |
| 7. | 252·62 | 186·49 | 117·54 | 129·82 | 87·71 | 119·29 | 30·70 | 22·80 | 28·94 | 11·40 | 16·6 | 37·71 | 15·78 | 9·64 |
| 8. | 277·14 | 177·14 | 134·85 | 107·14 | 99·28 | 110·71 | 26·0 | 20·0 | 25·71 | 11·42 | 16·42 | 32·42 | 15·0 | 8·85 |
| 9. | 277·61 | 210·44 | 128·35 | 128·35 | 94·02 | 112·20 | 26·11 | 20·39 | 26·11 | 10·89 | 16·71 | 34·32 | 14·17 | 8·95 |
| 10. | 260·0 | 220·0 | 120·0 | 140·0 | 84·0 | 140·0 | 32·0 | 22·0 | 29·0 | 13·0 | 20·0 | 38·0 | 18·0 | 10·0 |
| 11. | 246·03 | 171·43 | 117·46 | 103·17 | 95·23 | 111·11 | 26·19 | 19·84 | 25·39 | 11·11 | 16·66 | 31·74 | 14·28 | ... |
| Av. | 278·41 | 201·21 | 119·67 | 128·84 | 87·52 | 117·23 | 28·47 | 21·77 | 27·24 | 12·11 | 17·05 | 35·19 | 15·56 | 8·26 |

Nos. 1-7. Roy. Coll. Surgeons. Nos. 8, 9. Nat. Hist. Mus. Nos. 10, 11. Oxford.

The British breed of PUG is, according to 'Stonehenge,' one of those known to have existed from the earliest times. The two chief strains are the Morrison and the Willoughby d'Eresby. Fitzinger supposes the breed to have been derived by selection from the smaller kind of Bull-dog.

Table XXIV.—*Pugs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 229·76 | 157·14 | 110·71 | 125·0 | 88·09 | 111·90 | 28·57 | 20·23 | 28·57 | 10·0 | 15·47 | 29·76 | 11·90 | ... |
| 2. | 238·88 | 161·11 | 122·22 | 116·66 | 86·11 | 106·94 | 31·11 | ... | ... | ... | ... | 33·33 | 13·88 | ... |
| 3. | 213·63 | 138·63 | 113·63 | 122·72 | 68·18 | 88·63 | 29·54 | 18·18 | 25·0 | 9·09 | 10·22 | 30·68 | 12·5 | 4·54 |
| Av. | 227·4 | 152·96 | 115·52 | 121·46 | 80·79 | 102·49 | 29·74 | 19·20 | 26·78 | 9·09 | 12·84 | 31·26 | 12·76 | 4·54 |

No. 1. Roy. Coll. Surgeons. No. 2. Trin. Coll. Dublin. No. 3. Cambridge.

## Group VI.—Terriers.

According to Smith the Terriers are the oldest breed of dogs in England, the wire-haired or Scotch being the ancient and genuine breed. In the tables which follow measurements of different specimens belonging to several varieties are given.

### Table XXV.—*English Terriers.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. / L. | L. Pm. & M. | Pm. 4. / L. | M. 1. / L. | M. 1. / Br. | M. 2. / L. | M. 2. / Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 279·56 | 172·04 | 143·01 | 100·0 | 98·77 | 98·92 | 26·88 | 17·20 | 19·75 | 8·17 | 13·97 | 32·25 | 11·82 | ... |
| 2. | 295·45 | 181·81 | 155·0 | 122·72 | 109·09 | 115·90 | 37·5 | 26·13 | 30·68 | 13·63 | 17·04 | 40·90 | 15·90 | ... |
| 3. | 280·0 | 170·0 | 137·0 | 100·0 | 96·0 | 120·0 | 32·0 | 22·0 | 27·0 | 11·0 | 16·0 | 36·0 | 15·0 | 8·0 |

No. 1. Trin. Coll. Dublin. No. 2. Nat. Hist. Mus. No. 3. Oxford.

We have not given an average of these, as it is doubtful whether they can be considered in any way as belonging to the same breed.

### Table XXVI.—*Scotch Terriers.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. / L. | L. Pm. & M. | Pm. 4. / L. | M. 1. / L. | M. 1. / Br. | M. 2. / L. | M. 2. / Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 280·0 | 175·38 | 132·50 | 120·0 | 100·0 | 120·0 | 29·84 | 23·69 | 24·61 | 11·38 | 16·61 | 41·53 | 14·15 | ... |
| 2. | 277·27 | 181·81 | 155·68 | 118·18 | 111·36 | 118·18 | 37·5 | 25·0 | 30·68 | 11·36 | 17·04 | 36·36 | 15·90 | ... |
| Av. | 278·63 | 178·59 | 143·99 | 119·09 | 105·68 | 119·09 | 33·67 | 24·34 | 27·64 | 11·37 | 16·82 | 38·94 | 15·02 | ... |

No. 1. Nat. Hist. Mus. No. 2. Cambridge.

### Table XXVII.—*Skye-Terriers.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. / L. | L. Pm. & M. | Pm. 4. / L. | M. 1. / L. | M. 1. / Br. | M. 2. / L. | M. 2. / Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 330·23 | 197·67 | 165·11 | 134·88 | 106·97 | 129·06 | 39·67 | 22·69 | 26·74 | 12·79 | 17·91 | 40·69 | 15·58 | ... |
| 2. | 307·89 | 210·52 | 152·63 | 121·05 | 115·78 | 126·31 | 36·84 | 26·31 | 26·31 | 13·15 | 19·73 | 40·78 | 13·15 | ... |
| 3. | 272·72 | 172·72 | 140·90 | 102·27 | 100·0 | 120·45 | 31·81 | 20·45 | 25·0 | 10·22 | 11·36 | 36·26 | 15·90 | ... |
| Av. | 303·61 | 193·64 | 152·88 | 119·40 | 107·58 | 125·27 | 36·11 | 22·95 | 26·02 | 12·05 | 16·33 | 39·24 | 14·85 | ... |

No. 1. Roy. Coll. Surgeons. Nos. 2 & 3. Cambridge.

Table XXVIII.—*Fox-Terriers, pure.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 267·24 | 169·02 | 139·20 | 103·44 | 96·55 | 115·51 | 27·58 | 21·03 | 24·13 | 10·34 | 10·37 | 33·62 | 13·79 | 7·75 |
| 2. | 288·56 | 178·09 | 139·04 | 106·57 | 102·85 | 116·19 | 28·57 | 22·85 | 25·71 | 10·85 | 15·61 | 39·38 | 14·24 | 5·14 |
| 3. | 322·22 | 195·55 | 155·55 | 117·77 | 92·55 | 115·55 | 34·44 | 24·44 | 28·88 | ... | ... | 37·77 | 15·55 | ... |
| 4. | 260·41 | 170·83 | 133·33 | 104·16 | ... | 114·58 | 32·29 | 20·83 | 28·12 | 10·41 | 15·62 | 35·41 | 12·50 | 6·25 |
| Av. | 284·61 | 178·37 | 141·03 | 108·48 | 98·32 | 115·48 | 30·72 | 22·29 | 26·71 | 10·53 | 13·86 | 35·03 | 14·02 | 6·36 |

The Turnspit is included in the Terrier group although, being a semi-monstrous form, it is not confined to that breed. It is figured on the ancient monuments of Egypt, and found among Pariahs and other breeds. In England it generally occurs amongst Terriers and Hounds.

The following table gives the measurements of a specimen in the Oxford Museum.

Table XXIX.—*Turnspit.*

| Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 282·98 | 174·46 | 148·93 | 102·12 | 113·76 | 119·14 | 31·91 | 29·40 | 26·59 | 12·76 | 19·14 | 39·36 | 14·89 | ... |

## Group VII.

In this group we have included a number of wild or semi-wild and other forms, as it seemed better to place them separately than to distribute them among such of the preceding as they might questionably belong to.

The Pariah or native cur of India is placed near the Terriers by Smith, who states that they all have "lengthened backs, pointed ears, a sharp nose, and the tail more or less fringed." According to Youatt there are several varieties, viz.:—(1) A wild form bred in the jungles and lower ranges of the Himalayas, of a reddish-brown colour with sharp-pointed ears. (2) A form belonging to inhabited districts; Turnspits are often found amongst these (*Sykes*). There is a petted variety which is usually white, with long silky hair. (3) The Sumatran form, which has the "countenance of a fox, eyes oblique, ears rounded and hairy, muzzle foxy-brown, tail bushy and pendulous." (4) The Javan indigenous dog. Stonehenge describes the Pariah as a cross between the Dhole and any domesticated dog of the neighbourhood, and Fitzinger as a variant of the Sheep-dog. Pelzeln believes that it springs originally from the same form as the Dingo, and that this stem is the Indian wolf (*Canis pallipes*), from which, according to Jeitteles, the dog of the Bronze period (*Canis ma'ris optimæ*, J.) was also derived.

The following table gives the measurements of different specimens.

Table XXX.—*Pariah Dogs.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 290·32 | 149·19 | 138·70 | 90·32 | 88·70 | 108·45 | 28·22 | 16·90 | 23·38 | 9·67 | 13·70 | 32·58 | 15·32 | ... |
| 2. | 320·32 | 166·61 | 158·09 | 108·12 | 110·89 | 125·20 | 31·20 | 21·13 | 25·52 | 13·28 | 17·88 | 33·65 | 14·65 | 8·94 |
| 3. | 305·45 | 188·18 | 155·40 | 105·45 | 121·81 | 131·27 | 30·90 | 20·0 | 26·72 | 10·90 | 17·27 | 30·90 | 13·09 | ... |
| 4. | 284·48 | 167·24 | 127·58 | 110·68 | 94·82 | 125·86 | 32·41 | 21·55 | 27·93 | 10·68 | 17·24 | 39·13 | 13·27 | 8·27 |
| 5. | 301·58 | 150·47 | 153·96 | 90·47 | 105·50 | 121·42 | 30·15 | 21·42 | 27·30 | 10·79 | 15·87 | 33·65 | 12·69 | 7·14 |
| 6. | 303·84 | 156·07 | 144·30 | 94·61 | 106·92 | 115·38 | 29·25 | 18·0 | 30·15 | 11·84 | ... | 31·23 | 13·38 | 8·46 |
| 7. | 305·50 | 180·74 | 151·37 | 102·76 | 124·78 | 133·94 | 35·57 | 21·65 | 27·65 | 13·21 | 16·51 | 38·16 | 16·51 | 10·09 |
| Av. | 301·64 | 165·78 | 146·77 | 100·34 | 107·83 | 122·79 | 31·08 | 20·12 | 26·38 | 11·48 | 16·41 | 34·18 | 12·69 | 8·58 |

No. 1 (Bengal). Nos. 2, 3, 4 (Nepaul). No. 5 (Bengal). Nos. 6 & 7 (Nepaul).
All from Nat. Hist. Mus.

Various opinions have been expressed with regard to the origin and relations of the DINGO. Ogilby[1] says "there are strong grounds for believing that the Dingo or native dog (of Australia) is not an aboriginal inhabitant of the continent, but a subsequent importation, in all probability contemporary with the primitive settlement of the natives. Many circumstances might be advanced in support of this opinion; the simple fact of his anomaly is itself a strong corroboration of it; and his absence from the contiguous islands of Tasmania and New Zealand, inhabited by races of human beings differing in language and origin from the natives of Continental Australia, appears almost to demonstrate his introduction from the north, where he is found in New Guinea, in Timor, in many of the smaller groups scattered throughout the Pacific Ocean, and in all the great islands of the Indian Archipelago. The extirpation of the *Thylacinus harrisii* and *Dasyurus ursinus* from the continental portion of Australia, is a strong corroboration of this supposition." Youatt states that it approaches in appearance the largest kind of Sheep-dog. Its head is elongated, forehead flat, ears short and erect or directed slightly forwards. Its body is covered with hair of two kinds—(1) woolly and grey, (2) silky and deep yellow or fawn. It seldom barks. 'Stonehenge' says that it resembles the Fox so closely in the shape of its body that an ordinary observer could readily mistake it for one of that species, while the head is that of a wolf. Pelzeln, as already mentioned, believes this dog to have had a common origin with the Pariah. It is not in his opinion a native of Australia, the varieties of its colouring being a proof of this fact.

The measurements of several specimens will be found in the next table.

[1] Trans. Linn. Soc. xviii. p. 121.

Table XXXI.—*Dingo.*

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | L. M. 2. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 314·03 | 172·80 | 152·63 | 107·89 | 107·01 | 121·05 | 30·17 | 21·05 | 25·43 | 8·77 | 14·91 | 35·96 | 13·15 | 7·89 |
| 2. | 283·60 | 178·22 | 143·44 | 108·19 | 112·62 | 121·31 | 30·65 | 20·0 | 25·08 | ... | ... | 32·95 | 12·29 | ... |
| 3. | 322·30 | 173·3 | 156·60 | 107·5 | 116·03 | 140·0 | 33·63 | 23·66 | 30·33 | 12·50 | 18·60 | 38·0 | 15·0 | 8·33 |
| 4. | 300·0 | 173·48 | 150·0 | 98·48 | 98·78 | 124·24 | 29·09 | 19·09 | 25·75 | 11·36 | 16·66 | 31·81 | 12·87 | ... |
| 5. | 291·93 | 167·74 | 141·93 | 100·0 | 103·22 | 125·0 | 29·35 | 18·06 | 26·12 | 12·90 | 18·54 | 31·45 | 12·90 | 8·57 |
| Av. | 302·57 | 172·71 | 148·92 | 104·41 | 107·39 | 128·32 | 30·58 | 20·37 | 26·54 | 11·39 | 17·18 | 34·03 | 13·24 | 8·26 |

Nos. 1 & 2. Roy. Coll. Surgeons. Nos. 3, 4, 5. Nat. Hist. Mus.

In the next table are given the measurements of several miscellaneous specimens.

Table XXXII.

| No. | Total length. | Zygomatic width. | Length of bony palate. | Width of bony palate. | Pm. & M. L. | L. Pm. & M. | Pm. 4. L. | M. 1. L. | M. 1. Br. | M. 2. L. | M. 2. Br. | L. M. 1. | Br. M. 1. | L. M. 3. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 320·0 | 194·6 | 156·19 | 121·90 | 100·0 | 123·80 | 32·38 | 20·0 | 25·14 | 10·47 | 17·14 | 36·19 | 12·53 | 6·6 |
| 2. | 307·84 | 189·78 | 150·0 | 106·86 | 101·96 | 120·58 | 30·39 | 21·56 | 21·56 | 10·19 | 14·70 | 32·35 | 14·11 | ... |
| 3. | 269·23 | 176·92 | 128·20 | 102·56 | 101·28 | 116·6 | 36·41 | 23·84 | 30·76 | 11·53 | 18·46 | 38·97 | 15·38 | 8·20 |
| 4. | 311·11 | 164·44 | 144·44 | 111·11 | 106·66 | 122·22 | 33·33 | 22·22 | 26·66 | 11·11 | 17·77 | 37·77 | 14·44 | ... |
| 5. | 323·07 | 173·07 | 169·46 | 111·53 | 109·61 | 130·76 | 30·76 | 22·11 | 27·88 | 14·42 | 17·30 | 38·46 | 16·34 | 9·61 |

Nos. 1 & 2. Chinese dogs; No. 3. Chinese dog (tame), Nat. Hist. Mus. No. 4. West-Indian dog (almost without hair). No. 5. Dog from New Zealand, Oxford.

The *New-Zealand* dog described by writers, to an animal of which kind we presume the last-mentioned skull to have belonged, is called Karáráhé by Youatt, who states that it was probably introduced into the island by Spaniards from Juan Fernandez. Fitzinger states that the similarity of characteristics between this dog and the great Pariah is so marked as to leave no doubt that the former is a climatic modification of the latter. The naked *West-Indian* dog is presumably one of the Greyhound family.

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In order to bring the leading points to be drawn from these measurements together, we shall summarize in two further tables the averages of the chief breeds. The tables are drawn up only from those groups of which, at least, three specimens have been examined. The maximum measurement of each breed, the minimum, the difference between these two, and the average, are given for each of the several measurements which have been made and detailed in former tables. Table XXXIII. gives those figures which relate to measurements of bones. Table XXXIV. those having to do with the individual teeth.

## Table XXXIII.—*Comparative Measurements.—Cranial.*

| | Total length. | | | | Zygomatic width. | | | | Length of bony palate. | | | | Width of bony palate. | | | | Length of Pm. & M. | | | | Length of Pm. & M. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Diff. | Av. | Max. | Min. | Diff. | Av. | Max. | Min. | Diff. | Av. | Max. | Min. | Diff. | Av. | Max. | Min. | Diff. | Av. | Max. | Min. | Diff. | Av. |
| Esquimaux | 339·09 | 269·23 | 69·86 | 299·08 | 197·81 | 156·41 | 41·40 | 170·62 | 162·96 | 138·46 | 24·50 | 145·71 | 119·09 | 92·30 | 26·79 | 109·38 | 121·48 | 93·07 | 28·41 | 101·55 | 137·62 | 92·30 | 45·32 | 112·91 |
| Sheep-dog | 309·78 | 261·66 | 39·12 | 288·50 | 173·43 | 136·66 | 37·77 | 157·01 | 150·86 | 130·83 | 20·03 | 141·26 | 109·44 | 91·66 | 17·78 | 99·89 | 154·68 | 95·83 | 58·85 | 112·93 | 128·12 | 109·16 | 18·96 | 116·86 |
| Newfoundland | 321·62 | 297·14 | 24·48 | 308·01 | 189·18 | 157·14 | 32·04 | 173·43 | 156·75 | 140·6 | 16·15 | 150·12 | 113·51 | 100·00 | 13·51 | 105·38 | 100·00 | 96·00 | 4·00 | 98·32 | 142·85 | 109·30 | 33·55 | 129·15 |
| Greyhound | 359·70 | 280·00 | 79·70 | 313·74 | 167·18 | 138·46 | 29·72 | 151·30 | 153·96 | 147·76 | 6·20 | 150·35 | 93·75 | 87·69 | 6·06 | 90·78 | 111·71 | 104·28 | 7·43 | 107·51 | 128·57 | 113·49 | 15·06 | 119·27 |
| Italian Greyhound | 275·05 | 268·00 | 7·05 | 271·29 | 164·00 | 145·83 | 18·17 | 155·82 | 143·52 | 133·41 | 8·11 | 139·64 | 100·00 | 89·65 | 10·35 | 94·46 | 105·65 | 98·39 | 7·26 | 102·88 | 120·00 | 112·00 | 8·00 | 114·83 |
| Irish Wolf-dog, modern | 337·41 | 304·34 | 33·07 | 319·18 | 169·56 | 152·63 | 16·93 | 162·03 | 161·29 | 146·05 | 15·24 | 153·65 | 103·22 | 96·05 | 7·17 | 100·24 | 111·57 | 105·79 | 6·78 | 108·24 | 130·86 | 121·05 | 9·81 | 124·79 |
| Irish Wolf-dog, old | 326·66 | 284·84 | 42·82 | 304·47 | 176·60 | 153·73 | 20·93 | 165·70 | 153·33 | 133·33 | 20·00 | 143·17 | 105·00 | 88·60 | 17·40 | 96·36 | 109·72 | 96·96 | 13·76 | 104·09 | ... | ... | ... | ... |
| Spaniel | 313·79 | 258·18 | 55·61 | 283·19 | 175·86 | 154·54 | 21·32 | 163·82 | 151·72 | 124·19 | 27·53 | 139·23 | 112·06 | 100·00 | 12·06 | 104·81 | 113·20 | 89·09 | 24·11 | 97·67 | 129·34 | 103·22 | 26·02 | 113·78 |
| Bloodhound | 348·33 | 284·70 | 63·63 | 307·59 | 191·66 | 154·28 | 37·38 | 166·96 | 171·66 | 142·35 | 29·31 | 150·56 | 112·33 | 90·00 | 23·33 | 101·71 | 109·09 | 90·90 | 19·66 | 98·52 | 119·16 | 105·8 | 13·36 | 114·17 |
| Pointer | 300·0 | 252·99 | 47·01 | 280·08 | 175·92 | 148·68 | 27·24 | 166·02 | 155·55 | 128·70 | 26·85 | 144·99 | 111·11 | 95·72 | 15·39 | 104·95 | 101·58 | 96·47 | 5·11 | 98·70 | 116·23 | 109·85 | 6·38 | 112·54 |
| Mastiff | 350·16 | 279·86 | 76·30 | 306·51 | 203·38 | 162·33 | 41·05 | 175·73 | 169·86 | 129·87 | 39·99 | 149·60 | 115·38 | 95·71 | 19·67 | 104·82 | 110·95 | 84·41 | 26·54 | 99·02 | 122·03 | 88·31 | 33·72 | 108·09 |
| Bull-dog | 350·00 | 244·80 | 105·20 | 278·41 | 238·72 | 171·42 | 67·30 | 201·21 | 139·36 | 104·00 | 35·36 | 119·67 | 153·19 | 103·17 | 50·02 | 128·84 | 99·28 | 78·72 | 21·56 | 87·52 | 140·00 | 108·20 | 31·79 | 117·23 |
| Pug | 238·88 | 213·63 | 25·25 | 227·40 | 188·63 | 157·14 | 31·49 | 168·96 | 122·22 | 110·71 | 11·51 | 115·52 | 125·00 | 116·66 | 8·44 | 121·46 | 88·09 | 68·18 | 19·91 | 80·79 | 111·90 | 88·63 | 23·27 | 102·49 |
| Fox-Terrier | 322·22 | 260·41 | 61·81 | 284·61 | 195·55 | 169·82 | 26·73 | 178·57 | 155·55 | 133·33 | 22·22 | 141·03 | 117·77 | 103·44 | 14·33 | 108·48 | 102·85 | 95·55 | 7·30 | 98·32 | 116·19 | 114·58 | 2·61 | 115·45 |
| Skye-Terrier | 330·23 | 272·72 | 57·51 | 303·61 | 210·52 | 172·72 | 37·80 | 193·64 | 165·11 | 140·60 | 24·51 | 152·88 | 134·88 | 102·27 | 32·61 | 119·40 | 115·78 | 100·00 | 15·78 | 107·58 | 129·06 | 120·45 | 8·53 | 125·27 |
| Puriah | 320·32 | 284·48 | 35·84 | 301·64 | 188·18 | 149·19 | 38·99 | 165·75 | 156·09 | 127·58 | 28·41 | 146·77 | 110·62 | 90·32 | 20·36 | 100·34 | 124·78 | 88·70 | 36·08 | 107·63 | 133·94 | 106·45 | 27·49 | 122·79 |
| Dingo | 329·50 | 283·60 | 29·70 | 302·57 | 176·22 | 167·74 | 9·48 | 172·71 | 156·60 | 141·93 | 14·67 | 148·92 | 108·19 | 98·48 | 9·61 | 104·41 | 116·33 | 98·78 | 17·55 | 107·59 | 140·00 | 121·05 | 18·95 | 129·32 |

Table XXXIV.—*Comparative*

| | Length of Pm. 4. | | | | Length of M. 1. | | | | Breadth of M. 1. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | D. | Av. | Max. | Min. | D. | Av. | Max. | Min. | D. | Av. |
| Esquimaux | 38·72 | 25·64 | 13·08 | 30·74 | 24·36 | 16·06 | 8·30 | 20·53 | 30·90 | 22·05 | 8·85 | 26·32 |
| Sheep-dog | 30·17 | 27·50 | 2·67 | 28·83 | 20·43 | 19·82 | 1·61 | 20·60 | 27·34 | 24·40 | 2·94 | 26·01 |
| Newfoundland | 28·57 | 27·70 | ·87 | 28·27 | 20·71 | 20·00 | ·71 | 20·41 | 25·00 | 22·29 | 2·71 | 24·04 |
| Greyhound | 29·23 | 26·26 | 2·97 | 28·13 | 21·53 | 18·25 | 3·28 | 20·10 | 26·15 | 23·03 | 3·12 | 24·95 |
| Italian Greyhound | 31·29 | 28·00 | 3·29 | 29·48 | 23·52 | 20·00 | 3·52 | 21·45 | 27·05 | 24·00 | 3·05 | 25·35 |
| Irish Wolf-dog, modern | 29·71 | 25·80 | 3·91 | 27·27 | 21·73 | 19·61 | 2·12 | 20·36 | 26·81 | 23·68 | 3·13 | 25·09 |
| Irish Wolf-dog, old | 30·85 | 25·75 | 5·08 | 28·93 | 19·44 | 13·63 | 5·81 | 15·83 | 26·66 | 22·38 | 4·28 | 24·69 |
| Spaniel | 33·33 | 24·13 | 9·20 | 29·30 | 22·72 | 20·40 | 2·32 | 21·56 | 28·88 | 25·71 | 3·17 | 26·62 |
| Bloodhound | 30·00 | 23·52 | 6·48 | 26·94 | 21·16 | 17·85 | 3·31 | 19·01 | 26·25 | 21·42 | 4·83 | 23·83 |
| Pointer | 30·95 | 24·64 | 6·31 | 28·29 | 22·22 | 20·15 | 2·07 | 19·99 | 28·88 | 22·30 | 6·58 | 24·33 |
| Mastiff | 31·61 | 24·02 | 7·59 | 27·22 | 21·32 | 16·88 | 4·44 | 18·88 | 27·96 | 19·74 | 8·22 | 23·95 |
| Bull-dog | 31·91 | 26·00 | 5·91 | 28·47 | 25·95 | 19·84 | 6·11 | 21·77 | 35·10 | 24·5 | 11·50 | 27·24 |
| Pug | 31·11 | 28·57 | 2·54 | 29·74 | ... | ... | .... | 19·20 | ... | ... | ... | 26·78 |
| Fox-Terrier | 34·44 | 27·38 | 6·86 | 30·72 | 24·44 | 20·83 | 3·61 | 22·29 | 28·88 | 24·13 | 4·75 | 26·71 |
| Skye-Terrier | 39·67 | 31·81 | 7·86 | 36·11 | 26·31 | 20·45 | 5·86 | 22·95 | 29·74 | 25·00 | 1·74 | 26·02 |
| Pariah | 35·37 | 28·22 | 7·35 | 31·09 | 21·65 | 16·93 | 4·72 | 20·12 | 27·93 | 23·28 | 4·65 | 26·38 |
| Dingo | 33·62 | 29·06 | 4·54 | 30·58 | 23·66 | 18·06 | 5·60 | 20·37 | 30·35 | 25·08 | 5·25 | 26·54 |

The most noteworthy fact learnt from these tables is that the averages of the different breeds in each column, and especially in those relating to some of the teeth, differ very little from one another; in other words, that, speaking generally, the teeth in one dog are relatively to the skull very similar in size to those of any other. It will also be noticed from the last two tables that the range of variation in any breed is much greater, in almost every case, than that existing between any two breeds.

The extreme variations in any breed are probably due to the fact that, strictly speaking, so few animals of the same group are really in any sense of the same breed. The various members of a carefully selected strain of Terriers, for example, bred by one breeder, might be comparable with one another, and yet quite different in descent from another and perhaps equally good strain belonging to another breeder and to another part of the country. With dogs bred for show purposes, as so many of the pure strains are, and with constantly varying requirements of fashion, all sorts of crosses, as any manual on dog-breeding will show, have been tried with a view of attaining the ideal, whether of symmetry, pace, or carriage.

That such crosses should, at times at least, leave their marks

*Measurements.—Dental.*

| Length of M. 2. | | | | Breadth of M. 2. | | | | Length of M. 1. | | | | Length of M. 2. | | | | Length of M. 3. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | Min. | D. | Av. | Max. | Min. | D. | Av. | Max. | Min. | D. | Av. | Max. | Min. | D. | Av. | Max. | Min. | D. | Av. |
| 13·48 | 8·97 | 4·51 | 10·93 | 20·36 | 14·10 | 6·26 | 16·39 | 39·27 | 29·48 | 9·79 | 34·23 | 15·71 | 12·05 | 3·66 | 13·86 | 9·52 | 6·15 | 3·37 | 7·19 |
| 14·17 | 9·48 | 4·69 | 11·88 | 18·28 | 15·00 | 3·28 | 16·35 | 34·51 | 31·03 | 3·48 | 32·68 | 17·32 | 11·70 | 5·62 | 14·11 | 11·81 | 8·33 | 3·48 | 9·51 |
| 12·60 | 10·81 | 1·79 | 11·74 | 18·00 | 14·86 | 3·14 | 15·89 | 34·90 | 30·67 | 4·29 | 32·48 | 14·60 | 12·85 | 1·15 | 13·81 | 9·5 | 6·08 | 3·22 | 7·51 |
| 11·93 | 10·19 | 1·74 | 11·40 | 17·18 | 14·92 | 2·26 | 16·10 | 33·57 | 31·74 | 1·83 | 32·49 | 14·28 | 12·69 | 1·59 | 13·06 | 9·37 | 7·69 | 1·68 | 8·29 |
| 12·00 | 10·56 | 1·44 | 11·34 | 16·00 | 14·56 | 1·44 | 15·39 | 38·35 | 34·00 | 4·35 | 35·92 | 14·00 | 12·70 | 1·30 | 13·41 | ... | ... | ... | 5·00 |
| 12·75 | 11·61 | 1·14 | 12·07 | 17·41 | 16·44 | ·97 | 16·93 | 34·05 | 31·57 | 2·48 | 33·06 | 14·47 | 13·76 | ·71 | 14·05 | ... | ... | ... | 5·92 |
| 12·5 | 9·09 | 3·41 | 11·35 | 19·16 | 16·25 | 2·91 | 17·88 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 13·33 | 10·20 | 3·13 | 11·58 | 19·00 | 14·69 | 4·31 | 16·95 | 37·77 | 32·38 | 5·39 | 35·17 | 19·25 | 14·13 | 5·22 | 15·81 | 10·37 | 5·64 | 4·73 | 7·64 |
| 12·50 | 10·00 | 2·50 | 11·10 | 17·85 | 13·76 | 4·19 | 17·67 | 37·00 | 31·42 | 5·58 | 33·27 | 14·16 | 10·58 | 3·58 | 12·95 | 9·16 | 5·71 | 3·45 | 7·42 |
| 13·88 | 9·57 | 4·31 | 11·10 | 18·51 | 13·85 | 4·66 | 15·50 | 35·18 | 30·42 | 4·76 | 32·15 | 16·66 | 12·30 | 4·36 | 14·31 | 10·00 | 5·63 | 4·37 | 7·82 |
| 12·71 | 9·72 | 2·99 | 11·06 | 18·64 | 12·77 | 5·87 | 15·71 | 36·76 | 27·08 | 9·68 | 31·51 | 15·64 | 11·11 | 4·53 | 13·59 | 8·97 | 5·68 | 3·29 | 7·29 |
| 14·89 | 9·60 | 5·29 | 12·11 | 21·27 | 14·16 | 7·11 | 17·65 | 42·55 | 31·74 | 10·81 | 35·19 | 19·04 | 13·6 | 5·44 | 15·56 | 10·00 | 5·92 | 4·8 | 8·26 |
| ... | ... | ... | 9·05 | ... | ... | ... | 12·84 | 33·33 | 29·76 | 3·57 | 31·26 | 13·88 | 11·90 | 1·98 | 12·76 | ... | ... | ... | 4·54 |
| 10·85 | 10·34 | ·51 | 10·53 | 16·37 | 15·61 | ·76 | 15·86 | 37·77 | 33·33 | 4·44 | 35·03 | 13·55 | 12·50 | 3·05 | 14·02 | 7·75 | 5·14 | 2·61 | 6·38 |
| 13·15 | 10·22 | 2·93 | 12·05 | 19·73 | 11·36 | 8·37 | 16·53 | 40·78 | 36·26 | 4·52 | 39·24 | 15·90 | 13·15 | 2·75 | 14·88 | ... | ... | ... | ... |
| 13·28 | 9·67 | 3·61 | 11·48 | 17·88 | 13·70 | 4·18 | 16·41 | 39·13 | 30·90 | 8·23 | 34·18 | 16·51 | 12·69 | 3·82 | 12·69 | 10·09 | 7·14 | 2·95 | 8·68 |
| 12·96 | 8·77 | 4·19 | 11·29 | 18·60 | 14·91 | 3·69 | 17·18 | 38·00 | 31·45 | 6·55 | 34·00 | 15·00 | 12·29 | 2·71 | 13·24 | 8·57 | 7·89 | ·68 | 8·26 |

upon the skulls, and cause differences in breeds which cannot be accounted for, is, of course, to be expected. The presence of the disturbing factor can be appreciated, though its exact nature cannot always or even frequently be ascertained with any correctness. Thus amongst the eleven Bull-dogs' skulls which we have examined there was one which differed in measurements considerably from the rest. It was nearly 1 cm. longer than any other and, what is much more significant, it was 7 cm. longer than it was broad, the average for the others being about 3 or 4 cm. Moreover its palate was 1·90 cm. longer than it was broad, whilst in every other case but one the breadth exceeded the length. In the second case, the length was ·90 greater than the breadth of the palate, and the length of the skull nearly 5 cm. greater than the zygomatic width. We hope to be able to show more fully in another part of this paper that the first effect of impurity in breeding upon an artificially broadened and shortened skull such as the Bull-dog possesses, is in the direction of elongation and narrowing. We cannot doubt that both of the skulls above mentioned were those of dogs in whom, to a greater or lesser degree, there was an admixture of strain, of what kind it is impossible to say. And what is true of

these is doubtless true also in lesser degree of the greater number of specimens coming under examination. It thus becomes apparently a hopeless task to look for evidence as to the proximate or ultimate derivation of the breeds of domestic dogs in their skulls or teeth.

Some points of interest may, however, be learnt from a comparison of certain of the measurements, and with these we now proceed to deal in order.

*Relative Breadth and Length of Skulls and Palates.*

In the tables next to follow we have endeavoured to classify the skulls according to their relative breadth and length and according to that of their palates. An index has in each case been taken by using the formula

$$\frac{\text{Width} \times 100}{\text{Length}}.$$

In the first instance this has been applied to the measurements "total length" and "zygomatic width." Those dogs of which the index is above the average are those possessed of short, broad heads, whilst those below are in varying degrees long and narrow-headed. A distinct group placed near to but slightly below the average, may be looked upon as occupying a medium position between the two extremes. The second column, which has been placed side by side with the first for the sake of more easy comparison, deals with the relative size of the palatine surface. The first column, whilst conveying a good idea of the relative length and breadth as they appear in the living animal, conveys at the same time a somewhat incorrect idea of the actual condition, since it is dependent upon the amount of projection of the zygoma, which is obviously a more or less variable factor. A comparison of the two columns shows how much some skulls owe their apparent breadth to zygomatic projection. It also shows that the broadest and narrowest heads fall into nearly the same positions in both columns, those intermediate between the two extremes showing greater discrepancies. Some of the figures are from the measurements of single specimens; in cases where more than one has been examined the measurements are averages.

It will be noticed that the distinctly broad-headed dogs form a well-marked group by themselves, including the Chinese Pug-nosed Spaniel, the Pug, Bull-dog, Black-and-tan Toy Terrier, and King Charles' Spaniel, a considerable interval existing between these and the next. All these, it will be noticed, are highly artificial breeds which require great care and attention to be bestowed upon them to prevent deterioration with its consequent elongation. Next to this group comes one largely consisting of Terriers with heads inclining to be broad. A miscellaneous group next follows gradually decreasing to the distinctly narrow-headed dogs such as the Irish Wolf-dog and the Greyhound. It is interesting to notice the

Table XXXV.—*Comparison of Length and Breadth.*

| No. | Total length and zygomatic width. Average 63·53. | | Palatine length and width. Average 76·93. | |
|---|---|---|---|---|
| | Dog. | Index. | Dog. | Index. |
| 1. | Chinese Pug-nosed Spaniel | 91·13 | Chinese Pug-nosed Spaniel | 120·00 |
| 2. | Pug | 74·83 | Bull-dog | 106·84 |
| 3. | Bull-dog | 73·72 | Pug | 105·76 |
| 4. | Black-and-tan Toy Terrier | 73·52 | King Charles | 91·20 |
| 5. | King Charles | 72·00 | Black-and-tan Toy Terrier | 86·56 |
| 6. | Skye | 63·57 | English Terrier | 81·82 |
| 7. | Fox-Terrier | 62·94 | Harrier | 80·00 |
| 8. | Turnspit | 61·65 | Skye | 77·98 |
| 9. | English Terrier | 61·53 | Pomeranian | 77·37 |
| 10. | Beagle | 61·07 | West-Indian Dog | 76·92 |
| 11. | Black-and-tan Terrier | 60·71 | Fox-Terrier | 76·92 |
| 12. | Otter-dog | 60·00 | Spaniel | 76·68 |
| 13. | Pomeranian | 59·54 | Beagle | 76·33 |
| 14. | Pointer | 59·19 | Black-and-tan Terrier | 72·99 |
| 15. | Harrier | 58·49 | Otter-dog | 72·36 |
| 16. | Spaniel | 57·78 | Mastiff | 71·86 |
| 17. | Italian Greyhound | 57·63 | Esquimaux | 71·76 |
| 18. | Mastiff | 57·16 | Sheep-dog | 70·78 |
| 19. | Dingo | 57·13 | Newfoundland | 70·23 |
| 20. | Esquimaux | 56·86 | Pointer | 70·21 |
| 21. | Newfoundland | 56·35 | Dingo | 70·03 |
| 22. | Fox-hound | 55·70 | Turnspit | 68·57 |
| 23. | Sheep-dog | 55·45 | Fox-hound | 68·42 |
| 24. | Bloodhound | 54·79 | New-Zealand dog | 68·23 |
| 25. | Pariah | 54·28 | Pariah | 68·22 |
| 26. | New-Zealand dog | 53·57 | Italian Greyhound | 68·14 |
| 27. | Irish Wolf-dog (old) | 53·02 | Bloodhound | 67·77 |
| 28. | West-Indian dog | 52·85 | Irish Wolf-dog (old) | 67·06 |
| 29. | St. Bernard | 52·62 | St. Bernard | 65·35 |
| 30 | Irish Wolf-dog (modern) | 50·59 | Irish Wolf-dog (modern) | 65·17 |
| 31. | Greyhound | 49·89 | Greyhound | 60·36 |

effect of the artificial shortening of the skull effected upon the dentition in the first group. The teeth are not decreased in number, nor in size, it is only their position with regard to one another which alters. The first change is closer approximation of the teeth, less

space existing between neighbours in less roomy jaws. In still further shortening a torsion of certain teeth in the upper jaw takes place which always follows a very definite course.

The tooth first to feel the strain in every case with which we have met is the third upper premolar, which becomes slightly oblique and then is rotated until it lies transversely across instead of along the alveolar border. The next tooth to yield is the second premolar, which is sometimes slightly oblique, the third being transverse and sometimes in further advanced cases also rotated into a transverse position. The teeth of the lower jaw exhibit no such transverse rotation. In the Bull-dog shortening does not proceed so far in the lower as in the upper, and consequently the upper canine has for its lower antagonists one or more of the premolars. Thus, in six Bull-dogs' skulls in which we noted the position the upper canine three times was over Pm. 3, twice between Pm. 2 and Pm. 3, and once over Pm. 2.

In other cases the pressure for space may carry the last lower molar up on to the ramus of the jaw. Sometimes the lower jaws, instead of being nearly straight, are distinctly bowed to accommodate themselves to the curve of the teeth in the upper jaw. The following table shows the torsion of premolars in certain cases where it was well marked.

Table XXXVI.—*Torsion of Premolars.*

| Dog. | Torsion. |
|---|---|
| Bull-dog | Pm. 3 nearly transverse. |
| Bull-dog | " " " |
| Bull-dog | Pm. 2 & Pm. 3 oblique. |
| Bull-dog | " " transverse. |
| Bull-dog | Pm. 3 transverse ; Pm. 2 oblique. |
| Pug | Pm. 2 & Pm. 3 transverse. |
| Pug | Pm. 3 transverse. |
| Pug ¾-bred | Pm. 3 transverse, Pm. 2 nearly so R., oblique L. |
| Bull-Terrier | Pm. 3 transverse. |
| Black-and-tan Terrier | " " |
| King Charles Spaniel | " " |
| Skye | Slight rotation of Pm. 3. |
| Islay Terrier | Pm. 3 nearly transverse. |
| Fox-Terrier | Pm. 3 oblique. |

We have already mentioned the fact that in the highly artificial broad-headed dogs, elongation of skull and palate is a sign of impure breeding, an evidence of admixture with the broad-headed strain of that of some other and narrower-headed dog. Examples of this may be seen almost any day in the streets in the shape of the half-bred Pugs, in which the elongated muzzles present so great a contrast with the short square faces of their pure-bred cousins. We have no facts before us to prove whether the long-headed dogs such as Greyhounds tend to become broader when impurely bred, but it is highly probable that they would do so, and consequently that the dogs at both ends of the scale would, under the influence of promiscuous interbreeding, tend to approximate to the average head. We have thought that it might be useful to terminate this paper by giving a list of accessory molars noticed amongst the specimens examined, being 176 in all. In concluding we may say that the figures and calculations have been checked with care; nevertheless, in dealing with so many figures it may be that errors may have crept in. Should such be the case we much regret it with other shortcomings of this paper.

Table XXXVII.—*Additional upper Molars.*

| Variety of Dog. | Right. | Left. |
|---|---|---|
| Sheep-dog | ... | 1 |
| Pointer | 1 | 1 |
| Bull-dog | ... | 1 |
| Bull-dog | 1 | 1 |
| Bull-dog | ... | 1 |
| Esquimaux | 1 | ... |
| Pug | 1 | ... |
| Spaniel | 1 | ... |
| Black-and-tan Terrier (cross-bred) | 1 | 1 |
| Black-and-tan Terrier (cross-bred) | 1 | 1 |
| Lurcher | 1 | 1 |
| West-Indian Dog | 1 | ... |

In several of these specimens the additional molars had never been cut but lay in crypts.

## 3. Fourth Contribution to the Herpetology of the Solomon Islands [1]. By G. A. Boulenger, F.Z.S.

[Received December 3, 1889.]

(Plate II.)

The last collection brought home by Mr. C. M. Woodford comprised a series of Reptiles and Batrachians from Florida Island, or Gela, north of Guadalcanar. Together with examples of the following known species, there was one of another new Snake of the genus *Hoplocephalus*:—

Lizards: *Corucia zebrata*, Gray, *Lygosoma cyanogaster*, Less., *L. concinnatum*, Blgr.

Snakes: *Enygrus carinatus*, Schn., *Dendrophis calligaster*, Gthr., *Dipsas irregularis*, Merr.

Frogs: *Ceratobatrachus guentheri*, Blgr., *Hyla macrops*, Blgr.

Hoplocephalus elapoides, sp. n. (Plate II. fig. 3.)

Body very elongate; head much depressed, with broad, rounded snout; eye very small, its diameter hardly half its distance from the mouth. Rostral much broader than deep, just visible from above; internasals two thirds the length of the præfrontals, which are a little shorter than the frontal; latter shield small, much longer than broad, hexagonal, as long as its distance from the rostral or two thirds the length of the parietals, once and a half as broad as the supraocular; parietals as long as the præfrontals and frontal together; posterior nasal forming a suture with the præocular; two postoculars, upper a little larger than lower; temporals 1+2; seven upper labials, third and fourth entering the eye; two pairs of subequal chin-shields, anterior in contact with four labials. Scales in 17 rows. Ventrals 208; anal entire; subcaudals 35 pairs. Cream-colour (in spirit), with 22 black bands, broader than the interspaces between them, interrupted on the belly, encircling the tail; on the posterior three fourths of the body series of small black spots form a lateral streak along each side of the back; end of snout and ocular region black.

Total length 750 millim.; tail 75.

A single specimen.

This makes the fourth species of *Hoplocephalus* from the Solomon Group. These four species may be distinguished as follows:—

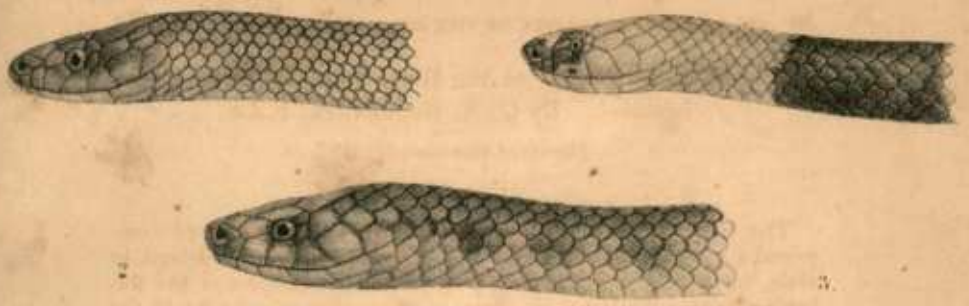
I. Subcaudals single.

| | |
|---|---|
| Scales in 16 rows ..... | *H. par* (Faro). |
| Scales in 15 or 17 rows ..... | *H. melanurus* (Guadalcanar). |

II. Subcaudals paired; scales in 17 rows.

| | |
|---|---|
| The diameter of the eye nearly equals its distance from the mouth; frontal nearly as broad as long, twice as broad as the supraocular; ventrals 166 ..... | *H. woodfordi* (New Georgia). |

[1] *Cf.* P. Z. S. 1888, p. 88.



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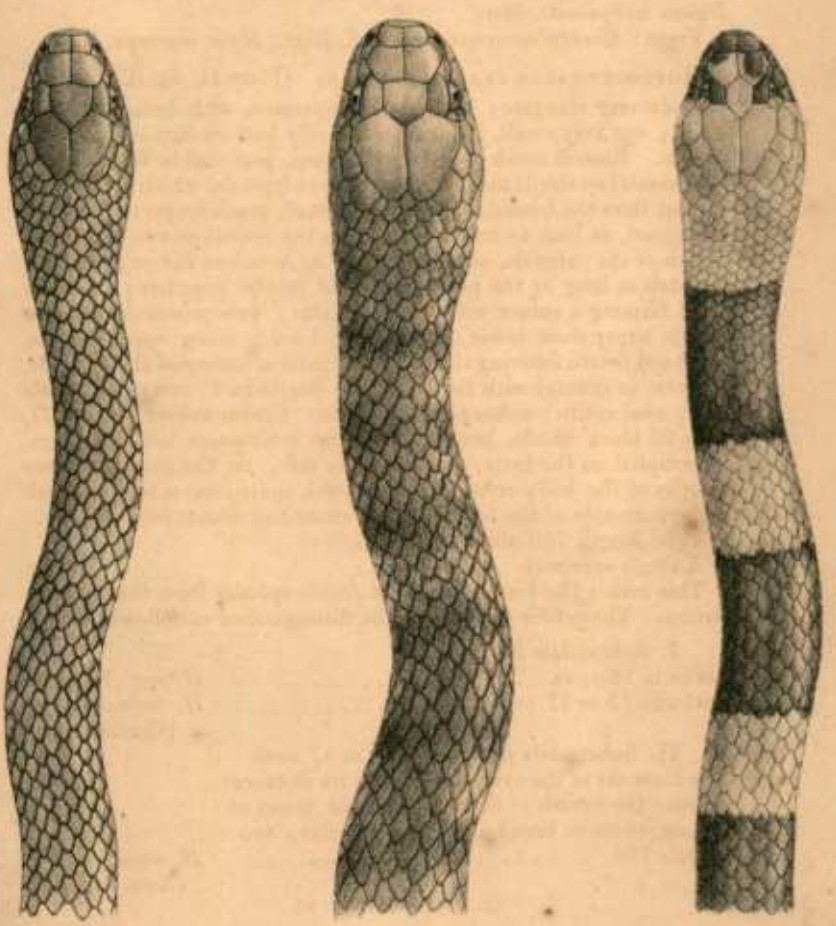


A. Menzies del. et lith. Mintern Bros. imp.

1. HOPLOCEPHALUS MELANURUS.
2. H. WOODFORDII. 3. H. ELAPOIDES

The diameter of the eye equals hardly half its distance from the mouth; frontal much longer than broad, once and a half as broad as the supraocular; ventrals 208 ..... *H. elapoides* (Florida).

EXPLANATION OF PLATE II.

Fig. 1. *Hoplocephalus melanurus*, Blgr.
2. " *woodfordii*, Blgr.
3. " *elapoides*, Blgr.

## 4. List of the Reptiles, Batrachians, and Freshwater Fishes collected by Professor Moesch and Mr. Iversen in the district of Deli, Sumatra. By G. A. Boulenger, F.Z.S.

[Received December 30, 1889.]

A few weeks ago I was requested by Dr. Günther to name a collection of Reptiles, Batrachians, and Freshwater Fishes from Deli and Langkat, North-east Sumatra, transmitted to him for examination by the collector, Professor Moesch, of Zurich. As the collection contains, in addition to two novelties, representatives of a considerable number of species new to Sumatra, although previously known from the Malay Peninsula or from the neighbouring islands, I thought a full list would be of zoogeographical interest and offered it to this Society for publication. On hearing of this Professor Collett, of Christiania, very kindly proposed to submit to me for examination a large collection brought together during a stay of 20 months precisely in the same localities by a preparator of his Museum, Mr. Iversen, which had reached him almost on the very day he read the announcement of my paper. I gladly availed myself of Prof. Collett's offer, and postponed the reading of my paper so as to be able to incorporate in it the results of the examination of the Iversen collection. In addition to a good number of species not in the Moesch collection, the latter contains a new frog of the genus *Rhacophorus*. In the following list I have marked M. the species represented in Prof. Moesch's collection, I. those in Mr. Iversen's. Small species are better represented in the former collection and large ones in the latter, so that the two together should give a very fair idea of the herpetological and ichthyological faunas of this part of Sumatra. I was much interested to find in Prof. Moesch's collection examples of three of the new Batrachians which I described not long ago from the hills near the town of Malacca, thus showing once more how extremely alike the forest faunas of the opposite coasts of the Straits of Malacca are. A fact worthy of record is that many of the Batrachians in this collection, however widely remote their affinities, are spotted or ornamented with bright carmine, a colour which is by no means frequent in Batrachians. Thus out of the

12 species obtained by Prof. Moesch, carmine spots or markings are present in the following:—*Rana limnocharis*, *Microhyla achatina*, *Phrynella pulchra*, *Bufo melanostictus*, *B. parvus*, *B. asper*. A somewhat similar proportion of carmine-spotted forms was observable in the collection from Malacca presented by Mr. Hervey. Such ornamental markings cannot be regarded as adaptations to the surroundings, and doubtless fall under the head of geographical isomorphism or mimetic analogy.

As noticed by Wallace, the fauna of Sumatra is much more nearly allied to that of the forests of the Malay Peninsula and Borneo, than is that of Java to either Sumatra or Borneo. Dr. Jentink [1] finds "that the Mammalian fauna of East Sumatra agrees much more with the Borneo than with the West Sumatra fauna." I am not struck by any such relation in the herpetological fauna.

[P.S. (Feb. 7, 1890).—This list was in type when I received from my colleague, Dr. van Lidth de Jeude, an advanced copy of a paper "On a collection of Snakes from Deli," to be published by him in the 'Notes from the Leyden Museum,' xii. 1890, pp. 17–27, and which, very curiously, was completed on the very same day as my own (Leyden Museum, 30 Dec. 1889). There is, however, no duplication of names, from the fact that both the new forms described by Dr. de Jeude were not represented in the collection worked out by me; and I have no alteration to make to my list. Of the two novelties in Dr. de Jeude's paper, one, *Calamaria vermiformis*, var. *sumatrana*, is, however, not unknown to me, as I had found a specimen (also from Deli) in the Fischer Collection, and this I had likewise referred, as a colour-variety, to *C. vermiformis*. Should such a form warrant a name, that of *sumatrana* (Jeude) will have to be changed, being preoccupied by Edeling.

*Hypsirhina hageni*, Jeude, is unknown to me; but, judging from the careful description, appears to be a very interesting new form, intermediate between *Hypsirhina bocourti*, Jan (Siam), *H. sieboldii*, Schleg. (India, Burma, Malay Peninsula), and *Homalophis doriæ*, Peters (Borneo). The snake described by Steindachner in 1887 [2], as a variety of the latter, is probably, again a distinct species, which agrees with *H. hageni* in the single loreal and 27 rows of scales.

Other species mentioned by Dr. de Jeude and not represented in the Moesch and Iversen collections are *Typhlops lineatus*, Reinw., *Lycodon aulicus*, L., *Odontomus subannulatus*, Schleg., *Coluber* (*Gonyosoma*) *oxycephalus*, Reinw., *Dryophis fasciolatus*, Fischer,

[1] Notes Leyden Mus. xi. 1889, p. 19.

[2] *Molge strauchii*, Steind., described and figured in the same paper, = *Neurergus crocatus*, Cope (1862). It appears to me probable that the affinities of *Molge crocata* are with *M. montana*, Savi, not with *M. cristata* and *marmorata*, as suggested by Steindachner. I cannot see how the presence of a ligamentous *arcus fronto-temporalis* can justify the inference that a dorsal crest is probably present in the breeding male. There are Newts with a ligamentous fronto-temporal arch, both with (*Molge marmorata*) and without (*M. montana*) a dorsal crest; the same is the case with those in which the arch is ossified (*Molge vittata*, *M. boscæ*) and with those in which it is absent (*Molge cristata*, *Chioglossa lusitanica*).

*Platurus laticaudatus*, L. (*fischeri*, Jan), and *Trimeresurus gramineus*, Shaw. There is possibly identity between the author's *Coryphodon korros*, *Leptognathus lævis*, *Dipsas drapiezii*, *Bothrops erythrurus*, *B. hageni*, and my *Zaocys carinatus*, *Amblycephalus carinatus*, *Dipsas cynodon*, and *Trimeresurus formosus*.]

## REPTILIA.

### Emydosauria.

1. Crocodilus porosus, Schn. I.

### Chelonia.

2. Trionyx phayrii, Theob. I.

The occurrence of this *Trionyx* in Sumatra is of very great interest. The skull, type of Gray's *T. jeudi*, supposed to be from Java (?), may be also from Sumatra. The halfgrown specimen from Deli agrees in every respect with the Burmese specimens in the British Museum.

3. Trionyx cartilagineus, Bodd. I.

A young specimen from Langkat agrees in colour with Theobald's *T. ephippium*.

4. Geoemyda spinosa, Gray. I.

5. Cyclemys amboinensis, Daud. I.

### Lacertilia.

6. Hemidactylus frenatus, D. & B. I.

7. Gehyra mutilata, Wgm. I.

8. Draco volans, L. I.

9. Draco fimbriatus, Kuhl. I.

10. Calotes cristatellus, Kuhl. M., I.

11. Gonyocephalus grandis, Gray. I.

12. Varanus dumerilii, Schleg. I.

13. Varanus salvator, Laur. I.

14. Mabuia rugifera, Stol. M.

Two specimens, with 28 scales round the body, and five light dorsal lines. In the larger specimen, the præfrontals form a short suture with each other, and the frontal is in contact with the second supraocular only.

15. Mabuia multifasciata, Kuhl. M., I.

16. Lygosoma olivaceum, Gray. M., I.

17. Lygosoma temminckii, D. & B. M.

OPHIDIA.

18. PYTHON RETICULATUS, Schn. I.

19. CYLINDROPHIS RUFUS, Laur. I.

20. XENOPELTIS UNICOLOR, Reinw. M., I.

21. CALAMARIA SUMATRANA, Edeling. M., I.

Three specimens of this little-known *Calamaria* were obtained, two by Prof. Moesch, one by Mr. Iversen. The following description is drawn up from these specimens :—

Rostral a little broader than deep ; frontal longer than broad, a little shorter than the parietals, rather more than twice as broad as the supraocular ; one præ- and one postocular ; five upper labials, third and fourth entering the eye ; two pairs of chin-shields in contact with each other, the anterior in contact with the mental. Scales in 13 rows. Ventrals 168, 176, 174 ; anal entire ; subcaudals 13, 12, 12. Tail pointed. Reddish brown above, with five black longitudinal lines ; each scale of the outer row with a white spot ; a yellow collar on the nape, narrowly interrupted in the middle, and a similar marking at the base of the tail ; lower parts uniform yellowish, with a black line along the middle of the tail.

Total length 265 millim. ; tail 12.

This *Calamaria* resembles strikingly, at a first glance, the Javan *C. quadrimaculata*, from which it differs in having five instead of four upper labials, and in the separation of the first pair of lower labials by the anterior chin-shields. Specimens from Kiu Kiang and Hong Kong have recently been referred [1] to *C. quadrimaculata*, but, in spite of their similar coloration, belong to a distinct species, for which I propose the name of *C. septentrionalis*. *C. septentrionalis* differs from *C. quadrimaculata* in the frontal being as broad as long and in the tail being rounded at the end.

22. PSEUDORHABDION LONGICEPS, Cant. M.

23. LYCODON SUBCINCTUS, Boie. M., I.

I suspect *Elapoides annulatus*, Sauvage (1884), to be founded on a young specimen of this species.

24. LYCODON EFFRENIS, Cant. M.

25. ABLABES BALIODIRUS, Boie. M.

26. ABLABES TRICOLOR, Schleg. M.

27. SIMOTES PURPURASCENS, Schleg. M., I.

= *S. trinotatus*, D. B., *S. labuanensis*, Gthr., *S. catenifer*, Stol., *S. dennysi*, Blanf., *S. affinis*, Fisch.

Otherwise identical specimens, from the same locality, have either 19 or 21 rows of scales.

[1] Günther, Ann. & Mag. N. H. (6) i. 1888, p. 165.

28. SIMOTES OCTOLINEATUS, Schn. I.

The variety with five yellow dorsal lines separated by broader black stripes.

29. SIMOTES SIGNATUS, Gthr. M.

30. ZAOCYS CARINATUS, Gthr. I.

The largest specimen measures 10 feet; tail 2 feet 5 inches.

31. COLUBER MELANURUS, Schleg. I.

32. DENDROPHIS PICTUS, Gm. I.

33. DENDRELAPHIS CAUDOLINEATUS, Gray. I.

34. TROPIDONOTUS CHRYSARGUS, Boie. M., I.

35. TROPIDONOTUS TRIANGULIGERUS, Boie. M., I.

36. TROPIDONOTUS FLAVICEPS, D. & B. M., I.

37. TROPIDONOTUS RHODOMELAS, Schleg. I.

38. CHERSYDRUS GRANULATUS, Schn. I.

39. DIPSAS CYNODON, Cuv. I.

40. DIPSAS DENDROPHILA, Reinw. I.

41. PSAMMODYNASTES PULVERULENTUS, Boie. M.

42. PSAMMODYNASTES PICTUS, Gthr. M., I.

43. DRYOPHIS PRASINUS, Boie. I.

44. CHRYSOPELEA ORNATA, Shaw. I.

45. HOMALOPSIS BUCCATA, L. I.

46. CERBERUS RHYNCHOPS, Schn. I.

47. HYPSIRHINA PLUMBEA, Boie. I.

48. ADENIOPHIS INTESTINALIS, Laur. I.

49. ADENIOPHIS BIVIRGATUS, Boie. I.

50. BUNGARUS FASCIATUS, Schn. I.

51. NAIA TRIPUDIANS, Merr. I.

The numerous specimens collected by Mr. Iversen are brown or blackish, without spectacle-mark; lower surface of neck white, followed by a black cross-band, and with an azygous black spot anteriorly and one or two on each side. 23 or 25 scales across the neck, 17 or 19 across the middle of the body. Ventrals 183–192; subcaudals 50–52 pairs.

This variety, which is closely allied to Cantor's var. *nigra*, connects the typical *N. tripudians* with Reinwardt's *N. sputatrix*.

52. Naia bungarus, Schleg. I.

Up to 13 feet long.

53. Amblycephalus carinatus, Reinw. I.

54. Trimeresurus formosus, Schleg. I.

55. Trimeresurus wagleri, Schleg. I.

56. Trimeresurus purpureomaculatus, Gray. I.

A single adult specimen, belonging to the var. *carinatus*, Gray. Uniform green above, the interstitial skin purplish brown; a series of whitish spots along the outer series of scales; lower parts uniform pale greenish. Scales in 27 rows; 15 scales in a transverse series between the supraoculars; ventrals 161; subcaudals 64.

## BATRACHIA.

1. Rana macrodon, Kuhl. M., I.

2. Rana tigrina, Daud. I.

3. Rana limnocharis, Wgm. M.

4. Rana erythræa, Schleg. I.

5. Rana nicobariensis, Stol. M.

6. Rhacophorus leucomystax, Gravh. M.

7. Rhacophorus colletti, sp. n. I.

Vomerine teeth in two oblique series commencing at the inner front edge of the choanæ, which are very large. Head as long as broad; skin of head free, smooth; snout triangular, a little longer than the diameter of the orbit; canthus rostralis angular; loreal region oblique, slightly concave; nostril near the tip of the snout; interorbital space a little broader than the upper eyelid; tympanum very distinct, three fourths the diameter of the eye. Fingers long, with a slight rudiment of web; toes nearly entirely webbed; disks of fingers about half the size of the tympanum, of toes smaller; subarticular tubercles moderate; a very small inner metatarsal tubercle. Hind limbs very long; the femoro-tibial articulation reaches the fore limb and the tibio-tarsal far beyond the tip of the snout; tibia two thirds the length of head and body. Skin smooth, granular on the belly and under the thighs. Grey above, loreal region and sides of body lighter; lips with a fine blackish edge; limbs with dark cross-bands; anal region blackish, with a white edge above; lower parts whitish.

From snout to vent 62 millim.

A single female specimen from Langkat.

This species is closely allied to *R. leucomystax*, but differs in the much longer hind limbs.

8. MICROHYLA ACHATINA, Boie. M.

9. MICROHYLA INORNATA, sp. n. M.

Snout obtuse, shorter than the diameter of the orbit; interorbital space a little broader than the upper eyelid. First finger much shorter than second; toes moderately elongate, quite free; tips of fingers and toes dilated into very small disks; subarticular tubercles very distinct; inner metatarsal tubercle very small, round; no outer tubercle. The tibio-tarsal articulation reaches the eye. Back covered with small smooth warts. Dark brown above, spotted or marbled with black; sides of head black, with a series of white spots along the upper lip; lower parts brown; throat of male black. Male with a subgular vocal sac.

From snout to vent 20 millim.

Three specimens, two males and one female.

10. PHRYNELLA PULCHRA, Blgr. M.

Two male specimens, agreeing with the types from Malacca. The specimen from the mountains of Perak, referred to this species by Günther (Ann. & Mag. N. H. (5) xx. 1887, p. 313, pl. xvi. fig. B), is a distinct species, which I will call *P. pollicaris* on account of the strong tubercle-like rudiment of pollex which is developed in the male of this species but not of *P. pulchra*. Other differences are found in the stouter habit, the shorter head, the presence of a strong transverse fold connecting the posterior borders of the eyelid, the shorter and thicker digits with much stronger subarticular tubercles, and the hardly half-webbed toes. The coloration is also a much plainer one.

11. BUFO MELANOSTICTUS, Schn. M., I.

12. BUFO QUADRIPORCATUS, Blgr. M.

13. BUFO PARVUS, Blgr. M., I.

14. BUFO ASPER, Gravenh. M., I.

15. LEPTOBRACHIUM HASSELTII, Tsch. I.

A larval specimen with well-developed limbs, obtained by Mr. Iversen, enables me to name several tadpoles of rather large size, from Larut, Perak, presented to the Museum in 1886 by Dr. J. Anderson. These are remarkable in being marked all over with numerous deep black dots. Spiraculum sinistral, equally distant from the end of the snout and from the tail; latter once and a half as long as the body. Length of body 25 millim.

16. MEGALOPHRYS NASUTA, Schleg. M.

## PISCES.

### Acanthopterygii.

1. Gobius caninus, C. & V. M., I.

D. 6/$\frac{1}{9}$. A. $\frac{1}{9}$. L. lat. 33–35.

Depth of body six times in the total length, length of head four times and one third; head once and three fourths as long as broad.

2. Eleotris butis, C. & V. I.
3. Catopra grootii, Blkr. M.
4. Anabas scandens, Dald. I.
5. Helostoma temminckii, K. & v. H. I.
6. Osphromenus olfax, Comm. M., I.
7. Osphromenus trichopterus, Pall. M., I.
8. Osphromenus leerii, Blkr. M., I.
9. Betta pugnax, Cant. I.
10. Ophiocephalus gachua, Ham. Buch. M., I.
11. Ophiocephalus striatus, Bloch. M., I.
12. Ophiocephalus lucius, K. & v. H. M.
13. Ophiocephalus marulius, Ham. Buch. M.
14. Rhynchobdella aculeata, Bl. M.
15. Mastacembelus unicolor, K. & v. H. M.
16. Mastacembelus erythrotænia, Blkr. M.
17. Mastacembelus maculatus, Reinw. M.
18. Mastacembelus armatus, Lacép. M.

### Physostomi.

19. Clarias magur, Ham. Buch. M., I.
20. Clarias nieuhofii, C. & V. M.
21. Cryptopterus mononema, Blkr. M.
22. Callichrous bimaculatus, Blkr. I.
23. Callichrous hypophthalmus, Blkr. I.
24. Macrones micracanthus, Blkr. M., I.
25. Macrones nigriceps, C. & V. M.
26. Macrones nemurus, C. & V. M., I.

27. MACRONES PLANICEPS, K. & v. H. M.

28. LIOCASSIS PŒCILOPTERUS, K. & v. H. M.

29. LIOCASSIS MICROPOGON, Blkr. M.

30. LIOCASSIS STENOMUS, K. & v. H. M.

31. LIOCASSIS MOESCHII, sp. n. M.

D. 1/7. A. 15. P. 1/8.

Upper surface of head naked and rugose; occipital process as long as broad; a separate shield, a little broader than long, between the occipital process and the basal shield of the dorsal spine; head longer than broad, a little broader than deep; snout not prominent. The depth of the body contained five times in the total length (without caudal), the length of the head thrice and two thirds. Barbels slender and short, the maxillary reaching the opercle. Dorsal spine serrated behind, its length two thirds that of the head. Adipose fin twice as long as dorsal, as long as its distance from the latter. Pectoral spine strong, considerably longer than the dorsal, strongly serrated on the inner edge. Brown above, fins blackish brown.

Total length 90 millim.

Three specimens.

32. GLYPTOSTERNUM PLATYPOGON, K. & v. H. M.

33. BELONE CANCILOIDES, Blkr. M.

34. HEMIRHAMPHUS BUFFONIS, Blkr. I.

35. DANGILA KUHLII, C. & V. M.

36. OSTEOCHILUS WAANDERSII, Blkr. M.

37. CROSSOCHILUS OBLONGUS, C. & V. M.

38. BARBUS MACULATUS, K. & v. H. M., I.

39. BARBUS LATERISTRIGA, C. & V. M.

40. BARBUS HAMPAL, C. & V. M., I.

41. BARBUS SUMATRANUS, Blkr. M.

42. BARBUS APOGON, Blkr. I.

43. RASBORA LATERISTRIATA, Blkr. M., I.

44. RASBORA SUMATRANA, Blkr. M., I.

45. CHELA ANOMALURUS, v. Hass. M.

46. ACANTHOPSIS CHŒRORHYNCHUS, Blkr. M.

47. LEPIDOCEPHALICHTHYS HASSELTII, Blkr. I.

48. NOTOPTERUS CHITALA, Ham. Buch. M.

49. MONOPTERUS JAVANENSIS, Lacép. M., I.

50. ANGUILLA SIDAT, Blkr. M.

51. MURÆNA TILE, Ham. Buch. M.

LOPHOBRANCHII.

52. DORYICHTHYS CAUDATUS, Ptrs. M.

PLECTOGNATHI.

53. TETRODON PALEMBANGENSIS, Blkr. M.

54. TETRODON LIURUS, Blkr. M.

## 5. A Contribution to our Knowledge of British Pleuronectidæ. By Dr. A. GÜNTHER, F.R.S., V.P.Z.S.

[Received December 6, 1889.]

(Plate III.)

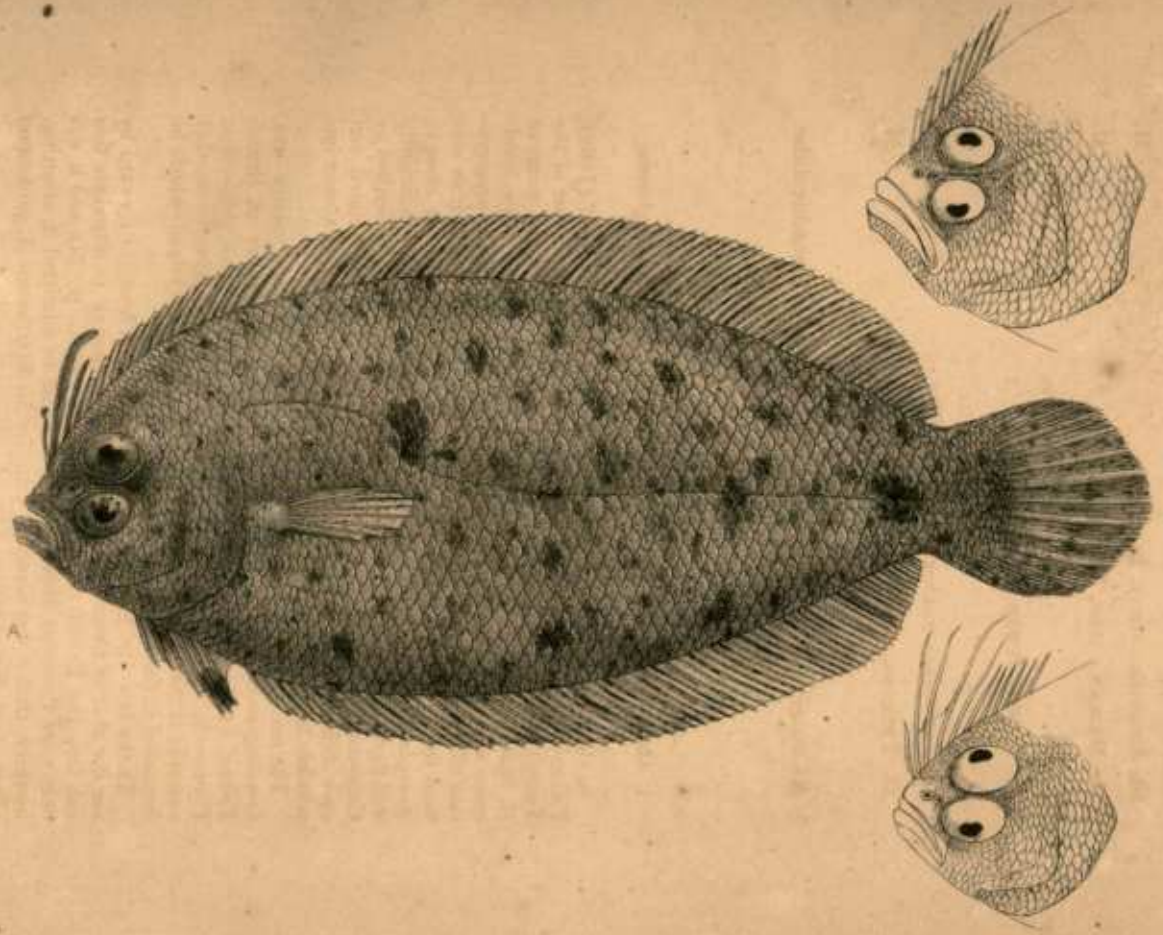
### 1. *On the Occurrence of* Arnoglossus lophotes *and* Arnoglossus grohmanni *in British Seas.*

In the fourth volume of the 'Catalogue of Fishes,' p. 417 (1862), I described from three skinned specimens which formed part of the Yarrell Collection a new species of *Arnoglossus* under the name of *A. lophotes*. I was unable to give the locality whence these specimens were obtained, but inferred from the mode of their preservation that it was more probable that they came from British seas than from the Mediterranean. I placed this new species close to *Arnoglossus grohmanni* from the Mediterranean, which is sufficiently well figured in Bonaparte's 'Fauna Italica,' and correctly described by Canestrini (Arch. Zool. i. p. 12, tav. i. fig. 3); and pointed out such differences between the two species that it seemed almost impossible to confound them.

The uncertainty about *A. lophotes* being a British species was, however, soon removed by Couch, who in his 'History of British Fishes' (1864) states that he had examined a specimen obtained at Plymouth, and by Professor Moseley, who in 1882 captured another example of the same species in the trawl off Lundy Island, which he deposited in the British Museum.

To the late Mr. F. Day neither the evidence brought forward by me nor that of Couch seemed satisfactory enough to introduce this fish into the British fauna (Fish. Great Brit. ii. p. 23), and it was only after Professor Moseley's capture that he admitted it, asserting, however, that it was identical with the Mediterranean *A. grohmanni* (Proc. Zool. Soc. 1882, p. 748, pl. 53).

The opportunity of again setting right this error is now offered




R. Mintern del. et lith.
Mintern Bros. imp.

A. ARNOGLOSSUS GROHMANNI. B. ARNOGLOSSUS LOPHOTES. C. ARNOGLOSSUS LATERNA.

by the discovery by the Rev. W. S. Green of a fish on the coast of Ireland which proves to be an adult specimen of the true *A. grohmanni*. Thanks to the kind help of the Marquis G. Doria, Professor Doderlein of Palermo, and Professor Bellotti of Milan, I have materials before me which place the question beyond any doubt, the result of my examination being:—

1. That the two species are quite distinct, and well characterized by constant characters.

2. That both species are found both in the Mediterranean and on the British coasts, but are rarer in the latter area.

3. That the outlines of the figure in Proc. Zool. Soc. 1882, pl. 53, are taken from a British specimen of *A. lophotes*[1], with the scaling and markings added from a Mediterranean *A. grohmanni*.

The arguments brought forward by Mr. Day in support of his assertion that the two species are identical were the following:—

1. That he had received specimens of *A. grohmanni* from Prof. Giglioli of Florence, "which are identical with Prof. Moseley's fish." If that was the case, and if those specimens had the four or five anterior dorsal rays prolonged, and not the second only, then I have no hesitation in stating that those specimens were misnamed *A. grohmanni*.

2. That "the typical specimens of *A. lophotes* are stretched or abnormally elongate skins." It is quite possible that these skins are a little more elongate than the fishes were whilst in the flesh; but all the fresh specimens of *A. lophotes* have a more elongate body than adult and halfgrown specimens of *A. grohmanni*, as may be seen on comparing the figure of this species now given (Plate III. fig. A) with the figure in P. Z. S. 1882, pl. 53. And in conformity with this greater prolongation of the body, the numbers of the fin-rays and transverse series of scales are larger in *A. lophotes* than in *A. grohmanni*. I have to add, however, that the smallest and youngest specimen of *A. grohmanni* (2½ inches long), which I received among those sent by Prof. Bellotti, has the body more elongate than older examples: a very common occurrence in the Pleuronectidæ.

3. That the numbers of fin-rays show greater variations in Pleuronectoids than in other fishes; that, for instance, in the Lemon Sole (*Solea lascaris*) the number of dorsal rays varies between 65 and 89, and of the anal between 52 and 70! This is contrary to the observations of almost all ichthyologists (Mr. Day included): the fin-rays of Pleuronectoids do not vary more than in other fishes with a similarly great number of fin-rays; and the statement of so extraordinary a variation as the one referred to can only be accounted for by the observer having mixed up several species. The following table of the fin-rays of our specimens of *A. lophotes* and *A. grohmanni* will be, however, more to the point than any far-fetched comparisons of doubtful value.

[1] The specimen when brought to the Museum by Professor Moseley immediately after its capture had lost not only the scales, but also the integuments; and of course every trace of colour was gone.

*Arnoglossus lophotes.*

| | Dorsal rays. | Anal rays. |
|---|---|---|
| Dry typical specimen no. 1 ..... | 95 | 77 |
| „ „ no. 2 ..... | 96 | 76 |
| „ „ no. 3 ..... | 102 | 81 |
| Lundy Island specimen in spirit .. .... | 99 | 79 |
| Specimen from Palermo „ ..... | 98 | 75 |

*Arnoglossus grohmanni.*

| | | |
|---|---|---|
| Specimen from Kenmare River in spirit .. | 86 | 64 |
| „ Dalmatia „ .. | 85 | 65 |
| „ Nice no. 1 „ .. | 84 | 64 |
| „ „ 2 „ .. | 88 | 61 |
| „ „ 3 „ .. | 88 | 62 |
| „ „ 4 „ .. | 84 | 65 |

It is difficult to understand why Mr. Day in his paper makes no reference whatever to the most striking distinctive character, viz. the prolonged dorsal rays. Bonaparte and Canestrini distinctly say that in *A. grohmanni* the second dorsal ray is prolonged, and so it is in the six specimens before me, in the youngest as well as oldest. In *A. lophotes* the four or five anterior rays are prolonged; and there is no difference in this respect in the five specimens before me, in the smallest as well as in the largest. No author mentions a prolongation of fin-rays in the common British species of Scald-fish, *Arnoglossus laterna*, which, besides, has a conspicuously smaller eye than *A. lophotes* (see Plate III. figs. B, C), as may be seen from the following measurements:—

| | *A. laterna.* | *A. lophotes.* |
|---|---|---|
| Total length..... | 187 mm. | 174 mm. |
| Horizontal diameter of eye..... | 7½ mm. | 9½ mm. |
| Total length..... | 120 mm. | 136 mm. |
| Horizontal diameter of eye ..... | 5½ mm. | 8 mm. |

Also the maxillary is somewhat shorter in *A. lophotes* than in *A. laterna*.

I add now a complete diagnosis of *A. grohmanni*, drawn up from specimens preserved in spirit:—

D. 84–88. A. 61–65. P. 9. L. lat. 51.

The greatest width of the body is contained twice and one third in the total length (without caudal), the length of the head four times. The upper profile of the head descends rapidly downwards, there being a considerable space between the upper eye and the upper profile. Eyes of moderate size, one fourth of the length of the head and equal to the length of the snout; eyes separated by a sharp ridge, the lower somewhat in advance of the upper. Mouth oblique and rather narrow, with prominent lower jaw and with the maxillary not extending to below the middle of the eye. The length of the maxillary is one

third of the length of the head. Vomerine teeth none. Vertical fins rather high, the dorsal fin commencing in front of the upper eye and terminating close to the caudal. Of the three anterior rays, especially the second is elongate, being two thirds as long as the head and broadly fringed; caudal fin somewhat shorter than the head, and about equal in length to the pectoral fin. Lateral line with a semicircular curve above the pectoral fin; scales of moderate size, minutely ciliated on the edge. Ground-colour brownish grey, marbled with black; some of the rays of the dorsal and anal fins partially black; the other fin-rays finely dotted with black.

The largest specimen is 6 inches long and in an excellent state of perservation. It was obtained by the Rev. W. S. Green in the Kenmare River, depth 10 fathoms.

### 2. *On the Occurrence of* Rhombus boscii *in British Seas.*

*Rhombus boscii* (Risso) is another species new to the British fauna; specimens were discovered by the Rev. W. S. Green in 150 and 315 fathoms off the S.W. coast of Ireland[1]. As this fish possesses vomerine teeth, it has to be removed from the genus *Arnoglossus*, to which I had referred it before having seen specimens[2]. In fact, it comes near to *Rhombus megastoma*, with which it was confounded by Mr. Day[3].

### 3. *On the Nomenclature of the Lemon Sole.*

I proposed for the Lemon Sole of the North Atlantic the name of *Solea aurantiaca*, believing that I had recognized Risso's *Solea lascaris* in a Sole from Madeira which has the body considerably narrower and more elongate. Risso's description applies equally well to both species, and I had no other reason for retaining the name given by him for the Madeira fish than its southern origin: it seemed to be more probable that the Mediterranean fish was identical with the one from Madeira than with that of the North Atlantic. However, the British Museum has now obtained a specimen from Nice which is evidently identical with our Lemon Sole, and gives sufficient ground for applying the name of *Solea lascaris* to the latter, and not to the Madeira fish, which is clearly a distinct species. Therefore the synonymy of the two fishes will stand as follows:—

SOLEA LASCARIS.

*Pleuronectes lascaris*, Risso, Ichth. Nice, p. 311.

*Solea lascaris*, Risso, Eur. mérid. iii. p. 249; Day, Fish. Great Brit. ii. p. 42.

*Solea pegusa*, Yarrell, Brit. Fish. 2nd ed. (nec Lacép.).

*Solea nasuta*, Richardson, in Yarrell, Brit. Fish. 3rd ed. (nec Pall.).

*Solea aurantiaca*, Günth. Fish. iv. p. 467.

Lemon Sole.

North-Eastern Atlantic; Mediterranean.

[1] Ann. & Mag. N. H. 1889, iv. p. 418.
[2] Fish. Great Brit. ii. p. 21.
[3] Cat. Fish. iv. p. 416.

SOLEA SCRIBA.

*Solea scriba*, Valenc. in Webb & Berthel. Iles Canar., Poiss. p. 84, pl. 18. fig. 3 (bad).

*Solea luscaris*, Günth. Fish. iv. p. 467 (nec Risso).

Madeira, Canary Islands.

4. *On the Identity of* Solea lutea *and* Solea minuta.

I am indebted to Professor Doderlein of Palermo for fresh specimens of *Solea lutea* (Risso) from the Mediterranean, and to the Officers of the Marine Biological Association for examples of *Solea minuta* (Parnell) obtained by them in Cowsand Bay; and am unable to discern any specific differences between them.

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February 4, 1890.

Prof. Flower, C.B., 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 1890:—

The total number of registered additions to the Society's Menagerie during the month of January was 139, of which 89 were acquired by presentation, 4 by exchange, 41 by purchase, and 5 were received on deposit. The total number of departures during the same period, by death and removals, was 84.

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A communication was read from Mr. W. K. Parker, F.R.S., containing a memoir on the Morphology of a Reptilian Bird (*Opisthocomus cristatus*), of which the following is an abstract:—

The expression "Reptilian bird" is, I believe, one of my own coining; it occurs frequently in my early papers. For the bird had long been to me a transformed and, one might even say, a *glorified* Reptile, the quasi-imago of the reptile, which takes the place of an active *pupa*, the fish doing duty, in the present economy of nature, as the *larva*. Things might have remained in this state and all this have been called "Parker's poetry," but very opportunely a severely scientific and very powerful mind found time to take up this subject; for Professor Huxley, in his masterly paper on the Classification of Birds (P. Z. S. 1867, pp. 416–472), put true Reptiles and Birds into one bundle, and called this bundle of life "Sauropsida." Everyone knows that that is one of the largest strides in the progress of modern science, yet at the time it made men of the old school "lift their brows" and wonder what would be the next move. These men "entered not in:" the old wilderness of thought was enough for them; but our brave leader led us into a good land and a large one.

No man of this generation is startled at the term "Reptilian bird," although everyone must wonder how the slow, cold-blooded, scaly

beast ever became transformed into the quick, hot-blooded, feathered fowl, the joy of creation.

Now if any one will look at the picture I have made of the half-ripe embryo of the *Hoatzin*, he will see that which will help him to imagine how the Reptile crept out of his lowliness and became that high and noble creature—a Bird.

Of course the wings dominate everything else in the organization of the bird; all other parts must be correlated to these metamorphosed paws. That wings were paws we see in this Reptilian bird, and the suppression of the parts of a five-fingered hand, which is so striking a character in the normal wing of a bird, wherein three digits only, and these strangely mangled and fused, are all that remain of the Reptilian fore-foot. That suppression is incomplete in *Opisthocomus*. In the half-ripe chick of this bird, the first and second fingers have claws as large, or nearly as large, as those of the toes; and on the third finger, which, as a rule, in birds has only one phalanx, instead of *four* (as in the Reptiles), I found in one of the embryos a definite claw, such as I have shown to exist in *Struthio* and *Rhea*; I have seen this in no other bird but *these three*. There is, also, what I have found in many birds, a rudiment of the *fourth finger*; this is a "phalanx" in this bird, it is a "metacarpal" in the chick of the common fowl and in the Carinatæ generally.

In *Opisthocomus*, and in a few other birds, the two normal proximal carpals, those that in the adult bird are always free and mobile, are, *for a few days*, segmented into additional elements. Thus, taking what I find in this and other birds, the bird's wrist may have all the carpals seen in Amphibia and Reptiles. I am familiar with *nine* carpals in the wrist of birds, although normally only *two* are permanently distinct.

If these facts are not remarkable, I know of nothing that one need wonder at and admire; they cannot be made into *poetry*, but they are not *prosaic*. Nor are there wanting, in this bird, as in others, signs of *marginal* and *intercalary* digits in the wing of the embryo; *atavistic remnants* or *vestiges* that are Reptilian and probably Amphibian "stigmata." But the more fused proximal structures that help to form the organ of flight in this bird are as remarkable as the free distal parts.

This bird, which I take to be an *archaic Curassow*, an unchanged "waif" of the family from which the *Cracidæ* arose, like the Tinamou, never lost its sternal keel; the *Ratitæ* have lost it: they are overgrown, degenerate birds that were once on the right road for becoming flying fowl, but through greediness and idleness never reached the "goal," went back, indeed, and lost their sternal keel and almost lost their unexercised wings.

Now the Tinamou has lost its tail, or nearly so; the Hoatzin has kept its tail; the former, to make up for this, has a huge keel in his extremely long sternum, whilst the Hoatzin has a small keel on a short sternum.

Both of these birds can fly a little, they are not careful to cultivate that talent, they are not birds of "understanding." Now the

keel of the sternum in *Opisthocomus* being on the hinder third of the bone, the leg of the Y-shaped merrythought (or furcula) lies close to the flat under surface of the bone and is strongly strapped to it. I showed, long ago, that the leg of the merrythought is developed as a distinct bone, the homologue of the long dagger-shaped interclavicle of the Lizards and the Monotrematous Mammals. Whether I was believed, or not, by those who had not worked these parts out, did not signify anything to me. Here, in the Hoatzin, this median bone is larger than in any other bird, and is more *Lacertian* in its attachments, as my figures show.

This bird has a "supra-scapular" segment; that is an Amphibian character.

Its hind limbs are quite normal, they are similar to those of the Pigeon-footed fowls (*Peristeropodes*), viz. the Cracidæ and Megapodidæ, the more archaic kinds of Gallinaceous birds.

The vertebræ, as in fowls, the Ratitæ, and the toothed *Hesperornis*, are *cylindroidal* up to the sacrum. Many birds, now living, have their dorsal vertebræ "opisthocœlous." As to the skull, it is in many respects that of a normal Carinate bird; but the palatal bones have a *Struthious simplicity*, and the basipterygoids, which are aborted in the adult, are developed in the embryo; they articulate with the pterygoid bones at their *hind part*, just as in the Ratitæ and the Tinamous; in Gallinaceous birds this articulation is at the *front third* of the pterygoids. That character, alone, is diagnostic as to the position of *Opisthocomus* in this class; added to others, nothing can be clearer than that this bird is one of a nearly extinct type, and that its nearest living relations are birds of an old sort; it might be called a "Struthious Curassow."

Professor Huxley, in his second paper (P. Z. S. 1868, pp. 294-319), makes this single, lonely bird the representative of his suborder "Heteromorphæ"; an equivalent suborder, the "Coracomorphæ," contains more than *six thousand* living species. I agree with him in this daring classification.

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The following papers were read :—

1. Observations on Wolves, Jackals, Dogs, and Foxes. By A. D. Bartlett, Superintendent of the Society's Gardens.

[Received December 6, 1889.]

Wolves, jackals, dogs, and foxes are found spread nearly all over the world. So much has been written and published on these animals that at the first sight it would appear that little can be added to the knowledge we already possess. It is, however, agreed by all writers who are entitled worthy of notice, that all the varieties of domestic dogs have descended from wolves and jackals, or from the admixture of animals of these kinds, as no other animals are known to which we can in any reasonable way ascribe their origin.

I may, however, from the opportunities I have had of observing so many living examples of the above-named animals, be able to offer a few remarks on the subject.

In the first place, I find that Wolves differ greatly amongst themselves in size, colour, and markings. Wolves from the Arctic regions are larger, lighter in colour, and have much longer and thicker coats than those which inhabit milder climates. Some of these varieties from different parts of the world have been considered as distinct species, without, in my opinion, sufficient characters to mark their distinctness.

With reference to the Jackals, they are more easily distinguished, and several well-marked species are readily known and recognized.

The extraordinary and wonderful number of well-marked breeds of the domestic dog and their variations of size, form, and colour, render any attempt to account for their origin a task of some difficulty; but as many wild dogs appear to be descendants of domestic dogs, it is necessary to endeavour to account for the origin of the domestic race. There can be no doubt, for example, that the Esquimaux dogs are reclaimed or domesticated wolves.

All wolves, if taken young and reared by man, are tame, playful, and exhibit a fondness for those who feed and attend to them. The same may be said of all the species of jackals. This being so, it is highly probable that both wolves and jackals were for many ages found in the company of man, and that owing to this association the different species of these animals may have bred together and become mixed.

A mixed breed would at once develop a new variety. A variety once commenced would in all probability, in a few generations, undergo many changes, especially if any well-marked variety should occur. Nothing would be more natural than to suppose that the owners of this variety would endeavour to increase its number, especially if it was found to possess useful qualities.

The fashion of hunting led in all probability to the separation of domestic dogs into two well-known breeds, viz. those that hunt by sight, as distinguished from those that hunt by scent; for there can be no doubt that at a very early period dogs were used in the chase of wild animals. There are plenty of ancient monuments on which there is unmistakable evidence of this fact. The usefulness of dogs being established at a very early period would naturally lead to great care being bestowed upon them, and doubtless to the breeding of them in a domestic state. This would lead to the production of the many breeds and varieties that have been developed, and thus varieties may have been perpetuated by the mixing and crossing of breeds originally obtained from distinct wild animals.

I have found no difficulty in crossing wolves and jackals with domestic dogs, when suitably matched. It is a well-known fact that the Esquimaux frequently allows his dogs to breed with wolves, in order to keep up the strength, the power of endurance, and the courage of the race. But as regards foxes, so far as my experience goes, I have never met with a well-authenticated instance of a hybrid

between a fox and a dog, notwithstanding numerous specimens of supposed hybrids of this sort which from time to time have been brought to my notice. The habits of wolves and jackals are so much alike that I am unable to point out any marked differences between them.

Domestic dogs exhibit many of the habits of wolves and jackals, such as the scratching up of earth with the front feet, and the pushing back of it with the hind feet, in order to cover up the droppings. Again, when about to rest, the turning round two or three times with the object of forming a hole in which to rest may be noticed in pet dogs about to lie down upon the hearth-rug, a habit evidently acquired by inheritance from their wild ancestors.

The whining, growling, and howling of wolves, jackals, and dogs are so much alike as to be indistinguishable; but the barking of dogs is undoubtedly an acquired habit, and doubtless due to domestication.

Wolves and jackals in a wild state never bark, nor do Esquimaux dogs nor Dingos, but if kept associated with barking dogs, these and other wild dogs in many instances acquire the habit of barking.

A well-known instance of this occurred under my notice. A wild Antarctic Wolf, after a few months, hearing the barking of dogs in the immediate neighbourhood, began to bark, and succeeded admirably. The same thing has happened to my knowledge in the case of pure-bred Esquimaux dogs and Dingos. This reminds me of a similar instance of the development of the voice by domestication. There can be no doubt that the origin of our domestic fowls must be attributed to the wild Jungle-fowls of Asia, but none of the known wild species are ever heard to utter the fine loud crow of our domestic cock.

The different breeds of dogs do not present greater difficulties in accounting for them than are offered by the different breeds of domestic pigeons and the extraordinary varieties of domestic poultry.

Individual differences are observable in all living animals. The members of a family, the produce of the same parents, reared, treated, and fed on the same spot with the same surroundings, are frequently found to differ to such an extent in appearance, temper, and disposition, as to lead observers to doubt their uniform origin. It is probable that in this way varieties spring up and form distinct races.

In conclusion I may call attention to the fact that wolves, jackals, and wild dogs have a great aversion to go into the water. I have been informed upon good authority that the Eskimos, at times that they do not require to use their dogs, in order to prevent their being troublesome by entering the huts, convey them to an island, and there land and keep them, and that in such cases, although the dogs are sometimes half-starved, they never venture into the water. It therefore appears to me that during the domestication of the dog, by careful selection, breeding, and training, certain breeds have developed an aquatic habit that may be regarded as entirely foreign to its original wild ancestors. In fact the dog appears to me the most perfectly domesticated of all animals.

## 2. A Synopsis of the Genera of the Family *Soricidæ*.

By G. E. Dobson, M.A., F.R.S.

[Received December 21, 1889.]

The following synopsis of the genera of the family *Soricidæ* has been based on a very careful examination of a great number of specimens representing nearly all the known species, and differs from preceding synopses and classifications not only in the number and mode of arrangement of the genera, but also in many of the characters used for their discrimination[1]. In such a very compact family it is extremely difficult to obtain characters sufficiently salient to distinguish the genera when presented in synoptical form, and I am well aware that the discovery of new species may render changes inevitable in the definition of some of the genera as given below. While certain species, such as *Sorex vulgaris* and *Blarina brevicauda*, are easily relegated to their respective genera, this is not so readily effected with other species in which many of what appear to be the most important generic characters are either feebly developed or are altogether absent. So closely, indeed, are the species allied, all possessing the same number and character of mandibular teeth (*Myosorex varius*, in which there is a seventh pair of rudimentary lower teeth, can scarcely be considered an exception), that it is probable that the only really natural division of the Shrews is into two sections, one including the white-toothed and the other the red-toothed species.

I. Teeth red-tipped ..... Subfamily SORICINÆ.

*a*. Tail clothed with equal or subequal sized hairs; glans penis cylindroid or tapering. (*Terrestrial*, rarely *aquatic*.)

*a'*. Opening of male or female generative organs separated from the anal orifice.

*a''*. Ear-conch well developed; tail long.

Dent. $\frac{\text{i. } 4-4^2,\ \text{pm. } 3-3^3,\ \text{m. } 3-3}{\text{mand. } 6-6} = 32$ teeth ..... Sorex.

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[1] Most of the synopses and classifications of the genera were based upon the dental formulæ of which a *résumé* is given in Brandt's well-known papers on the dentition of the Shrews (Bullet. Soc. Imp. Nat. Moscou, t. xli. 2e part. pp. 76–95, 1868, t. xliii. 2e part. pp. 1–40, 1871). Since the appearance of Brandt's work A. Milne-Edwards published in 1872 (Recherches pour servir à l'Hist. Nat. des Mammifères, p. 250) a synopsis of the genera of this family, by far the most noticeable of the classifications which had yet appeared. This classification was adopted by me in the article "Mammalia," Encyclop. Britannica, 9th edition, 1882.

[2] Brandt (*l. c.*) has clearly shown that the position of the premaxillary suture in *Sorex vulgaris* and in *S. minutus* is between the third and fourth unicuspidate teeth, and that therefore there are 4 upper incisors on each side in these species, one more than in any other species of placental mammal not belonging to this family and to be met with among existing mammals in the *Marsupialia* only.

[3] As the anterior maxillary tooth is neither functionally nor morphologically a canine in any species of this family, I have not designated it as such in the dental formulæ, but have included it in the number of the premolars.

*b'*. Opening of male or female generative organs forming with the anal orifice a shallow cloaca.
*b''*. Ear-conch well developed; tail long; the fourth upper incisor larger than the anterior maxillary tooth.
Dent. $\frac{\text{i. 4—4, pm. 2—2 or 3—3, m. 3—3}}{\text{mand. 6—6}}$ = 30, rarely 32 teeth ... SORICULUS[1], Blyth.
*c''*. Ear-conch truncated above; tail short; the fourth upper incisor rudimentary or absent.
Dent. $\frac{\text{i. 4—4 or 3—3, pm. 3—3, m. 3—3}}{\text{mand. 6—6}}$ = 32 or 30 teeth..... BLARINA, Gray.
*d''*. Ear-conch well developed; tail moderate; first upper incisor as in *Blarina*, without internal talon.
Dent. $\frac{\text{i. 3—3, pm. 2—2, m. 3—3}}{\text{mand. 6—6}}$ = 32 teeth ..... NOTIOSOREX, (subg.) Baird.
*b*. Tail with an inferior fringe of long hairs; glans penis broad with lateral processes. (*Aquatic.*)
*b'*. Opening of male or female generative organs enclosed within the same integumentary ring as the anal orifice.
*b''*. Ear-conch small but perfect; tail long.
Dent. $\frac{\text{i. 3—3, pm. 3—3, m. 3—3}}{\text{mand. 6—6}}$ = 30 teeth ..... CROSSOPUS, Wagler.

II. Teeth white ..... Subfamily CROCIDURINÆ.
*a*. Tail without inferior fringe of long hairs; glans penis cylindroid, tapering. (*Terrestrial.*)
*a'*. Male or female generative organs opening close to the anal orifice but distinct from it, not forming a shallow cloaca as in *Crocidura*.
*a''*. Ear-conch well developed; tail long, clothed with equal or subequal hairs.
Dent. $\frac{\text{i. 3—3, pm. 3—3, m. 3—3}}{\text{mand. 6—6 or 7—7}}$ = 30 or 32 teeth ..... MYOSOREX, Gray.
*b'*. Opening of the male or female generative organs forming with the anal orifice a shallow cloaca.
*b''*. Ear-conch well developed; tail long, clothed with long and short hairs intermixed.
Dent. $\frac{\text{i. 3—3, pm. 3—3 or 2—2, m. 3—3}}{\text{mand. 6—6}}$ = 28 or 30 teeth..... CROCIDURA, Wagler.
*c''*. Ear-conch well developed; tail moderate; soles of the feet hairy.
Dent. $\frac{\text{i. 2—2, pm. 2—2, m. 3—3}}{\text{mand. 6—6}}$ = 26 teeth ..... DIPLOMESODON, Brandt.
*d''*. Ear-conch very short; tail rudimentary; soles of the feet naked.
Dent. $\frac{\text{i. 2—2, pm. 2—2, m. 3—3}}{\text{mand. 6—6}}$ = 26 teeth ..... ASUROSOREX, A. Mil.-Edw.
*b*. Tail with an inferior fringe of long hairs; glans penis broad with lateral processes. (*Aquatic.*)
*b'*. Male or female generative organs opening within the same integumentary ring as the anal orifice.
*b''*. Ear-conch perfect but small; plantar callosities simple.
Dent. $\frac{\text{i. 3—3, pm. 2—2, m. 3—3}}{\text{mand. 6—6}}$ = 28 teeth..... CHIMARROGALE, Anderson.
*c''*. Ear-conch not developed; plantar callosities forming adhesive pads.
Dent. $\frac{\text{i. 3—3, pm. 2—2, m. 3—3}}{\text{mand. 6—6}}$ = 28 teeth..... NECTOGALE, A. Mil.-Edw.

An examination of the arrangement and characters of the genera as given above shows that a certain parallelism exists between the

[1] I have found two minute maxillary teeth between the last incisor and the last premolar in *S. quadraticauda*, A. Mil.-Edw., in which also the anterior mandibular tooth has three notches; but in all other respects this species is and must be considered a true *Soriculus*.

genera of the two subfamilies. Thus *Sorex* is represented among the white-toothed Shrews by *Myosorex*, *Blarina* by *Anurosorex*, and *Crossopus* by *Chimarrogale* and *Nectogale*. It would seem as if, after the red-toothed Shrews diverged from the white-toothed, development had proceeded on somewhat similar lines in the descendants of both according to similarity of environment and modes of life.

To M. Milne-Edwards's list I have added four genera, *Soriculus*[1], *Notiosorex*, *Myosorex*[2], and *Chimarrogale*[3], and omitted one, *Neosorex*[4], from it. I had long suspected the validity of the last-named genus, founded for the reception of *Sorex navigator*, Baird, and examination of a well-preserved specimen of a Water-Shrew lately described[5] by me under the name of *Sorex hydrodromus*, convinced me that these species[6] must be merged in *Sorex*, of which they cannot even be considered as representing a subgenus. *S. hydrodromus*, although evidently aquatic like *Crossopus fodiens*, the fringes of the manus and pes being even better developed than in that species, agrees in all other generic characters with those of the genus *Sorex* as defined in the synopsis above; but while agreeing with *Sorex palustris* from the adjoining continent of America in external characters, it differs from it in the proportions of its teeth, resembling in this respect the section of which *S. vulgaris* is typical, while *S. palustris* agrees with those represented by *S. vagans*. No better proof could be afforded of the uselessness of retaining *Neosorex* as a distinct genus for the American species characterized by the possession of swimming-fringes in the digits, while the tail is simple as in *Sorex*. These species are in fact aquatic forms of the genus *Sorex*.

As I have omitted *Neosorex* so I am compelled to omit *Atophyrax*, although the distinguishing marks of that genus have been so well and clearly described by its founder, Dr. Merriam, through whose kindness I have been enabled to examine the type, *A. bendirii*[7]. This species is, as noted by its discoverer, an inhabitant of marshy land, and appears to me to present many characters intermediate between *Sorex palustris* and the terrestrial species of the genus, differing from the former in the absence of well-defined fringes to the digits, but agreeing with it closely in dentition, in the large size of the infra-orbital foramen, and in the remarkable shortness of the angular process of the mandible. In fact there are no leading characters which would enable me to define the genus, were I inclined to admit it in my synopsis.

[1] See the writer's paper "On the Genus *Myosorex*," in P. Z. S. 1887, p. 575.

[2] Blyth, Journ. Asiat. Soc. Beng. 1855, xxiv. p. 36.

[3] This genus was defined by Anderson (Ann. & Mag. Nat. Hist. vol. xvi. 1875, p. 252), subsequently to the appearance of A. Milne-Edwards's synopsis.

[4] *Neosorex*, Baird, Mammals of North America (Reports of Explorations and Surveys for a Route from the Mississippi to the Pacific Ocean, vol. vii. 1857).

[5] Annals & Mag. Nat. Hist., Nov. 1889, p. 374.

[6] From comparison of the types of *Sorex palustris* and *S. navigator* I am much inclined to doubt the distinctness of the latter species.

[7] Trans. Linnean Society of New York, vol. ii. 1884, pp. 217-225.

## 3. Observations upon an American Species of *Perichæta*, and upon some other Members of the Genus. By Frank E. Beddard, M.A., Prosector to the Society.

[Received December 23, 1889.]

(Plates IV. & V.)

Some weeks since Mr. C. Bartlett brought me two living earthworms, which he had found in earth surrounding the roots of an orchid, received from South America. One of these was a very small example of a *Lumbricus*, which I have not yet identified; the other was a *Perichæta*, which is illustrated in the accompanying coloured sketch (Plate IV. fig. 1). There are so very few coloured figures extant of foreign earthworms[1] that I have considered it desirable to put on record the coloration of this species, which appears to be *P. indica*. The worm is remarkable for its extreme activity, as has been already noted by Baird (1) and by Perrier (18) in other species of *Perichæta*, studied in the living condition. Another curious characteristic of the worm is its method of progression; many Oligochæta seem to make use of the mouth in locomotion, attaching themselves firmly by it, while the following segments are moved forwards; in the present species a considerable portion (? the whole) of the buccal cavity is everted whenever the animal moves, so that the head has a remarkably leech-like aspect. I have attempted to illustrate the appearance of the anterior end of the body during locomotion in the accompanying drawings (Plate IV. figs. 2, 3). I never observed the worm in motion without this alternate eversion and inversion of the buccal cavity.

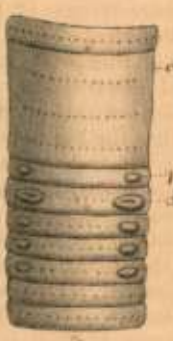
As will be seen, the colour of the worm is a rich brown, somewhat darker upon the clitellum, with a whitish line in the middle of each segment. The colour appears to be caused by at least two distinct pigments; one or more of these is dissolved out by alcohol, leaving the worm colourless, except for a dark bluish-brown area along the back (which resists the action of the spirit), and is recognizable in sections as black granules lying in the epidermis and in the circular muscular layer. I lay particular stress upon this fact, for the reason that in other specimens of *P. indica* (see no. 5), which I received from New Caledonia and which were sent to me *in alcohol*, the brown coloration and the whitish line in the middle of each segment are preserved. It is interesting to find that *P. indica*, which has been already recorded from the East Indies and from New Caledonia, occurs also in South America. There are not many species which have so wide a distribution; *P. affinis*, *P. houlleti*, and *Urochæta corethrurus*, however, are forms which inhabit the tropics of both the

[1] The only coloured figures known to me (taken from life) are several of *Perichæta* and *Hypogæon* by Schmarda (20), and of *Microchæta rappii* in a paper by myself upon the anatomy of this worm (3); Schmarda's figures lose some of their value from the fact that they are not accompanied by any description of the internal characters, and cannot, therefore, be easily identified.

2.

3.

4.




5.

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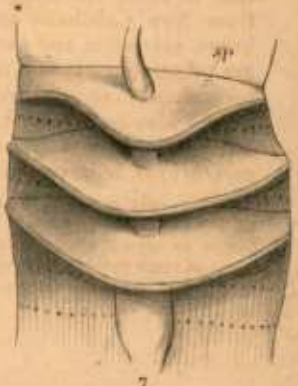
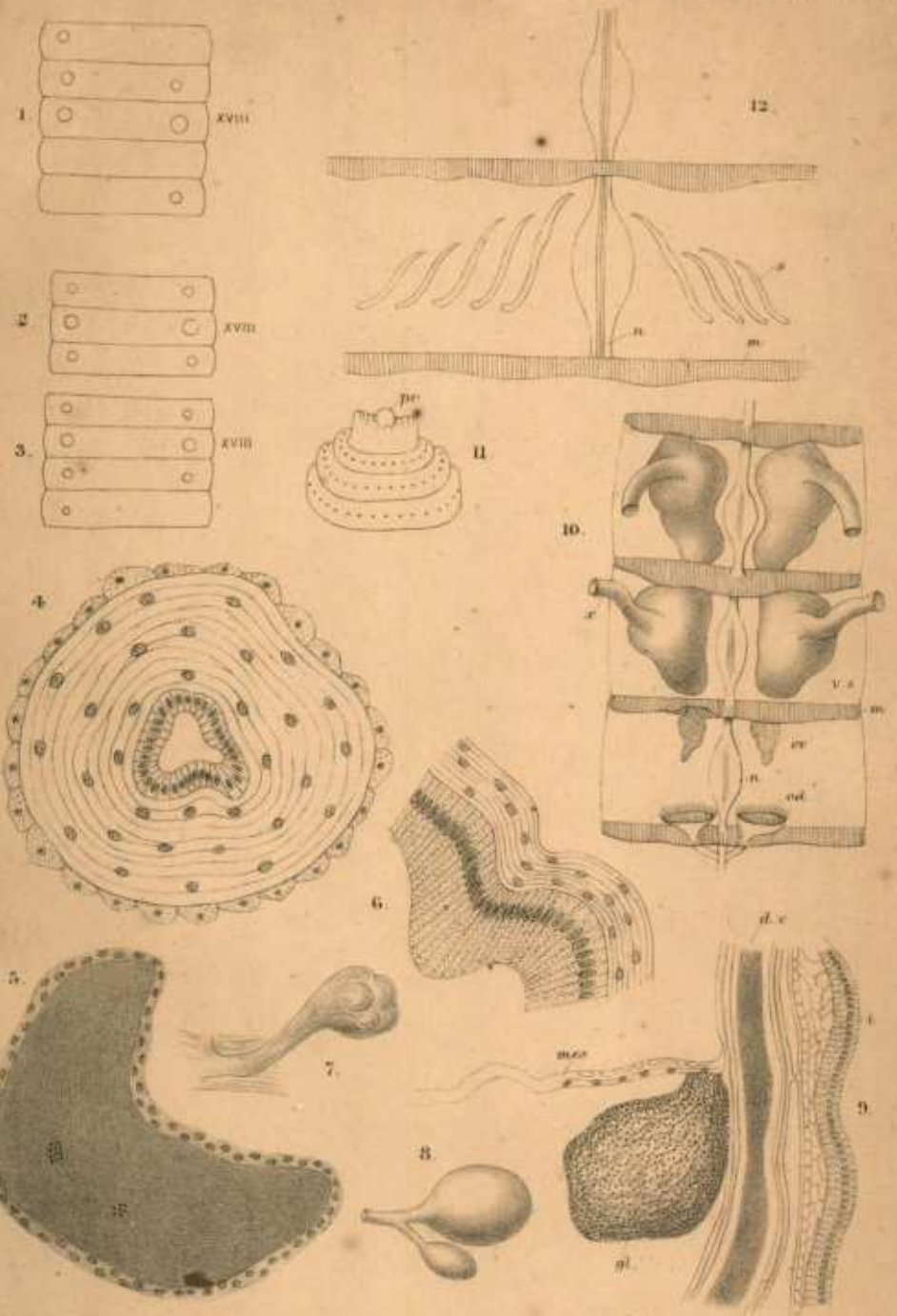



7.

J. Smit, lith. Mintern Bros. imp.

ANATOMY OF PERICHÆTA.




J. Grant, lith.

Mintern Bros. imp.

ANATOMY OF PERICHÆTA.

Old and New World, while *Eudrilus* has been recorded from South America and the West Indies and from New Caledonia, and it also occurs in New Zealand.

I take this opportunity to put together a few notes upon other species of *Perichæta*.

### *Proposed Subdivisions of the Genus* Perichæta, *Schmarda.*

The genus was instituted by Schmarda (20), who, however, only directed attention to the numerous setæ forming a row round the middle of each segment, and to the form of these setæ. Vaillant (22) subsequently described the internal anatomy of *Perichæta*, and pointed out the important differences which distinguish the type from *Lumbricus*. In the next year Baird (1) called attention to the identity of this genus with *Megascolex*, which was described by Templeton (21) twenty years before the publication of Schmarda's work. The reason which, apparently, caused these two genera to be regarded as distinct was a misunderstanding of Templeton's original description. I have directed attention myself (2) to the fact that both Schmarda and Vaillant misquoted Templeton's original description, making him responsible for the statement that setæ are *only* present on the dorsal surface of the body of *Megascolex*; Templeton himself defined the species as having "each ring in the middle of its length dilated into a ridge, which carries on it, *except in the mesial line of the back*, minute conical mamillæ, 100 in number, each surmounted with a minute bristle." These inaccuracies on the part of Schmarda and of Vaillant have been also pointed out by Horst in a paper published (15) about the same time as my own.

Perrier, in his most important paper (18) upon the anatomy of Earthworms, retains, in spite of Baird, Schmarda's name of *Perichæta*; but the value of his opinion in the matter is greatly discounted by the fact that, like his predecessors, he entirely misunderstood and misquoted Templeton's description of *Megascolex cæruleus*, probably taking his information from Schmarda, Vaillant, or Grube.

The synonymy of the genus was, I regret to say, somewhat confused by my own paper (2) upon a large Ceylon worm, which I described under the name of "*Pleurochæta moseleyi*." I was led to describe this form, which I afterwards (4) recognized as identical with Templeton's *Megascolex cæruleus*, as belonging to a new genus, on account of the inaccuracy and incompleteness of Templeton's description. In a subsequent paper (8), dealing partly with the nomenclature of the genus, I proposed to retain the name *Megascolex* for "those worms which are characterized by (1) the presence of a continuous ring of setæ upon the segments of the body, (2) the possession of a clitellum occupying segments 14–16 inclusive, (3) the position of the two male generative apertures upon the eighteenth segment behind the clitellum . . . . .; while the name *Perichæta* might be applied to certain other forms which present a fundamental resemblance to the above-mentioned groups, but differ

in one or both of the following characters:—(1) in the ring of setæ upon each segment being discontinuous at one or more points; (2) in the clitellum occupying more or fewer segments of the body than three."

Rosa has lately pointed out (24) that my distinctions are valid, but that the names should be reversed. I am now quite prepared to agree with him; at the time when I wrote I was inclined to consider that Templeton's *Megascolex* was identical with *Perichæta*, even to the extent of having a *continuous* circle of setæ in each segment, inasmuch as Baird (1), who had examined the type in the British Museum, stated that he could find no difference between it and *Perichæta*. Taking for granted the accuracy of Baird's observations, it appeared to me necessary to use the name *Megascolex* for the worms which Schmarda termed *Perichæta*; strictly speaking I should have allowed the name *Perichæta* to drop, but it was proposed to retain it for *perichætous* worms with a dorsal and ventral interrupted line &c.

When I discovered (4) that my *Pleurochæta* was identical with Templeton's *Megascolex cæruleus*, it seemed necessary to restrict the generic name to that form, and to group all the other known *perichætous* forms under the genus *Perichæta*; it will be seen that the definition of *Perichæta* appended to that paper includes such forms as *P. armata*, though I omitted to state in so many words that it was proposed to drop the generic distinction between *Megascolex affinis* and *Perichæta armata*, since the differences between *Megascolex cæruleus* and any other perichætous worm are rather more important than those which differentiate the latter species among themselves.

Rosa (24) has, as already stated, proposed to divide *Megascolex* from *Perichæta* by the distribution of the setæ and the presence or absence of intestinal cæca; the genera are thus defined by him:—

*Megascolex*. Line of setæ interrupted; no intestinal cæca.
*Perichæta*. Line of setæ continuous; intestinal cæca present.

Fletcher (17, III.) has proposed a similar division, but also (17, II.) has pointed out that in the typical *Perichæta*, with continuous row of setæ and cæca, the gizzard is situated further back than in *Megascolex* and occupies two segments, the mesentery between them having vanished[1].

This distinction, although it applies to so large a number of species, falls to the ground before the Indian species described by Prof. Bourne[2]; *Perichæta hulikalensis* (Bourne, 11. p. 668) has dorsal and ventral gaps, but possesses intestinal cæca in the usual position.

[1] I had previously directed (6) attention to this difference between certain species of *Perichæta*, though mistaken in supposing that in *P. newcombei* the gizzard occupied three segments; I have since convinced myself the gizzard is really in segment 6; in any case this species does not fit in very accurately with the proposed subdivision of *Perichæta*.

[2] This paper was overlooked by Rosa, as he mentions in a postcript (24. p. 11).

If Rosa's definition of the two genera be slightly altered, it will be possible to arrange most of the species of "*Perichæta*" as follows:—

MEGASCOLEX. Line of setæ interrupted; clitellum occupying more than three segments.

PERICHÆTA. Line of setæ continuous; clitellum consisting of three segments only.

There are, however, other species which present more important differences among themselves than those above mentioned. Prof. Bourne (11) calls attention to the fact that there are anatomical differences, to which considerable weight must be attached, between several of the forms described by him.

*Perichæta novæ zelandiæ* (Beddard, 7) differs from all other species in the following combination of characters:—No dorsal pores; nephridia paired; atria tubular.

*P. bakeri* and *P. barronensis* of Fletcher agree in their nephridia and atria, but have dorsal pores.

A number of species described by Fletcher (17), viz. *P. attenuata*, *P. enormis*, and *P. coxii*, agree to differ from others in the very remarkable fact that the setæ in the anterior segments are eight in number to each segment, increasing in the posterior segments to 20–30.

In both these cases the different geographical area occupied by the species is, perhaps, a further argument in favour of separating them.

Then *Perichæta stuarti* has four pairs of atria, as in *Acanthodrilus*; they open on to the same segments as in that genus, and appear to be similar in structure; the diverticula of the spermatheca also appear, from Bourne's description (11. p. 667), to be more like those of *Acanthodrilus* than of most *Perichæta*. *P. ceylonica* (Beddard, 9) has two distinct pairs of atria, but they open both of them on to the same segment, the 18th; at present I am not inclined either definitely to unite this form, generically, with *P. stuarti*, or definitely to separate it; further information as to its structure is first needed.

If these various types be accepted by zoologists as of generic value, it must still be admitted that they cut off very small corners from the mass of species (about sixty in number) of which the family consists. At present, however, it does not seem easy to make any further alterations, and I am not satisfied that *Megascolex* has the same value, as a generic type, that *Aporochæta* has.

The following is a definition of the family Perichætidæ and its various genera as advocated in this paper.

### Fam. PERICHÆTIDÆ, Claus.

Earthworms with a continuous circle of numerous setæ round all the segments of the body (with the occasional exception of a few of the most anterior); clitellum commencing with the thirteenth or

fourteenth, and extending over three to six segments. Gizzard always present and single; intestines frequently provided with a pair of conical cæca. Nephridia generally diffuse. Spermathecæ nearly always[1] furnished with one or more diverticula; atria (prostates) always present, and sometimes penial setæ.

(1) Genus Perichæta, Schmarda.

Setæ numerous, and forming a continuous or nearly continuous row round all the segments of the body[2]. Nephridia diffuse, with many external pores in each segment. Atria (prostates) branched and lobate. Dorsal pores present (? always). Penial setæ sometimes present.

*Distribution.* World-wide, especially tropics of Old World and Australia.

Subg. 1. Perichæta (Beddard).—Line of setæ continuous; clitellum consisting of 3 segments only (14–16). One or more pairs of intestinal cæca. Gizzard posterior to 7th segment, occupying 2 segments, the septum between which has disappeared.

Subg. 2. Megascolex[3] (Beddard).—Line of setæ interrupted; clitellum occupying more than 3 segments. Cæca generally absent. Gizzard usually situated in, or in front of, segment 7; occupying only one segment.

(2) Genus Perionyx, Perrier.

Setæ forming a continuous row round each segment; generative pores closely approximated in middle ventral line; atria (prostates) lobate; nephridia paired; dorsal pores present.

*Distribution.* India and Burmah.

(3) Genus Diporochæta, gen. nov.

Setæ forming a continuous row round each segment; atria tubular; nephridia paired.

(For *P. novæ zelandiæ* and perhaps *P. bakeri.*)

*Distribution.* Australia and New Zealand.

(4) Genus Anisochæta, gen. nov.

Setæ 8 in number per segment anteriorly, afterwards increasing up to 30; nephridia diffuse; atria lobate.

(For *P. attenuata, P. enormis,* and *P. coxii.*)

*Distribution.* Australia.

[1] The only exception appears to be *Megascolex cæruleus*; but this matter requires reexamination.

[2] Except of course the peristomial segment.

[3] N.B.—These divisions will not do unless Prof. Bourne finds, as he has thought possible, that such species as *P. burliarensis* and *P. hulikalensis* should be separated as distinct genera.

(5) Genus HOPLOCHÆTA, gen. nov.

Setæ forming a continuous row round each segment; atria tubular, two pairs opening on to segments 17 and 19.

(For *P. stuarti*, Bourne.)

*Distribution.* India.

PERICHÆTA INDICA (Horst).

'Eine *Perichæta* von Java,' Horst, Nederl. Arch. f. Zool. iv. p. 3.

*Megascolex indicus*, Horst, Notes Leyden Mus. vol. v. p. 186.

*Perichæta indica*, Beddard, Proc. Zool. Soc. 1886, p. 298; Horst, Midden-Sumatra, Vermes, p. 4.

This species is already pretty well known, and I have not much to add to our knowledge of it beyond the appearance of the living worm, which has been already described (p. 52) and which is illustrated in the accompanying coloured drawing (Plate IV. fig. 1). Horst remarks (15. p. 189) that probably some of the specimens of *P. cingulata* described by Vaillant (22) are identical with this species; Perrier has suggested that several species are included under the name of *P. cingulata*. In view of these difficulties it seems to be reasonable to adopt Horst's name of *P. indica* and to drop the name of *P. cingulata* altogether.

On the first few segments of the body there are two specially large and distinct pairs of setæ, situated at almost equidistant intervals on the ventral side of the body. I did not refer to them in my earlier paper upon *P. indica*; the condition of the setæ is a step in the direction of those very remarkable Perichætous worms described by Mr. Fletcher, which I have ventured to include in a distinct genus. These facts have an important bearing upon the general question of

*The Distribution of the Setæ in Chætopoda.*

The paired setæ of *Lumbricus* and other Oligochæta are usually compared to the parapodia of the marine Chætopods; and it has been supposed that four distinct parapodia and four pairs of setæ represent the typical arrangement of the locomotor organs of these two divisions of the Chætopoda. Deviations from this arrangement, the extremes of which are shown in the Capitellidæ and in the genera *Perichæta* and *Perionyx*, are regarded by perhaps the majority of naturalists as secondary modifications. There is, however, a certain amount of evidence which seems to point the other way, indicating that the complete circle of setæ, which characterizes the family Perichætidæ, is the primitive arrangement; in this case the paired setæ of *Lumbricus*, *Acanthodrilus*, &c., will be due to reduction, and the comparison with the four seta-bundles of Polychæta will fall to the ground. Among Polychæta the nearest approach to the Perichætous condition is found in the Capitellidæ; but Eisig (13) argues with considerable force against regarding the almost continuous circle of setæ found in some Capitellids as the primitive

condition. The summary which Eisig gives of our knowledge respecting the structure and development of the parapodia and their setæ in other Polychæta does not permit of a decisive answer as to the original condition of these organs; the "diplostichous biremal" form may have been evolved from a "monostichous uniremal," or the reverse. The former alternative is more in accord than the latter with the derivation from a continuous circle of setæ.

Among the Oligochæta there is more evidence; and this seems to favour the supposition that the continuous circle of setæ is the archaic condition.

(1) The continuous circle of setæ characterizes the genera *Perichæta* and *Perionyx*; of these the former is the most widely distributed and the most abundant of all Earthworms. There are more species of *Perichæta* than of any other two genera; that is, of course, well described species. There is, moreover, a large amount of structural variation in the species of this genus; so much so, that were it not for the fact of the agreement among the species in the very striking character of the setæ, they would probably have been more subdivided into genera; this I have attempted to do. Such forms as *P. intermedia*, *P. stuarti*, *P. ceylonica*, and *P. affinis* differ from each other quite as much as do such genera as *Urochæta*, *Diachæta*, and *Urobenus*. Accordingly when the existence of some 18 or 20 *genera* possessing only 8 setæ in each segment is contrasted with the two genera above-named as an argument in favour of the more prevalent "biramous" condition, it must be discounted by these considerations. Even with regard to the number of species, *Perichæta* and *Perionyx* are probably not far behind the remaining genera of Earthworms taken together, though it is difficult to make an estimate[1].

(2) The Perichætidæ show in many respects a type of structure which is less specialized and more primitive than that of other Earthworms. The continuous network of nephridia with numerous irregularly disposed internal and external apertures is, so far as our knowledge goes, confined to that genus and found in nearly all its species. In other genera which have a diffuse nephridial system (*Megascolides*, *Typhæus*, some species of *Acanthodrilus*, and *Cryptodrilus*, *Deinodrilus*, *Trigaster*, and *Dichogaster*) there appears to be generally some modification—such as loss of funnels, specialization of part of nephridial network, restriction of network to segments, &c.—which can be best explained on the hypothesis that it has been *derived* from a condition like that of *Perichæta*.

(3) In most (? all) Perichætidæ the buccal lobe does not divide the buccal segment; this appears from the nature of the case to be a primitive condition. Most *Perichætæ* have dorsal pores, the presence of which may fairly be regarded as typical for the terrestrial Oligochæta: it is worthy of note that some forms, in which these pores are absent, show signs of degeneration; for example the absence of dorsal pores in *Acanthodrilus georgianus* and in *Pontodrilus* is correlated with

[1] About 60 species of *Perichæta* to about 120 of other genera; but the differences between individual species of *Lumbricus* and *Allolobophora* (comprising 50 out of the 120) are often very small.

the feeble development of the gizzard. The subneurian vessel, commonly believed to be absent from *Perichæta*, *is* found, at least in some species. The reproductive organs, although not presenting any specially archaic characters, are not at any rate more modified than those of other Earthworms. In short it cannot be urged that the organization of the Perichætidæ, as a whole, is opposed to the view that these are the most primitive Oligochæta; while the structure of the excretory system in my opinion favours the supposition.

(4) The most striking evidence, however, in favour of the derivation of the paired arrangement by a gradual reduction of a continuous circle of setæ, is afforded by the structure of *Deinodrilus*. This genus is a native of New Zealand, and is in many respects intermediate between *Perichæta* and *Acanthodrilus*. It is at present the only Oligochæte known which possesses *more than* 8 *setæ in each segment* [1] and yet has not the continuous circle of setæ of *Perichæta*. *Deinodrilus* has 12 setæ in each segment, disposed at approximately equidistant intervals; it therefore furnishes a connecting link between the continuous circle of setæ and the paired setæ. *Deinodrilus* has diffuse nephridia, more like those of certain species of *Acanthodrilus* than those of *Perichæta*; the nephridia of a few of the anterior segments are more concentrated, as also are the corresponding nephridia of *Trigaster lankesteri* (Benham), a species which, in the opinion of Horst, should be referred to the genus *Acanthodrilus*, and which is at any rate closely allied to that genus; this concentration reaches its extreme in *A. multiporus*, where the nephridia of these segments are metamorphosed into a gland opening into the buccal cavity. The reproductive organs are exactly like those of *Acanthodrilus*, but the clitellum, which occupies segments 14–16, and is developed continuously round the body, is like that of *Perichæta*. There is, therefore, a strong case for believing that *Deinodrilus* represents a stage in the evolution of *Acanthodrilus* from *Perichæta*, or of *Perichæta* from *Acanthodrilus*. The question is, which of these two alternatives is the more probable? The species of *Acanthodrilus* which come nearest to *Deinodrilus* are evidently those which have a diffuse nephridial system, i. e. *A. multiporus*, *beddardi*, *schlegelii*, *büttikoferi*, and *antarcticus*; all these species furthermore agree with *Deinodrilus* in having an incomplete prostomium (not dividing buccal lobe) and dorsal pores, while the first and last have the persistent double dorsal vessel of *Deinodrilus*. The species which are furthest away from *Deinodrilus* are such forms as *A. dissimilis*, where the prostomium completely divides the buccal segment, the nephridia are paired, and the dorsal pores have commenced to disappear. These extremes are connected by *A. annectens*, which has the incomplete prostomium and paired nephridia, but the anterior pair of nephridia are much specialized and open into the buccal cavity, as in *A. multiporus*. There are, moreover, other intermediate forms. The question is really intimately connected with the development of the nephridia; if the

[1] The statement that *Hypogæon* has 9 setæ in each segment requires verification.

presence of a single pair of these organs in each segment is the archaic condition, then *Perichæta* will be a modification of *Acanthodrilus*: but this view is confronted with two serious difficulties—(1) the apparent specialization of a part of the nephridial network to form a series of paired nephridia in *Megascolex armata* and in *Megascolides australis* (Spencer) will require explanation; and (2) the connection of the vasa deferentia with the atria (=prostates) will have to be regarded as having been derived from a condition in which these organs are independent of each other (*Acanthodrilus*). These structural peculiarities are capable of an intelligible explanation if we assume that *Deinodrilus* is an intermediate stage in the evolution of *Acanthodrilus* from *Perichæta*.

The remarkable arrangement of the setæ in certain Australian *Perichætæ*, which I have in the present paper associated together in the genus *Anisochæta*, and the commencing reduction of the setæ in *P. indica* must be considered in relation to this question. It is noteworthy that in these cases it is the anterior segments only which differ from the posterior in the reduction of the setæ. The formation of a "head" is also brought about by specialization in the alimentary and excretory systems, and by a partial obliteration of the cœlom and loss of internal segmentation. These facts tend to show that the reduction in the number of the setæ is also secondary; and this reduction is very general in Perichætidæ, though not anywhere so apparent as in *Anisochæta*. It is true that, as Perrier first pointed out, the hindermost segments of *Perichæta* may also show a reduction in the number of setæ; but this fact may be in accord with the views here advocated, inasmuch as the nephridial system in *Megascolides* begins to be specialized in the posterior region of the body. I would, however, rather insist upon the increase in length produced by the addition of new segments at the end of the body, and explain the few setæ of these segments as due to their recent formation and consequent imperfect development.

If we were acquainted with a species of *Lumbricus* in which the anterior segments were provided with a larger number of setæ than ordinarily, it would certainly be set down to "cephalization;" there is therefore nothing unreasonable in regarding the converse change, which actually occurs, as due to the same cause. These facts, therefore, are at least not contrary to the assumption that the "*perichætous*" condition is the more primitive. Among the species of *Anisochæta* which show the reduction to 8 setæ per segment, some have more segments modified in this way than others; there is, therefore, evidence of a gradual change in this direction which lends more weight to the arguments here advanced than if all were modified to exactly the same extent. In the latter case the facts could be referred only to a modification affecting the "head" and comparable for example to the loss of the setæ in some of the first few segments in *Chætogaster*; as it is the facts appear to point to a gradually advancing reduction of the setæ commencing in the most modified region of the body.

### *Nephridia.*

In describing the remarkable nephridia of a New-World *Perichæta*, *P. aspergillum* (10), I pointed out that probably all *Perichætæ* with irregular diffuse nephridial tufts—that is to say, all the species belonging to *Perichæta*, *Anisochæta*, and *Megascolex*, as these genera are defined in the present paper,—would prove to possess a nephridial system of the same kind as that which characterizes *P. aspergillum*. The pores upon the cuticle often render it possible to predict of a given Earthworm that the nephridia will be found to be dysmetamerie; after finding upon the cuticle of *P. houlleti* numerous pores which could be referred to no other known structure than to the apertures of nephridia, I ventured to predict that this species would be found to agree in all essentials of its excretory system with *P. aspergillum*. Unfortunately I have not been able to put this prediction to the proof, as the specimens of *P. houlleti* which I have are not in a sufficiently good state of preservation for sectionizing. The specimen of *P. indica*, however, I carefully preserved, and the examination of transverse, and particularly of longitudinal, sections shows that it agrees with *P. aspergillum* in the minute structure and in the relations of the nephridia. A dissection of the worm shows that the nephridia do not present the regular paired condition of such forms as *Lumbricus*; they are represented only by minute tufts attached to the ventral body-wall, especially to both sides of the intersegmental septa. This condition of the nephridia would lead to the assumption that a microscopic investigation of the nephridia would prove the presence of numerous irregularly-disposed external pores and cœlomic funnels. I made a number of longitudinal sections in the hinder region of the body, and found that the nephridial tubes were in places perfectly continuous from segment to segment through the septa; the external pores also had that irregular arrangement of a large number of pores per segment which is apparently to be now regarded as a very prevalent condition among Earthworms.

### *Spermathecæ.*

The structure of the spermathecæ is illustrated in the accompanying figures (Plate V. figs. 4, 5, 6, 8). As appears to be always the case in Earthworms, the diverticula have a different histological structure from the pouch. The epithelium lining the pouch (see fig. 6) is tall and columnar. In the diverticulum, on the other hand, the structure not only differs from that of the pouch itself, but also from that of the diverticula of other species of *Perichæta*; but these differences are very possibly due to immaturity in the present specimen. The diverticulum was filled (see fig. 5) with a perfectly homogeneous fluid, slightly stained by the colouring reagent used; the epithelium lining the pouch was formed of very low cells, not in the least columnar, and hardly to be distinguished from the muscular fibres which make up the very thin walls.

### *Glycogenic Organs.*

*Perichæta indica* is furnished with a series of curious glandular-

looking bodies in most of the posterior segments of the body; these are attached, close to the middle line on either side of the dorsal vessel, to the posterior side of the septa. They were perfectly recognizable both in transverse and longitudinal sections, though naturally their relations to the septum were better shown by the latter, their position with reference to the dorsal vascular trunk by the former series of sections.

Structurally these small white bodies consist of a mass of cells continuous with the peritoneal epithelium and probably formed by a local proliferation of its cells; in the interior of each were a few muscular fibres; there was no trace whatever of a central cavity, which occurs in the corresponding bodies of the allied genus *Acanthodrilus*. These "septal glands" were in *Perichæta indica* solid throughout.

As to *Acanthodrilus* the observations recorded in this paper were made upon some examples of *Acanthodrilus georgianus* (Michaelsen, 26), which were collected for me in the Falkland Islands by Dr. Dale, at the request of Mr. Coleman, Secretary to the Falkland Islands Company.

This worm differs from all other species of the genus, which I have examined, in possessing a series of sac-like organs connected with the septa. These have the appearance of white solid bodies attached to the septum close to the nephridium—a pair to each segment; they commence at about the 20th segment and continue to the end of the body; the first three or four pairs are commonly larger than the rest. These organs are not really solid bodies, but sac-like outgrowths of the septa depending freely into the interior of the segments; they are, in fact, exactly similar to the sperm-sacs and egg-sacs of the same and other Earthworms in their early stages of development; and their absence in the anterior segments of the body, where the sperm-sacs and egg-sacs are found, may possibly be due to their homology with those structures.

Each sac has a somewhat racemose appearance owing to the irregular bulging of its walls; the walls are muscular with a thick coating of peritoneal cells, which are larger and more numerous than those on the adjoining surface of the septum; the interior of the sac has a delicate lining of peritoneum and communicates with the segment in front by a pore.

The only structures with which I can compare these septal sacs are the oval aggregations of peritoneal cells described by Claparède (26) in the common Earthworm. Claparède figures and describes these bodies as consisting of a mass of peritoneal cells enclosing a few muscular fibres; the presence of muscles suggests that the bodies may really be sacs, and not solid proliferations of the peritoneum. Vejdovsky (29) has recorded the presence of similar sacs in *Rhynchelmis* and in *Tubifex*; but inasmuch as in *Tubifex* they were only found in a few cases and in the posterior younger segments, Vejdovsky regards them as connected with the growth of the septa.

In *Acanthodrilus georgianus*, as already mentioned, they commence in the anterior region of the body; and as they were found

in both specimens (sexually mature) dissected, the probability is that they are definite organs and not temporary outgrowths of the septum caused by its rapid development.

The cells covering the septal sacs, when these organs were treated with a weak solution of iodine in potassium iodide, were stained a deep mahogany-brown. This colour disappeared on warming the slide and reappeared on cooling; it seems therefore to be due to the presence of glycogen.

Glycogen was first discovered in the tissues of the Earthworms by Claude Bernard, and its presence in that animal has been lately reaffirmed by Barfurth (30). The last-mentioned author particularly states that it occurs in the muscular tissue. As far as concerns the muscles of the septa, I do not find myself able to agree with Barfurth. In preparations of the septal sacs it was distinctly the peritoneal cells and *not* the muscular tissue which showed the glycogen reaction; the muscles were stained *yellow*; and this colour did not disappear on warming, unless the tissue was exposed for some time to a temperature of 60° C., when the colour disappeared but did not return on cooling.

The glycogen reaction was not confined to the peritoneal cells covering the septal sacs, but was found also in the peritoneal cells covering the surface of the septum and elsewhere.

The large size of the peritoneal cells upon the septal sacs and their abundant granular contents, combined with their very dark staining, seems, however, to indicate that these cells are specially concerned with the formation of glycogen. The septal gland is so far analogous with the vertebrate liver in that it "has more glycogen than other organs; it is not an organ *sui generis*, but only *primus inter pares*" (Barfurth).

The formation of glycogen in the peritoneal cells is interesting, since in the Mollusca the formation of this substance has been shown by Blundstone (31) to occur in the "vesicular connective tissue," which is apparently the lining membrane of the much reduced cœlom of these animals.

I may take this opportunity of mentioning that I have found glycogen in the peritoneal cells of *Æolosoma*, in which worm the presence of glycogen has never yet been recorded.

PERICHÆTA BISERIALIS, E. P.[1]

*Perichæta biserialis*, Perrier, C. R. t. lxxxi. (1875), p. 1043.

Some years ago I received from Manila, through the kindness of Mr. H. E. Barwell, several species of a *Perichæta* which I refer with some little doubt to the above-named species. M. Perrier has as yet only given a very short preliminary account of this species, which cannot be regarded as sufficiently defined.

The most marked external characters are the peculiar ventral

[1] M. Vaillant (23 A) proposes subgeneric rank for this species under the name of *Perriera*, on the grounds that there is a median and ventral line devoid of setæ. *P. luzonica* is referred to the same subgenus. I have already (53) discussed this question; but these species are *not* the only two with ventral gaps.

setæ and the genital papillæ; and it is precisely these characters which lead me to identify the present species, at least provisionally, with *Perichæta biserialis*.

The *prostomium* is small and does not divide the circumoral segment.

The *setæ* form a continuous row round each segment; on the ventral side a single pair, one on either side of the median line, are very much enlarged, being three or four times as large as the rest. On the anterior segments of the body two or three setæ on each side are thus enlarged; posteriorly there is only a single pair of these setæ.

The *clitellum* occupies segments 14–16 inclusive and is developed all round the body. There are *no setæ* on the clitellum [1].

The *male generative pores* are upon segment 18.

The five succeeding segments each have a pair of *genital papillæ*, which are placed in positions exactly corresponding with the male pores some distance on either side of the median line; these papillæ as well as the male pores are situated just in front of the ring of setæ (Plate V. fig. 4).

The *oviducal pore* is single and median upon the 14th segment.

No *spermathecal pores* could be detected.

*Dorsal pores* are present, but I am not able to state at which segment they commence.

Concerning the internal anatomy I am not able to say much, as none of the specimens examined by me were in a sufficiently good state of preservation for section-cutting.

The *nephridia* show the usual characters which are found in the genus *Perichæta*; they present a series of minute tufts attached to the body-wall; in some of the anterior segments they form immense masses completely occupying the cavity of the segment.

There are only three *mesenteries* which are specially thickened; these lie between segments 6–7, 7–8, 8–9; of these three mesenteries the last two are considerably thicker than the first.

The *gizzard* lies behind the last thick mesentery and occupies at least two segments.

The most remarkable fact about this species is that *there are apparently no spermathecæ*. I have only been able to examine two specimens, and there was not the slightest indication of spermathecæ in either of these. I cannot of course state positively that these structures are absent, which seems unlikely seeing that in all other species of *Perichæta* they are present; but the fact remains that they were undoubtedly absent in two examples, the only complete examples which I possess [2].

[1] The presence or absence of setæ on the clitellum is characteristic of a given species and should always be carefully noted. It serves, for example, to distinguish *P. indica* (where they are absent) from *P. affinis* (where they are present).

[2] Since writing the above I have received Rosa's paper (27) in which he refers to the absence of spermatheca in *Lumbricus eiseni* and *Allolobophora constricta*, besides *Criodrilus*.

PERICHÆTA FORBESI, n. sp.

I possess two specimens of this *Perichæta*, which were collected by Mr. H. O. Forbes in New Guinea and given to me; I have great pleasure in associating the name of this new species with Mr. Forbes.

Both examples are of an almost exactly similar size. The length is about 9 inches, the breadth nearly half an inch. The colour of the spirit-preserved specimens is a dark greyish brown, darker upon the clitellum.

The *prostomium* is very small, and does not extend over a large portion of the peristomial segment.

The *setæ* form a continuous row round the middle of each segment.

The *clitellum* occupies the usual number of segments, *i. e.* 3 (segments 14–16); but the glandular tissue, instead of being, as is usually the case, continued as far as the posterior boundary of segment 16, appeared in both specimens to end at the setæ of that segment.

As in *Perichæta affinis*, setæ are developed upon the ventral side of the clitellum.

The *male generative pores* occupy the usual position, *i. e.* upon the 18th segment.

The 17th segment and the 19th, 20th, and 21st have each a pair of genital papillæ occupying a position corresponding to that of the male pores, and situated like them just in front of the circle of setæ. The number and arrangement of the genital papillæ of this species serve to distinguish it from *Perichæta biserialis* (*cf.* Plate IV. figs. 4, 5).

The *oviducal pore* is single and median upon the 14th segment.

*Dorsal pores* are present and commence between segments 12 and 13.

The arrangement of the *specially thickened mesenteries* is very distinctive of *P. forbesi* (*cf.* Plate IV. fig. 6). The mesentery separating segments 7 and 8 is thickened and then there is a considerable interval consisting of three segments which are apparently undivided by any mesenteries at all; in this space lies the *gizzard*. The 10th segment is separated from the 11th by a very thick mesentery, and the 11th from the 12th; these two are much thicker than the mesentery between segments 7 and 8, especially the first of the two.

The *spermathecæ* present a character which is, so far as my experience goes, unique among Earthworms, and that is their marked asymmetry.

In the 8th and 9th segments are a pair of these organs; each is a somewhat pear-shaped pouch with a single small sessile diverticulum. In the 8th segment, on the left-hand side of the body, was an additional spermatheca placed close to the other one and of exactly similar structure. This duplication occurred in both specimens, but in the second specimen it affected the spermatheca of the 9th segment. It is of course possible that this structural peculiarity

is merely an abnormality of no special interest; on the other hand it occurred in *both* specimens, the only ones which I possess of this species. If a structural peculiarity is found in two specimens selected at random, there is, as it appears to me, considerable probability in favour of the structure being a normal one; at the same time an asymmetry of this kind is most surprising in so typically a bilaterally symmetrical worm as *Perichæta*. I mention the fact therefore for what it is worth, without venturing to commit myself to a definite opinion as to whether it is normal or abnormal [1].

The *sperm-sacs* in both examples were limited to a single pair of large greyish kidney-shaped bodies attached to the anterior mesentery of segment 12, the last of the three specially thickened mesenteries. Lying upon each of these (again in both specimens), but attached separately to the mesentery, was a pedunculated sac (Plate V. fig. 7) of a brownish colour entirely filled with Gregarines. I am not at present able to say whether this sac is a part of the sperm-sac pathologically altered by the presence of these parasites or not.

The *ovaries* are large and situated in the usual position in segment 13.

In the next segment are a pair of bodies of similar shape and occupying an exactly corresponding position, which I regard as *receptacula ovorum*.

PERICHÆTA VAILLANTI [2], n. sp.

Of this new species I only have a single example; like *P. biserialis* it comes from Manila, and was collected near that town by Mr. Herbert Barwell, to whom my thanks are due for a large number of Earthworms collected in Luzon.

The colour (in alcohol) is a yellowish brown, the yellow tint being particularly marked upon the clitellum.

The *prostomium* is small and does not extend far over the peristomial segment.

The *setæ* form a continuous row round each segment.

The *male generative pores* are upon the 18th segment.

There are no *genital papillæ*.

The *clitellum* occupies segments 14–16 inclusive, and as in other species of *Perichæta* is developed all round the body; there are *no* setæ upon it.

The *oviducal pore* is single and median upon segment 14.

*Dorsal pores* are present.

The *apertures of the spermathecæ* are very conspicuous on the interspaces between segments 5–6, 6–7, 7–8, 8–9.

There are *no* specially thickened mesenteries at all.

The *nephridia* form, as in other *Perichætæ*, a series of scattered tufts.

[1] In a preliminary note in the 'Zoologischer Anzeiger,' Bd. xii. no. 318, I erroneously stated that the doubling of the spermatheca affected that of the 8th segment in both cases.

[2] Named after M. Leon Vaillant.

The *spermathecæ*, 4 pairs, present nothing remarkable in their structure; each is a small pear-shaped pouch with a single small stalked diverticulum.

The *sperm-sacs* have a somewhat peculiar structure which is illustrated in fig. 10. In segments 11 and 12 are a pair of oval sacs; those of each side of the body are connected with each other, but there is no contact between the sacs of the right and left sides ventrally; from each of the oval sacs is a small projecting tube-like outgrowth (*x*, Plate V. fig. 10), which in the dissected worm appeared to be broken off at its extremity. I am inclined therefore to suppose that there is a connection above the intestine between the two sperm-sacs of each segment by means of these outgrowths; if so, there is a striking resemblance in this particular between *Perichæta vaillanti* and *Dichogaster*, in which worm I have figured and described (**10**) an almost identical arrangement.

The *ovaries* are in segment 13, attached to the anterior mesentery of this segment.

The *oviducts* are perfectly normal.

The *atrium* is again rather unusual in its structure; as a general rule that portion of it which lies nearest to the external orifice has thickened muscular walls and is curved upon itself like a horseshoe; its calibre gradually increases towards the external orifice.

In *Perichæta vaillanti* the terminal portion of the atrium abruptly widens to form an oval, thick-walled sac, as in *P. indica* (Horst, **16**), into which the thin tube-like proximal part of the atrium opens.

The only species with which the present could be confounded is *P. modigliani* (Rosa, **25**); but it differs from that species in having no thick mesenteries and apparently in the structure of the sperm-sacs. There is no knowing whether *P. vaillanti* is the same as *P. juliana* (Perrier, **19**); the only fact known about the latter species is that it has four pairs of spermathecæ.

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## EXPLANATION OF THE PLATES.

### Plate IV.

Fig. 1. *Perichæta indica*, nat. size; drawn and coloured from a living specimen.
2, 3. Anterior segments of *Perichæta indica*, to show protrusion of buccal cavity.
4. Anterior segments of *Perichæta biserialis*.
5. Clitellar and following segments of *Perichæta forbesi*.
6. *Perichæta forbesi*; segments 7–12, dissected, to show position of spermathecæ and thickened septa.
7. —— *biserialis*; corresponding dissection of segments 6–10 to show thickened mesenteries.

### Plate V.

Fig. 1, 2, 3. Variations in position of genital papilla in *Perichæta affinis*, fig. 2 being the normal.
4. *Perichæta indica*; transverse section through duct of spermatheca.
5. —— ——; transverse section through spermathecal appendix.
6. —— ——; a portion of a transverse section of wall of spermatheca.
7. —— *forbesi*; portion of sperm-sac modified by presence of gregarines.
8. —— *indica*; spermatheca.
9. —— ——; longitudinal section through intersegmental septum to show attachment of "glycogenic" organ (*gl*); *d.v*, dorsal blood-vessel; *mes*, septum; *i*, epidermis.
10. Genitalia of *Perichæta vaillanti*; *v.s*, sperm-sacs; *x*, process of ditto, which appears to meet that of its fellow in the dorsal median line; *ov*, ovary; *od*, oviduct; *n*, nerve-cord; *m*, intersegmental septa.
11. Anterior segments of *Perichæta affinis*; *pr*, minute prostomium.
12. *Perichæta houlleti*; dissection to show increase in size of seta near ventral median line; *s*, seta; *n*, nerve-cord; *m*, intersegmental septum.

## 4. Notes on the Habits and Oviposition of *Xenopus lævis*.

By J. M. Leslie, F.Z.S.

[Received January 11, 1890.]

At the suggestion of Mr. Boulenger[1] I have, for the last two years, been investigating the life-history of the Clawed Aglossal Frog, *Xenopus lævis*, Daud., which is common here at Port

[1] [Mr. Leslie's observations on the oviposition of *Xenopus lævis* fill up a desideratum of long standing. The development of *Pipa* being of an ultra-specialized type, we have to fall back on the only other genus of *Aglossa* for information on this head. What we know of the structure of the *Aglossa* shows

Elizabeth; and I have now the honour to lay before the Society the results of my observations.

*Xenopus lævis* is called by the colonists the *Platkanda*. It is commonly found in the Sunday, Zwartkop, Baakens, and Sharks Rivers and the adjacent vleys. Its habits are essentially aquatic, the animal never leaving the water except in search of places where food or shelter are better supplied. Unlike other frogs, it feeds in the water, on insects, small fishes, or even young and larvæ of its own kind, and is apparently unable to feed out of that element. The mode of eating is by forcing the prey into the mouth by means of the hands, which act as a pair of claspers; the deglutition always takes place under water. Locomotion on land is by difficult and awkward crawling and leaping. But *Xenopus* is a most admirable swimmer, and remarkable for the manner in which it remains poised for a long time immediately under the surface of the water, with the nostrils only exposed. The whole structure of the animal denotes its thoroughly aquatic habits—the broadly webbed toes, the smooth slimy skin with its symmetrically disposed muciferous tubules; there are no eyelids proper, but merely the transparent nictitating membrane, moving up and down; and the nostrils have a disk-like internal valve. When at rest, *Xenopus* never assumes a sitting posture like other frogs and toads, and the back never appears humped.

Pairing takes place in early spring (August), when the male, of which the palmar surface and inner side of the forearm acquire a black horny layer, clasps the female with his arms round the waist, the fingers interlocking on the pubic region.

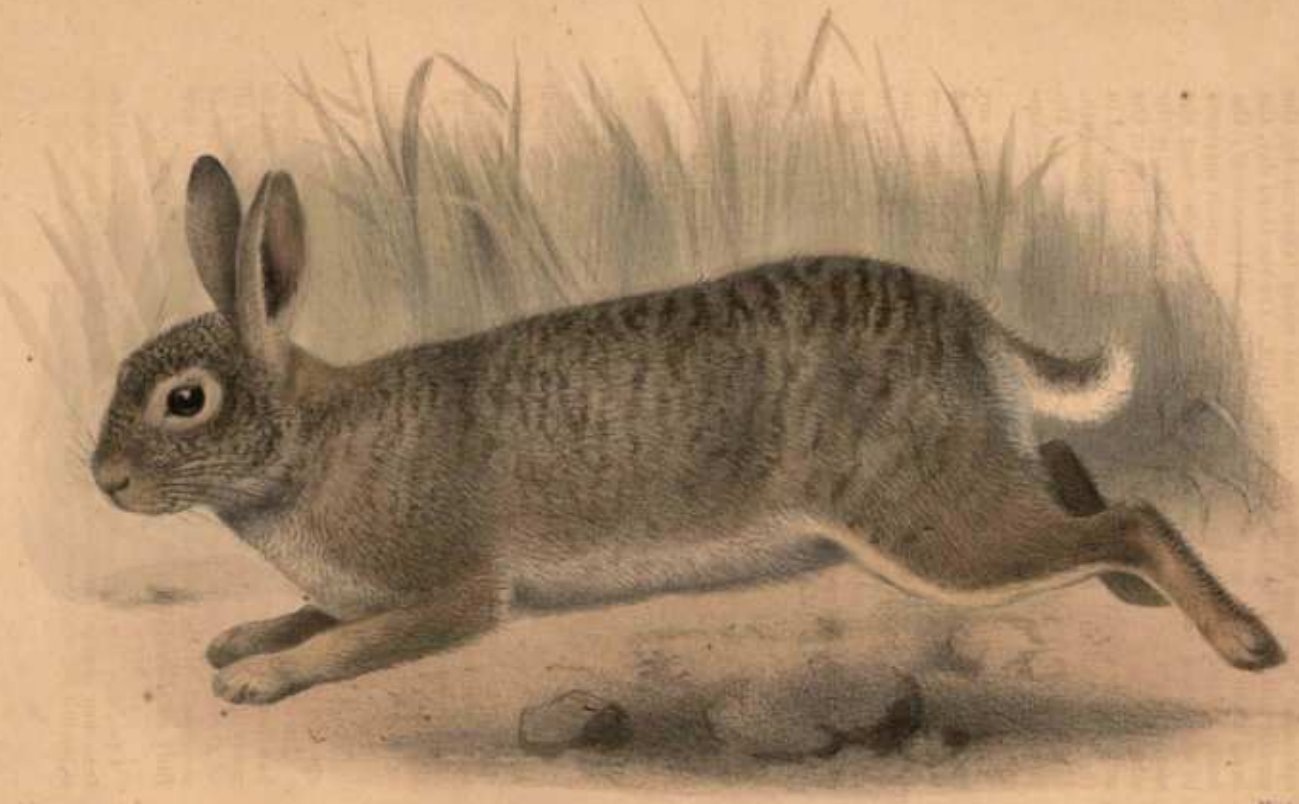
The ova are extruded singly and appear to be held for a short time between the cloacal labial folds which are so much developed in, and characteristic of, the female. I separated a pair during copulation, and placed the female in a small clean aquarium, and witnessed the oviposition. After about 90 ova had been deposited, I killed her for dissection and observed a small lot more of ova in the oviduct. These did not hatch, thus proving that the cloacal folds are not seminal receptacles. The eggs immediately after being laid measured $\frac{1}{16}$ inch in diameter; 24 hours after, through swelling of the mucilaginous envelope, they measured $\frac{1}{8}$ inch. They are found attached singly to aquatic plants or stones. After leaving

them to be a type affined to the lowest *Exaudata*, viz. the *Discoglossidæ* and *Pelobatidæ*, though in many respects more specialized, *i. e.* diverging more from the Urodele type. The larva of *Xenopus*, however, was known to approach more nearly to the Urodele than to the Anurous type, as is exemplified by the structure of the mouth without horny armature, by the two spiracula, and especially by the presence of a pair of barbels which are the homologues of the well-known 'balancers' of the Newt-larvæ.

From Mr. Leslie's investigations we learn that *Xenopus* agrees with the lower *Exaudata* (*Discoglossidæ*, *Pelobatidæ*, some *Bufonidæ* and *Cystignathidæ*) in being inguinamplex, to use the term proposed by de l'Isle, *i. e.* the male holding the female round the waist during oviposition; and with the Discoglossoid genera *Discoglossus* and *Bombinator*, as well as with the Newts, in the mode in which the eggs are deposited.—G. A. Boulenger.]

J. Smit, del. et lith. Mintern Bros. imp.

SCIURUS NIGER MELANONOTUS.



J. Scott. del. et lith.

Mintern Bros. imp.

LEPUS VERÆ-CRUCIS.

the egg, the fish-like larva does not acquire any external gills, but opercular folds are distinctly visible and water taken in by the mouth is expelled by these branchial clefts. On the third day, the head broadens, flattens; the eyes become large and prominent; the nostrils assume a dorsal position; the gape of the mouth increases in width and two long maxillary barbels rapidly appear near the angles of the mouth, and soon grow into long feelers which give the advanced larva its well-known Siluroid appearance. Neither in the embryo nor in the tadpole are any teeth or horny plates developed in the jaws; nor are there any special papillæ surrounding the mouth. I have prepared and forwarded some ova and early larvæ to Dr. Schauinsland, of Bremen, who proposes to investigate the development.

*Xenopus lævis*, unlike most frogs and toads, does not produce any croaking, but has during the breeding-season a peculiar dull *tick-tick* note, almost inaudible at three feet distance, which it produces under water. I have satisfied myself, by dissections, that the sound is produced by friction of the glottis against the borders of the (median) eustachian opening, the air being at the same time carried from the lungs into the buccal cavity, and *vice versâ*[1].

## 5. On a Collection of Mammals from Central Vera Cruz, Mexico. By Oldfield Thomas, F.Z.S., Natural History Museum.

[Received January 14, 1890.]

(Plates VI. & VII.)

During the years 1887 and 1888 a large number of zoological specimens were collected in the Province of Vera Cruz by a scientific expedition organized by the authorities of the Mexican Museum, under the superintendence of Dr. F. Ferrari Perez, Director of that Institution. Thanks to the kind intervention of Messrs. F. D. Godman and O. Salvin the Mammals then obtained have been entrusted to me for determination, and a duplicate set of them acquired by exchange for the Natural History Museum.

The collection consists of about 100 mammals, belonging to 21 species, and a complete list of them is given below.

The importance of this series lies in the fact that every specimen has been properly labelled with its exact locality and date, and in many instances with its native name and the colour of its eyes, all of these particulars being too commonly neglected in the case of mammals by the very collectors who would insert them most carefully on the labels of birds.

[1] [Six examples of *Xenopus lævis* have just been received alive by the Society from their excellent correspondent the Rev. G. H. R. Fisk. They were obtained at Rondebosch, near Capetown.—P. L. S.]

The species represented are partly Nearctic and partly Neotropical, as might be expected from the locality; and on this account an exact record of the stations where each was obtained becomes of special value as helping to fix the exact line of demarcation between the two American Zoological regions.

In this district one would hardly have expected to find any novelties, especially among the comparatively large animals of which the collection chiefly consists; and Dr. Ferrari Perez is therefore to be specially congratulated that his expedition resulted in the discovery of two new mammals, a Hare and a Squirrel. This fact shows that, after all, there must still be many of the smaller Rodents (rats, mice, bats, &c.) remaining undiscovered in Mexico; and I venture to hope that in future expeditions special attention will be given to these obscure and difficult groups—an attention that will most probably be rewarded with the discovery of interesting novelties.

1. Ateles vellerosus, Gray.

2 ♂, 1 ♀. 10/88. Raya de Boca Agustin, Misantla.
♂. 11/88. Boundaries of Misantla and Jalapa.
♀. 11/88. Hacienda de Tortugas, Jalapa.
"Chango." Eyes dark yellowish grey.

2. Felis pardalis, L.

♀. 11/88. Santa Ana, Jalapa.
"Zorrillero." Eyes yellow.

3. Felis tigrina, Erxl.

♂. 7/88. Cofre de Perote, Vera Cruz.
"Gato-monte." Eyes grey.

4. Canis latrans, Say.

♀. 10/8/88. Ciudad de Jalapa, rumbo del Cofre de Perote.
♂ young. 7/88. Jalapa.
"Coyote." Eyes clear grey

5. Vulpes virginiana, Schr.

♂ and young. 6 & 8/87. Jalapa.
2 ♂. 8/88. Coatepec, near Jalapa.
"Zorra." Eyes dark grey.

6. Galictis barbara, L.

♂. 11/88. Hacienda de Tortugas, Jalapa.
♀. 8/88. Plan del Rio, Jalapa.
"Cabeza de Viejo." Eyes grey.

7. Putorius brasiliensis, Sewast.

♂. 7/88. Huatusco.
"Onza." Eyes black.

8. Nasua nasica, L.

♂ and 4 ♀. 10 & 11/88. R. Juan Martin, Misantla, 2600 feet.

5 ♀. 10 & 11/88. Hacienda de Tortugas, Jalapa. 3600 feet.

♀. 8/88. Huatusco.

"Tejon manado, Tejon solo, and Tejon suelto." Eyes dark bluish grey. Lives on maize.

9. Sciurus niger melanonotus[1], var. nov. (Plate VI.)

♂ and 2 ♀. 7 & 9/88. Las Vigas, Jalapa.

"Ardilla de Pinal." Eyes dark grey.

Most nearly allied to *S. niger cinereus*, but distinguished by the presence of a broad stripe of black running down the centre of the back from the neck to the rump. Size as in var. *ludovicianus*.

General colour above clear grizzled grey, without any fringe of rufous or fulvous. Face similar but darker; crown of head between the ears black. A well-defined ring round the eye bright pale yellow. Ears grey on both surfaces, a prominent pale-yellowish patch on the side of the neck behind each one. Nape and back of neck grey, the centre rather darker, and deepening backwards into the characteristic dorsal stripe, along which the hairs are deep shining black at their tips, while the underfur is dark smoky grey, the whole stripe therefore contrasting very markedly with the clear grey of the sides. Sometimes, however, the stripe is itself grizzled, owing to the hairs of the underfur being ringed with pale yellow. Whole of under surface from chin to anus, and inside of limbs, bright salmon-colour, the hairs of this tint to their roots, and sharply contrasted with the grey of the neck and flanks. Upper surfaces of hands and feet also yellowish, but the hairs slate-coloured at their bases. Tail long and full, without any tinge of fulvous; the hairs, which are upwards of two inches in length, with their basal half dirty white interrupted by one or two narrow black rings, and their terminal half deep black to within half an inch of the tip, where they are pure white. This coloration of the tail-hairs is essentially the same as is found in *S. niger typicus* and *S. niger cinereus*.

Skull and teeth as in *S. cinereus*; premolars of course only $\frac{1}{1}$ in number.

[1] In connection with this species I may take the opportunity of correcting an error of identification committed by me in 1882, in a paper on some mammals from Durango (P. Z. S. 1882, p. 372). Two Squirrels from Ciudad are there referred to as belonging to *S. griseoflavus*, Gr.; but a renewed examination proves that they are really examples of *S. niger ludovicianus*, Cust., for which that locality is the most southern on record. This correction is of all the more importance as doubt has been thrown on the occurrence of *S. niger* in Mexico at all (Alston, Biol. Cent.-Amer., Mamm. p. 124), and it also renders more marked the striking difference between the faunas of Ciudad and Ventanas, the two villages at which Mr. Forrer's Durango specimens were obtained. The former is, in fact, proved more decisively than ever to be Nearctic, and the latter Neotropical, although the two are within quite a short distance of one another.

Measurements (approximate) of an adult male, preserved as a skin:—Head and body 290 millim.; tail, without hairs 245, with hairs 330; hind foot without claws 62; ear, above crown, 17. Skull: basal length 53·5, greatest breadth 37; length of upper tooth-row 11·1.

It seems at first sight impossible that this very well-marked Squirrel should be conspecific with the ordinary Fox-Squirrel of the United States; but, bearing in mind the extraordinary difference between *S. cinereus* and *S. lodovicianus*, admittedly only varieties of one species, I think it safer, for the present, only to give a varietal appellation to this new form, especially as the characteristic dorsal stripe varies considerably in its development even within the small series before me.

10. Sciurus variegatus, Erxl.

♂ and 2 ♀. 11/88. Hacienda de Tortugas, Jalapa. 2000 feet.
2 ♂, 1 ♀. 9/87. Jalapa.
2 ♂, 2 ♀. 7 & 8/88. Coatepec.
2 ♂, 1 ♀. 7 & 8/88. Plan del Rio.
3 ♂, 1 ♀. 7–9/88. Huatusco, 4000 feet.
♂. 2/88. Alvarado.
"Ardilla." Eyes dark bluish brown or black.

11. Sciurus deppei, Ptrs.

♀. 11/88. R. Juan Martin, Misantla.
2 ♂, 1 ♀. 8/88. Coatepec, Jalapa.
♂. 8/88. Plan del Rio, Jalapa.
4 ♂, 6 ♀. 7–9/88. Huatusco, 3500–4000 feet.
"Ardilla parda," "Moto," "Motito." Eyes dark bluish brown or black.

12. Geomys hispidus, LeC.

2 ♂. 8/88. Huatusco, 3600 feet.
"Tuza." Eyes bluish grey.

13. Lepus callotis, Wagl.

♂ and 2 ♀. 7–9/88. Las Vigas, Jalapa.
Eyes greyish yellow.

14. Lepus sylvaticus, Bachm.

♂. 8/88. R. Rancho Nuevo, Misantla, 60 feet.
♀. 11/88. Hacienda de Tortugas, Jalapa, 3000 feet.
2 ♂. 7 & 8/88. Coatepec.
♀ and 4 young. 8/88. Zeutla, Huatusco, 3300 feet.
"Conejo." Eyes brownish or bluish grey.

15. Lepus veræ-crucis, sp. n. (Plate VII.)

2 ♀ and 1 young. 7/88. Las Vigas, Jalapa.
Eyes grey.

Apparently allied to *L. sylvaticus*, but markedly larger, with longer ears, and much duller in general colour.

Fur very soft, markedly softer than in the ordinary southern forms of *L. sylvaticus*. General colour dirty yellowish or greyish, without rufous, except on the nape, the light subterminal rings on the hairs uniformly pale cream-colour. Face grizzled greyish yellow, the light area round the eye well-marked, pale cream-colour. Ears about as long as the head, their backs thinly haired, grey, the extreme tips and outer edges darkening to black, but not more prominently so than in *L. sylvaticus*. Inner surfaces dull yellow, this colour not visible along the edges of the ear. Nape dull pale rufous. Underfur of back slaty basally, dull brown terminally; longer hairs black, with a cream-coloured subterminal ring. Sides gradually becoming yellowish towards the belly; under surface dirty yellowish grey, the line of demarcation not marked at all. The belly-hairs themselves are pale slaty basally, and dull yellowish terminally, while there are scarcely any white-tipped hairs present. On the chin, however, the hairs are white-tipped. Fore limbs dull orange-yellow, their posterior sides scarcely lighter; fore feet about as hairy as in ordinary Mexican *L. sylvaticus*. Hind limbs dull orange-grey externally, gradually becoming more fulvous to the heels; their inner edges, the pale line along the groin in front of the hip, and the upper surfaces of the hind feet dull yellow, not white. Tail rather short, greyish brown above, the hairs both here and on the rump in front of it slaty basally, and yellowish brown terminally; under surface pure white.

Skull readily distinguishable from that of *L. sylvaticus* by its greater size. Postorbital processes pressed against the sides of the brain-case at their tips posteriorly, but free at their bases. Interparietal triangular, its antero-posterior nearly two thirds its transverse diameter. Occipital shelf unusually broad. Anterior edge of palatal bridge level with the front of the anterior premolar, and its hinder edge level with the division between the last premolar and the first molar.

Measurements (approximate—from a dried skin):—Head and body 460 millim.; tail, without hairs 32, with hairs 43; hind foot, without claws 94, with claws 104; ears, above crown, 90.

Skull—Greatest length (occiput to gnathion) 85, basal length 69·5, greatest breadth 39; nasals, length 36, breadth, anteriorly 10, posteriorly 15; interorbital breadth, including supraorbital ridges, 19·4, intertemporal breadth, internal to processes, 13; interparietal, length 5·3, breadth 8·7; occipital shelf, breadth 11·6; diastema 23·4; palatine foramina, length 20·4; least breadth of palatal bridge 9·2; length of upper tooth-series, crowns only, 14; basi-cranial axis 22; basi-facial axis 52. Lower jaw—length, bone only, 65, to incisor-tips 68; height from condyle to antero-inferior corner of angular ridge 43; length of the ridge 31.

It is with much hesitation that I presume to add to the long list of described American Leporidæ, but *L. veræ-crucis* seems so distinct from any known form that there appears to be no alternative.

From *L. sylvaticus*, an inhabitant of the same district, it is distinguishable at the first glance by the characters already referred to. *L. graysoni*, if really distinct from *L. sylvaticus*, does not approach it at all. It cannot of course be confounded with any of the American Changing Hares, nor with the large and peculiarly marked *L. callotis* and *L. californicus*. *L. trowbridgei* is very much smaller. *L. brasiliensis* and *L. gabbi* are smaller, have harsher fur, and much shorter ears and tail; and, finally, *L. palustris* and *L. aquaticus* are distinguished from it by their harsh fur and by the fusion of their postorbital processes with the frontal bone. I have also compared it with specimens of *L. cuniculus*, which might of course have been introduced, but it is evidently quite distinct from that animal.

16. Dicotyles tajacu, L.

2 ♂, 1 ♀. 9 & 11/88. R. Juan Martin, Misantla, 2000 feet.
♂. 11/88. R. Ranchro Nuevo, Misantla, 320 feet.
♂. 11/88. Santa Ana, Jalapa.
♂ ♀. 11/88. Hacienda de Tortugas, Jalapa.
♂. 10/88. Jalapa.
"Jaboli." Eyes dark bluish grey.

17. Cariacus virginianus, Bodd.

Young ♂. 8/88. Palo Gacho, Jalapa.
"Gamito." Eyes grey.

18. Coassus rufinus, Puch.

♀. 8/88. Huatusco, 4000 feet.
"Femasate." Eyes brownish grey.

19. Tamandua tetradactyla, L.

♀. 11/88. Hacienda de Tortugas, Jalapa.
"Hormiguero." Eyes black.
The most northern locality recorded.

20. Tatusia novemcincta, L.

♀. 11/88. Hacienda de Tortugas, Jalapa, 2600 feet.
"Fochi." Eyes clear bluish grey.

21. Didelphys marsupialis, L.

♂ young. 8/88. Huatusco, 4000 feet.
"Flacuache." Eyes black.

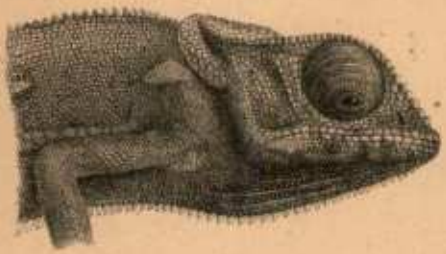
2a.

3a.

2.

3.

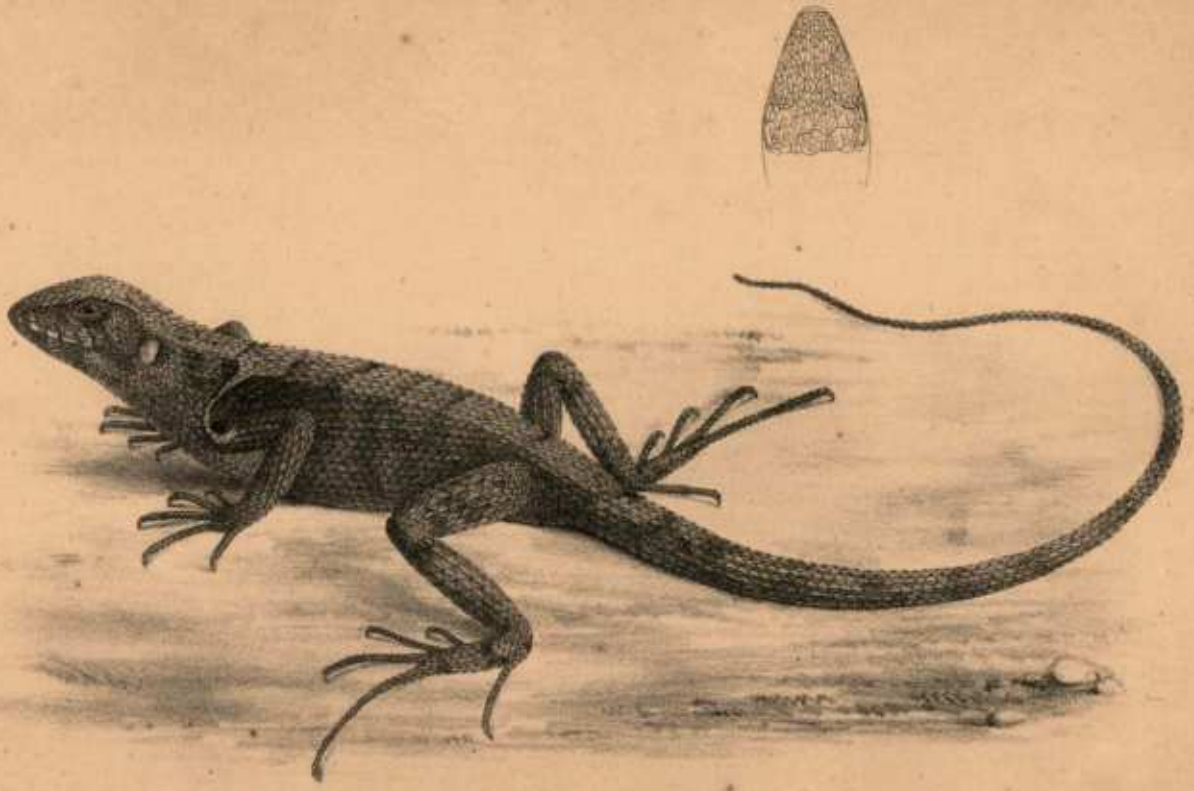
1.



4.

R. Mintern. del. et lith. Mintern. Bros. imp.

1. LYGODACTYLUS FISCHERI. 2. PLATYPHOLIS FASCIATA.
3. ANOLIS PANAMENSIS. 4. CHAMÆLEON ROPERI.



Mintern Bros. del. et lith.

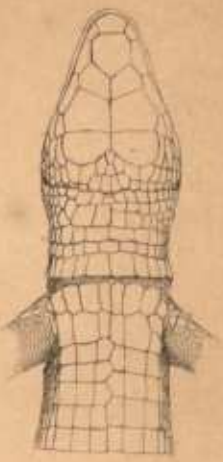
Mintern Bros. imp.

LIOCEPHALUS BOLIVIANUS

1b.

1a.

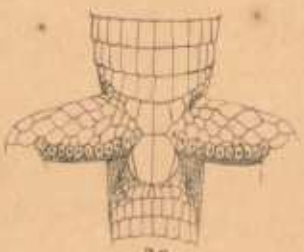
2a.



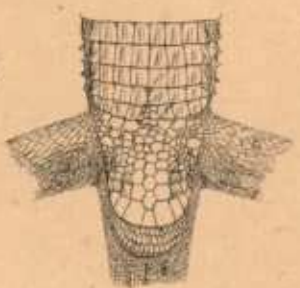
2b.

2d.

1.



2c.



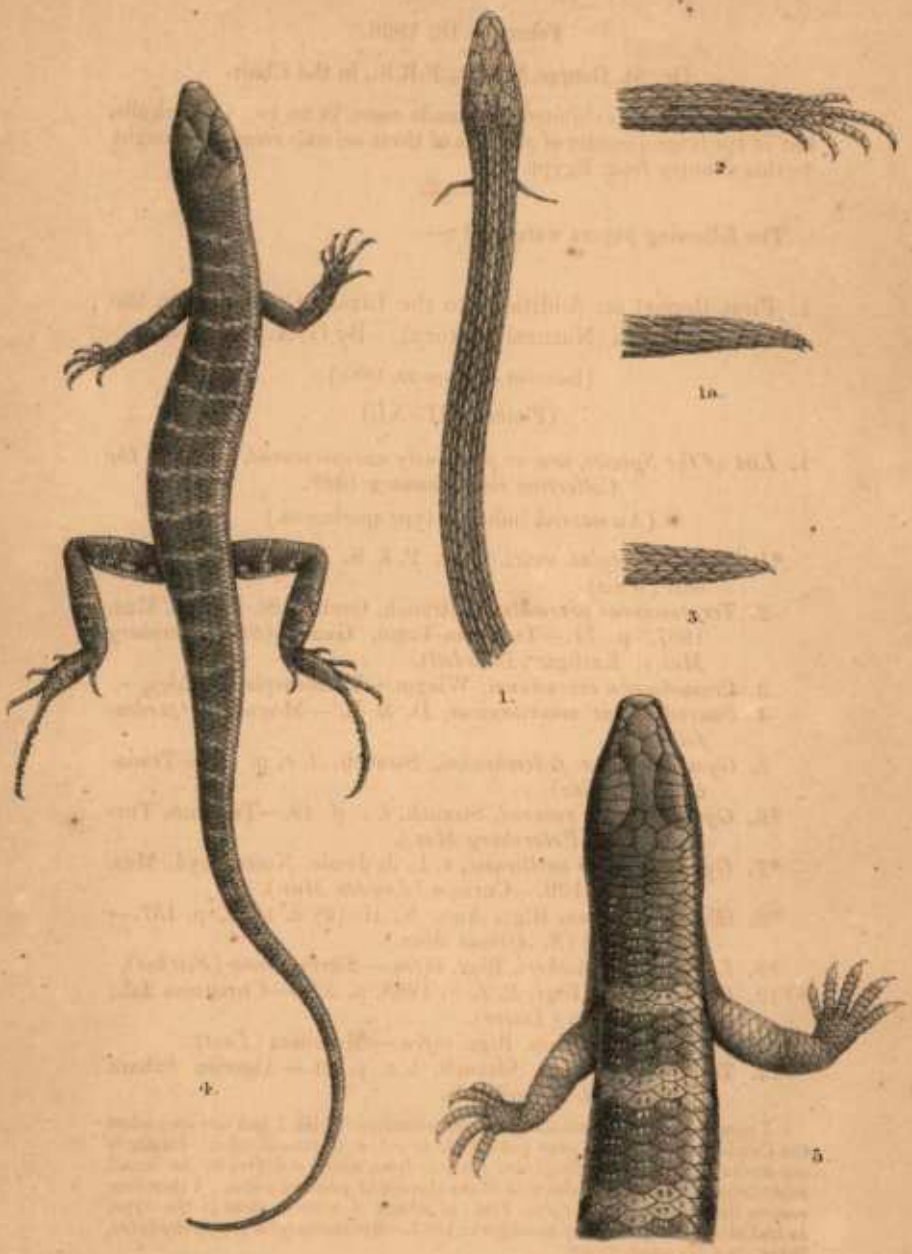
1c.

2.

R. Mintern, del. et lith.

Mintern Bros. imp.

1. ECHINOSAURA HORRIDA. 2. PTYCHOGLOSSUS BILINEATUS.




Mintern Bros. del. et lith. Mintern Bros. imp.

1. CHAMÆSAURA DIDACTYLA. 2. CHAMÆSAURA ÆNEA.
3. CHAMÆSAURA ANGUINA. 4. LYGOSOMA ANOMALOPUS.
5. SCINCUS ALBIFASCIATUS.

February 18, 1890.

Dr. St. George Mivart, F.R.S., in the Chair.

Mr. Tegetmeier exhibited and made remarks on two Cats' skulls, out of the large quantity of remains of these animals recently brought to this country from Egypt.

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The following papers were read :—

## 1. First Report on Additions to the Lizard Collection in the British Museum (Natural History). By G. A. Boulenger.

[Received January 29, 1890.]

(Plates VIII.–XI.)

### 1. *List of the Species, new or previously unrepresented, added to the Collection since January* 1887.

(An asterisk indicates type specimens.)

*1. *Chondrodactylus weiri*, Blgr. P. Z. S. 1887, p. 339.—Kalahari (*Weir*).
2. *Teratoscincus przewalskii*, Strauch, Geckon. St. Petersb. Mus. 1887, p. 71.—Tschagan-Togoi, Gansu (*St. Petersburg Mus.*); Kashgar (*Lansdell*).
3. *Crossobamon eversmanni*, Wiegm.—Transcaspia (*Radde*).
4. *Saurodactylus mauritanicus*, D. & B.[1]—Mogador (*Quedenfeldt*).
5. *Gymnodactylus fedtschenkoi*, Strauch, *l. c.* p. 46.—Transcaspia (*Radde*).
*6. *Gymnodactylus russowi*, Strauch, *l. c.* p. 49.—Tschinas, Turkestan (*St. Petersburg Mus.*).
*7. *Gymnodactylus antillensis*, v. L. de Jeude, Notes Leyd. Mus. ix. 1887, p. 129.—Curaçoa (*Leyden Mus.*).
*8. *Œdura africana*, Blgr. Ann. N. H. (6) ii. 1888, p. 137.—Damaraland (*S. African Mus.*).
*9. *Lygodactylus fischeri*, Blgr. *infra*.—Sierra Leone (*Fischer*).
*10. *Gecko listeri*, Blgr. P. Z. S. 1888, p. 535.—Christmas Isl., Indian Ocean (*Lister*).
*11. *Platypholis fasciata*, Blgr. *infra*.—Mombasa (*Last*).
12. *Tarentola neglecta*, Strauch, *l. c.* p. 21.—Algerian Sahara (*Lataste, R. Blanchard*).

[1] I now find that *Gymnodactylus mauritanicus*, which I had not seen when the Catalogue of Lizards was published, is not a *Gymnodactylus*. Its digits are similar to those of *Alsophylax pipiens*, from which it differs in its small subimbricate flat dorsal scales, and in the absence of præanal pores. I therefore restore the genus *Saurodactylus*, Fitz., of which *G. mauritanicus* is the type, as had already been done by Boettger in 1883.—*Gymnodactylus trachyblepharus*, Bttgr., is a *Gymnodactylus*.

*13. *Pachydactylus lævigatus*, Fischer, JB. Hamb. Wiss. Anst. v. 1888, p. 15.—Namaqualand (*Fischer*).
*14. *Pachydactylus fasciatus*, Blgr. Ann. N. H. (6) ii. 1888, p. 138.—Namaqualand (*S. African Mus.*).
15. *Rhoptropus afer*, Ptrs.—Damaraland (*S. African Mus.*).
*16. *Sphærodactylus meridionalis*, Blgr. Ann. N. H. (6) ii. 1888, p. 40—Iguarasse, Pernambuco (*Ramage*).
17. *Sphærodactylus microlepis*, R. & L.—S. Lucia (*Ramage*).
18. *Eublepharis variegatus*, Baird.—Texas (*Forrer, Taylor*).
*19. *Uroplates phantasticus*, Blgr. Ann. N. H. (6) i. 1888, p. 101.—Madagascar (*Baron*).
20. *Aphaniotis fusca*, Ptrs.[1]—Malacca (*Hervey*).
*21. *Dendragama boulengeri*, Doria, Ann. Mus. Genova, (2) vi. 1888, p. 649.[2]—Mt. Singalang, Sumatra (*Doria*).
*22. *Calotes microlepis*, Blgr. Ann. Mus. Genova, (2) v. 1887, p. 476.—Plapoo, Tenasserim (*Fea*).
23. *Agama stoliczkana*, Blanf.—Kashgar (*Lansdell*).
*24. *Phrynocephalus raddii*, Bttg. Zool. Anz. 1888, p. 262.—Transcaspia (*Radde*).
25. *Phrynocephalus affinis*, Strauch.—E. Mongolia (*Fischer*).
26. *Phrynocephalus axillaris*, Blanf.—Kashgar (*Lansdell*).
*27. *Anolis panamensis*, Blgr. *infra*.—Panama (*Boulenger*).
*28. *Liocephalus bolivianus*, Blgr. *infra*.—Bolivia (*Fischer*).
29. *Sauromalus ater*, A. Dum.—Arizona (*Forrer*).
30. *Uta ornata*, B. & G.—El Paso, Texas (*Forrer*).
*31. *Sceloporus omiltemanus*, Gthr. Biol. C.-Am., Rept. p. 66, 1890.—Omilteme, Mexico (*Godman*).
32. *Sceloporus ornatus*, Baird.—N. Leon, Mexico (*Taylor*).
*33. *Sceloporus jalapæ*, Gthr. *l. c.* p. 74.—Jalapa, Mexico (*Godman*).
34. *Sceloporus couchii*, Baird.—Texas (*Taylor*).
*35. *Sceloporus rubriventris*, Gthr. *l. c.* p. 72.—Omilteme, Mexico (*Godman*).
36. *Sceloporus pyrrhocephalus*, Cope.—Colima (*Godman*).
*37. *Sceloporus teapensis*, Gthr. *l. c.* p. 75.—Teapa, Tabasco (*Godman*).
38. *Sceloporus lateralis*, Cope, P. U. S. Nat. Mus. 1888, p. 397.—Texas (*Taylor*).
39. *Phrynosoma modestum*, Gir.—N. Leon (*Taylor*).
*40. *Chamæsaura didactyla*, Blgr. *infra*.—S. Africa.
*41. *Anniella texana*, Blgr. Ann. N. H. (5) xx. 1887, p. 50.—El Paso, Texas (*Forrer*).
42. *Ameiva tæniura*, Cope.—Hayti.
43. *Ameiva fuscata*, Garm. Bull. Essex Inst. xix. 1887, p. 5.—Dominica (*Ramage*).

[1] The specimens from Nias referred by me to *A. fusca* belong to a distinct species which has been named *A. acutirostris* by Modigliani, Ann. Mus. Genova, (2) vii. 1889, p. 3.
[2] = *Salea rosaceum*, Thominot, Bull. Soc. Philom. (8) i. 1889, p. 24 (type examined).

44. *Ameiva chrysolæma*, Cope.—Hayti.
*45. *Ameiva pluvionotata*, Garm. *l. c.*—Montserrat (*Mus. Comp. Zoology*).
*46. *Echinosaura horrida*, Blgr., *infra*.—Ecuador.
*47. *Ptychoglossus bilineatus*, Blgr. *infra*.—Ecuador.
*48. *Stenolepis ridleyi*, Blgr. P. Z. S. 1887, p. 640.—Iguarasse, Pernambuco (*Ridley*).
49. *Micrablepharus maximiliani*, R. & L.—Iguarasse, Pernambuco (*Ramage*).
50. *Gymnophthalmus pleii*, Bocourt.—S. Lucia (*Mus. Comp. Zool., Ramage*).
51. *Amphisbæna occidentalis*, Cope.—Pacasmayo, N. Peru (*Boettger*).
52. *Amphisbæna cæca*, Cuv.[1]—Porto Rico (*Lütken*).
53. *Monopeltis magnipartita*, Ptrs.—Gaboon.
54. *Lepidosternum rostratum*, Strauch.—Bahia (*Walsingham*).
55. *Agamodon anguliceps*, Ptrs.—Somaliland (*Paris Mus.*).
56. *Trachydromus amurensis*, Ptrs.—Chabarowka (*Fischer*).
*57. *Eremias guineensis*, Blgr. Ann. N. H. (5) xx. 1887, p. 51.—Mouth of the Niger.
58. *Eremias suborbitalis*, Ptrs.—Angra Pequena (*Fischer*).
*59. *Mabuia peringueyi*, Blgr. Ann. N. H. (6) ii. 1888, p. 139.—Namaqualand (*S. African Mus.*).
*60. *Mabuia quadricarinata*, Blgr. Ann. Mus. Genova, (2) iv. 1887, p. 618.—Bhamo, Burma (*Fea*).
61. *Mabuia elegans*, Ptrs.—Madagascar (*Baron*).
62. *Mabuia wahlbergii*, Ptrs.—Angra Pequena (*Fischer*).
63. *Lygosoma fischeri*, Blgr.—Port Walcott, N.W. Australia (*Beckett*).
*64. *Lygosoma anomalopus*, Blgr. *infra*.—Pinang (*Fischer*).
*65. *Lygosoma malayanum*, Doria, Ann. Mus. Genova, (2) vi. 1888, p. 651.—Mt. Singalang, Sumatra (*Doria*).
*66. *Lygosoma zebratum*, Blgr. Ann. Mus. Genova, (2) v. 1887, p. 478.—Plapoo, Tenasserim (*Fea*).
*67. *Lygosoma kakhienense*, Blgr. *op. cit.* iv. 1887, p. 621.—Kakhyen hills, Burma (*Fea*).
*68. *Lygosoma doriæ*, Blgr. *l. c.* p. 620.—Kakhyen hills (*Fea*).
*69. *Lygosoma melanostictum*, Blgr. *op. cit.* v. 1887, p. 479.—Tenasserim (*Fea*).
70. *Lygosoma devisii*, Blgr. (= *Heteropus lateralis*, De Vis, *nec L. lateralis*, D. & B.).—Queensland (*Howes*).
*71. *Lygosoma nativitatis*, Blgr. P. Z. S. 1887, p. 516.—Christmas Isl., Indian Ocean (*Maclear, Lister*).
*72. *Lygosoma feæ*, Blgr. Ann. Mus. Genova, (2) iv. 1887, p. 623.—Rangoon (*Fea*).
*73. *Lygosoma forbesii*, Blgr. Ann. N. H. (6) i. 1888, p. 343.—New Guinea (*H. O. Forbes*).
74. *Lygosoma muelleri*, Schleg.—New Guinea (*Doria, Forbes*).

[1] The specimen referred to *A. cæca* in the Catalogue of Lizards belongs to a distinct species, *A. ridleyi*, Blgr., recently discovered in Fernando Noronha.

*75. *Ablepharus egeriæ*, Blgr. P. Z. S. 1888, p. 535.—Christmas Isl., Indian Ocean (*Lister*).
76. *Ablepharus grayanus*, Stol.—Kurrachee (*Murray*).
77. *Tropidophorus yunnanensis*, Blgr.—Kakhyen hills (*Fea*).
*78. *Eumeces xanthi*, Gthr. Ann. N. H. (6) iv. 1889, p. 220.—Ichang, Yang-tse-kiang (*Pratt*).
79. *Eumeces brevilineatus*, Cope.—Texas (*Taylor*).
*80. *Scincus albifasciatus*, Blgr. *infra*.—Senegambia.
*81. *Scelotes macrolepis*, Blgr. Ann. N. H. (6) i. 1888, p. 102.—Madagascar (*Baron*).
82. *Herpetosaura arenicola*, Ptrs.—Delagoa Bay.
*83. *Sepsina frontoparietalis*, Blgr. Ann. N. H. (6) iv. 1889, p. 244.—Madagascar (*Majaster*).
*84. *Sepsina hessii*, Bttg. Zool. Anz. 1887, p. 650.—Lower Congo (*Hesse*).
85. *Acontias hildebrandti*, Ptrs.—Nossi Bé.
*86. *Chamæleon roperi*, Blgr. *infra*.—Kilifi, E. Africa (*Roper*).
*87. *Chamæleon guentheri*, Blgr. Ann. N. H. (6) i. 1888, p. 22.—Nossi Bé.
88. *Chamæleon polleni*, Ptrs.—Mayotta, Comoro Islands (*Paris Mus., Doria*).
*89. *Chamæleon willsii*, Gthr. Ann. N. H. (6) v. 1890, p. 71.—Madagascar (*Wills, Baron*).
*90. *Chamæleon gastrotænia*, Blgr. Ann. N. H. (6) i. 1888, p. 103.—Madagascar (*Baron*).
91. *Chamæleon campani*, Grand.—Madagascar (*Baron*).
*92. *Chamæleon boettgeri*, Blgr. Ann. N. H. (6) i. 1888, p. 23.—Nossi Bé.
93. *Brookesia ebenaui*, Bttg.—Nossi Bé.

## II. *Descriptions of new Species.*

LYGODACTYLUS FISCHERI. (Plate VIII. fig. 1.)

Nostril pierced just above the suture between the rostral and the first labial, between the latter and two nasals; rostral entering largely the nostril; nine upper and six lower labials; mental large, followed by small chin-shields graduating into the gular granules. Dorsal scales minutely granular; ventrals smooth. Limbs as in *L. capensis*. A transverse series of ten præanal pores. Tail depressed, inferiorly with a double series of transversely enlarged scales. Pale olive above; a blackish streak on each side of the head, passing through the eye; a very large black spot behind the axil, followed by a series of smaller ones; uniform white inferiorly.

From snout to vent 35 millim.

A single specimen from Sierra Leone (S. Stahl, 1882) in the collection of the late Dr. J. G. Fischer.

PLATYPHOLIS, g. n. (*Geckonidarum*).

Digits strongly dilated, free, with transverse undivided lamellæ below, all but the thumb and inner toe armed with a retractile claw.

Body covered with uniform flat juxtaposed scales. Male with præanal pores.

This genus is most nearly related to *Homopholis*, Blgr., with which it agrees in the structure of the digits, but differs in the juxtaposed scales and the presence of præanal pores.

PLATYPHOLIS FASCIATA. (Plate VIII. fig. 2.)

Head oviform, very convex; snout as long as the diameter of the orbit, or the distance between the latter and the ear; ear-opening small, round. Upper surface of head with equal granules, which are smaller and more convex than the dorsals; rostral pentagonal, not cleft above; nostril pierced between the first labial and three nasals, the anterior of which is large; ten upper and nine lower labials; mental small, pentagonal, followed by very small chin-shields passing gradually into the minute granules of the throat. Dorsal scales flat, roundish, smooth, larger than ventrals, which are subimbricate. A pair of anal pores. Greyish olive, with crescentic dark brown bands, broader than the interspaces between them, the anterior on the nape and extending on each side to the eyes, four others on the body; lower parts marbled with brown.

From snout to vent 50 millim., head 15, fore limb 14, hind limb 19.

A single male specimen was obtained at Mombasa by Mr. Last, Mr. Grose Smith's entomological collector.

ANOLIS PANAMENSIS. (Plate VIII. fig. 3.)

Allied to *A. beckeri*, Blgr. The width of the head equals the length of the tibia, the length once and two thirds the width; frontal concavity feebly marked, no frontal ridges; upper head-scales slightly rugose, not keeled; scales of the supraorbital semicircles enlarged, separated in the middle by one series of scales; enlarged supraocular scales numerous, smooth; occipital larger than the ear-opening, separated from the supraorbitals by two or three series of scales; canthus rostralis moderate, canthal scales four or five; nine or ten upper labials to below the centre of the eye; ear-opening small, roundish. Gular appendage moderate. Body scarcely compressed. Dorsal and lateral scales equal in size, minute, granular, smooth; ventrals larger, smooth. The adpressed hind limb reaches the neck; digital expansions well developed; 24 lamellæ under phalanges II. and III. of the fourth toe. Tail slightly compressed, with a dorsal series of enlarged flat scales. Greyish-olive above, marbled with whitish and dark brown; lower parts whitish, dotted with brown.

| | millim. | | millim. |
|---|---|---|---|
| Total length ..... | 115 | Fore limb ..... | 20 |
| Head ..... | 15 | Hind limb ..... | 31 |
| Width of head..... | 9 | Tibia ..... | 9 |
| Body ..... | 35 | Tail ..... | 65 |

Two male specimens from Panama.

LIOCEPHALUS BOLIVIANUS. (Plate IX.)

Upper head-scales small, strongly keeled; nostril lateral, below the canthus rostralis; nasal separated from the rostral by one scale; no large supraoculars. Side of neck not plicate, covered wtih pointed, imbricate, keeled scales. A low dorsal crest. Dorsal scales large, strongly keeled, feebly mucronate, forming slightly oblique longitudinal lines; lateral scales smaller; ventrals a little larger than dorsals, very strongly keeled; gulars a little smaller than dorsals; 38 scales round the middle of the body. The adpressed hind limb reaches the end of the snout. Tail very slightly compressed, not crested. Pale bronzy brown above, with angular dark brown markings pointing backward; a brown oblique band from below the eye to the lip; shoulder and upper surface of arm blackish brown, with a white anterior border; lower parts pale olive, with white spots.

| | millim. | | millim. |
|---|---|---|---|
| Total length ..... | 245 | Fore limb ..... | 43 |
| Head ..... | 21 | Hind limb ..... | 75 |
| Width of head .... | 13 | Tail ..... | 165 |
| Body ..... | 59 | | |

A single female specimen from Bolivia in Dr. J. G. Fischer's collection.

CHAMÆSAURA DIDACTYLA. (Plate XI. fig. 1.)

Both pairs of limbs present, with two minute clawed digits, inner shortest. Head-shields striated; nasals forming a suture, separating the rostral from the frontonasal; latter longer than broad, forming a suture with the frontal, separating the præfrontals; frontal heptagonal; four subequal parietals; an elongate interparietal; no occipital; the posterior parietals forming a suture behind the interparietal; three supraoculars, anterior largest; three supraciliaries, anterior largest; nasal large, pierced in its posterior portion; a single loreal; subocular between the third and fourth labials. Scales on the body in 26 longitudinal and 39 transverse series. Three femoral pores. Bronzy brown above, with a lighter vertical line; golden inferiorly.

| | millim. | | millim. |
|---|---|---|---|
| Total length ..... | 530 | Hind limb ..... | 8 |
| Head ..... | 15 | Tail ..... | 420 |
| Fore limb ..... | 5 | | |

A single specimen from South Africa.
This new species lessens the gap between *C. ænea* and *C. anguina*.

ECHINOSAURA, g. n. (*Teiidarum*).

Tongue moderately elongate, arrow-headed. Lateral teeth compressed, bi- or tricuspid. Head with large shields anteriorly, granular posteriorly; frontonosal separating the nasals; nostril pierced in the

centre of a single nasal. Eyelids developed, lower scaly. Ear exposed. Limbs well developed, pentadactyle. Upper parts granular with enlarged tubercles, the largest of which are spines; ventral plates large, squarish, obtusely keeled, forming regular longitudinal and transverse series; no collar-fold; throat with large, trihedral, spine-like tubercles. No femoral or præanal pores. Tail cyclotetragonal, slightly compressed, with rings of enlarged tubercles.

The nearest ally of this very striking new genus is *Neusticurus*, D. & B. Apart from the presence of eyelids it is not without resemblance, in its external appearance, to *Lepidophyma*[1].

Echinosaura horrida. (Plate X. fig. 1.)

Head very distinct from neck, with pointed snout; rugose symmetrical shields on the snout and the anterior half of the vertex, and on the supraocular region; the rest of the head with unequal-sized granules; ear-opening smaller than the eye-opening; five or six upper and as many lower labials. Vertebral line with two series of enlarged keeled scales, on each side of which are several oblique convergent series of similar scales; large erect spines on the nape and flanks, smaller ones on the limbs. Ventral shields in 8 longitudinal and 20 transverse series. A transverse series of seven small shields borders the anal cleft. The hind limb reaches the shoulder, the fore limb nearly the nostril. Tail a little longer than head and body, the keeled scales forming rings largest and subspinose on the upper surface. Brown, with more or less distinct large yellowish spots.

| | millim. | | millim. |
|---|---|---|---|
| Total length ..... | 150 | From end of snout to vent..... | 65 |
| Head..... ..... | 17 | Fore limb ..... | 25 |
| Width of head..... | 10 | Hind limb ..... | 34 |
| From end of snout to fore limb..... | 26 | Tail ..... | 85 |

Two specimens, female and young, from Ecuador.

Ptychoglossus, g. n. (*Teiidarum*).

Tongue moderately elongate, arrow-headed, with oblique plicæ converging towards the median line. Lateral teeth compressed, bi- or tricuspid. Head with large regular shields; frontonasal separating the nasals; præfrontals and frontoparietals present; nasal pierced in the suture between two nasals. Eyelids developed, lower scaly. Ear exposed. Limbs well developed, pentadactyle. Dorsal and lateral scales subequal, narrow, with parallel sides, ending in an obtuse point, imbricate and keeled; ventral plates large, square, subimbricate, smooth, forming regular longitudinal and transverse series. A strong collar-fold. Tail subcylindrical. Male with femoral pores.

Distinguished from *Alopoglossus*, Blgr., in the scaling of the body and the strong collar-fold.

[1] I seize this opportunity to change the name of the allied genus *Cricosaura*, Gundl. and Peters, 1863, which is preoccupied by a fossil Crocodilian (Wagner, 1860), to *Cricolepis*.

PTYCHOGLOSSUS BILINEATUS. (Plate X. fig. 2.)

Head short, snout obtuse; frontonasal broad; prefrontals forming a short suture; interparietal about half the width of the parietals; no occipitals; a small loreal; seven upper labials, third very long; five lower labials; chin-shields very large, one anterior and three pairs in contact on the median line. Gular scales squarish, in seven transverse series; collar formed of ten scales, the median pair largest. Dorsal scales in 28 longitudinal and 30 transverse series; ventrals longer than broad, in 10 longitudinal and 17 transverse series. Four præanals, median pair large. The hind limb reaches the elbow, the fore limb the posterior border of the orbit; scales on limbs smooth. 11 femoral pores on each side. Tail scaled like the body. Pale brown above, with a yellowish streak along each side of the back; lower parts white.

| | millim. | | millim. |
|---|---|---|---|
| Total length ..... | 97 | From end of snout to vent... ..... | 53 |
| Head ..... | 12 | Fore limb ..... | 15 |
| Width of head..... | 8 | Hind limb ..... | 23 |
| From end of snout to fore limb..... | 21 | Tail (reproduced) .. | 44 |

A single male specimen from Ecuador.

LYGOSOMA ANOMALOPUS. (Plate XI. fig. 4.)

Section *Hinulia*. The distance between the end of the snout and the fore limb nearly equals the distance between axilla and groin. Snout short, obtuse; loreal region nearly vertical. Lower eyelid scaly. Nostril pierced in a single nasal; no supranasal; two superposed anterior loreals; rostral flat above, forming a broad straight suture with the frontonasal, which is broader than long; prefrontals forming a short suture with each other; frontal very narrow posteriorly, as long as frontoparietals and parietals together, in contact with the first, second, and third supraoculars; four supraoculars, first and fourth largest, second and third band-like; nine supraciliaries; frontoparietals and interparietal distinct; parietals in contact behind the interparietal; fifth and sixth or sixth and seventh labials largest and below the eye. Ear-opening oval, smaller than the eye-opening; no auricular lobules. 38 smooth scales round the middle of the body, laterals smallest. A pair of large præanals. The adpressed hind limb reaches nearly the eye. Fingers moderate; toes extremely unequal in length and compressed; fourth toe half as long as the distance between axilla and groin, fifth very short, hardly longer than first; subdigital lamellæ keeled, 16 under the fourth toe, the subarticular much enlarged. Brown above, with pale reddish-brown transverse bands; a black loreal streak; a series of white spots along each side; lower parts uniform white.

| | millim. | | millim. |
|---|---|---|---|
| Total length ..... | 175 | Fore limb ..... | 23 |
| Head ..... | 16 | Hind limb ..... | 50 |
| Width of head..... | 10 | Tail (injured) ..... | 105 |
| Body ..... | 54 | | |

Two specimens, adult and young, from Pinang, in the collection of Dr. J. G. Fischer.

SCINCUS ALBIFASCIATUS. (Plate XI. fig. 5.)

*Scincus officinalis*, var. B, Dum. & Bibr. v. p. 568.

Head and limbs as in *S. officinalis*. Ear-opening barely distinguishable, covered by two scales, which are not fringed. Scales perfectly smooth, dorsals larger than ventrals. 24 scales round the middle of the body. Brown above, with seven white transverse bands, each occupying two transverse series of scales; each brown scale with two or three whitish dots; sides white, with a blackish spot at the end of each white dorsal band; limbs and lower parts white.

From snout to vent 115 millim.

A single specimen from Dakar, Senegambia.

CHAMÆLEON ROPERI. (Plate VIII. fig. 4.)

Casque feebly raised posteriorly; parietal crest well-marked but low; the distance between the commissure of the mouth and the extremity of the casque a little shorter than the mouth; no rostral appendages; lateral crest strong; occipital lobes well developed, entirely separated from each other. Body covered with uniform rather coarse granules; a feebly serrated dorsal crest; a strong gular-ventral crest. No tarsal process. Gular-ventral crest white; a whitish lateral stripe from the axilla, not reaching the groin.

| | ♂. millim. | ♀. millim. |
|---|---|---|
| Total length | 220 | 197 |
| From end of snout to extremity of mandible | 27 | 23 |
| From end of snout to extremity of casque | 35 | 30 |
| Greatest width between lateral cranial crests | 16 | 13 |
| Depth of skull (mandible included) | 20 | 19 |
| Width of head | 18 | 16 |
| Body | 82 | 80 |
| Tibia | 22 | 20 |
| Tail | 110 | 93 |

Two specimens from Kilifi, East Africa, collected and presented by Mr. G. D. Trevor-Roper.

## EXPLANATION OF THE PLATES.

### PLATE VIII.

Fig. 1. *Lygodactylus fischeri*, p. 80.
2. *Platypholis fasciata*, p. 81.
2*a*. —— ——, lower view of foot. × 2.
3. *Anolis panamensis*, p. 81.
3*a*. —— ——, upper view of head. × 2.
4. *Chamæleon roperi* (p. 85), upper and side views of head.

PLATE IX.

*Liocephalus bolivianus* (p. 82), with upper view of head.

PLATE X.

Fig. 1. *Echinosaura horrida*, p. 83.
2. *Ptychoglossus bilineatus*, p. 84.
*a*. Side view of head, × 2. *b*. Lower view of head and breast, × 2. *c*. Posterior ventral and anal regions, × 2. *d*. Tongue, × 2.

PLATE XI.

Fig. 1. *Chamæsaura didactyla*, p. 82.
1 *a*. —— ——, hind limb, × 3.
2. —— *anea*, hind limb, × 3.
3. —— *anguina*, hind limb, × 3.
4. *Lygosoma anomalopus*, p. 84.
5. *Scincus albofasciatus*, p. 85.

## 2. On a Guinea-fowl from the Zambesi allied to *Numida cristata*. By P. L. SCLATER, Ph.D., F.R.S., Secretary to the Society.

[Received January 30, 1890.]

(Plate XII.)

On January 4th last year we received, as a present from Mr. Percy C. Reid, a living Guinea-fowl, which I was unable to determine. It was obviously a member of the group allied to *Numida cristata*, and had a bunchy crest as other members of that section, but appeared to be different from *N. cristata* in having the mentum slightly feathered and no red wattle or red naked skin on the throat. Upon referring to Mr. Reid I was kindly informed by that gentleman that this Guinea-fowl was the survivor of three specimens which he had obtained at Pandamatanga, a trading-station on the Zambesi close to its junction with the Chobé. This species was, however, stated not to be indigenous to the country round Pandamatanga, but the specimens in question had been brought there from a district some sixty miles east, that is to the east of the Victoria Falls. Mr. Reid was inclined to refer the species to *Numida pucherani*, and it is no doubt the Guinea-fowl indicated under that name in Sharpe's edition of Layard's 'Birds of South Africa' (p. 586) as found near the Victoria Falls. But it is certainly not the true *Numida pucherani*, which is a very well marked species without any black ring round the neck, and with a bright red naked skin round the eyes and on the throat, found in Eastern Africa on the Zanzibar coast[1].

The specimen presented by Mr. Reid having died in September

[1] *Cf.* Shelley, P. Z. S. 1881, p. 597, and the figure P. Z. S. 1877, p. 652, pl. lxv., where this species is called *Numida elliotı*. *Numida granti*, Elliot (P. Z. S. 1871, p. 584; id. Mon. Phas. ii. pl. 43), was founded on a drawing by Col. Grant of a specimen obtained in Ugogo, and is probably the same species.

HEAD OF NUMIDA FROM ZAMBESIA.

last, I have taken considerable trouble to find a correct name for it, but as yet, I regret to say, not quite successfully. It belongs, as will be observed, to a species allied to *N. cristata*, of which I have examined a fine skin kindly lent to me by Mr. Büttikofer and obtained by that gentleman in Liberia in 1880. It agrees generally with *N. cristata* in its spotted body, white-edged primaries, broad black ring round the neck, and crested head. But it seems to differ from *N. cristata* in having a conspicuous fold of naked skin at the back of the neck of a pale yellowish-grey colour, the naked skin on the throat not red but leaden-grey, and a slightly feathered chin.

The representative of *N. cristata* on the eastern coast of Africa is commonly supposed to be *N. edouardi*, Hartlaub, of which *N. verreauxi*, Elliot, is a synonym (*cf.* Sclater, P. Z. S. 1871, p. 496).

Mr. Elliot, in his 'Monograph of the Phasianidæ,' it is true, refers *N. edouardi* to *N. cristata*, and makes *N. verreauxi* different. But it appears that the specimen in the Paris Museum, mentioned by Mr. Elliot ('Ibis,' 1870, p. 300) as an example of his *N. verreauxi*, is the identical specimen upon which Dr. Hartlaub established his *N. edouardi*[1]. Therefore, I hold *N. verreauxi* to be $=N.$ *edouardi*. But I am unable to say positively whether *N. edouardi* is distinct from *N. cristata*, as also to which species the Zambesi bird should be referred. One of the types of *N. verreauxi* (formerly living in the Jardin d'Acclimatation, Paris, and subsequently in this Society's Gardens[2]) is now in the British Museum. I have examined this specimen and have compared it with Mr. Reid's bird now before us. I have also examined the other specimens of the same form of Guinea-fowl in the National Collection, and have quite satisfied myself that Mr. Reid's bird is identical with a specimen obtained on the Zambesi by Dr. Kirk. But according to Mr. Elliot his *N. verreauxi* (i. e. *N. edouardi*) had when living a "very conspicuous red throat"[3], of which, indeed, there are also some indications in the type specimen of that species now in the British Museum; but this was certainly not the case in the Zambesi bird when alive.

I must therefore leave the question of the exact name of the Zambesi Guinea-fowl unsettled, but I claim to have established the following point satisfactorily:—

The *Numida* of the Zambesi referred by Capt. Sperling ('Ibis,' 1868, p. 291), by Mr. Elliot (Mon. Phas. ii. sub tab. xlvi.), and by Mr. Sharpe (B. S. Afr. p. 586) to *N. pucherani* is not that species, but a species more nearly allied to *N. cristata*, and possibly $=N.$ *edouardi*, Hartl., if the latter is really different from *N. cristata*.

The figure (Plate XII.) represents the head of the Zambesi Guinea-fowl, taken from a sketch made by Mr. Smit of the living bird.

[1] See also my remarks on this point, P. Z. S. 1871, p. 496.
[2] See List of Vert. An. 1883, p. 495.
[3] Ibis, 1870, p. 300.

## 3. Notes on the Genus *Cyon*.

By St. George Mivart, F.R.S.

[Received February 1, 1890.]

Through the kindness of the authorities in charge of the Zoological Collection in our National Museum, I have been enabled to make as careful an examination as I could of the numerous specimens (skins and skulls) of the above-named interesting genus which are therein preserved.

Amongst the skulls I find one, No. 58. 5. 4. 99, which came from the collection of this Society, and which presents the singular anomaly of having no trace of the second upper molar on either side.

With this exception, all the skulls examined by me agree in possessing the following characters, most of which I have not found to have been as yet noted:—

Nasal bones extending backwards much beyond the adjacent portions of the maxillæ; the external margin of each nasal, distad of the nasal process of the frontal, strongly concave, so that the outer margin of the whole length of each nasal has a subsigmoid outline. Face relatively short; dorsal surface of interorbital region but little concave transversely; skull viewed in profile showing very little vertical elevation of the interorbital region, the concavity thus apparent between it and the distal end of the nasals being very slight both in degree and in antero-posterior extent; postorbital processes of the frontal projecting outwards but slightly; postorbital processes of the malar rather marked; zygomata not strongly arched outwards; anterior palatine foramina very large and much elongated. First upper premolar approaching the second in size more nearly than in *Canis*; fourth upper premolar with a smaller internal lobe; inner portion of first upper molar relatively smaller, its inner tubercles and cingulum having more or less completely coalesced; first lower molar relatively smaller, especially its inner ridge. Tail decidedly less than half the length of the body.

I have been unable to satisfy myself that more than two species of this genus can be distinguished, and it seems to me possible that even this distinction may be found unsatisfactory when more skulls are obtained from Northern Asia.

The North-Asiatic species *C. alpinus* of Pallas[1] is represented by two skins which differ slightly in colour. One from Siberia is very white; the other, which has a yellow tinge, comes from the Altai, and its skull is in the collection[2]. It differs from all the other skulls in the large size of its second upper molar (as has been previously recorded) and also in the large size of the second (and last) lower molar, and in the less massive form of the angle of the mandible.

[1] Zoogr. Rosso-Asiat. i. p. 34.

[2] It is that marked No. IX. in Prof. Huxley's table of measurements, P. Z. S. 1880, p. 275.

The numerous other skins in the Museum present a wide range of variation, some having the hair short and harsh, and others having long and more or less woolly hair. There is a light-coloured woolly skin from Nepal (45. 1. 8. 311); and one specimen, brought by Lieutenant Abbott from Cashmere, which nearly approaches in lightness of colour and length of hair the specimen of *C. alpinus* from the Altai. Its skull[1], however, which is labelled 158 *g*, has but a small second upper molar, and the colour of the skin is redder and the fur less soft than that of *C. alpinus*, even the specimen from the Altai, which is the less white of the two. I would therefore, provisionally at least, retain *C. alpinus* as a distinct species.

I have carefully examined the skin from Moulmein (61. 11. 14. 2), which, from its dark back, certainly has an exceptional appearance, and has been regarded as an example of a distinct species, *C. rutilans*. I cannot, however, detect anything exceptional in its skull. Considering also the gradations of difference in colour and characters of fur between such specimens as that from Malacca (39. 12. 20. 3), the true type[2] of *C. dukhunensis* of Sykes, and others with yet longer or darker coats, I have found no external characters which I think can be regarded as specifically distinctive. The teeth of the red forms also vary more or less in size and proportion, without such differences coinciding with differences in the coloration, texture, and length of the coat. The two skins from which skulls[3] have been extracted closely resemble each other, while the proportions of their first upper molars differ considerably; a circumstance which tends to throw doubt on the distinctness of the North-Asiatic species, a doubt, however, which will disappear if future specimens of the latter animal are found to have large upper first molars.

We may therefore, I think, distinguish the species of this genus provisionally as follows:—

## Genus Cyon, Hodgson (1838).

### 1. Cyon javanicus[4].

Colour normally red; hair generally rather or very short and not woolly. $M^3$ small.

[1] This is Prof. Huxley's No. VI. *l. c.*

[2] Dr. Murie, in his paper on this species (P. Z. S. 1872, p. 715), observes that the skull "from the Deccan forwarded by Colonel Sykes . . . . is juvenile, and therefore not to be relied on osteologically as distinctive of a type." This same skull is referred to by Dr. Gray (Catalogue of Carnivora, &c. 1869, p. 186) as that of *Cuon dukhunensis*. I find, however, that it is not a *Cyon* at all, but a true *Canis*.

[3] These are respectively, Nos. 45. 3. 19. 5 and 46. 5. 13. 2.

[4] This species has been commonly named *sumatrensis*, after Hardwicke, whose paper in vol. xiii. of the Linnean Society's 'Transactions' dates from 1822. I do not doubt, however, that it is the same species which was described by F. Cuvier as "Le Loup de Java," in the Dict. des Sc. Nat. tom. viii. (1817), upon which Desmarest founded his species *Canis javanicus*, published in his 'Mammalogie,' p. 193—a name which thus dates from 1820, and which therefore, if I have correctly determined this synonymy, must take precedence.

2. CYON ALPINUS.

Colour normally white or whitish, at least in winter; hair very long and woolly. $M^2$ large.

I subjoin certain osteological dimensions of *Cyon javanicus* with comparisons between it and *Canis lupus* var. *occidentalis* and *C. familiaris* var. *dingo*.

| | *Cyon javanicus.* | *Canis lupus.* var. *occidentalis.* | *Canis familiaris* var. *dingo.* |
|---|---|---|---|
| Length of cervical region ... | 16·5 | 21·5 | 16·0 |
| Length of dorsal region ..... | 24·0 | 26·0 | 24·0 |
| Length of lumbar region..... | 19·0 | 20·0 | 18·5 |
| Length of sacral region ..... | 4·0 | 4·0 | 5·0 |
| Atlas to end of sacrum ..... | 63·5 | 71·5 | 63·5 |
| Pectoral limb ..... | 37·0 | 67·0 | 47·0 |
| Pelvic limb ..... | 47·5 | 76·0 | 54·0 |
| Humerus ..... | 13·5 | 22·0 | 16·5 |
| Radius to root of styloid process ..... | 12·0 | 21·5 | 16·0 |
| Femur ..... | 15·5 | 24·2 | 18·0 |
| Tibia to root of malleolus ... | 14·3 | 24·0 | 17·4 |
| Third metacarpal..... | 5·5 | 9·8 | 6·4 |
| Third metatarsal ..... | 6·7 | 10·5 | 7·1 |
| Index metacarpal..... | 4·5 | 8·7 | 5·7 |
| Pollex metacarpal ..... | 1·7 | 3·0 | 2·0 |
| Index metatarsal ..... | 5·5 | 9·3 | 6·3 |
| Hallux metatarsal ..... | 1·1 | 1·4 | 1·2 |
| Pollex, total length ..... | 3·4 | 6·3 | 4·3 |
| Hallux, total length..... | 1·6 | 3·0 | 1·8 |

| | *Cyon javanicus.* | *Canis familiaris* var. *dingo.* |
|---|---|---|
| Basion to ovalion[1] ..... | 3·1 | 3·2 |
| Basion to sphenoideum[2]..... | 4·4 | 4·9 |
| Spheniodeum to gnathion ... | 10·8 | 12·5 |
| Basion to gnathion ..... | 15·0 | 17·2 |
| Length of palate ..... | 7·5 | 9·3 |
| Breadth of palate ..... | 5·1 | 5·3 |
| Greatest length of nasals..... | 6·3 | 7·3 |
| Breadth of nasals..... | 1·9 | 2·0 |
| Interorbital breadth ..... | 3·2 | 3·3 |
| Between postorbital processes | 4·4 | 5·3 |
| Breadth of cranium..... | 6·2 | 5·6 |
| Breadth of zygomata ..... | 9·7 | 10·3 |
| Longest incisor ..... | 1·2 | 1·4 |
| Shortest incisor ..... | 0·8 | 1·0 |

[1] By ovalion I mean the middle point of a line extending from the hinder margin of one foramen ovale to the hinder margin of the other.

[2] See P. Z. S. 1882, p. 465. By sphenoideum I mean the junction of the basi- and pre-sphenoids, which is generally distinguishable in the basis cranii of the *Canidæ*.

TABLE (*continued*).

| | *Cyon javanicus.* | *Canis familiaris* var. *dingo.* |
|---|---|---|
| Length of $\frac{P.1}{}$ | 0·6 | 0·6 |
| " $\frac{P.2}{}$ | 0·8 | 1·1 |
| " $\frac{P.3}{}$ | 1·0 | 1·2 |
| " $\frac{P.4}{}$ | 1·9 | 2·0 |
| " $\frac{M.1}{}$ | 1·1 | 1·3 |
| " $\frac{M.2}{}$ | 0·6 | 0·8 |
| Breadth of $\frac{P.4}{}$ | 1·0 | 1·1 |
| " $\frac{M.1}{}$ | 1·5 | 1·6 |
| " $\frac{M.2}{}$ | 0·8 | 1·1 |
| Length of $\overline{P.1}$ | 0·45 | 0·35 |
| " $\overline{P.2}$ | 0·8 | 0·9 |
| " $\overline{P.3}$ | 0·9 | 1·1 |
| " $\overline{P.4}$ | 1·1 | 1·2 |
| " $\overline{M.1}$ | 2·0 | 2·0 |
| " $\overline{M.2}$ | 0·8 | 1·0 |
| Breadth of $\overline{M.1}$ | 0·7 | 0·9 |
| " $\overline{M.2}$ | 0·5 | 0·6 |
| Length of $\overline{M.3}$ | 0 | 0·5 |
| Breadth of $\overline{M.3}$ | 0 | 0·4 |

Atlas to end of sacrum being taken at 100 :—

| | *Cyon javanicus.* | *Canis lupus.* |
|---|---|---|
| Relative length of cervical vertebræ | 25·9 | 30·0 |
| " " dorsal vertebræ | 37·8 | 36·3 |
| " " lumbar vertebræ | 29·9 | 27·9 |
| " " pectoral limb | 68·2 | 93·7 |
| " " pelvic limb | 74·8 | 106·2 |
| " " humerus | 21·2 | 30·7 |
| " " radius | 18·8 | 30·0 |
| " " femur | 24·5 | 33·8 |
| " " tibia | 22·5 | 33·5 |
| " " third metacarpal | 8·6 | 13·7 |
| " " third metatarsal | 10·6 | 14·6 |
| " " cranial axis [1] | 6·7 | 7·8 |
| " " facial axis [2] | 17·0 | 22·5 |

[1] *I. e.* Basion to sphenoideum.

[2] *I. e.* Sphenoideum to gnathion. These are the cranial and facial axes adopted by Mr. Oldfield Thomas, which I think are the most convenient and serviceable.

Cranial axis being taken at 100 :—

| | *Cyon javanicus.* | *Canis familiaris* var. *dingo.* |
|---|---|---|
| Facial axis | 245·3 | 255·1 |
| Relative length of palate | 170·4 | 189·7 |
| " breadth of palate | 115·9 | 108·1 |
| " length of nasals | 143·1 | 148·9 |
| " breadth of nasals | 43·1 | 40·8 |
| " interorbital breadth | 72·7 | 67·3 |
| " breadth between postorbital processes | 100·0 | 102·0 |
| " breadth of cranium | 140·9 | 114·2 |
| " breadth of zygomata | 220·4 | 210·2 |
| " " $\frac{P.1}{P.4}$ | 13·6 | 12·2 |
| " " $\frac{P.4}{M.1}$ | 43·1 | 40·8 |
| " " $\frac{M.1}{M.2}$ | 25·0 | 26·5 |
| " " $\frac{M.2}{M.2}$ | 13·6 | 16·3 |
| Relative breadth of $\frac{M.1}{M.2}$ | 34·0 | 32·6 |
| " " $\frac{M.2}{P.4}$ | 18·1 | 22·4 |
| " length of $\frac{P.4}{M.1}$ | 25·0 | 24·4 |
| " " $\frac{M.1}{M.2}$ | 45·4 | 40·8 |
| " " $\frac{M.2}{M.1}$ | 18·1 | 20·4 |
| " breadth of $\frac{M.1}{M.2}$ | 15·9 | ..... |
| " " $\frac{M.2}{M.2}$ | 11·3 | ..... |
| Length of first metacarpal | 38·6 | 39·2 |
| " index metacarpal | 102·2 | 111·7 |
| " pollex | 77·2 | 84·3 |
| " first metatarsal | 25·0 | 23·5 |
| " index metatarsal | 125·0 | 123·5 |
| " hallux | 36·3 | 45·2 |

The specimens of *Cyon alpinus* in the British Museum are probably in their winter coat, for the animal is described as being also of a red colour, like a fox, with the back somewhat darker, and the belly and inner side of the limbs white. The dimensions of its teeth are as follows:—

| | |
|---|---|
| Length of $\frac{P.4}{M.1}$ | 2·1 |
| " $\frac{M.1}{M.2}$ | 1·5 |
| " $\frac{M.2}{M.1}$ | ·7 |
| Breadth of $\frac{M.1}{M.2}$ | 1·5 |
| " $\frac{M.2}{M.1}$ | 1·0 |
| Length of $\frac{M.1}{M.2}$ | 2·3 |
| " $\frac{M.2}{M.2}$ | ·9 |

## 4. Notes on two Mountain-Antelopes of Central China. By Dr. Augustine Henry[1].

[Received February 3, 1890.]

During my residence at Ichang on the Yang-tze and journeys in its vicinity I met with indications of two species of Mountain-Antelopes.

The larger of these is known by the natives as the "Bright-maned Antelope," "*Mingtsung yang*." North-west of Ichang the mountain-range, which divides the basins of the rivers Yang-tze and Han, attains an altitude of over 9000 feet, and in parts is clad for the upper 3000 feet with coniferous forests. The Antelope roams in these woods in small herds. Often when collecting plants we startled the animals and could hear them on in front breaking through the brambles and shrubs, and followed their freshly made tracks. I was never lucky enough to see one, but I procured a skin, which measured 5 feet long by 3½ feet broad. In colour it is a darkish grey, and on the neck there is a bristly mane, composed of greyish-white hairs about 5 inches long. The horns are about 8 inches long, curved backwards. The animal is said to stand as high as a cow, and to yield, when killed, about 100 to 150 lbs. of flesh. It is so large and strong that occasionally when one is caught and tamed it is used for riding on. I brought the skin to Père Heude of Sikanei, who identified it as his *Capricornis argyrochætus*[2].

The second, smaller Antelope occurs on the precipices of the gorges and glens near Ichang. It is known as the "*Shan-yang*" or "*Yhe-yang-tzu*," *i. e.* "Mountain-Goat" or "Wild Goat." Père Heude received a skull and skin from me, and has described it as *Kemas henryanus*.

A live specimen from the Ichang gorge was obtained by one of the steamer captains, and is now in the gardens at Zikawei near Shanghai, *i. e.* at Père Heude's establishment.

This particular Antelope (or forms akin to it) occurs in nearly all the mountains of the west and north of China; *i. e.* in Szechuen, Hupeh, Shansi, Kansuh, Chihli, &c., and doubtless the Ichang one is a marked variety of the species.

The Ichang animal stands as high as a sheep. It occurs only on precipices, and the obtaining of a live specimen in the case mentioned

[1] Extracted from letters received from Dr. Henry and communicated by the Secretary.

[2] [*Capricornis argyrochætus*, Heude, Mém. conc. l'Hist. Nat. de l'Emp. Chinois, ii. p. 4 (note).

"Animal plus petit que le *C. edwardsi*. Face rousse, crinière épaisse, blanc sale; pelage noir semé de blanc. Tête osseuse comprimée latéralement: prémolaire antérieure d'en bas mince, à talon élevé et bien dégagé. Cette espèce est des montagnes du Tché-kiang."

In the same note is described another species from Tonquin, *Capricornis maritimus*.—P. L. S.]

was a piece of the sheerest luck; the foreigners at Ichang have never even succeeded in shooting one, though a good many trials have been made by them, and the precipices on which the Antelopes occur are not more than 5 or 6 miles from Ichang[1].

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March 4, 1890.

Prof. Flower, C.B., 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 February 1890:—

The total number of registered additions to the Society's Menagerie during the month of February was 16, of which 7 were acquired by presentation, 4 by birth, 1 by exchange, 1 by purchase, and 3 were received on deposit. The total number of departures during the same period, by death and removals, was 72.

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Mr. F. E. Beddard exhibited and made remarks on some living specimens of Oriental Earthworms of the genus *Perichæta* (*P. indica*) found in a greenhouse in Scotland, and supposed to have been introduced from India.

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Mr. Arthur Thomson, the Society's Head Keeper, exhibited a series of Insects reared in the Insect-house in the Society's Gardens during the past year, and read the following Report on the subject:—

*Report on the Insect-house for* 1889.

Examples of the following species of Insects have been exhibited in the Insect-house during the past season:—

*Silk-producing Bombyces and their Allies.*

Indian.

*Attacus atlas.*
—— *pernyi.*
—— *cynthia.*
*Antheræa mylitta.*
*Actias selene.*
*Cricula trifenestrata.*

American.

*Samia cecropia.*
*Telea polyphemus.*
—— *angulifera.*
*Telea promethea.*
*Actias luna.*
*Hypochera io.*

[1] [A skin and skull of this animal have been recently received by the British Museum from our Corresponding Member Mr. P. H. S. Montgomery. It is obviously closely allied to *Nemorhædus cinereus*, Milne-Edwards (Recherches s. l. Mamm., Atlas, pl. 70), and *N. swinhoii*, Gray (P. Z. S. 1862, p. 263), pl. 35, but may be different, and if so should be called *Nemorhædus heuryanus*. I cannot, however, ascertain whether Père Heude's name has been actually published or not.—P. L. S.]

African.

*Antheræa cytherea.*

*Diurnal Lepidoptera.*

European.

*Papilio machaon.*
—— *podalirius.*
*Vanessa antiopa.*
*Vanessa levana.*
*Limenitis populi.*

American.

*Papilo ajax.*
—— *asterias.*
*—— *philenor.*
*Papilio turnus.*
*Limenitis disippus.*
**Goniloba tityrus.*

*Nocturni.*

*Smerinthus ocellatus.*
—— *tiliæ.*
—— *populi.*
*Sphinx ligustri.*
*Deilephila euphorbiæ.*
—— *galii.*
*—— *dahli.*
**Macroglossa croatica.*
*Bombyx rhadama.*
*Saturnia pyri.*
**Lasiocampa otus.*
*Endromis versicolor.*
**Pseudophia tirrhæa.*
*Eacles imperialis.*
*—— *regalis.*

Of the insects which I have the honour to place before the Meeting this evening the following are exhibited for the first time, viz.:—*Papilio philenor*, *Goniloba tityrus*, *Deilephila dahli*, *Macroglossa croatica*, *Lasiocampa otus*, *Eacles regalis*, and *Pseudophia tirrhæa*.

The fine specimens of *Eacles regalis* were reared from pupæ deposited in the Insect-house by the Hon. Walter Rothschild, F.Z.S.

From the cocoons of *Lasiocampa otus* it has been said that the Greeks and Romans obtained their silk, before the introduction of the silkworm from China. I exhibit some cocoons of this species, and I have no doubt from their appearance that silk of some kind could be obtained from them.

*Orthoptera.*

**Harpax ocellata.*
**Diaphemora femorata.*

On the 15th of July last we received from Col. J. H. Bowker F.Z.S., two living specimens (out of three sent) of the beautiful and interesting Mantis (*Harpax ocellata*). On their arrival they were not fully developed, but changed into the perfect state, one on the 27th of July, and one on the 8th of August.

Col. Bowker in his letter says:—"I hope they will survive the voyage, as they are most interesting and beat the Chameleon hollow in

* Exhibited for the first time.

changing colour. What I send you have been transferred from the Blue Convolvulus to other flowers, and after a few days take the colour of the flowers to which they have been transferred." I did not myself try any experiments in this direction with them, as they were a pair, and I had some hopes of breeding them. They appeared to agree perfectly, but I am sorry to say that on the 19th of August the female attacked and killed the male. During the time they lived together they were never seen to copulate. On the 19th of October the female died.

These insects during life were very beautiful, especially immediately after the change to the perfect state, and I have the pleasure of exhibiting three characteristic coloured sketches, from life, by Mr. H. Goodchild, and also two photographs taken by Mr. D. Turner Belding, which, however, I am sorry to say, have not come out very well.

I have also the honour to exhibit:—

I. The two "skins" of these insects which were cast on July 27th and August 8th respectively.

II. The male insect (or rather as much as was left of it after the female had killed it), set with its wings spread out.

III. The female, set as near as possible in the position assumed during life, to show the mode of catching and holding its prey. I may here mention that these insects while living in the Gardens fed upon flies only.

IV. The "batch" of ova formed on a twig by the female about 8 days before death. The layer of ova *nearest* the twig was laid *first* and during *one* night, and the upper layer was *laid* and *completed* during the *third night after* the *first* layer was laid.

Early in the spring of last year Mr. J. B. Williams, of Toronto, was good enough to send us a number of ova of a species of Stick-insect (*Diaphemora femorata*). The first specimen emerged on the 11th of June, and others from time to time during the summer. Nearly all the specimens lived and did well, feeding upon hazel-leaves. They changed their "skins" four times before reaching maturity. After the 1st, 2nd, and 3rd changes they were of a bright grass-green colour; but after the 4th and last change the males were of a brownish colour, with the front pair of legs green, the four other legs brown to the second joint, and the rest of the legs green. The females were all green except the abdomen, which was of a greenish-brown colour.

These insects copulated frequently, and produced a large number of ova, which I hope to be able to hatch during the coming summer.

I exhibit this evening a male and female of this species. The female is set to show the manner in which these insects, when at rest, employ their front pair of legs to protect their very long and slender antennæ. I also exhibit a female set upon a spray of grass, to give some idea of how well these creatures are protected during life by their form and colour.

A communication was read by Mr. T. D. A. Cockerell, of West Cliff, Custer Co., Colorado, containing particulars of a series of Galls obtained in that district and enclosing the specimens for exhibition.

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Mr. H. Seebohm, F.Z.S., gave an account of his proposed new Classification of Birds as put forward in his recently published book on this subject[1]. This communication was followed by a general discussion of Mr. Seebohm's arrangement.

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March 18, 1890.

Prof. Flower, C.B., LL.D., F.R.S., President, in the Chair.

The Secretary exhibited on behalf of the Rev. G. H. R. Fisk, C.M.Z.S., an albino Bat shot in January last at Broadlands, the farm of Mr. J. Rawbone, at Somerset West, not far from Cape Town.

Mr. Oldfield Thomas, F.Z.S., had kindly determined this specimen to be an albino variety of *Vesperus capensis*, Smith.

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Capt. Percy Armitage, 24th Regiment, exhibited two mounted heads of the Panolia Deer (*Cervus eldi*) which had been obtained in Lower Burmah. One of these bore antlers of the normal form of *Cervus eldi*, widely expanding at their base; in the other head the two antlers rose from the front much nearer together, more as in the Sambur and its allied forms. Both specimens had been obtained in the same district, and were undoubtedly of the same species.

Captain Armitage made the following remarks on this subject:—"These two stags, of which the heads are on the table, were both shot on the same day (28th April, 1888) near Wimpeedaw, a small village on the Sittang river, some 52 miles below Shwigyin. Wimpeedaw is in the Shwigyin district of Lower Burmah. The Burmese name for *Cervus eldi* is 'Thanin.' These Deer are very wild and difficult to approach, and are generally found on large plains covered with patches of 'lime' grass 9 or 10 feet high. After proceeding to the shooting-ground in a bullock-cart, the method pursued is to drive slowly through the lime-grass, the sportsman standing up in the cart and looking over the top of the grass until he sees a herd of deer. The cart is then stopped and the stalking commences. This is very often a long and troublesome business, as the 'Thanin,' when alarmed, leave the jungle and make for the open plain, generally keeping well out of range."

[1] Classification of Birds; an attempt to diagnose the Subclasses, Orders, Suborders, and some of the Families of existing Birds. By Henry Seebohm. London: R. H. Porter, 18 Princes Street, Cavendish Square, W., 1890.

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Mr. Sclater exhibited on behalf of Mr. Robert B. White, C.M.Z.S., skins belonging to four species of Mammals obtained by Mr. White at an elevation of from 5000 to 7000 feet on the mountains of the Upper Magdalena valley, in the department of Tolima, U. S. of Colombia.

Mr. Oldfield Thomas had kindly referred these specimens to the following species:—

1. *Cebus fatuellus.*
Native name, "Mico Maizero."

2. *Lagothrix humboldti.*
Native name, "Churuco."

3. *Nyctipithecus vociferans.*
Native name, "Dormilon" or "Putamono."

4. *Galictis barbara.*
Native name, "Zorro" or "Ulauca."

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The following papers were read:—

## 1. Notes on the South-American *Canidæ*.

By St. G. Mivart, F.R.S.

[Received February 24, 1890.]

Some of the South-American *Canidæ* present as yet rather trying difficulties to the systematic zoologist. My object in the present paper is to endeavour to make a small contribution towards clearing up existing difficulties of classification and synonymy. My hope is that this attempt may at least, by criticism and collecting together references to the literature of the subject, facilitate a future complete rectification. What, however, is greatly to be desired is the acquisition of a large number of skins with skulls in them, the sexes being ascertained, and both the localities where and the season of the year when the individuals were obtained being carefully noted in each case.

No naturalist who has worked at either the skins or the skulls of the Dog family can have failed to be struck with their great variability. This fact was strongly expressed by Professor Huxley in his paper (P. Z. S. 1880), both with regard to the form of the skull and the proportions of the teeth. Quite recently Dr. Windle, after making most elaborate measurements and comparisons of different breeds of domestic dogs, has told us "the variation in any breed is much greater, in almost every case, than that existing between any two breeds."

Some studies recently undertaken by me at the British Museum (for much kind aid during which I have to express my thanks to

Mr. Oldfield Thomas) have very strongly impressed me with the necessity which there is of examining a series of specimens of any asserted species in order to arrive at any certainty as to its specific distinctness.

The species I propose to refer to here are those which are more or less allied to or identical with the form named by Prince Wied *Canis azaræ*.

(1) As to *Canis azaræ* itself, the original description of Wied (Beiträge, vol. ii. p. 338, 1826) describes it as a yellowish-grey animal, with the back and upper parts blackish and a blackish stripe in front of the belly; the margins of the lips white; dark greyish brown under the jaws; shoulders and thighs rather grey; sides of the neck and outside of the legs light reddish yellow, outside of the ears yellowish grey-brown.

In the Prince's volume of plates there is a fairly good, coloured figure of the animal.

The specimen brought back by Mr. Darwin was described by Mr. Waterhouse (Zoology of H.M.S. 'Beagle,' p. 14, plate vii.), and determined to be the true *C. azaræ* of Wied. He says in a note, "I am indebted to Mr. Ogilby, who visited the Prince's collection, for a description from the specimens of *C. azaræ* therein preserved." The figures given by Waterhouse and Wied are much alike. I think we may regard the determination of our careful and accurate compatriot as a probably correct one.

The specimen thus determined is now in the British Museum (No. 55. 12. 24. 238) and came from Chile. Its skull is still within the skin. There are, however, five other skulls, one of which (817 *b*) is from a stuffed specimen in the collection. They are remarkably similar as to dentition. I find that the mean length of $\frac{P.4}{}$ in these is 1·22, while that of $\frac{M.1+M.2}{}$ is 1·38, or as 100 : 113.

The sagittal ridge varies much as to development and the form, the breadth, and the length of the raised flattened portion between the temporal ridges.

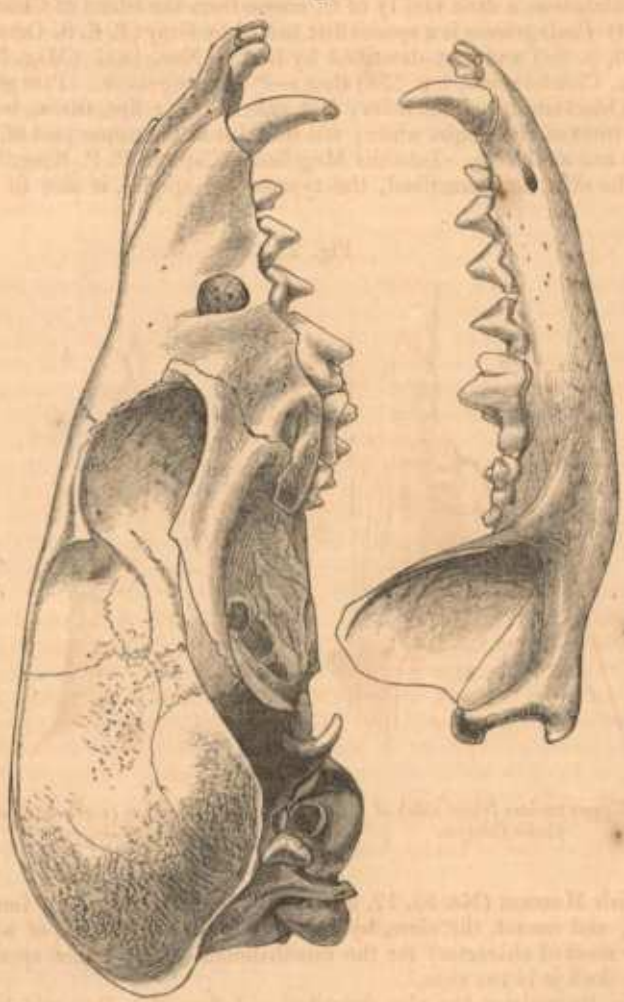
The length of the fourth upper premolar and the two molars behind it are as follows in the five skulls:—

| P. 4. | M. 1+M. 2. |
|---|---|
| 1·30 | 1·55 |
| 1·15 | 1·25 |
| 1·20 | 1·35 |
| 1·15 | 1·28 |
| 1·30 | 1·50 |

(2) *Canis fulvipes* reposes on a description (P. Z. S. 1837, p. 11) by my deceased friend Mr. Martin. He describes it as "hoary mixed with black, the latter being more decided down the top of the back; the head fulvous, grizzled with hoary; edges of lips white ears chestnut-brown; outside of limbs dusky black, freckled with fulvous; a dark mark above tarsal joint; tarsi and toes fulvous rown; underparts dirty white," &c.

The specimen thus described, which is the type of the species, is in the British Museum (No. 758), and its skull (figs. 1 & 2) is there also.

Fig. 1.



Side view of skull of *Canis fulvipes*. (Size of nature.)

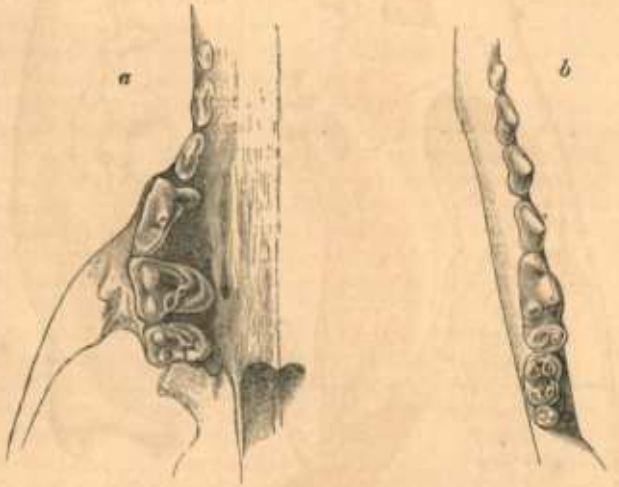
Bearing in mind my past experience of Canine variability, I have carefully examined this skin and skull, but cannot convince myself that it is anything more than a dark form of *C. azaræ*. The skull I found to present no noteworthy differences. Its snout is slightly shorter and broader than are the snouts of three skulls of *C. azaræ*, but not more so than is a fourth skull also attributed to that species.

Length of $\frac{P.4}{}$ 1·15, of $\frac{M.1+M.2}{}$ 1·50, or as 100 to 130. Thus these molars are relatively larger than in *C. azaræ*, but it is not larger than in the *C. vetulus* of Lund, which probably is (as Burmeister believes) the same as Wied's *C. azaræ*. I can, at present, only regard *C. fulvipes* as a dark variety of *C. azaræ* from the island of Chiloe.

(3) *Canis griseus* is a species first named by Gray (P. Z. S. October 1836, p. 88) and first described by him in Nov. 1837 (Mag. Nat. Hist., Charlesworth, i. p. 578) thus:—"*Vulpes griseus*. Pale grey, with blackish tips to the hairs; legs pale fulvous; lips, throat, belly, and front of the thighs white; tail blackish at the upper part of the base and at the tip. Inhabits Magellan.—Captain P. P. King."

The skin thus described, the type of the species, is also in the

Fig. 2.




Upper molars (right side) of *Canis fulvipes*.

Lower molars (right side) of *Canis fulvipes*.

British Museum (No. 55. 12. 24. 239). It is, however, quite immature, and cannot, therefore, by itself serve (in the absence of some very marked character) for the establishment of a distinct species. The skull is in the skin.

Dr. Burmeister has also described and figured a Dog, which he has entitled *C. griseus*, Gray ('Fauna Brasiliens,' p. 48, pls. xxv., xxviii., and xxix., and description 'Descript. phys. Rép. Argentine,' vol. iii. p. 151); and the question arises, Is, or is not, *this* a distinct species?

Now Dr. Burmeister is a naturalist who very distinctly merits our esteem; he has long lived in South America, and it is impossible

to suppose that he can be mistaken as to obvious facts concerning the many individuals which have, doubtless, passed through his hands.

But a keen appreciation of facts does not guarantee a sound drawing of inferences. I cannot persuade myself that he has not been too apt to draw hasty inferences from insufficient data. Thus in 1856 (Fauna Brasil. p. 24) he separated *C. cancrivorus* and *C. vetulus* generically from *C. azaræ* and *C. griseus* on the ground that in the first two the sagittal ridge is present though weak, and that it is absent in the last two; that the upper fourth premolar is a little shorter than the two upper molars in the former pair of species and much shorter in the latter, and, finally, that the pupil becomes elliptical in the one pair and remains round in the other.

I have, however, found the sagittal ridge to be very differently developed in different adult skulls of undoubtedly the same species. As to whether the fourth premolar is much shorter or only a little shorter than the two molars behind it, I consider that a very useful specific character but not a valid generic one—at least in the *Canidæ*. I regard the contraction of the pupil as a most unsatisfactory distinction [1].

Twenty years later Dr. Burmeister seems to have come more distinctly to recognize the variability of these Dogs. He says of the South-American forms (Archiv f. Naturgesch. 1876, p. 117) that "In der Färburg sind nicht bloss alle diese Arten einander sehr ähnlich sondern sie variiren auch etwas nach der Jahreszeit." He also speaks, on the same page, of variation in the skull.

Without any disrespect, then, to Dr. Burmeister, we must not deny ourselves the right to criticise freely his various representations.

With respect to the form he describes and figures as *C. griseus*, he tells us that it is slenderer than *C. azaræ*. Now by *C. azaræ* he always intends that form which was described as *C. azaræ* by Mr. Waterhouse. But Dr. Burmeister seems more than once to have changed his mind as to the identity of his and Mr. Waterhouse's *C. azaræ* with the *C. azaræ* of Wied. Thus in his 'Uebersicht Thiere Brasiliens,' 1854, p. 99, he says of the form he describes as the *C. azaræ* of Waterhouse: "Ich habe auch den *Canis azaræ*, Pr. Max. *wieder* zu dieser Art gezogen;" while in his 'Fauna Brasiliens' (1856, p. 37) he identifies the Prince's *C. azaræ* with the *C. vetulus* of Lund. In his 'Reise durch La Plata,' 1861, p. 405, and in his description of the Argentine State, vol. iii. p. 147, he leaves out all reference to Lund's *C. vetulus* amongst the synonyms he there gives of his *C. azaræ*. He distinguishes his own (and Waterhouse's) *C. azaræ* from his new species *C. griseus* as follows (Fauna Brasil. p. 24):—

| *C. azaræ*. | *C. griseus*. |
|---|---|
| "Fore limbs grey to the carpus; soles blackish brown." | "Fore limbs entirely reddish yellow; soles reddish brown.' |

He further tells us (p. 48), as we have said, that *C. griseus* is the

[1] For reasons before stated by me, see P. Z. S. 1882, p. 141.

slenderer beast of the two, and that it has a fuller and softer coat; but the colour of the limbs he regards as the great character, the reddish-yellow tract being separated sharply from the grey body by a transverse blackish mark.

The skull of Burmeister's *C. griseus* is much smaller than that of his *C. azaræ*, but the difference is by no means greater than I have met with between specimens of undoubtedly the same species of other kinds of *Canidæ*. He speaks, indeed, of a distinction in the length of the premaxillæ, but his plate does not agree with the statement. The dentition of both is extremely similar. In his 'Reise durch La Plata,' p. 407, he gives a table of the dimensions of the teeth in most of the species considered in this paper. The combined length of the upper molars is there stated to be 17 in *C. azaræ* and 13 in *C. griseus*; while the length of the fourth upper premolar is 15 in *C. azaræ* and 12 in *C. griseus*; or the premolar to the molars as 100 to 112 in *C. azaræ* and as 100 to 108 in *C. griseus*, a difference which is practically no difference at all.

No one, I venture to think, who has worked at the varieties of the Wolf and the Fox, can attach great importance to a distinction reposing upon the limbs being "grey" or "reddish yellow," or upon a softening of the colour of the soles of the feet from a blackish brown into a reddish brown. There remains the transverse blackish band across the proximal part of the limbs. But this cannot constitute a distinctive character, for it exists most distinctly on the hind limbs of the type of *C. fulvipes*, where it sharply marks off the red colour below it. The same is the case in the skin of *C. azaræ*, No. 55. 12. 24. 238, and to a less degree in the skin brought by Burnett and Fitzroy from Patagonia.

The teeth not only agree with those of *C. azaræ*, but the teeth of these two forms agree in differing very markedly from another South-American form which I take to be represented by the *C. vetulus* of Burmeister. I cannot, on the evidence before us, accept the *C. griseus* of Burmeister as an established species, especially on the strength of a single skin[1] and skull. I would provisionally regard it as a variety of *C. azaræ* coming from Sandy Point in the Straits of Magellan. The *C. griseus* of Gray must be simply ignored.

(4) *Canis patagonicus* is a species which was proposed by Philippi (Archiv f. Natur. xxxii. (1866) i. vol. p. 116) for a skin from the Straits of Magellan without a skull. He rests its distinctness from *C. azaræ* on its shorter tail; its hair being shorter and not so thick, and of a yellowish-grey colour; its bristly hairs being softer and whiter; the dark colour of the chin extending back "six lines" further beyond the angle of the mouth; the limbs being less white externally; the hairs of the tail being shorter (as well as the tail itself), with its under-fur ashy grey instead of yellow and having its black hairs so disposed as to form about ten transverse rings alternating with white, and the claws being pure-pointed, indicating that the animal did not burrow.

[1] Burmeister (Erläut. p. 50) uses the expression "Mein Exemplar stammt von Punta de las Arenas."

I think it well to note these characters as indicating, with respect to the tail, what is possibly another local variety of *C. azaræ*, but I submit that the characters are by no means sufficient to justify its acceptation as a distinct species on the evidence of a single skin unaccompanied by its skull. I am the more inclined to regard it as a mere variety because the skin of *C. azaræ* brought by Fitzroy from Patagonia (No. 227 A) shows two imperfect annulations towards the root of the tail.

(5) *Canis entrerianus* is a species instituted by Burmeister ('Reise durch La Plata,' 1861, p. 400) for a Canine form found by him between the rivers Paraná and Uruguay. He obtained specimens exemplifying very different ages of both sexes. He describes it as reddish-yellow brown, the hairs of the back having black terminations and being whiter further down; face and limbs red-brown like the back; front of the neck, breast, and inner side of the limbs whitish or pale yellowish red; end of the tail black.

The young (which he found sucking in January) were of a yellowish brown, except the face, limbs, and tail-end, which were blackish brown.

The mother, which was in milk on the 27th October, was reddish brown but dappled by the intermixture of white and black bristly hairs. The front of the neck, breast, and inner side of the limbs were reddish yellow.

An old male was a much lighter and clearer yellow colour, without any dappling on the back, being of a homogeneous tint, the bristly hairs having less black and no white. Underparts white.

The male was taken on 27th February, so that he had probably a summer dress on, while the female was in winter clothing, which was longer and thicker than the male's. She had six mammæ.

The skulls of the male and female differed considerably, that of the female being more contracted behind the orbits. The length of the fourth upper premolar was in the male 15 and the two molars 20; in the female P. 4 was 14 and $\frac{M.1+M.2}{}$ 15; the mean of the two being as 100 to 120. The difference between the male and the female is so remarkable that it would almost justify a little scepticism as to the numbers given.

The external characters I have quoted—characters which differ so much according to sex or season—do not seem to me enough to distinguish and establish a species, although they are very interesting as pointing out another local variety—that of Entre Rios—of the very widely diffused *C. azaræ*.

(6) *Canis gracilis*.—This is again a species proposed by Burmeister ('Reise durch La Plata,' 1861, p. 406, and 'Description phys. Rép. Argentine,' vol. iii. p. 150) for a Dog inhabiting the bushy pampas of the environs of Mendoza. There he often saw it alive, and many skins brought to market. Amongst these was one with the dorsum and end of the tail rusty red. He describes the species, however, as an uncommonly slender form, more elegant than his *C. griseus*. The ground-colour is pale yellowish grey on the back—

*C. griseus* being reddish grey and *C. entrerianus* a rusty[1] yellowish red. The long bristly hairs are black on the distal half and with a broad white ring lower down, which, however, is wanting in that of the end and dorsum of the tail and hindmost part of the back; so that these parts are darker. Dorsum of muzzle, crown, and outside of ears reddish brown, but the hairs have white points which especially produce a light spot over each eye. Upper lip, chin, front of throat, breast, and inner side of limbs pure white. A sable transverse band across the upper part of the chest. Outside of limbs and behind the ears pale rusty-yellow. Soles of the feet reddish. A transverse rusty-brown stripe above the heel, becoming black on the bend of the knee. Underjaw and middle of chin also black. Ears whitish yellow within; nose black. Ears without, pale brown.

The skull is said to be much like that of his *C. griseus* but somewhat shorter, especially the facial portion. The frontal region broader. Burmeister says much here and elsewhere about the precise development of the postorbital processes; but these parts I have found to vary much in skulls of undoubtedly the same species. The dentition is said to agree with that of *C. griseus*, except that all its parts are shorter. Length of upper fourth premolar 12; length of the two upper molars 14, or as 100 : 116.

These characters seem to me to be in so many respects intermediate between *C. azaræ* and his *C. griseus*, that bearing in mind the, to me, unsatisfactory character of his species *C. griseus* and *C. entrerianus*, I cannot feel satisfied as to its specific distinctness.

I fully concede, of course, that it may be a good species, but I would provisionally regard it as another local variety (from the neighbourhood of Mendoza) of *C. azaræ*.

My distrust of Burmeister's specific determinations reposes in part on considerations derived from the two following forms:—

These are his (7) *Canis vetulus* and (8) *C. fulvicaudus*. Both these names were proposed by Lund for forms described by him (Blik paa Brasiliens Dyreverden, femte Afhandling (Copenhagen, 1843), pp. 20–31, pls. xl. and xlii.).

They were differentiated by him as follows:—

| *C. vetulus.* | *C. fulvicaudus.* |
|---|---|
| Body and limbs slender; above light ashy grey. Limbs below isabel-yellow; end of the tail and a fourth of its length black. | Body and limbs somewhat slender; above whitish grey. Limbs below brownish yellow; end of the tail and a patch upon its dorsum yellowish red. A patch of ochre-yellow behind the ear. |

These distinctive characters seem to me to depend almost entirely on the tail, and when I reflect how I have found species of *Canidæ* described as having a black end to the tail, with a white end and

[1] But in describing *C. entrerianus* he says "röthlich gelbbraun" and not "rostgelbroth," as in his reference to it here.

*vice versâ*, I cannot but look with much scepticism on the specific distinctness of these forms.

Burmeister describes ('Fauna Brasiliens,' p. 37, pls. xxiii., xxviii., and xxix.) a specimen in his possession which he regards as identical with the *C. vetulus* of Lund, which species he (as before said) also identifies with the *C. azaræ* of Wied. But his description and his plates show that an important distinction exists between what *he* calls *C. vetulus* and both the *C. vetulus* of Lund, and Wied's and Waterhouse's *C. azaræ*; for its fourth upper premolar is extremely small, while the two upper molars are relatively very large. He also gives their dimensions ('Reise durch La Plata,' p. 407) as follows:—

Length of $\frac{P.\ 4}{}=9$; length of $\frac{M.\ 1+M.\ 2}{}=14$, or as 100 to 155.

But Lund gives an apparently careful and accurate figure of the skull of his *C. vetulus*, the type of the species, and this shows a well-developed fourth premolar and a small molar, which teeth bear to each other the proportions of 100 to 130.

Now my experience is that though the proportions of the teeth are not constant, they yet afford better characters than do variations of tint in the fur—a condition often variable with the season.

I do not think that the *C. vetulus* of Burmeister can be the same as the *C. vetulus* of Lund; and if it is not, it must be distinguished by some other appellation. As to what the latter may be, Burmeister identifies it with the *C. azaræ* of Wied, and therefore he ought not to call it *C. vetulus*, but what he regards as its original denomination, *C. azaræ*; and this, for all we can see, it may be, and I am disposed to think that it is a pale variety of it, judging from Lund's representation of its external form.

Now in the British Museum there are two skins and three skulls[1] from Brazil, which appear to me to belong to the same species as that described by Burmeister under the name *C. vetulus*. Its external characters fairly correspond with those of Burmeister's form, but its dentition appears to me to weigh heavily in favour of their specific identity. I find the $\frac{P.\ 4}{}$ to be ·7, and $\frac{M.\ 1+M.\ 2}{}$ to be 1·20 in two skulls, and in the remaining one, $\frac{P.\ 4}{}$ is ·75 and $\frac{M.\ 1+M.\ 2}{}$ is 1·15. The average of the three is therefore 7·1 and 1·18, or as 100 to 166.

It is interesting to note that the three skulls referred to differ amongst themselves in the form and development of the sagittal elevation and in the shape and proportions of the frontal postorbital processes.

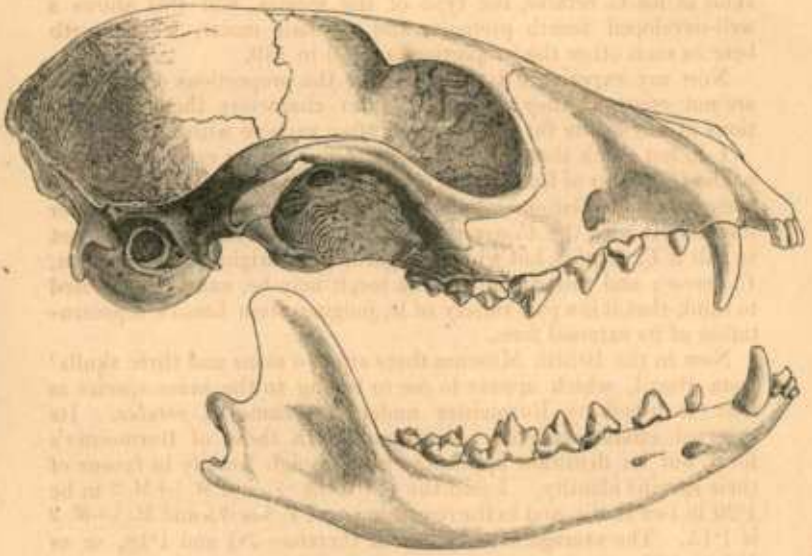
As to Lund's *C. fulvicaudus*, Burmeister remarks ('Fauna Brasiliens,' p. 40) that it seems to be very near Lund's *C. vetulus*, but is distinguished by its smaller stature, blunter head, and proportionally stronger build, clearer and more yellow ground tint, and rusty tail with black end, ochre-coloured patch behind the ear[2]; finally the front of the arms and the hind legs, above the knees, are darker.

[1] Nos. 821 a, 821 b, and 821 c. The first of these is extracted from the skin No. 44. 3. 7. 3.

[2] The mounted skin of *C. vetulus* in the British Museum has an ochre patch behind the ear, but has not the characters otherwise attributed to *C. fulvicaudus*.

Burmeister tells us he received a specimen from Lagoa Santa, which seemed to agree with Lund's *C. fulvicaudus*, save that the end of the tail was black. He then held (see his 'Uebersicht,' p. 102) this species of Lund to be a mere variety of Lund's *C. vetulus*. Later, however, he received from Lagoa Santa what he regarded as a true example of Lund's *C. vetulus*, and on studying it he came to the conclusion that the two species were distinct ('Fauna Brasiliens,' p. 41). Thus, he adds, "it was proved that a ruddy tail-end was no distinctive character of *C. fulvicaudus*, although the underside of the tail was much redder than the upper, while in *C. vetulus* it appears

Fig. 3.



Side view of skull of *Canis parvidens*.

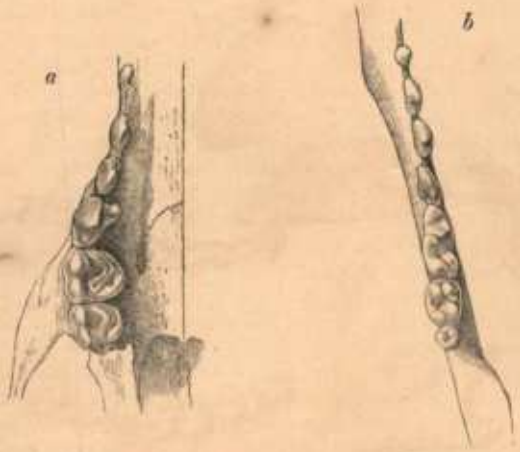
a degree lighter and more faded[1]. Thus the two species can be well distinguished at the first glance" [!]. This appears to me a truly wonderful assertion. The species may be distinct, but I am confident a "first glance" would by no means serve to assure us of such a fact. Now whatever may be the case as to the specific identity of Lund's *C. vetulus* and *C. fulvicaudus*, the specific identity of Burmeister's *C. vetulus* and *C. fulvicaudus* seems to me to be confirmed by Burmeister's representations of their skulls. His figures only show small distinctions as to the form of the sagittal ridge and of the post-frontal processes, upon which he lays much stress, but which are in my eyes valueless.

[1] His words are:—"Grade blasser und mehr wie verblichen erscheint."

As to the teeth, in spite of the imperfection of the specimen figured (pl. xxix. fig. 2), it is plain that P. 4 is rather smaller compared with M. 1+M. 2 than even in his *C. vetulus*. Burmeister himself gives (Reise durch La Plata, p. 407) the proportions as P. 4 = 8, M. 1+M. 2 = 13, or as 100 to 162. Lund gives no figure of the dentition of this species proposed by him.

Thus altogether I think we should provisionally identify, as Burmeister was at first inclined to do, these two species of Lund, and they may turn out to be, as Burmeister believes Lund's *C. vetulus* to be, identical with the *C. azaræ* of Wied. The coloured plate given by Lund might certainly stand for a pale example of *C. azaræ*, and it is higher on its legs than the *C. vetulus* of Burmeister or the

Fig. 4.




Surfaces of molar teeth of *Canis parvidens* (right side).

Lower jaw of *Canis parvidens* (right side).

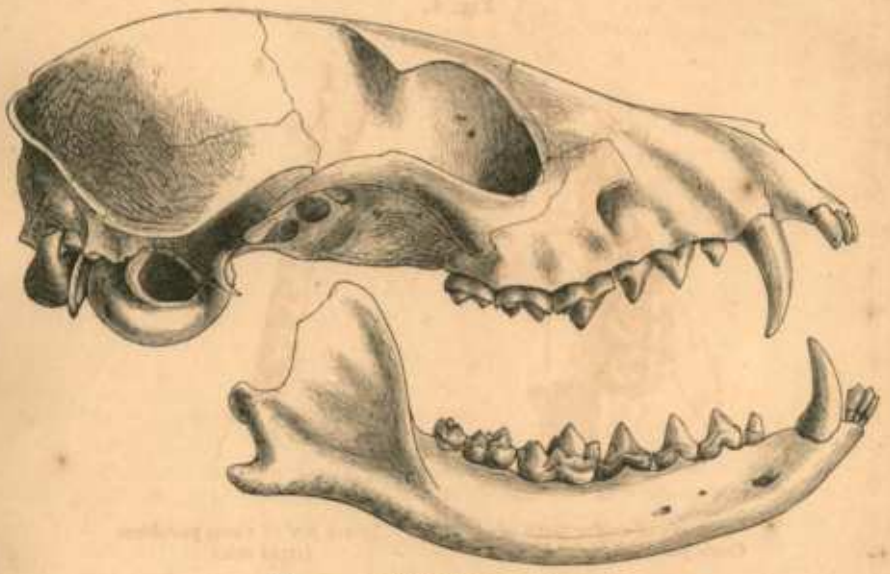
British-Museum skin. The form called *C. vetulus* by Burmeister must not be so called any longer, and it therefore needs a distinct designation. I propose to call the British-Museum skin and skull —44. 3. 7. 3 & 821 A—(as the type of the species or variety) *C. parvidens*, from its most characteristic feature; and for the present I regard the *C. vetulus* of Burmeister as probably identical with my *C. parvidens* (figs. 3 & 4).

In 1869, Philippi published a paper (Arch. f. Natur. xxxv. vol. i. pp. 38–51) referring to the publications of his "much honoured friend" Burmeister. He seeks to know (p. 47) whether the Chilla (*C. azaræ* of Chili), *C. patagonicus*, and *C. fulvipes* are or are not all the same species; and in the second place, whether the animal from Chile (the Chilla) is identical with *C. azaræ* or rather with Burmeister's *C. gracilis*.

To this paper Burmeister replied (Arch. f. Natur. xlii. vol. i. p. 116), and after blaming Philippi for non-attention to his figures, he expresses his opinion that the animal from Chile, which Philippi speaks of as the Chilla, is his *C. gracilis*. In his work on the Argentine Zoology, vol. iii. p. 150, he uses a note of interrogation about it. Such is the literature of the subject, so far as I have been able to ascertain, up to the present time.

The varieties or species hitherto referred to seem to me to arrange themselves in two sets, as regards the proportions borne by the fourth upper premolar to the upper molars. In *C. azaræ*, *C. griseus*,

Fig. 5



Side view of skull of *Canis urostictus*.

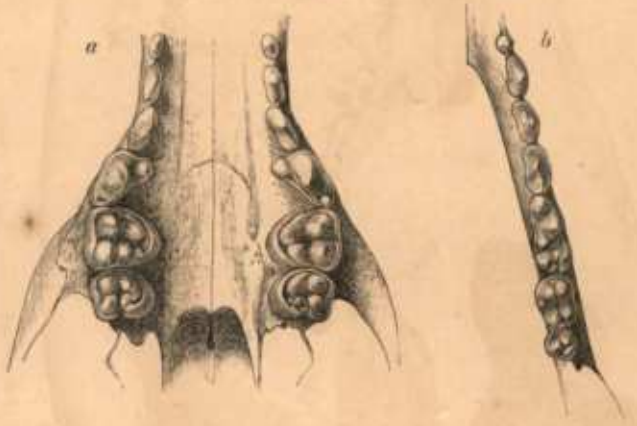
*C. gracilis*, *C. fulvipes*, and *C. entrerianus*, and the *C. vetulus* of Lund, it ranges from 100 and 107 up to 100 and 130. In *C. vetulus* of Burmeister and the British Museum specimen like it (my *C. parvidens*) it varies from 100 and 155 to 100 and 166. But there is in the British Museum a very interesting skull [1] extracted from a skin, also there preserved, which was bought of Claussen from Brazil. On its label is a suggestion, made by an unknown author, that it may be the *C. brasiliensis* of Lund (*l. c.* p. 10, pl. xlii. figs. 1–3), but this it cannot be. Lund gives a side view of the skull (probably life-size), which shows not only a strikingly different configuration, but an extremly contrast as to the dimensions of the teeth. In his species the last

[1] No. 46.4.25.8. 1033 ♂, out of skin 44.3.7.4.

premolar is very small, and the two upper molars compared with the fourth upper premolar are only as 122 to 100. But in the specimen at the British Museum now referred to, the upper molars are very large, bearing to the fourth upper premolar a proportion of 160 to 100, or just about the proportions exhibited by skulls of *C. vetulus* and Burmeister's figure of the dentition of that species. It cannot therefore be *C. brasiliensis*.

Lund's *C. brasiliensis* much more resembles *C. cancrivorus*, as Burmeister (in his 'Fauna') took it to be, though later (Archiv f. Natur. ii. vol. i. p. 120) he was more inclined to regard it as distinct from that species. Certainly the aspect of the figure given by Lund differs considerably from any skull of *C. cancrivorus* I have noticed, and its outline reminds one a good deal of that seen in the genus *Cyon*. In the proportions of the teeth, however, it is like *C. cancrivorus*. In four skulls of the last-named species I find the average length of P. 4 is 1·27 and that of M. 1+M. 2 is 1·57, or as 100 to 123, with which Lund's *C. brasiliensis* almost perfectly agrees.

Fig. 6.




Surfaces of upper molars of *Canis urostictus*.

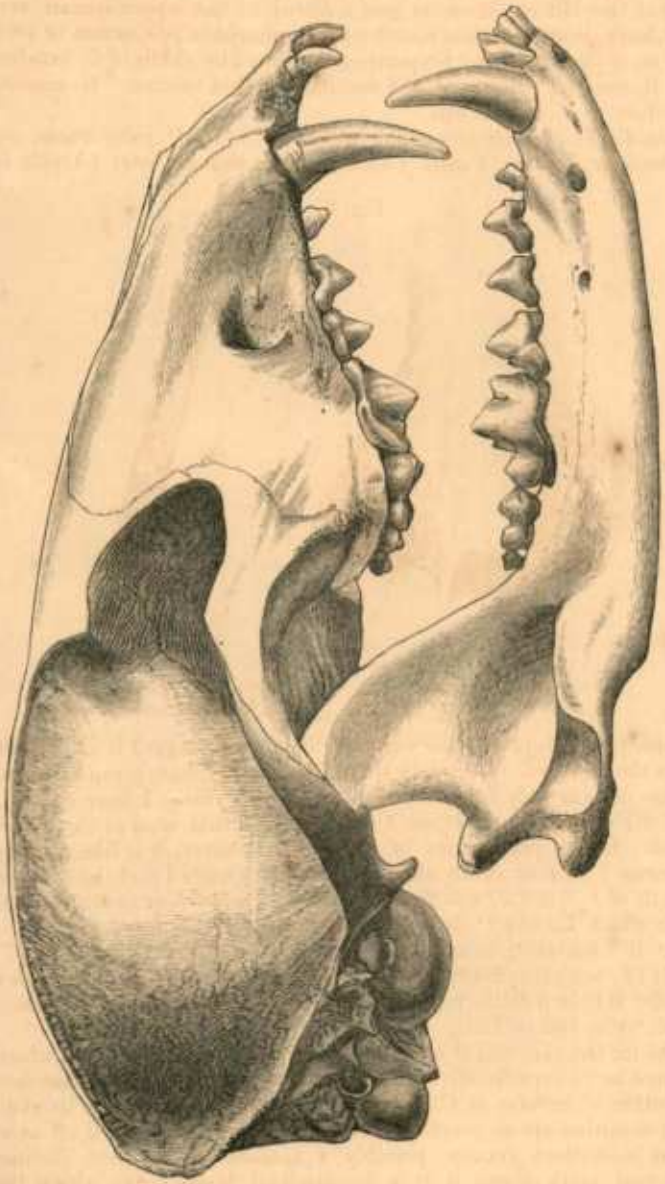
Surfaces of molar teeth of lower jaw of *Canis urostictus*.

It is interesting to note that the *C. microtis* of Sclater (fig. 7, p. 111)[1] shows its affinity in this respect to *C. cancrivorus*, although I believe it to be a distinct species, P. 4 being 1·30 and M. 1+M. 2 being 1·65, or as 100 to 126.

As for the skin and skull (1033 e) in the British Museum, which cannot be *C. brasiliensis*, it is also destitute of the characters ascribed to either *C. vetulus* or *C. fulvicaudus* of Burmeister, while its skull and dentition are so peculiar that it demands to be marked off as at least a distinct variety, possibly a species. The most distinct external mark about it is a longitudinal black stripe along the

[1] P. Z. S. 1882, p. 631, pl. xlvii.

Fig. 7.

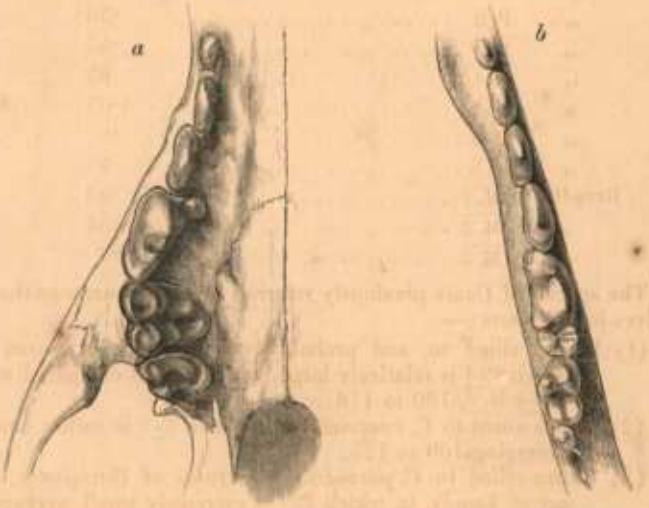


Side view of skull of *Canis microtis*. (Size of nature.)

dorsum of the tail, on which account I propose to distinguish this species, or variety, as *C. urostictus* (figs. 5 and 6).

The colour of the back is grizzled by its black and white annulated hairs; the limbs and side of the neck are red; the tail is not

Fig. 8.




Surfaces of molar teeth of upper jaw of *Canis microtis* (right side).

Surfaces of molar teeth of *Canis microtis* (lower jaw).

black at the tip, though there are many black hairs there. There is a deep black line along the middle two fifths of the dorsum of the tail.

| | centimeters. |
|---|---|
| Length from point of snout to root of tail | 67·5 |
| ,, of tail | 22·0 |
| ,, of foot | 13·0 |
| ,, of ear | 5·2 |
| Basion to ovalion | 2·1 |
| Basion to sphenoideum | 2·9 |
| Sphenoideum to gnathion | 7·2 |
| Length of palate | 5·0 |
| Breadth of palate | 2·8 |
| ,, brain-case (at squamosals) | 4·0 |
| ,, zygomata | 5·8 |
| Length of P. 1 | ·3 |
| ,, P. 2 | ·6 |
| ,, P. 3 | ·55 |
| ,, P. 4 | ·9 |
| ,, M. 1 | ·82 |

| | | centimeters. |
|---|---|---|
| Length of | M. 2 | ·62 |
| Breadth of | P. 4 | ·5 |
| ,, | M. 1 | 1·0 |
| ,, | M. 2 | ·8 |
| Length of | P. 1 | ·2 |
| ,, | P. 2 | ·50 |
| ,, | P. 3 | ·55 |
| ,, | P. 4 | ·65 |
| ,, | M. 1 | 1·05 |
| ,, | M. 2 | ·8 |
| ,, | M. 3 | ·4 |
| Breadth of | M. 1 | ·55 |
| ,, | M. 2 | ·55 |
| ,, | M. 3 | ·4 |

The species of *Canis* previously referred to seem to arrange themselves in three sets:—

(1) Forms allied to, and probably varieties of, *C. azaræ*, in which P. 4 is relatively large, averaging, as compared with M. 1+M. 2, 100 to 118.

(2) Forms allied to *C. cancrivorus*, in which P. 4 is rather small, averaging 100 to 125.

(3) Forms allied to *C. parvidens* (*C. vetulus* of Burmeister, but *not* of Lund), in which P. 4 is extremely small, averaging 100 to 160.

If these views are not mistaken, the species and varieties will stand thus:—

I. *C. cancrivorus*. Brazil.
  Variety (*a*): *brasiliensis*. Brazil.

II. *C. microtis*. Brazil.

III. *C. azaræ*. Brazil to Tierra del Fuego.
  Variety (*a*): *fulvipes* (dark). Chiloe.
  (*b*): *griseus* (pale). Shores of the Straits of Magellan.
  (*c*): *patagonicus* (ring-tailed). Shores of the Straits of Magellan.
  (*d*): *entrerianus* (dark). Entre Rios.
  (*e*): *gracilis* (pale). Mendoza.
  (*f*): Lund's *vetulus* (pale). Brazil.
  (*g*): Lund's *fulvicaudus* (bright-tailed). Brazil.

IV. *C. parvidens*, mihi (very small P. 4). Brazil.
  Variety (*a*): Burmeister's *vetulus* (pale-tailed). Lagoa Santa.
  (*b*): Burmeister's *fulvicaudus* (bright-tailed). Lagoa Santa.

V. *C. urostictus*, mihi (black stripe on tail). Brazil.

## 2. A Revision of the Genera of Scorpions of the Family *Buthidæ*, with Descriptions of some South-African Species. By R. I. Pocock, of the British Museum (Nat. Hist.).

(Plates XIII. & XIV.)

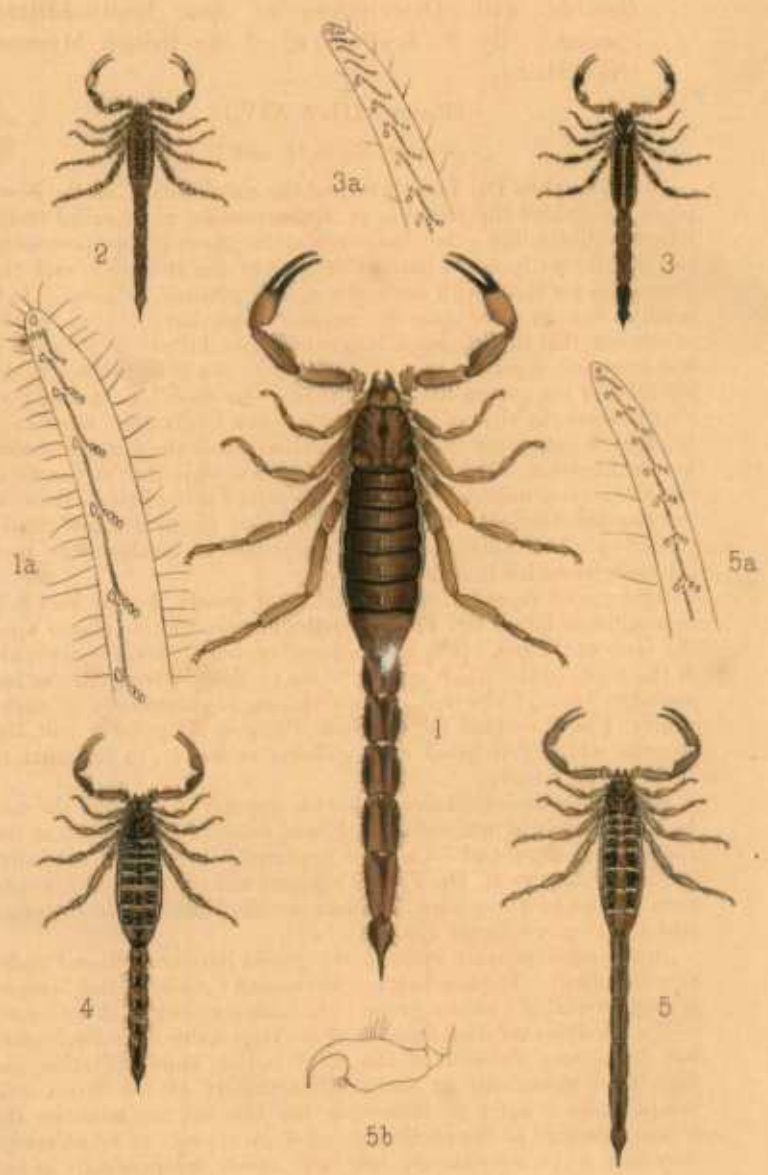
[Received March 15, 1890.]

In 1876, when Dr. Thorell revised the classification of the Scorpions, he divided the *Buthidæ*, or *Androctonoidæ*, as he called them, into two subfamilies—the *Androctonini* for those genera possessing two inferior teeth on the immovable digit of the cheliceræ, and the *Centrurini* for those with one tooth in this position, or none. It is needless here to enter upon the reasons which have led me to the conclusion that this division into subfamilies did not, at the time it was proposed, represent accurately the state of our knowledge of the affinities of the genera composing them; for doubtless, at the present moment, in view of the number of new forms that have been brought to light since 1876, Dr. Thorell would be the first to abandon his classification. It will be sufficient here to state that an examination of the rich material of *Buthidæ* contained in the British Museum has convinced me that the members of this family are too closely related to allow of its subdivision into groups of greater value than is usually accorded to genera.

Again, with regard to the foundation of genera, I find that it is impossible to follow Dr. Thorell in the reliance that he placed upon the form of the tail. The genera, however, based upon the armature of the digits of the chelæ appear to me to deserve recognition; but since the form of the tail varies with sex so enormously in many genera, I have decided not to retain *Phassus*, *Rhopalurus*, and *Babycurus*, which were based upon a character merely, to my mind, of specific importance.

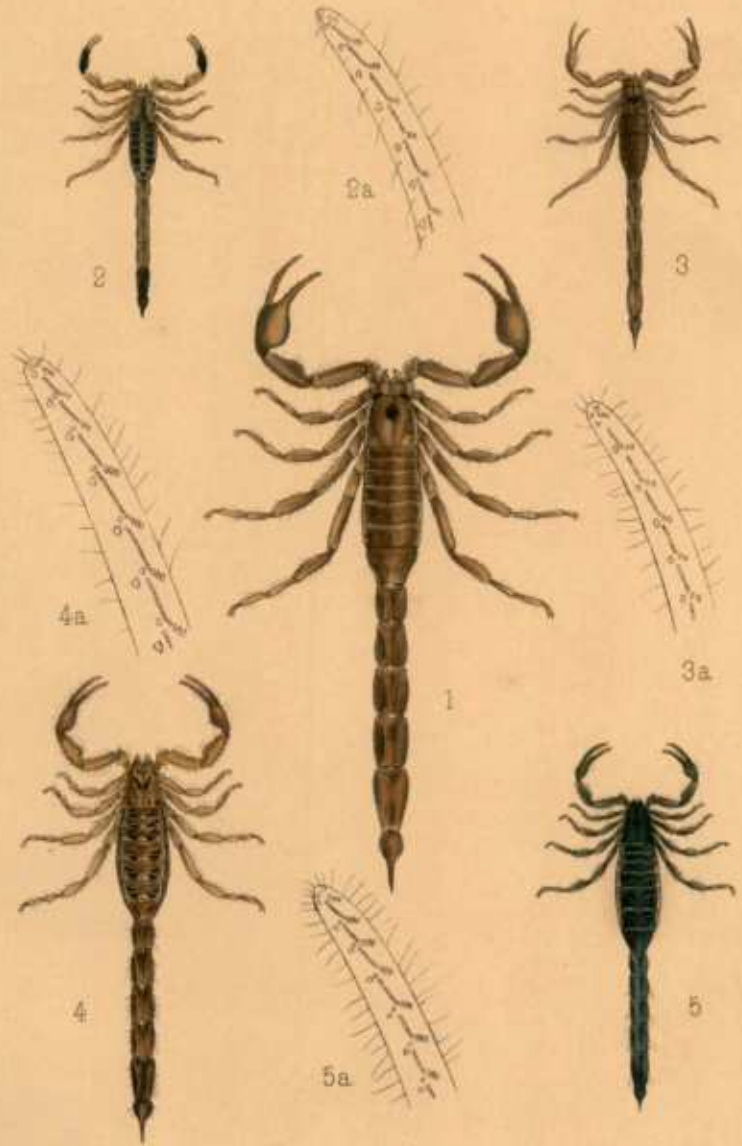
And, lastly, in accordance with what appears to me to be the best working system of nomenclature, I have thought it advisable, at the risk of some slight and, let us hope, temporary inconvenience, to alter the names of two of Dr. Thorell's genera and to substitute a new term for one of the genera proposed by Dr. Karsch. In each case reasons are given for the change.

In the accompanying synopsis the genera have been classed under three headings. The first heading, containing *Uroplectes* and *Lepreus*, is unquestionably a natural group; the same may be said of the second —if a possible exception be made of the remarkable form *Butheolus*; but I am very doubtful if the third section, namely *Buthus*, can rightly be considered as such. Undoubtedly all the forms contained under it agree in possessing the two inferior teeth on the immovable digit of the cheliceræ, but there appears to be no reason why such a character should not have arisen independently in two instances, and thus fail to be a sign of affinity between them. And,




SOUTH AFRICAN BUTHIDÆ

Mintern Brothers, del. et lith. Imp. Camb. Sci. Inst. Co.




SOUTH AFRICAN BUTHIDÆ

Mintern Brothers del. et lith.

Imp. Camb. Pat. Inst. Co.

indeed, there are some grounds for thinking that this may have taken place in the case of *Grosphus* and of *Rhoptrurus*; for the former appears to connect *Lepreus* with *Buthus*, and the latter *Isometrus* with *Buthus*; or, in other words, *Buthus* appears to have arisen from *Lepreus* by way of *Grosphus* and from *Isometrus* by way of *Rhoptrurus*, that is from two independent sources. And if anyone likes to believe that this has taken place, it is difficult to see how the idea can be shown to be wrong. Of course an alternative hypothesis, namely, that *Grosphus* is the ancestor of both *Buthus* and *Lepreus*, at once suggests itself; but in that case it is hard to see why *Lepreus* should have lost the two mandibular teeth, which must surely be of considerable service in the battle for life. Moreover, when we reflect that *Lepreus* agrees with almost all the Scorpionidæ (including provisionally *Vejovis* and *Bothriurus*) in the absence of these teeth, it is hard to believe that it is not a character which has been transmitted to *Lepreus* from some unknown member of this family. In that case we must, it seems to me, account for the resemblance between *Grosphus* and *Lepreus* on the hypothesis that the latter is the ancestor of the former, unless, indeed, we consider that it is the result of what, for want of a better term, may be called accident. However, from whichever side the question be approached, some obstacle presents itself which our knowledge of the affinities of the genera is at present too limited to surmount. For a variety of reasons, however, it seems to me to be perhaps well to regard provisionally *Lepreus* and *Uroplectes* as derived from *Grosphus*; for undoubtedly in most respects these two genera depart widely from a plan which is common to all the others. With the exception of these two and of *Butheolus*, a genus hard to locate, the accompanying pedigree (see p. 128) appears to me to represent fairly well the mutual relationship of the genera and subgenera here recognized. But it must be regarded as merely tentative and in no way as expressing a final opinion.

Considering the Scorpionidæ as a whole and the Buthidæ as a whole, and noting what characters are common to both and what are the average characters of the least specialized of the genera of Buthidæ, we are able to form some opinion as to the characters of the immediate ancestor of the Buthidæ, or, in other words, to discover the common plan from which all the modifications of the various genera can be derived.

By this means it may be inferred that in this hypothetical ancestral form the sternum was triangular; the movable digit of the cheliceræ was furnished with three teeth above and two below (not counting the terminal fang), the immovable with a single row of teeth; the armature of the digits of the chelæ was composed of a number of oblique, parallel, slightly overlapping rows of denticles; there were two median eyes, and three lateral eyes on each side; the cephalothorax was granular, but not carinate; the tergites were granular and furnished with a median keel, the last, in addition, bearing two lateral keels; the sternites were smooth and anteriorly bisulcate, the last only being furnished with two or four keels; the tail was keeled throughout, and there was probably a spine beneath the aculeus;

the tibiæ of the two posterior legs were armed with a spur; the pectinal teeth were all alike; the stigmata were slit-like.

This diagnosis agrees more nearly with the plan of *Isometrus* than with that of any other genus, notwithstanding that there is in *Isometrus* a single lower tooth on the immovable digit of the cheliceræ. *Isometrus* is cosmopolitan, and in Australia, Africa, and America it appears to have given rise to three distinct genera. In Australia *Isometroides* has sprung up through the loss of the spine beneath the aculeus and by the acquisition of coarse punctulation on the under surface of the fifth caudal segment; in America *Centrurus* originated by the development of short rows of teeth connecting the extremities of the median rows of the digits of the chelæ; in Africa *Buthus* arose when a second inferior tooth appeared behind the first on the immovable digit of the cheliceræ. Beyond this stage *Rhoptrurus* has not passed; but *Grosphus* has lost a distinct spine beneath the aculeus, and in the female the basal pectinal tooth has become dilated. *Parabuthus* can be derived from *Grosphus* by a slight modification in the arrangement of the denticles on the chelæ, by the loss of the enlarged pectinal tooth (perhaps through its fusion with the shaft of the pecten), and by an increase in the strength of the tail; whether *Buthus* (s. s.) has been derived by the development of lateral tergal keels from *Parabuthus* or *Grosphus* it is not easy to say; but that *Prionurus* has been developed from *Buthus* by an alteration in the form of the tail will probably not be disputed.

*Lepreus* resembles *Grosphus* in possessing an enlarged basal pectinal tooth in the female; but whether this genus has been derived from *Grosphus* by the loss of the two lower teeth, and by a modification in the armature of the chelæ, cannot as yet be settled. But inasmuch as the arrangement of the denticles on the chelæ more nearly approaches in *Lepreus* than it does in *Uroplectes* what is met with in *Grosphus* or *Isometrus*, I consider that *Uroplectes* is a descendant of *Lepreus*.

*Butheolus* is isolated, and may have been derived from either *Buthus* or *Isometrus*.

Before proceeding to a consideration of the genera, it will be well to discuss shortly the armature of the digits of the chelæ and the probable origin of the various modifications that are presented.

Generally speaking, the dentition throughout the family may be described as consisting of a number of oblique, overlapping, parallel rows of fine close-set denticles. On each side of this median series there is a row of larger, more widely separated teeth, and the question to be decided in connection with these lateral teeth is whether they have been derived from the median rows or have arisen independently of them. However, after examining many genera and species of *Scorpionidæ* as well as of *Buthidæ* I am strongly inclined to believe that the lateral teeth have been derived from the median series, and that originally the armature of the chelæ consisted solely of a number of oblique, overlapping, parallel rows of close-set denticles, and that perhaps one or two terminal denticles of each row were larger than the rest. From this relatively simple disposition of

denticles, all the arrangements met with throughout the family are easily derivable. The first modification that presents itself results from the assumption of an obliquely transverse position by the posterior tooth or two posterior teeth of each row. Thus arises the "external series" of Dr. Thorell. The internal series results, I believe, from the separation of the anterior tooth of each series from the rest; this separation is sometimes carried to such an extent that all connection between the tooth and the series from which it arose is lost.

If this view as to the original disposition of the denticles is correct, the arrangement seen in some species of *Isometrus* is that which comes nearest to the primitive plan. Thus in, *e. g.*, *I. messor*[1] the anterior tooth of each series is enlarged, but not isolated, and the posterior tooth has altered its position, so that with that which precedes it it forms a transversely set pair; in *I. insignis* the anterior tooth, although still in the same straight line with the rest of the series, is separated by a measurable interval from it, and in *Lepreus fischeri* the anterior tooth has shifted so much forwards that it is on a level with the anterior end of the row in front of the one from which it originated.

### Genus Lepreus, Thorell.
(Plate XIV. figs. 2–4.)

*Lepreus*, Thorell, Études Scorpiol. p. 8.

*Hab.* S. Africa.

Immovable digit of cheliceræ unarmed beneath. The external series of teeth on the chelæ is formed by the bending outwards in a direction nearly at right angles to the axis of the digit of the two or three posterior terminal teeth of the median rows; the internal series by the separation (greater or less, as the case may be) of the anterior terminal tooth.

The cephalothorax is not distinctly keeled; the tergites always have one median keel, and in a few cases two lateral short keels; the caudal keels may be well developed or absent, and there may or may not be a spine beneath the aculeus.

The tibiæ of the two posterior legs are spurred. The basal pectinal tooth in the female is (? always) enlarged.

In the arrangements of the denticles on the chelæ the species of this genus vary considerably. Thus in *L. fischeri*, var. *nigrimanus*, all the teeth of the internal series have moved so far forwards that each is on a level with the anterior extremities of the row distal to the one from which it originated. Whereas, in specimens of *L. occidentalis*, at the proximal end of the digit each of the separated teeth is about equidistant from the anterior end of its original series and from the corresponding end of the series distal to this last; but in the middle and distal half of the digit each tooth moves forward and approaches close to the anterior extremity of the series distal to the one to which

[1] I have no object in selecting this species; it happens to be the first that comes to hand.

it belongs; moreover quite at the distal end of the digit, the secondary apical tooth of the median rows becomes enlarged, slightly separated, and constitutes with the original apical tooth a transversely set pair. Thus in this species we clearly see how the arrangement met with in *Uroplectes* has been brought about.

### Genus Uroplectes, Peters.

(Plate XIII. figs. 3–5, and Plate XIV. fig. 5.)

*Uroplectes*, Peters, Monatsb. Ak. Wiss. Berl. 1862, p. 512—type *ornatus*, Peters.

*Tityus*, Thorell, Études Scorpiol. p. 8 (1876); not *Tityus*, C. Koch, 1836.

*Hab.* S. Africa.

This genus is closely allied to the preceding and can only be distinguished from it by the arrangement of the denticles on the chelæ. The denticles of the external series are the same in the two genera, but the internal series is composed, in *Uroplectes*, of a series of pairs of teeth. These appear to have arisen, as, indeed, they have arisen to a less extent in *L. occidentalis*, by the separation of the apical tooth of each median row and by its subsequent approximation to the enlarged and slightly separated tooth which forms the secondary anterior end of the series distal to the one from which the external tooth of each pair originated. It thus comes about that in this genus the internal series appears to have been formed, as has the external series, merely by the outward bending of the anterior termination of the median rows.

Both *Uroplectes* and *Lepreus* are found in S. Africa, and I think there is very little doubt that ultimately, owing to the discovery of intermediate forms, all the species will have to be united into one genus *Uroplectes*.

The genus *Tityus* was established in 1836 by C. Koch upon a S.-American species named *Scorpio bahiensis* by Perty.

Clearly, then, *bahiensis* is the type of the genus *Tityus*; but since this species is referable to *Isometrus* of Ehrenberg, a name which antedates *Tityus*, and since a generic name should never be transferred from its type, it follows that *Tityus* must be a synonym of *Isometrus*. In years subsequent to 1836 and especially in 1845 (Die Arachniden, xi.) C. Koch referred many more species to his *Tityus*. One of these, a S.-African form, *T. lineatus*, was selected by Dr. Thorell as the type of his *Tityus*; but since this form differs radically from *T. bahiensis*, it is clear that Dr. Thorell's *Tityus* is not equivalent to *Tityus* as C. Koch originally applied the name. And since this transference of a generic name from one typical species to another [1]

[1] I am aware that in the Ann. Nat. Hist. 1888, vol. ii. p. 245, in connection with the names *Scorpio*, *Heterometrus*, and *Palamnæus*, I was the advocate of another system. But further reflection and wider experience has led me to change the view there set forth: consequently I now think that *palmatus* is and must always be the typical species of *Heterometrus*, and that if *palmatus* be congeneric with *africanus*, then *Heterometrus* must be synonymous with *Scorpio*, and that in no case can the generic name *Heterometrus* be transferred from its type *palmatus* to the second species *spinifer*, which is consequently a *Palamnæus*.

is, in my opinion, very much to be deprecated, I have added *Tityus* to the synonyms of *Isometrus*, and have taken Peters's name *Uroplectes* for the species which Thorell called *Tityus*. This, however, I have done on the authority of Dr. Karsch, who in a footnote to his table of genera says that *Uroplectes* is synonymous with *Tityus* in Dr. Thorell's sense of the word. Presumably this statement is made after an examination of the type of *Uroplectes*, namely *U. ornatus*. If this, however, be not so, it will be well to bear in mind that there is nothing in Peters's diagnosis of *ornatus* to show that the species is not referable to *Lepreus*. In that case *Lepreus* will have to rank as a synonym of *Uroplectes*, and a new generic name will have to be established for the species here included under *Uroplectes*, unless the alternative be adopted of considering all the species of *Lepreus* and *Uroplectes* as referable to one genus *Uroplectes*[1].

## Genus Isometrus, Ehrb.

*Isometrus*, Ehrenberg, Symb. Phys. (Scorpiones), p. 3, pl. i. fig. 3 (1829)—type *filum*=*maculatus* (De Geer).

*Tityus*, C. Koch, Die Arach. iii. p. 33 (1836)—type *bahiensis* (Perty).

*Pilumnus*, id. Arach. Syst. p. 38 (1837) (nom. præocc.).

*Lychas*, id. Die Arach. xii. p. 1 (1845)—type *maculatus* (De Geer).

*Atreus*, Gerv. Apt. iii. p. 52 (1844) (in part), not of C. Koch, 1837.

*Centrurus*, Peters, Monatsb. Ak. Wiss. Berlin, 1862, p. 512 (in part).

*Isometrus*, Thorell, Etudes Scorpiol. p. 9 (1876) (and subsequent authors).

*Phassus*, id. ibid.

*Androcottus*, Karsch, Mitth. Münch. ent. Ver. p. 11 (1879).

*Hab.* Tropical countries.

Inferior border of the immovable digit of the cheliceræ armed with a single tooth.

The external series of teeth on the digits of the chelæ formed by the assumption of a more or less transverse position of the posterior one or two enlarged teeth of the median rows; the internal series of teeth formed by the enlargement and separation of the anterior tooth of each of the median rows; but this separation is never carried to any great extent. In most of the Old-World species the median rows scarcely overlap each other; but in the larger American forms, such as *I. androcottoides*, the rows overlap to such a degree that the anterior extremity of any one reaches the middle of the row in front of it.

The cephalothorax is usually without well-developed keels; the tergites are nearly always provided only with a median keel; the tail is, as a rule, keeled above and below, and the vesicle is nearly always provided with a strong spine beneath the aculeus.

The sexes generally differ considerably and in a variety of ways: thus the male of *I. messor* and of *I. maculatus* has long chelæ with slender hands and a long tail; *I. tricarinatus* has short chelæ with thick hands and a long tail; *I. mucronatus* (*varius*) has a thick hand

[1] I have refrained from definitely uniting the two genera, because *pilosus* the type of *Lepreus*, is unknown to me.

with the digits widely separated at the base, but with the tail almost unchanged; *I. americanus* has a thick hand with fingers widely separated at the base, and with the tail enormously dilated towards its distal end. The basal tooth of the pectines is never enlarged; but in the female of several of the American forms, such as *I. americanus*, *I. androcottoides*, and *I. insignis*, there is, at the base of the pecten, a distinct rounded lobe projecting over the basal tooth.

*Isometrus*, so far as geographical distribution is concerned, appears to be the dominant genus of the family, and, as might be expected from its wide range, it varies greatly in structure. Yet in the sum of its characters it appears to come nearest to the ancestral form; for from it by slight modifications most of the genera of the family can be derived. Thus in Australia it appears to have given rise to *Isometroides*, in America to *Centrurus*, in Africa to *Butheolus* and *Rhoptrurus*, the latter genus leading on towards *Buthus*.

Reasons[1] have already been given for regarding the genus *Phassus* as synonymous with *Isometrus*, on the ground that it was based upon a character belonging to the male of a certain species of this last-named genus.

With regard to *Androcottus* it may be said that there is nothing in the diagnosis to warrant the separation of the type as a genus distinct from *Isometrus*. The fusion of the inferior keels on the second, third, and fourth caudal segments, the character upon which it was founded, exists, although apparently to a slightly less extent, in *I. androcottoides*, and varies considerably within the limits of the species.

### Genus Isometroides, Keys.

*Isometroides*, Keyserling, Arachn. Austral., Scorpiones, p. 16, pl. ii. figs. 3 & 4 (1885).

*Hab.* Australia.

A genus closely allied to *Isometrus*, differing, in fact, only in the form of the tail, the vesicle being very slender and without a spine beneath the aculeus, and the fifth caudal segment being deeply punctured and without keels on its under surface.

Two species only have been made known, both being figured and described in the above-cited work. Of one of these species, *I. vescus*, the British Museum possesses a single specimen, from Port Lincoln.

### Genus Centrurus.

*Centrurus* (Hemp. and Ehrb.), Thorell, Études Scorp. p. 9.
*Rhopalurus*, id. ibid.

*Hab.* America.

This genus differs from *Isometrus* only in the armature of the digits of the chelæ, the space between the large lateral teeth on each side being occupied by a small row of smaller teeth arranged slightly obliquely, although, roughly speaking, parallel to the long axis of the digit.

[1] Ann. Nat. Hist. (6) iii. p. 55 (1889).

The genus is common in America, and appears to have been derived from the American species of *Isometrus*; since all the specimens of *Centrurus* that I have examined agree with all the American species of *Isometrus*, and differ from all the Buthidæ of the Old World [1], in possessing no spur at the extremity of the tibial segments in the last two pairs of legs.

The male may generally be recognized by having a much longer tail than the female. I look upon *Rhopalurus* as synonymous with *Centrurus* for the same reasons that have led me to consider *Phassus* as a synonym of *Isometrus*. The type of the genus, *R. laticauda*, of which the Museum possesses examples of both sexes from Brazil and Colombia, does not appear to me to be other than a well-marked species of *Centrurus*, standing in almost exactly the same relation to *C. biaculeatus* as *I. americanus* to *I. androcottoides*. So that if *I. americanus* be congeneric, as will hardly be disputed, with *I. androcottoides*, then must *R. laticauda* be congeneric with *C. biaculeatus*.

## Genus Butheolus, Simon.

*Orthodactylus*, Karsch, Berl. ent. Zeits. xxv. p. 90 (1881) (nom. præocc.) [2].

*Butheolus*, Simon, Ann. Mus. Genov. xviii. p. 258 (1882).

*Hab.* Mediterranean district of Palæarctic Region.

This is a genus of very doubtful affinities and is correspondingly hard to locate, inasmuch as it appears to partake of the characters of *Isometrus*, *Isometroides*, and *Buthus*. In his diagnosis of it M. Simon says that the inferior border of both the movable and immovable digits of the cheliceræ are furnished with only one tooth; but this is by no means always the case, for in one of the specimens of *B. melanurus* [3] preserved in the National Museum there are the normal number, namely, two teeth on this edge in the movable digit and also, which is a significant fact, two teeth on the corresponding edge in the immovable digit as in *Buthus*. This, although probably an abnormal development, serves to lessen considerably the hiatus between *Isometrus* and *Buthus*, and to diminish the systematic value that has been placed upon the presence or absence of these teeth. The features in which this genus resembles *Isometroides*, namely the slender and unarmed vesicle, the punctured keelless fifth caudal segment, and the feeble chelæ, are, considering the distribution of the two, in all probability not due to affinity between the genera, but have arisen independently in the two localities. *Isometroides* is much more nearly related to *Isometrus* than is *Butheolus*; the latter may be distinguished from both by the form of the cephalothorax, which is much sloped in front of the eyes and has a convex anterior border.

The arrangement of denticles on the digits of the chelæ is very simple in *B. melanurus* [3]; in the proximal half of the digit the median

[1] With the exception of *I. assamensis*, *melanophysa*, and the cosmopolitan *I. maculatus*.

[2] *Vide* Simon, Verh. z.-b. Ges. Wien, xxxix. 1889, p. 386.

[3] Kessler, Trudui Russkago Entomol. viii. (1876), p. 16, pl. i. figs. 1–3 (= *schneideri*, L. Koch, &c.).

denticles are arranged in a long simple longitudinal series, which only in the distal half divides into a number of oblique short rows; the internal series consists of enlarged teeth set singly and at a distance from the series from which they arose: the external teeth of the external series are also arranged in a single row, the individual teeth being close to the median series and alternating with, but not forming a transverse line with, those of the internal series.

The genus is further remarkable for the great size of the tail.

### Genus Buthus, Leach.

*Buthus* (Leach), Thorell, Études Scorpiol. p. 8—type *europæus* (Linn.).

This genus is unknown in America and Australia, but, including all the subgenera here admitted, is widely distributed elsewhere, being especially abundant in Africa and the Mediterranean district.

### Subgenus Rhoptrurus, Karsch.
(Plate XIII. figs. 1, 2, and Plate XIV. fig. 1.)

*Odonturus*, Karsch, Sitz. Ges. nat. Fr. 1879, p. 119 (nom. præocc.).
*Rhoptrurus*, id., Berl. ent. Zeits. xxx. p. 77 (1886).
*Babycurus*, id. ibid.

*Hab.* S. Africa, Madagascar.

Movable digit of cheliceræ with two teeth on the inferior border.

In the digits of the chelæ the posterior ends of the median rows of denticles are not enlarged, but are bent outwards, thus constituting the external series; the internal series is formed by the enlarged and slightly separated anterior tooth of each median row. The cephalothorax is not keeled; the tergites have one median keel.

The tail is powerful or moderate, strongly keeled or almost without keels; there is a spine beneath the aculeus.

The pectinal teeth are all alike.

The sexes may differ in many ways, as in *Isometrus*; thus the ♂ of *R. kirkii* has a widened tail, a widened hand, and a space between the base of the digits; in *R. baronii* the pectines of the ♂ are much larger than in the ♀.

Of all the subgenera of *Buthus* this one comes nearest to *Isometrus*, uniting *Isometrus* with *Parabuthus*. From *Isometrus* it may be distinguished by the dentition of the cheliceræ, and from *Parabuthus* by the spine beneath the sting, the much less strongly dentate or granular tail, and by the arrangement of the denticles on the digits of the chelæ. The genus *Babycurus* was separated from *Rhoptrurus* on the strength of the greater slenderness of the tail; but since this is merely a sexual character belonging to the female, the genus cannot well be retained.

This genus contains the following species:—

*R. dentatus*, Karsch (under *Odonturus*), Sitz. Ges. nat. Fr. Berlin, 1879, p. 119; Mombas.

*R. büttneri*, id. (under *Babycurus*), Berl. ent. Zeits. xxx. p. 78, pl. iii. fig. 1 (1886); Gaboon.

*R. centrurimorphus*, id. ibid. fig. 2; Madagascar; and the three species described below (pp. 137–141).

### Subgenus Grosphus, Simon.

*Grosphus*, Simon, Ann. Soc. Ent. Fr. (5) x. p. 378 (1880).

*Hab.* Madagascar.

This genus was established upon certain characters observed in the type specimen of *Andr. madagascariensis*, Gervais. These characters were (1) a single tooth on the inferior border of the movable digit of the cheliceræ, and (2) the enlargement of the basal pectinal tooth. At the time M. Simon probably was not aware that the latter character is sexual and, consequently, by itself, is not of generic importance. The first character, certainly, if proved to be constant in a number of individuals, would be unquestionably of generic value; but the fact that this very character has been noticed as an abnormality in *Butheolus*, and, moreover, that three other species[1] obviously very closely allied to *madagascariensis*, and inhabiting the same area, present the normal armature of this segment of the cheliceræ, have led me to conclude that the absence of the second tooth is merely an individual variation. But since these species, with *madagascariensis*, appear to me to constitute a natural and, at all events, subgenerically distinct group, I have retained the name *Grosphus* for them and have made the necessary alterations in the definition of the subgenus.

It may be characterized as follows:—

Denticles on the digits of the chelæ as in *Rhoptrurus*. Inferior border of the movable digit of the cheliceræ with one or two teeth.

Basal pectinal tooth in ♀ the largest of the series. Tergites with a median keel; cephalothorax without keels.

Tail moderate; not strongly and granularly keeled; with or without a spine beneath the aculeus.

As *Rhoptrurus* appears to connect *Isometrus* and *Parabuthus*, so does *Grosphus* connect *Lepreus* with *Parabuthus*. It differs from *Lepreus* in the armature of the cheliceræ and in the disposition of the internal series of teeth on the digits of the chelæ, but appears to be allied to it in having an enlarged basal pectinal tooth. Whether or not this last character is a sign of affinity between the two it seems to me impossible at present to say.

The following are the species I refer to this subgenus:—

*G. madagascariensis*, Gervais (under *Androctonus*), Arch. Mus. iv. p. 213, pl. xi. figs. 1–3 (1839); Simon, Ann. Soc. Ent. Fr. (5) x. p. 377 (1880).

*G. limbatus*, Pocock (under *Buthus*), Ann. Nat. Hist. (6), iii. p. 346 (1889).

*G. piceus*, id. t. c. p. 349.

*G. lobidens*, id. t. c. p. 461.

All are from Madagascar.

[1] *Buthus limbatus*, *B. piceus*, Pocock, Ann. N. H. (6) iii. p. 346 *B. lobidens*, id. t. c. p. 461.

Subgenus Parabuthus, nov.

*Prionurus*, Ehrenberg (in part); Karsch (in part).

Type, *P. liosoma* (Ehrb.), Symb. Phys. no. 10, pl. ii. fig. 6.

*Hab.* Ethiopian Region.

Ehrenberg included in his group *Prionurus* a species named *liosoma* which departs sufficiently widely from the type *P. funestus* to be worthy of special recognition. Dr. Karsch was the first to point out this fact; but in attempting to establish a separate genus of which *liosoma* was to be the type, this author appears to me to have fallen into error in two particulars. In the first place, since Thorell had restricted *Androctonus* to those Scorpions which were termed *Prionurus* by Ehrenberg—a proceeding justifiable on the grounds that no type had been named for *Androctonus* and that a genus must supersede its subgenus—it is clear that the type of *Prionurus*, namely *funestus*, is also the type of *Androctonus* and that *Prionurus* must, in that case, be regarded as a synonym of *Androctonus*. But Dr. Karsch, wishing to preserve the term *Prionurus*, selected as the type Ehrenberg's species *liosoma*, on the understanding that *liosoma* is generically, or at all events subgenerically, distinct from *funestus*. But, as stated above, it seems to me to be absolutely essential to select as the type of a genus the species which is the first referred to it by the author—unless any other be specially mentioned by him as typical—and never to transfer this generic term from this species and its allies to another, which differs from the type in generic characters, although this other was referred originally to the same genus. Consequently I hold that *funestus* is the type of *Prionurus*, and that the transference of the name to *liosoma* can only lead to confusion.

I have therefore found it necessary to create a new subgeneric name for *liosoma* and its allies, since the group appears to me to be a perfectly natural one, agreeing both in important characters and in geographical distribution.

But the group as characterized by Dr. Karsch cannot stand, inasmuch as it was based upon a character—the presence of a median lateral keel on the fourth caudal segment—which may or may not exist within the limits of a single species, and is valueless for generic distinction. Moreover, as thus defined the genus is quite an unnatural group, inasmuch as it includes forms, such as e. g. *liosoma* and *pelopponensis* (*gibbosus*), which are widely separated from each other, and in addition completely severs *pelopponensis* from its nearest allies—*europæus*, *leptocheles*, &c.

The subgenus may be characterized thus:—

On the digits of the chelæ the external series of teeth are formed by the enlargement and partial assumption of a lateral position of the two posterior teeth of the median rows; the internal series by the enlargement and separation of the anterior tooth of each median row. The cephalothorax is not costate, and the tergites are furnished with only a median keel. The tail is powerful and strongly keeled, but there is a marked tendency to obliteration on the part of

the inferior keels on the posterior segments; the vesicle and aculeus are large and there is no spine beneath the aculeus.

The pectines are armed with many teeth, which are all alike in both sexes; and the sternum is reduced to a minimum, being smaller than in any of the genera hitherto considered.

The males have a wider hand than the females; and the females of most of the species may be recognized by the possession of a remarkable internal lobate dilatation of the base of the pectines. This dilatation, although it appears to belong to the shaft of the pecten, results, I am now inclined to think, from the fusion of the enlarged basal tooth with the sclerite that supported it. If this be so, the character can be directly derived from what is seen in *Grosphus*, where the tooth is enlarged but still free, and it unmistakably points to *Grosphus* as the ancestor of *Parabuthus*.

The Museum possesses examples of the following representatives of this subgenus:—

*P. liosoma*, Ehrb. Symb. Phys. no. 10.

*P. villosus*, Peters, Monatsb. Ak. Wiss. Berlin, 1862, p. 26; Thorell, Études Scorpiol. p. 29.

*P. planicauda* [1], Pocock, Ann. Nat. Hist. (6) iii. p. 344 (1889).

*P. brevimanus*, Thorell, op. cit. p. 36.

*P. fulvipes*, Simon, Ann. Soc. Ent. Fr. vii. p. 378 (1888).

### Subgenus Buthus, s. s.

*Buthus*, Leach, Trans. Linn. Soc. xi. p. 391 (1815)—type *occitanus* (=*europæus*, Linn.).

*Androctonus* (*Leiurus*), Hempr. & Ehrb. Verh. nat. Fr. Berlin, i. p. 352 (1829)—type *tunetanus* (=*europæus*, Linn.).

*Hab.* The Old World, except Australia.

The denticles on the digits of the chela very much resemble in arrangement those of *Parabuthus*; but in the majority of cases the teeth of the internal series appear to have taken up a more forward position, so that they alternate with the teeth of the external series and do not form with them oblique short rows.

The cephalothorax is (? always) furnished with symmetrically placed granular keels, and the tergites with at least three granular keels. The tail is moderately powerful; there is no spine beneath the aculeus, and the upper sides of the fifth caudal segment are rounded and not compressed and carinate.

The pectines are long, all the teeth are alike, and there are no noticeable sexual variations in these organs. The 'manus' of the male may be wider than in the female and the dactyli may be more lobate and sinuate, but generally speaking the sexes are hard to recognize.

This subgenus contains more species than any other genus or subgenus of the family. These species are found principally in the countries bordering the Mediterranean; but from thence they spread southwards along the west and east coasts of Africa to the Cape of Good Hope, and eastwards through Persia and Afghanistan to Pekin

[1] ? = *capensis* (Ehrb.)

and Singapore. But beyond these limits no species have been recorded[1].

By the form of the tail the species have been, and may be, divided into two sections. The first is composed of those in which the fifth caudal segment is posteriorly excavated above, and has its infero-lateral keels weakly and uniformly denticulate throughout. Of this group the Museum possesses examples of the following:—*B. hottentota* (Fabr.), W. Africa; *B. minax*, L. Koch, Egypt (=? *acutecarinatus*, Simon); *B. eminii*, Pocock, E. Africa; *B. socotrensis*, Pocock, Socotra; *B. judaicus*, Simon, Syria; and *B. martensii*, Karsch, India. To the second section, comprising those forms in which the fifth caudal segment is but slightly, if at all, excavated above posteriorly and in which its inferior keels are irregularly and as a rule strongly denticulate, are to be referred a great number of species, which seem to be more highly specialized than those in the first category.

Subgenus PRIONURUS, Ehrb.

*Prionurus*, Hempr. & Ehrenb. Verh. nat. Fr. Berlin, i. p. 356 (1829)—type *funestus* (=*australis*, Linn.).

*Prionurus*, Peters, Monatsb. Ak. Wiss. Berlin, 1862, p. 513—type *funestus* (=*australis*, Linn.).

*Androctonus*, Thorell, Études Scorpiol.—type *australis* (Linn.).

Not *Prionurus*, Karsch, Berl. ent. Zeitschr. xxx. (1886) p. 77.

*Hab.* N. Africa and Syria.

This subgenus is closely allied to the preceding, and differs merely in having the lateral margins of the upper surface of the fifth caudal segment compressed and carinate, instead of rounded. The tail is always strong, sometimes exceedingly powerful.

It is not quite clear as to what is to be the name for this group. In his work on the Scorpions Ehrenberg constituted the genus *Androctonus*; and without definitely naming a type species divided the genus into two subgenera. The first of these—the small-tailed forms—he named *Leiurus*, with the type *tunetanus* or *quinque-striatus*; to the second or thick-tailed forms he gave the name *Prionurus*, with the type *funestus*. When Peters revised the group he concluded that the two sections should constitute genera; consequently he abolished *Androctonus*, apparently because it was without a type species; made, and rightly, *Leiurus* a synonym of *Buthus*, but preserved *Prionurus* as a genus in almost the sense in which the name was used by Ehrenberg. But Dr. Thorell, recognizing that the name *Androctonus* must take precedence of either one or other of its subgenera and that a type must consequently be fixed upon for it, decided to upset Peters's arrangement and to substitute *Androctonus* for his *Prionurus*.

But according to the system which has been followed, as far as possible, throughout this paper—that is, the system of selecting the first species mentioned under a genus as the type of the genus, when no other is specified—the type of *Androctonus* is *tunetanus*. But

[1] *Androctonus variegatus*, Gerv., from New Ireland, is in all probability an *Isometrus*.

since this species is also the type of *Leiurus* it follows that *Leiurus*, the subgenus, must give place to *Androctonus*. But *europæus*, the type of *Buthus*, is recognized as synonymous with *tunetanus*, and *Buthus* antedates *Androctonus* by 14 years: therefore *Androctonus* must be a synonym of *Buthus*. *Prionurus* can then be used to include those powerful-tailed species of which *australis* is the type —that is, in the sense in which Ehrenberg presumably meant it to be used, and in the sense in which Peters himself employed it.

*Synopsis of the* Buthidæ.

*a*. The inferior border of the immovable digit of the cheliceræ unarmed.
  *a*¹. The lateral-internal series of denticles on the digits of the chelæ composed of transversely set pairs of teeth ..... Uroplectes, Peters.
  Type *U. ornatus*, Peters.

  *b*¹. The lateral-internal series of denticles on the digits of the chelæ composed of a row of teeth widely separated and set singly ..... Lepreus, Thor.
  Type *L. pilosus*, Thor.

*b*. The inferior border of the immovable digit of the cheliceræ armed with one tooth.
  *a*². The intervals between the main teeth of the lateral series on the digits of the chelæ not occupied by smaller teeth.
    *a*³. Ante-ocular portion of cephalothorax horizontal, with lightly emarginate anterior border.
      *a*⁴. With a spine or tubercle beneath the aculeus; fifth caudal segment not coarsely punctured, and normally keeled beneath..... Isometrus (Ehrb.), Thorell.
      Type *maculatus* (De Geer).

      *b*⁴. Without a spine or tubercle beneath the aculeus; fifth caudal segment not keeled beneath and adorned with large punctures ..... Isometroides, Keys.
      Type *I. vescus* (Karsch).

    *b*³. Ante-ocular portion of cephalothorax sloped forwards, with its anterior margin convex; tail very powerful..... Buthiolus, Simon.
    Type *B. thalassinus*, Simon.

  *b*². The intervals between the main teeth of the lateral series on the digits of the chelæ occupied by a single row of smaller teeth; the rest as in *Isometrus* ..... Centrurus (Ehrb.), Peters.
  Type *C. gracilis* (Latr.).

*c*. The inferior border of the immovable digit of the cheliceræ armed with two teeth ..... Buthus, Leach.
  Type *B. europæus* (Linn.).

  *c*¹. Tergites with a single median longitudinal keel; cephalothorax without distinct keels.
    *c*². All the pectinal teeth alike in both sexes; tail moderate or powerful; the segments moderately strongly keeled; a distinct spine beneath the aculeus ..... Subgenus Rhoptrurus, Karsch.
    Type *R. dentatus*, Karsch.

    *d*². The basal pectinal tooth dilated in the female; tail moderate, not strongly keeled;

vesicle either with or without a tubercle beneath the aculeus..... Subgenus Grosphus, Simon.
Type *G. madagascariensis* (Gerv.).

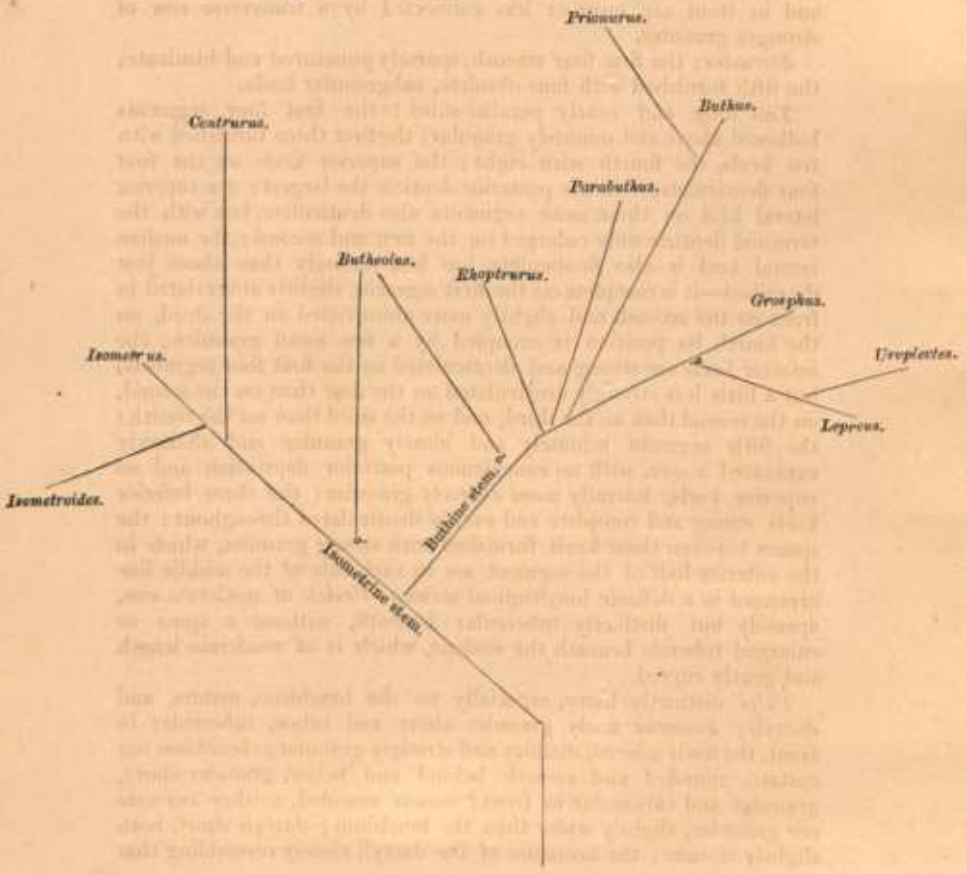
$e^2$. The basal pectinal tooth in the female like the rest; tail powerful and as a rule strongly keeled; without a spine or tubercle beneath the aculeus..... Subgenus Parabuthus, n.
Type *P. liosoma* (Ehrb.).

$d^1$. Tergites with a single median and two lateral keels; cephalothorax, as a rule, distinctly keeled.

$f^1$. Fifth caudal segment with rounded supero-lateral edges..... Subgenus Buthus (s. s.).
Type *B. europeus* (Linn.).

$g^1$. Fifth caudal segment with compressed carinate supero-lateral edges..... Subgenus Prionurus (Ehrb.).
Type *P. australis* (Linn.).

## *Hypothetical Pedigree of the* Buthidæ.



*Descriptions of new or little-known Species.*

LEPREUS CARINATUS, sp. n. (Plate XIV. fig. 3.)

*Colour* (dry specimen) almost uniformly dark ochraceous, the ocular tubercle and the anterior border of the cephalothorax black.

*Cephalothorax* thickly and somewhat coarsely granular throughout, without trace of keels; its anterior border lightly emarginate; the ocular tubercle deeply and widely cleft, granular in front and behind, smooth in the middle; the post-ocular sulcus deep and T-shaped.

*Tergites* closely granular throughout, the granulation coarser in the posterior half; the first six furnished with a conspicuous median granular keel; the fourth, fifth, and sixth, in addition, with traces of short lateral keels, formed of two or three large granules set in longitudinal series; the seventh tergite furnished with an anterior median, granular, subcarinate prominence, and two lateral, long, conspicuously denticulated keels, which behind almost attain the posterior margin, and in front are more or less connected by a transverse row of stronger granules.

*Sternites*: the first four smooth, sparsely punctured and bisulcate; the fifth furnished with four obsolete, subgranular keels.

*Tail* long and nearly parallel-sided; the first four segments hollowed above and minutely granular; the first three furnished with ten keels, the fourth with eight; the superior keels on the first four denticulate, with the posterior denticle the largest; the superior lateral keel on these same segments also denticulate, but with the terminal denticle only enlarged on the first and second; the median lateral keel is also denticulate, but less strongly than those just described—it is complete on the first segment, slightly abbreviated in front on the second, and slightly more abbreviated on the third, on the fourth its position is occupied by a few small granules; the inferior keels are strong and denticulated on the first four segments, but a little less strongly denticulated on the first than on the second, on the second than on the third, and on the third than on the fourth: the fifth segment minutely and closely granular and shallowly excavated above, with no conspicuous posterior depression and no superior keels, laterally more coarsely granular; the three inferior keels strong and complete and evenly denticulated throughout; the spaces between these keels furnished with strong granules, which in the anterior half of the segment are on each side of the middle line arranged in a definite longitudinal series. *Vesicle* of moderate size, sparsely but distinctly tubercular beneath, without a spine or enlarged tubercle beneath the aculeus, which is of moderate length and gently curved.

*Palpi* distinctly hairy, especially on the brachium, manus, and dactyli; *humerus* finely granular above and below, tubercular in front, the keels normal, distinct and strongly granular; *brachium* not costate, rounded and smooth behind and below, granular above, granular and tubercular in front; *manus* rounded, neither carinate nor granular, slightly wider than the brachium; *dactyli* short, both slightly sinuate; the armature of the dactyli closely resembling that

of *Parabuthus*, the external series being composed of pairs of teeth, enlarged and set obliquely, the internal series formed of single teeth only slightly separated from the apices of the median rows, and constituting with the teeth of the external series oblique, semi-transverse, short rows; the median rows not overlapping.

*Legs* hairy; the first pair almost without granules, the second slightly granular, the third with granular and subcarinate femur and granular patella, the fourth with strongly granular and subcarinate femur and patella; *tibiæ* of two posterior pairs spurred; *coxæ* smooth.

*Pectines* very long, projecting nearly to the end of the trochanter of the fourth pair of legs; furnished with from 24–27 similar teeth.

*Measurements in millimetres.*—Total length 34; length and width of cephalothorax 4; length of tail 22; of first two segments 6·5; of fifth segment 4·6; width of first 2·5; of fifth 2·1; humerus, length 3·5, of brachium 4; width of brachium 1·5, of manus 1·9; length of "hand-back" 2·8; of movable dactylus 4.

A single male specimen in the Museum collection ticketed "S. Africa, near the tropic of Capricorn."

This species is closely allied to *L. pilosus*, Thorell (the type of the genus), to *L. lunulifer*, Simon, and to *L. planimanus*, Karsch.

From *L. pilosus* it differs in having the inferior caudal keels well developed and denticulate; from *L. lunulifer* it may be recognized by its tubercular vesicle, granular legs, and by its subcostate and subgranular posterior abdominal sternite; and from *L. planimanus* by the form of its lateral tergal keels, by the presence of ten keels on the third caudal segment, and by its narrower hand.

Peters's species *Centrurus trilineatus* (Monats. Ak. Wiss. Berlin, 1862, p. 515), from Tette, is too briefly characterized to be identified; but it probably belongs to this genus and may, indeed, prove to be synonymous with either of the four species here discussed.

LEPREUS FISCHERI, Karsch, var. nov. NIGRIMANUS. (Plate XIV. fig. 2.)

? *Tityus tricolor*, Simon, Bull. Soc. Ent. Belg. 1882, p. lix.

*Colour*. Trunk above olivaceous, of a dull green colour, the sides of the cephalothorax paler than the middle; each of the first six tergites marked with three pale spots—one median, and one on each side near the lateral posterior angle; seventh tergite paler than the preceding; trunk below olivaceo-testaceous; upper surface of first four caudal segments ochraceo-testaceous, the under surface of the same colour, but on the second, third, and fourth there is an anterior black spot on each side and a median black posteriorly dilating band; fifth segment and the vesicle wholly piceous or brunneous; aculeus black at the tip, pale at the base; humerus, brachium, and distal half of digits clear ochraceous; manus and proximal half of digits piceous; legs wholly pale ochraceous.

*Cephalothorax* lightly emarginate in front; ocular tubercle with ante-ocular portion smooth; posterior and lateral portions finely and sparsely granular.

*Tergites* almost wholly smooth; the sixth bearing a few minute scattered granules, the seventh somewhat closely but finely granular; each of the first six furnished with a smooth median keel, the seventh with a low anterior median elevation, and two lateral almost obsolete granular keels.

*Sternites* wholly smooth, sparsely punctured, obsoletely bisulcate.

*Tail* wholly without keels; the first four segments shallowly excavated above and feebly granular; the first three furnished posteriorly on each side with two large granules which mark the positions of the terminations of the keels that have disappeared; on the first segment the superior keel is further represented by one or two granules *anterior* to the terminal one; on the other segments each superior keel is represented by a row of punctures; upper surface of the fifth posteriorly hollowed; under surface of the segments conspicuously but somewhat sparsely punctured. *Vesicle* punctured beneath, with a tuft of setæ above and another round the large spine which is situated beneath the aculeus; aculeus stout and considerably curved.

*Palpi*: *humerus* almost wholly smooth; the positions of the normal carinæ marked by a few granules and setiferous pores; *brachium* sparsely and weakly granular in front, rounded, smooth and punctured elsewhere; *manus* narrow, sparsely punctured, sparsely granular in front; *digits* long and curved, in contact throughout their extent; the internal series of teeth widely separated from the median rows.

*Legs* almost entirely smooth, not carinate.

*Pectines* projecting slightly beyond the fourth coxæ; furnished with 18 teeth, of which the basal is much dilated.

*Measurements in millimetres.*—Total length 29; cephalothorax, length and width 3·5: length of tail 18; of 1st two segments 5; of 5th 3·5: humerus, length 3; brachium, length 3·5, width 1·5; manus, width 1·3; length of "hand-back" 1; of movable digit 4.

A single female, probably immature, specimen in the Museum, collected at Mombassa by Mr. Grose Smith.

Very closely allied to the typical form of *L. fischeri*, Karsch, from Barawa (Somali). This species is unknown to me, but the description of it fails in a number of particulars to apply to the specimen here named. These particulars, although of small importance when considered separately, constitute in the aggregate a sufficiently wide distinction to justify the separation of this specimen as the type of a new variety.

Thus the cephalothorax of *L. fischeri* is said to be adorned with two oblique yellow bands which meet at an angle in the middle line; these bands are not observable in *L. nigrimanus*: the upper surface of the abdomen in *L. fischeri* is said to be adorned with a median wide yellow band, no mention being made of lateral spots; in *L. nigrimanus* this band is not complete, nor would it be wide if it were so, for the median spots exist only on the posterior half of the tergites and are narrow; moreover there are very conspicuous lateral

spots: the fourth caudal segment of *L. fischeri* is described as being infuscate; in *L. nigrimanus* it closely resembles the second and third segments in presenting an inferior median fuscous band and two antero-lateral fuscous spots: the band in *L. fischeri* is furnished with blackish lines; in *L. nigrimanus* it is wholly fuscous: in *L. fischeri* the general tint is "flavo-fuscus"; in *L. nigrimanus* it is olivaceous: and lastly the seventh tergite in *L. fischeri* is furnished with only a median keel, whereas in *L. nigrimanus* the two lateral keels in each side are distinct although not well developed.

It must be borne in mind, however, that specimens of the typical *L. fischeri* have been recorded by Dr. Karsch from Madagascar as well as from Barawa. Consequently on account of the wide range of this species it is quite likely that fresh collections will show that the characters here relied upon are too unstable to be even of varietal importance.

In the Ann. Soc. Ent. Fr. (5) x. p. 397, M. Simon expresses an opinion that his species, *Lepreus occidentalis*[1] (Plate XIV. fig. 4), may be synonymous with *L. fischeri*, Karsch. But judging from the series of *occidentalis* that the Museum possesses—namely two from the Gaboon, six from Angola, and two from the Congo—the two species are distinct, although very closely allied; *occidentalis* may be at once recognized by the presence on the under surface of the tail of three fuscous bands, whereof the lateral are bifid in front; in *fischeri* there is a single median band and two anterior spots.

UROPLECTES INSIGNIS, sp. n. (Plate XIII. fig 4.)

*Colour* variegated, testaceous and fuscous, the latter predominating; the tubercle and ante-ocular area infuscate, the posterior and lateral portions of the cephalothorax variegated; tergites with a testaceous stripe close to each side margin, a V-shaped testaceous mark nearer the centre, and a large yellow median patch which behind is divided by a black streak covering the median keel; upper surface of caudal segments infuscate in the middle, testaceous at the sides, lateral and inferior surface of the anterior segments adorned with black lines; inferior surface of the fifth almost wholly black; vesicle banded with yellow. *Humerus* and *brachium* infuscate above, manus lined and reticulated with black; dactyli infuscate at the base; *femora* with a black line along the lower margin, *patellæ* testaceous in the middle, *tibiæ* and *tarsi* with a patch of black at their proximal ends; under surface almost wholly testaceous, the last tergite with a conspicuous black band on each side.

*Cephalothorax* somewhat coarsely, but sparsely, granular; the ocular tubercle wholly smooth.

*Tergites* nearly smooth in front, coarsely and sparsely granular posteriorly; the first six furnished with an abbreviated smooth keel; the last with two coarsely granular keels on each side and a median nearly smooth prominence in its anterior half.

*Sternites* wholly smooth throughout, very sparsely hairy.

[1] ? Syn. *Tityus chinchoxensis*, Karsch, Zeitschr. ges. Naturw. 1879, p. 370.

*Tail* robust, somewhat widely and deeply excavated above, the sides of the excavation with a few granules, which in the fourth and anterior part of the fifth segment form a series parallel to the superior keel; superior keels strongly developed and coarsely granular, the terminal granule, except in the fifth, taking the form of a large tooth; the fifth segment deeply depressed behind, the superior keel evenly granular throughout; the superior lateral keel weakly granular, well developed in the first segment, becomes progressively weaker from before backwards, being wholly absent on the fourth; inferior surface of the first and second segments wholly smooth, without keels, but marked with serially arranged setiferous pores; lateral surfaces of the third sparsely and coarsely granular, keelless, inferior surface also keelless and almost smooth; inferior and lateral surfaces of the fourth segment somewhat coarsely granular, but without keels; inferior and lateral surfaces of the fifth coarsely and somewhat thickly granular, especially in its posterior half. *Vesicle* coarsely and subserially granular beneath and sparsely hirsute, smooth above and furnished with a median tuft of setæ; subaculear spine small and blunt.

*Palpi* beset with setiferous pores; upper surface of *humerus* smooth except for the granular keels which define it in front and behind; posterior and anterior surface bearing longer and smaller tubercles; inferior surface smooth; *brachium* bearing a few granules and tubercles above in front, the rest smooth and rounded and without keels; *manus* rounded, slightly wider than the brachium, neither keeled nor granular; without a spine; *dactyli* of moderate length, curved, in contact throughout, neither lobate nor sinuate; the armature in the proximal third of the dactylus resembles that supposed to be characteristic of *Lepreus*, inasmuch as the inner series is composed of isolated denticles; in the distal half, however, owing to the increase in size and partial separation of the apical or two apical denticles of the median rows and their approximation to the denticles of the internal lateral series, the arrangement is that of *Tityus* as restricted by Dr. Thorell.

*Legs* almost smooth; *femora* feebly granular along their upper and under edges; *tibiæ* of the two posterior pairs spurred; *coxæ* smooth.

*Pectines* short, bearing from 15–17 teeth, whereof the basal is much enlarged, although of much the same shape as, and not projecting beyond the line of, the rest.

*Stigmata* very small, slit-like.

Two female specimens from Table Mountain, collected by Dr. G. E. Dobson.

*Measurements in millimetres.*—Total length 39; cephalothorax, length and width 4; length of tail 20·2; of 1st two segments 5·2; of fifth segment 4·2; width of first segment 2·7; of fifth 2·5; length of vesicle and aculeus 5; humerus length 3·7; brachium length 4·5, width 2; width of manus 2; length of "hand-back" 2·6; of movable digit 4·2.

Differs from *U. lineatus* (Koch) and *U. variegatus* (Koch) in

having the vesicle strongly infuscate and a very conspicuous V-shaped testaceous mark on the tergites. By this last character also it may be recognized from *U. fallax* (Koch) and *U. striatus* (Koch). From *U. triangulifer* (Thorell) it may be at once separated by the absence of the longitudinal bands on the upper surface of the abdomen; moreover, Dr. Thorell in his elaborate description makes no mention of the enlargement of the basal pectinal tooth.

UROPLECTES FORMOSUS, sp. n. (Plate XIII. fig. 3.)

*Colour* variegated black and orange-yellow, cephalothorax with tubercle and ante-ocular area wholly black; the lateral portions marked with oblique testaceous bands and the posterior half with transverse testaceous bands; the side margins black; abdomen above with black side margins; marked throughout its extent by two parallel wide black bands alternating with three (one median) narrower yellow bands; the black spot on each of the tergites bears faint indications of the pale V-shaped mark, which is so characteristic of the species of this group; under surface of trunk mostly pale, the posterior abdominal sternite only being deeply infuscate at the sides, with a pale black-lined triangular area in the middle behind; tail with four first segments wholly pale above, with a median thin black line and black patches below; fifth segment deeply infuscate below and above, but paler in the excavation above; *vesicle* deeply infuscate, but marked with paler bands; aculeus pale at the base, darker at the apex; *palpi* with almost pale *humerus* and *brachium*, each of these segments being only marked above with two irregularly shaped patches of colour; the *manus* marked with black lines, the spaces between these lines more or less infuscate; *dactyli* wholly pale; anterior surface of the legs strongly variegated with black; the *maxillæ* of the first and second pairs infuscate.

*Cephalothorax* with anterior margin nearly straight, the central depression deep behind, shallow in front and over the ocular tubercle; the ocular tubercle with the area immediately at the sides and in front of it wholly smooth, the posterior half weakly and somewhat closely granular.

*Tergites.* First six almost smooth, marked only with a few lateral granules and a row of granules along the hinder margin; the median keel abbreviated in front and behind and smooth; the seventh tergite rougher than those that precede it; very finely and closely granular in the centre behind, more coarsely and sparsely granular at the sides; the lateral keels short, but coarsely granular, the median elevation low and smooth.

*Sternites* entirely smooth; sparsely hirsute.

*Tail* robust, widely and deeply excavated above and very feebly granular; fifth segment deeply depressed above and behind; superior keel well marked and granular on the first three segments, the *terminal* granule being large and tooth-like; superior keel wholly absent on the fifth and represented on the fourth by large granules subserially arranged; the superior lateral keel becomes progressively weaker from before backwards, being scarcely visible on the fourth segment;

inferior and lateral surfaces of first three segments smooth and keelless; inferior surface of the fourth keelless, but granular; inferior and lateral surfaces of the fifth keelless, but thickly and coarsely granular; the whole of the under surface of the tail marked with serially arranged setiferous pores. *Vesicle* smooth above, thickly hirsute and weakly granular below; subaculear spine small and blunt.

*Palpi* setose, especially on the fingers: *humerus* marked above with the customary anterior and posterior granular keel; anterior surface bearing larger and smaller granules: *brachium* furnished in front with a few tubercles, the rest of the segment smooth and rounded, without keels or granules: *manus* smooth and rounded, slightly wider than the brachium, neither keeled nor granular and not armed with a tooth: *dactyli* short and curved, in contact throughout, being neither lobate nor sinuate; denticles arranged as in the preceding species.

*Legs* hirsute, but almost wholly smooth; *tibiæ* of the two posterior pairs spurred.

*Pectines* armed with 17 approximately similar teeth; the basal tooth being only slightly thicker and slightly shorter than the rest.

*Stigmata* small and slit-like.

*Measurements in millimetres.*—Total length 28·5; cephalothorax length 4·2, width 4: length of tail 17; of first two segments 4; of fifth segment 3·5; of vesicle and aculeus 3·8; width of first segment 2·5, of fifth 2·3; humerus length 3; brachium length 3·7, width 1·5; width of manus 1·7; length of 'hand-back' 2, of movable dactylus 3·2.

Two specimens (♀) from Natal; one presented by Ernest Howlett, Esq., the other from the collection of Gueinzius.

This species may be recognized by the wide, undivided, median, longitudinal, yellow band on the abdomen, by the wide black band on each side of it, by the absence of fuscous patches on the upper surface of the four first tail-segments, by its fuscous hands and almost wholly ochraceous humerus and brachium. It differs, in addition, from *U. triangulifer* (Thor.) in being much smoother both above and below.

UROPLECTES FLAVOVIRIDIS, Peters. (Plate XIV. fig. 5.)

Monatsb. Ak. Wiss. Berlin, 1862, p. 516.

*Colour*. Upper surface of trunk and the whole of the tail of a dark shining green; extremities of the appendages and the sternal surface pale green or ochraceous.

♀. *Cephalothorax* thickly granular; the central depression well marked, deep behind; the ocular tubercle distinctly sulcate and smooth; anterior border widely and lightly emarginate.

*Tergites* granular, the first six furnished with a well-developed though nearly smooth median keel; the seventh more granular than the preceding, furnished with two granular keels on each side and a median granular prominence in its anterior half.

*Sternites* bisulcate, punctured, smooth, the last only very feebly granular laterally and not carinate.

*Tail* robust, almost parallel-sided; conspicuously sulcate above; the upper surface at least of the four anterior segments minutely granular and furnished in addition on each side with a series of larger granules parallel to the keels; the first and second segments with the four superior keels strongly developed, granular at the sides, almost smooth, not carinate, but deeply and sparsely punctured below; the third segment also with the superior keels well developed, but more granular at the sides and more closely punctured below, also bearing a faint indication of the inferior lateral keels; fourth segment with only the superior keel well developed, the rest almost obsolete; the sides and under surface thickly and coarsely granular and punctate; the fifth segment very coarsely and thickly granular below and at the sides, the superior keel obsolete behind; the upper surface hollowed behind. *Vesicle* ovate, smooth above, granular below, except for two smooth tracts which run backwards from the base of the aculeus; the rest granular and setose; a large spine beneath the aculeus, which is of the ordinary form.

*Palpi*. Upper surface of *humerus* minutely granular, the anterior and posterior keel strongly developed and coarsely granular; anterior surface subtubercular and bounded below by a row of granules; inferior surface almost smooth, feebly granular only in front and proximally; posterior surface furnished with a subtubercular keel; the whole segment sparsely setose: *brachium* sparsely setose; its anterior surface granular and subtubercular; its upper surface behind, its posterior and inferior surfaces smooth and rounded and punctured: *manus* hairy, with a tubercle at the base of the dactyli on the anterior surface, smooth, rounded, neither granular nor costate: *dactyli* very hairy, moderately long and curved, in contact throughout, neither sinuate nor lobate; the arrangement of denticles is much the same as in the preceding species, *i. e.* in the distal third, owing to the enlargement and partial isolation of the distally apical tooth of the separate rows which constitute the median series, the inner series is composed in this part of the digit of pairs of teeth.

*Legs* with *femora* anteriorly granular, but only subcarinate above; *patellæ* almost wholly smooth, the fourth pair only slightly granular; *tibiæ* of two posterior pairs armed beneath with a spur; *coxæ* smooth.

*Pectines* projecting beyond the edge of the fourth coxæ; furnished with 23 or 24 teeth, whereof the basal tooth is enormously enlarged but not longer than the rest.

*Stigmata* slit-like.

♂. Differs from the ♀ in having the tail much longer (*cf.* measurements), in having the hand longer and armed with a larger and sharper tooth, and in having the basal pectinal tooth like the rest of the series.

*Measurements in millimetres.*— ♀. Total length 38; cephalothorax length 5, width 5; length of tail 24; of first two segments 6·7; of fifth segment 5; width of first segment 4·3; of fifth 3: length of humerus 4; of brachium 5; width of brachium 2; of manus 1·8; length of

'hand-back' 2·3; of movable dactylus 5. ♂. Total length 45; length of cephalothorax 5; of tail 27, of first two segments 8, of fifth 6; width of first and fifth 4; length of humerus 4·7; of brachium 5·5; width of brachium 2; of hand 2; length of 'hand-back' 3; of movable dactylus 5·5.

The Museum has two specimens of this species from Lake Nyassa (Universities' Mission), and four ticketed merely E. Africa from the collection of Capt. Speke.

This form may be recognized from all its allies by the uniformly green tint of the upper surface; moreover, the superior lateral margins of the fifth caudal segment are elevated behind, terminate abruptly and not gradually as in the other species. The spine on the inner surface of the hand points apparently to affinity between this species and *U. triangulifer* (Plate XIII. fig. 5), of which the Museum possesses a single male specimen from Pietersberg. But the form of the vesicle in the ♂ of *triangulifer* is sufficiently peculiar to differentiate the species from all others.

RHOPTRURUS KIRKI, sp. n. (Plate XIV. fig. 1.)

*Colour* almost a uniform ochraceous tint throughout, the terminal segments of the tail and the dactyli of the palpi being somewhat darker.

*Cephalothorax* divided throughout by a median sulcus, lightly emarginate in front, its posterior width greater than its length; closely but feebly granular throughout; ocular tubercle prominent, deeply and widely sulcate and perfectly smooth; central eyes large and separated by a space about equal to a diameter; lateral eyes three on each side.

*Tergites* finely and closely granular throughout; from the second to the fifth armed with a low granular posterior median keel; the seventh with a low median keel in front, and two, more coarsely granular, anteriorly abbreviated keels on each side.

*Sternites* mostly smooth, the fourth granular laterally, the fifth very feebly, if at all, granular in the centre, more coarsely so at the sides, bearing traces of four abbreviated granular keels.

*Tail* very smooth, furnished only with exceedingly minute granules, almost parallel-sided, the fifth segment being only slightly wider than the first; the first segment bearing traces of ten minutely granular keels, the second and third segments with faint traces of but eight keels, the fourth with scarcely perceptible traces of the keels, and the fifth with scarcely perceptible traces of five keels; *vesicle* smooth above, minutely granular beneath, the spine beneath the aculeus simple, large and sharp.

*Palpi*. Upper surface of *humerus* minutely and closely granular, bounded in front and behind by a coarsely granular keel; anterior surface minutely granular and furnished with many larger tubercles, inferior surface very finely granular, posterior surface more coarsely granular; upper surface of *brachium* very finely granular throughout and furnished with more coarsely granular keels; anterior surface also minutely granular and furnished with several

large blunt tubercles: *manus* very wide, wider than brachium, almost wholly smooth, not carinate and not granular; movable *dactylus* half as long again as the "hand-back," bearing a distinct though small internal basal lobe which fits into a corresponding hollow in the immovable dactylus, so that when closed a sinuate space is left between them at the base; the internal series composed of nine sharp separated teeth, the external series of eight pairs of teeth.

*Cheliceræ*. The movable dactylus armed above with three strong teeth, whereof the posterior is bifid, and below with two sharp teeth; the two inferior teeth of the immovable dactylus well developed though smaller than the other teeth of this appendage.

*Legs*. *Femur* and *patella* anteriorly finely granular; the femur of the three posterior pairs carinate above and below, the patella of all of them carinate anteriorly; *tibiæ* of the fourth pair armed distally with a spur, tibiæ of the other pairs unarmed; *coxæ* smooth.

*Pectines* projecting considerably beyond the distal extremity of the fourth pair of coxæ, bearing 19 or 20 similar teeth. (The left pecten presents the curious abnormality of having the two apical teeth united.)

*Stigmata* slit-like.

*Measurements in millimetres of* (♂) *specimen*.—Total length 59; cephalothorax, length 7·5, width 8; distance of eyes from posterior margin 4·5; length of tail 42; of 1st segment 5; of 2nd 6; of 3rd 6·7; of 4th 7·5; of 5th 8·3; of vesicle 4·5; width of 1st 4·3; of 3rd 4·5; of 4th 5·7; of 5th 5; of vesicle 3·3. Palpi—humerus, length 7; brachium, length 7·7; width 3; manus, width 4·5; length of "hand-back" 6·3; movable dactylus 2.

A single specimen ticketed W. Africa, from the collection of Dr. (now Sir John) Kirk.

This species differs from *R. dentatus* in having the under surface of third, fourth, and fifth caudal segments smooth; in *R. dentatus* they are described as thickly granular. From *R. büttneri*[1] it differs in having the keels on the tail much more feebly developed and in having no granular keels on the hand.

### Rhoptrurus jacksoni, sp. n. (Plate XIII. fig. 1.)

*Colour* of cephalothorax and abdominal tergites fusco-ochraceous, the central and lateral eyes and lateral margins of the cephalothorax and tergites dull black. *Cheliceræ* infuscate distally above; *dactyli* of palpi infuscate, yellow only at the tips; *aculeus* black in its hinder half; the rest of the animal, i. e. the legs, tail, palpi (all but fingers), and lower surface of the trunk, clear ochraceous.

*Cephalothorax* very lightly and widely emarginate in front; its posterior width considerably greater than its length; almost wholly covered with coarse granulation, some smooth tracts extending

[1] Since the above was written the Museum has received two female specimens of *R. büttneri* from Rio del Rey, W. Africa.

laterally in the posterior half from the central sulcus; ocular tubercle with the ridges formed by the sulcus granular.

*Tergites* granular throughout, the granules in the posterior half of each much larger than in the anterior; each, except the last, marked in the middle line behind by a granular keel, the last bearing in its anterior half a median prominence and on each side two keels which anteriorly disappear in the general granulation of the tergite.

*Sternites*. The anterior three smooth; the fourth slightly granular only at the sides; the fifth somewhat coarsely granular and bicarinate in its posterior half.

*Tail* robust, nearly five times as long as the cephalothorax; upper surface not deeply excavated and very finely granular; lateral and inferior surfaces coarsely granular throughout and sparsely hairy; the first segment marked with ten strongly and evenly granular keels, the second, third, and fourth with eight similar keels, the fifth with five keels, whereof the two superior are weak. *Vesicle* smooth above, somewhat coarsely and subserially granular beneath, the spine long and slender; the aculeus stout and curved.

*Palpi* hairy; upper surface of *humerus* minutely granular throughout and bounded in front and behind by a series of coarse granules; anterior and posterior surfaces armed with small granules and larger tubercles; inferior surface finely granular proximally: *brachium* granular and carinate behind and above, sparsely tubercular in front, minutely granular beneath: *manus* smooth and rounded, neither granular nor costate, about equalling the brachium in width: *dactyli* curved, nearly twice as long as the "hand-back," in contact throughout, neither sinuate nor lobate; the arrangement of teeth approximately the same as in the preceding species.

*Cheliceræ* with dentition as in the preceding species.

*Legs* with *femora* feebly granular in front, carinate and granular above and below; *patellæ* carinate and granular anteriorly; *tibiæ* of the first three pairs unarmed, of the fourth pair spurred.

*Pectines* not extending so far as the distal extremity of the fourth coxæ, armed with 20 or 21 similar teeth.

*Stigmata* slit-like.

*Measurements in millimetres of* (♀) *specimen*.—Total length 76; cephalothorax, length 8·5, width 9·5; distance of eyes from posterior margin 5: tail, length 43; of 1st segment 5; of second 6; of 3rd 6·3; of 4th 7·5; of 5th 8·5; of vesicle 4·5. Palpi—humerus, length 7; brachium, length 8, width 3·3: manus, width 3; "hand-back," length 5; movable dactylus, length 9.

A single specimen in the Museum collection taken by Mr. F. J. Jackson at Taveita, Kilima-njaro.

This species is closely allied to, and may possibly prove to be only the female of, *R. dentatus*. But the under surface of the fourth and fifth caudal segments is furnished with distinct granular keels; in *R. dentatus* these segments are said to have only the upper side keeled.

RHOPTRURUS BARONI, sp. n. (Plate XIII. fig. 2.)

*Colour* fulvous, thickly marbled with black like *Isometrus maculatus*, the black patches taking the form of irregularly shaped, though symmetrically arranged, spots and bands. In the posterior lateral portions of the cephalothorax the fulvous tint predominates; the central tubercle and region of the lateral eyes are black; the ante-ocular area of the cephalothorax is black in the middle, lighter at the sides; a fulvous band runs from the region of the lateral eyes towards, but falls short of, the fulvous portion immediately behind the central tubercle; an oblique fuscous band runs from the fulvous patch behind the lateral eyes and divides on each of the prominences which defines the hinder third of the median sulcus. Roughly speaking, the tergites are marked on each side by six patches of dark colour, three of these being internal and three external; the two anterior of the internal patches more or less fused with their fellows of the opposite side, but the posterior of them surrounding a yellow patch is separated from the corresponding patch of the opposite side by a yellow patch which marks the median keel. The posterior sternites variegated with black; the inferior and lateral portions of the tail variegated with black, the upper surface of the segments adorned with a V-shaped black mark and the vesicle with straight black lines. The external surface of the legs, the *brachium* and *humerus* variegated; the *hand* almost wholly fulvous, the fingers darker at the base.

*Cephalothorax* somewhat coarsely granular throughout, very widely and lightly emarginate in front, divided throughout by a median sulcus; ocular tubercle deeply cleft and granular.

*Tergites* coarsely but somewhat sparsely granular; marked with a low median granular keel; the seventh furnished on each side with two anteriorly abbreviated denticulated keels.

*Sternites* smooth, sparsely hairy, the last only feebly granular but not carinate.

*Tail*. The first and second segments marked with ten granular keels, the superior keels coarsely granular, the inferior, especially on the first segment, much more feeble; the intercarinal spaces also granular; third segment with inferior keels very weak, the fourth with the superior keel visible and the inferior keels almost or entirely obsolete; the fifth evenly rounded above and below, without keels; both these segments feebly granular and sparsely hairy. *Vesicle* hairy, not granular, the spine simple; aculeus long, slender, and but lightly curved.

*Palpi*. Upper surface of *humerus* minutely granular, and bounded in front and behind by a series of coarser tubercles; the anterior surface beset with finer and coarser tubercles: *brachium* granular and costate above, armed in front with a few strong sharp teeth: *manus* rounded and smooth, about as wide as the brachium: *dactyli* long, slender, in contact throughout, neither lobate nor sinuate in either sex, armed with erect bristles; of the lateral teeth of the dactyli the internal series is composed of eight larger teeth and the external series of nine pairs of teeth.

*Legs* with anterior surface of *femur* and *patella* somewhat coarsely granular, but not markedly carinate, the granules being only subserially arranged; *tibiæ* of the two posterior pairs armed distally beneath with a spur; *coxæ* of legs smooth.

*Pectines* with 20 or 21 teeth; all the teeth alike; in the male the teeth are larger and the pectines longer, extending in fact considerably beyond the extremity of the coxæ of the fourth pair of legs; in the female they fall short of this point.

*Stigmata* slit-like.

*Measurements in millimetres.*—Total length 27; cephalothorax, length 3, width 3·5; length of tail 17·5; of 1st segment 2; of 2nd 2·3; 3rd 2·5; 4th 3; 5th 4; vesicle 2; width of 1st segment 2, of 5th 1·7. Palpi—humerus, length 3; brachium, length 3·5, width 1·3; manus, width 1·3; length of "hand-back" 2; length of movable dactylus 3·5.

Three specimens, ♂ and ♀, from Madagascar, collected by the Rev. R. Baron.

This species differs markedly from those here described in its variegated colouring. In this respect it somewhat resembles apparently *R. centrurimorphus*, which is also a Madagascar species; but according to Dr. Karsch this last species differs from *R. büttneri* only in colour. I conclude, therefore, that it is furnished with keels on the hand and with only eight keels on the second caudal segment; if so, *R. baroni* differs from it in having a smooth hand and ten keels on the second caudal segment.

## EXPLANATION OF THE PLATES.

### Plate XIII.

Fig. 1. *Rhoptrurus jacksoni*, sp. n. Nat. size. ♀, p. 138.
1 *a*. —— ——. Extremity of dactylus.
2. —— *baroni*, sp. n. Nat. size, p. 140.
3. *Uroplectes formosus*, sp. n. Nat. size, p. 134.
3 *a*. —— ——. Extremity of dactylus.
4. —— *insignis*, sp. n. Nat. size, p. 132.
5. —— *triangulifer* (Thor.). Nat. size. ♂, p. 137.
5 *a*. —— ——. Extremity of dactylus.
5 *b*. —— ——. Vesicle.

### Plate XIV.

Fig. 1. *Rhoptrurus kirki*, sp. n. Nat. size. ♂, p. 137.
2. *Leprens fischeri*, Karsch, var. *nigrimanus*. Nat. size, p. 130.
2 *a*. —— ——, ——. Extremity of dactylus.
3. —— *carinatus*, sp. n. Nat. size, p. 129.
3 *a*. —— ——. Extremity of dactylus.
4. —— *occidentalis* (Simon). Nat. size, p. 132.
4 *a*. —— ——. Extremity of dactylus.
5. *Uroplectes flavoviridis*, Peters. Nat. size. ♀, p. 137.
5 *a*. —— ——. Extremity of dactylus.

## 3. Notes on the Anatomy of the Condor. By FRANK E. BEDDARD, M.A., Prosector to the Society.

[Received March 4, 1890.]

In the present communication I wish to direct attention to the structure of the trachea and of the heart in the Condor. Certain interesting statements by Prof. Gegenbaur [1] concerning the structure of the right auriculo-ventricular valve made me specially anxious to study this bird, which the death of a specimen at the end of last year has enabled me to do.

In the trachea I refer to one or two structural points of slighter importance.

### 1. *Heart.*

The general structure of the right auriculo-ventricular valve in the Bird's heart is well known; there are, however, some discrepancies among the descriptions of the corresponding valve in the Crocodile, with which it is universally agreed that that of Birds must be compared.

Gegenbaur's description of this valve in the Crocodile is very detailed, though unaccompanied by figures. The valve consists of two halves, a muscular and a membranous; the former borders the anterior and outer margin of the atrio-ventricular orifice, the latter the septal margin of the same. "The hinder lateral part of the ventricular cavity appears spongy from the presence of a number of fleshy trabeculæ; of these one is of importance, which runs from the anterior ventricular wall upwards and backwards to the jutting-out muscular valve to be inserted in the neighbourhood of its free margin. This muscular trabecula is not in any way distinguished from the neighbouring ones; it is, indeed, less conspicuous, but it is constant (so far as the small number of hearts examined [4] enable me to say). It is more conspicuous in the Crocodile than in the Alligator, and is readily seen. It forms a fleshy bridge from the muscular margin of the ostium to the lateral ventricular wall."

In comparing these arrangements with that which characterizes the Bird's heart, Professor Gegenbaur duly calls attention (p. 380) to the absence in the latter group of all traces of the membranous valve *except in the Condor*, which is described as follows:—

"Only in the heart of *Sarcorhamphus* do I find a peculiarity which has interest in this connection. From the anterior origin of the muscular valve on the *septum ventriculorum* a fold runs backwards, which is formed by a thickening of the endocardium. The fold runs obliquely backwards and downwards and crosses in its direction the margin of the muscular valve. The course of this fold corresponds to the line of origin of the membranous valvular flap of the Crocodile; I think it reasonable therefore to regard it as a remnant of the structure which is further developed in the Crocodile."

[1] "Zur vergleichenden Anatomie des Herzens," Jen. Zeitsch. Bd. ii. (1866), p. 365.

by its insertion on to the valve the junction between its fleshy and membranous portions; on the right side the valve is muscular, on the left it is membranous. If this comparison be just, it seems to follow that *the septal portion of the right auriculo-ventricular valve is not entirely wanting in the Bird's heart, as it has been generally stated to be*[1]. In view of the possible comparison between that part of the Bird's valve which lies to the right of the fleshy bridge (when the heart is placed on its left side with the apex downwards) and the membranous or "septal" flap, as it has been better termed by Lankester[2], of the Crocodile's heart, it is important to bear in mind the following fact, *that this part of the valve in the Bird's heart*, though sometimes as thick and fleshy as the rest, *is often thin and delicate and sometimes partially membranous.*

Furthermore, the trabeculæ uniting the valve with the parietes have *not* entirely disappeared from the Bird's heart. Gegenbaur himself implies that they have by the quotation on p. 143. But in many birds, for example in the heart of Burmeister's Cariama (*Chunga burmeisteri*) shown in the accompanying drawing (woodcut fig. 2), *the margin of the valve is tied down to the free ventricular wall by several delicate muscular or tendinous threads in addition to the large fleshy bridge*, which is a constant structure in the bird's heart.

Next, as to the partial persistence of the septal flap in the Condor's heart. In one specimen which I dissected some years ago, I observed no traces whatever which could be compared to a septal flap. In the specimen which is more particularly described in the present paper there were a series of tiny yellowish spots and vesicles a little way from the posterior margin of the atrio-ventricular orifice, which formed a line occupying a position identical with that which would be occupied by a septal part of the valve if it were present. The structures in question seem to me to be probably pathological; but it is a significant fact that they are situated along a line which would correspond to the insertion of a septal half of the valve; I can, indeed, quite believe that in many Condor hearts a thickening such as that described by Gegenbaur exists, which is possibly, as a rudimentary structure, especially prone to disease.

In *Chunga burmeisteri* (see woodcut fig. 2) a band of muscles connects the fixed and free wall of the right ventricle; from this are given off several threads connected with the supplementary muscular bands which tie down the edge of the valve to the free wall of the ventricle. This muscular pillar is, I presume, the equivalent of the moderator band in the heart of *Casuarius* described by Prof. Rolleston. It has been, I think, suggested somewhere that this moderator band is the equivalent of part of the septal portion of the

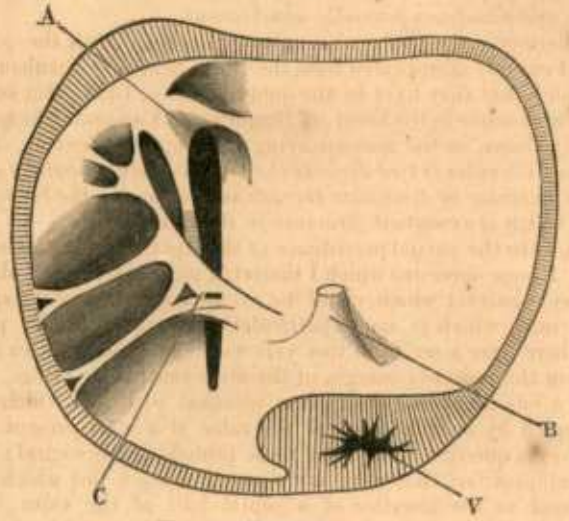
[1] Owen (article "Aves," Todd's 'Cyclopædia of Anatomy,' vol. i. p. 331) has erroneously compared, as Gegenbaur pointed out, this fleshy bridge of the Bird's heart with the entire membranous part of the valve in the Crocodile's heart. I find that Sabatier has apparently made the same comparison as that urged in the text.

[2] "On the Right Cardinal Valve of *Echidna* and of *Ornithorhynchus*," P. Z. S. 1883, p. 831 *et seq.* pl. iii. fig. 1, 3, 4, pl. iv. figs. 5, 6.

valve, otherwise wanting in the heart of *Chunga*; its position in that bird and its connection with the muscle attaching the free valve to the parietes to some extent favour such a supposition, which, however, I am unable at present further to support. In any case the very complicated interior of the right ventricle in *Chunga* appeared to me to be worth figuring.

In the figure of the Crocodile's heart (woodcut fig. 1, p. 143) a muscle entering the "membranous valve" at its lowermost point will be noticed; it appears to be just possible that the muscular processes lettered B in the heart of *Chunga* (woodcut fig. 2) may be comparable to this.

Fig. 2.




Heart of *Chunga burmeisteri*.

V, cavity of left ventricle; A, fleshy bridge uniting valve to free wall of ventricle; B, C, muscular bands uniting free and septal walls of ventricle.

Prof. Rolleston associated the presence of a moderator band with very active habits, its use being to increase the effect of the contraction of the parietes of the heart. *Chunga* does not seem to be a bird in which any such supplementary apparatus is greatly needed. Hence its importance may be more morphological than physiological.

The fact that in the two lowest mammals (*Echidna* and *Ornithorhynchus*) the outer fleshy half of the right auricular valve only is present, as in the Bird's heart, appears to me to be more than a coincidence; and the resemblance is more striking if we admit that the part of the valve lying to the left of the fleshy bridge in the Bird's heart has its equivalent in the parts lettered *l. a. c.* in Lankester's account of the heart of *Ornithorhynchus* and *Echidna*[1].

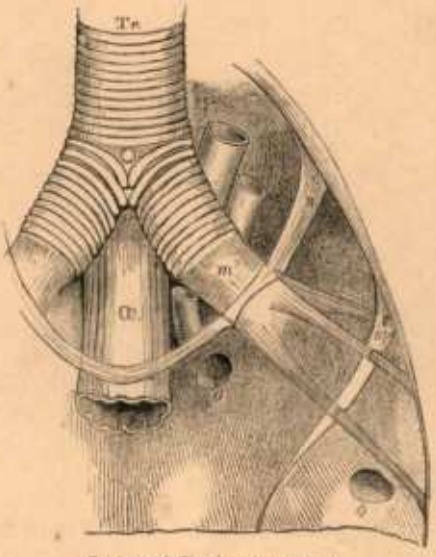
[1] *Loc. cit.*

The additional muscular and tendinous slips which have been described in this paper as uniting the valve-margin with the parietes in certain birds are comparable to the additional muscles which tie down the valve in the Monotremata, and, as has been pointed out, they are traceable in the Crocodile heart.

### 2. *Trachea.*

The trachea of the American Vultures (including, of course *Sarcorhamphus*) has been long known to differ greatly from that of other Accipitres in having no intrinsic muscles, and in showing no definite modification in the direction of the formation of a syrinx.

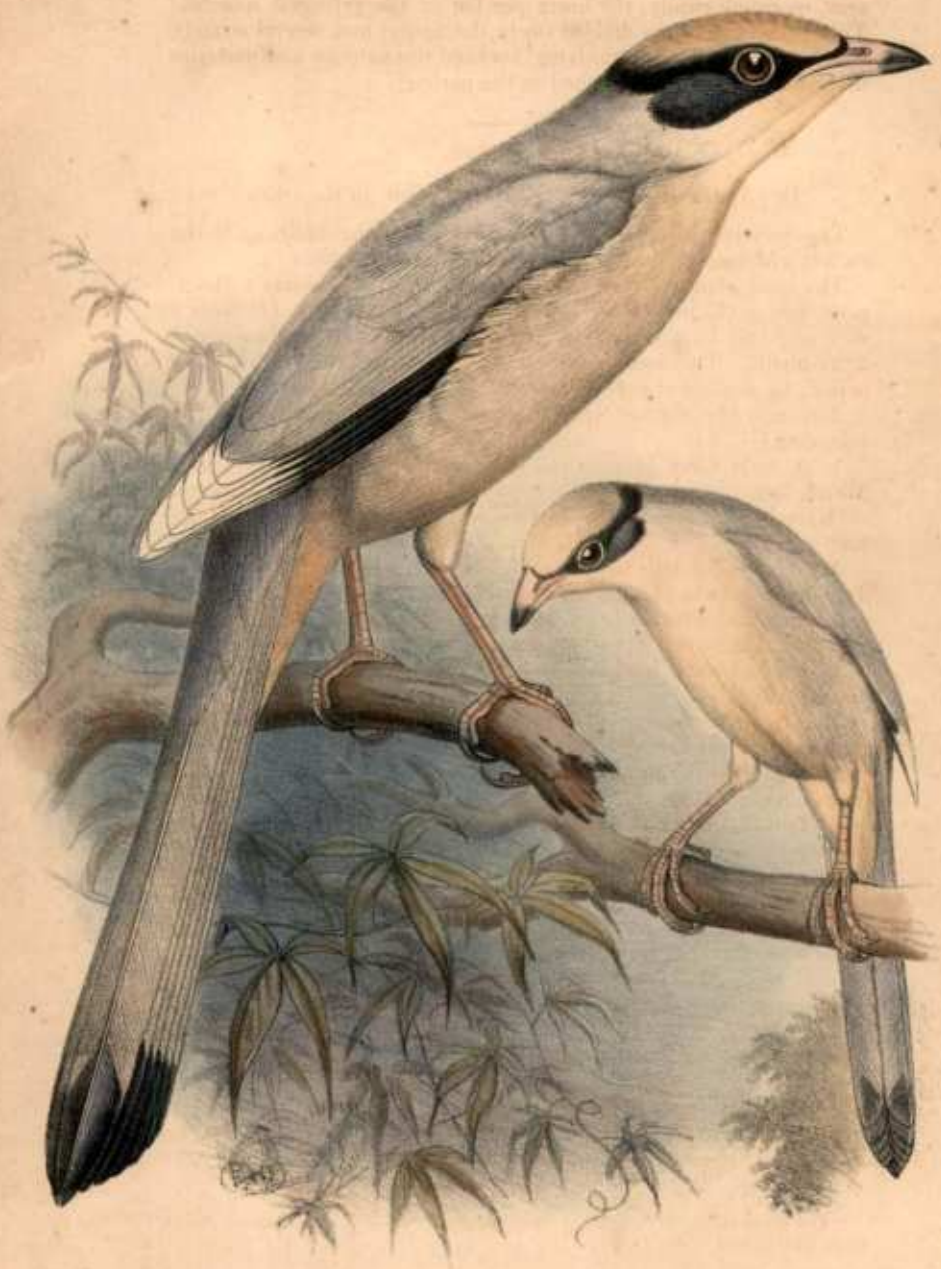
Fig. 3.




Syrinx of Condor (nat. size).

*œ*, œsophagus; *m*, muscles enveloping extremity of bronchia; *Tr*, trachea; *o*, ostia; *s*, septum dividing prebronchial from anterior intermediate air-sac; *sp*, septum between anterior and posterior intermediate air-sac.

In all three genera the bifurcation of the trachea is very similar; but on the whole *Sarcorhamphus* comes nearer to *Gypagus* than either of them do to *Cathartes*. This is principally shown in the comparative thickness of the rings at the point of bifurcation; these are extraordinarily thin in *Cathartes*, leaving therefore large membranous spaces. The bifurcation of the trachea in *Cathartes* is especially Lacertilian. The rings of the bronchi in *Sarcorhamphus* cease for some time before the bronchi enter the lungs; this fibrous portion (see woodcut fig. 3) is closely enveloped by a mass of muscle (*m*). The function of this muscle must be much the same as that of the intrinsic muscles of the syrinx in those forms which are furnished with



Hypocolius ampelinus.

these muscles. Is it not also possible that they may actually represent, morphologically, the lower portion of the syringeal muscles? This muscle becomes divided (as in the figure) into several strands, which traverse the septum lying between the anterior and posterior thoracic air-sacs to be attached to the parietes.

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April 1, 1890.

Dr. A. Günther, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of March 1890:—

The total number of registered additions to the Society's Menagerie during the month of March were 36 in number. Of these 8 were acquired by presentation, 13 by deposit, 11 by purchase, and 4 by birth. The total number of departures during the same period, by death and removals, was 78.

Amongst the former special attention may be called to the following:—

1. A male Grey Hypocolius (*Hypocolius ampelinus*), presented March 3rd, 1890, by W. D. Cumming, Esq., Curator of the Museum of Karachi, and brought to England in the S.S. 'Branksome Hall,' under the kind care of Mr. H. Wray.

Mr. Cumming tells us that this bird was taken from the nest in June 1889 and was brought up by hand, having been first fed on bread and water, and afterwards on dates and other fruits. It would also take flies, grubs, and grasshoppers as well as dry bread, bread steeped in sugar and water, and was delighted in having a little lucerne occasionally.

This is, no doubt, the first example of this rare Passerine form that has reached Europe.

I exhibit a drawing by Mr. Frohawk (Plate XV.), which shows its colours in life.

2. Two Mantchurian Cranes (*Grus viridirostris*), presented to the Society by C. W. Campbell, Esq., of H.B.M.'s Consular Service, Corea, 31st March. These birds, though not new to the Society's collection (as the species has bred in the Gardens and a young one was hatched out in June 1861 [1]), are yet of sufficient interest to be worthy of attention, as they are the first specimens received direct from Corea. Mr. Campbell writes to me that this Crane is very common in Corea during the winter months, and that numbers of them are trapped by the natives for sale to the Chinese and Japanese, by whom they are much appreciated.

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Mr. J. H. Gurney, Jun., F.Z.S., exhibited a specimen of a hybrid between the Tree-Sparrow (*Passer montanus*) and the House-Sparrow (*P. domesticus*), bred in captivity at Norwich.

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[1] See Bartlett, P. Z. S. 1861, p. 369, pl. xxxv., where the species is called *Grus montignesia*.

Mr. A. Smith-Woodward exhibited and made remarks on a Mesozoic Palæoniscid Fish from New South Wales, and pointed out that the structure of its pelvic fins seemed to confirm the recent opinion that the Palæoniscidæ are related to the Acipenseridæ and not to the Lepidosteidæ. The author believed the specimen exhibited to be the only one of the kind in existence.

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Mr. C. M. Woodford, C.M.Z.S., made some remarks on the fauna of the Solomon Islands, and exhibited a large number of photographs in illustration of his remarks and of his recent explorations in these islands.

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The following papers were read:—

## I. Contributions to the Study of *Heloderma suspectum*.

By R. W. Shufeldt, M.D., C.M.Z.S.

[Received March 5, 1890.]

(Plates XVI.–XVIII.)

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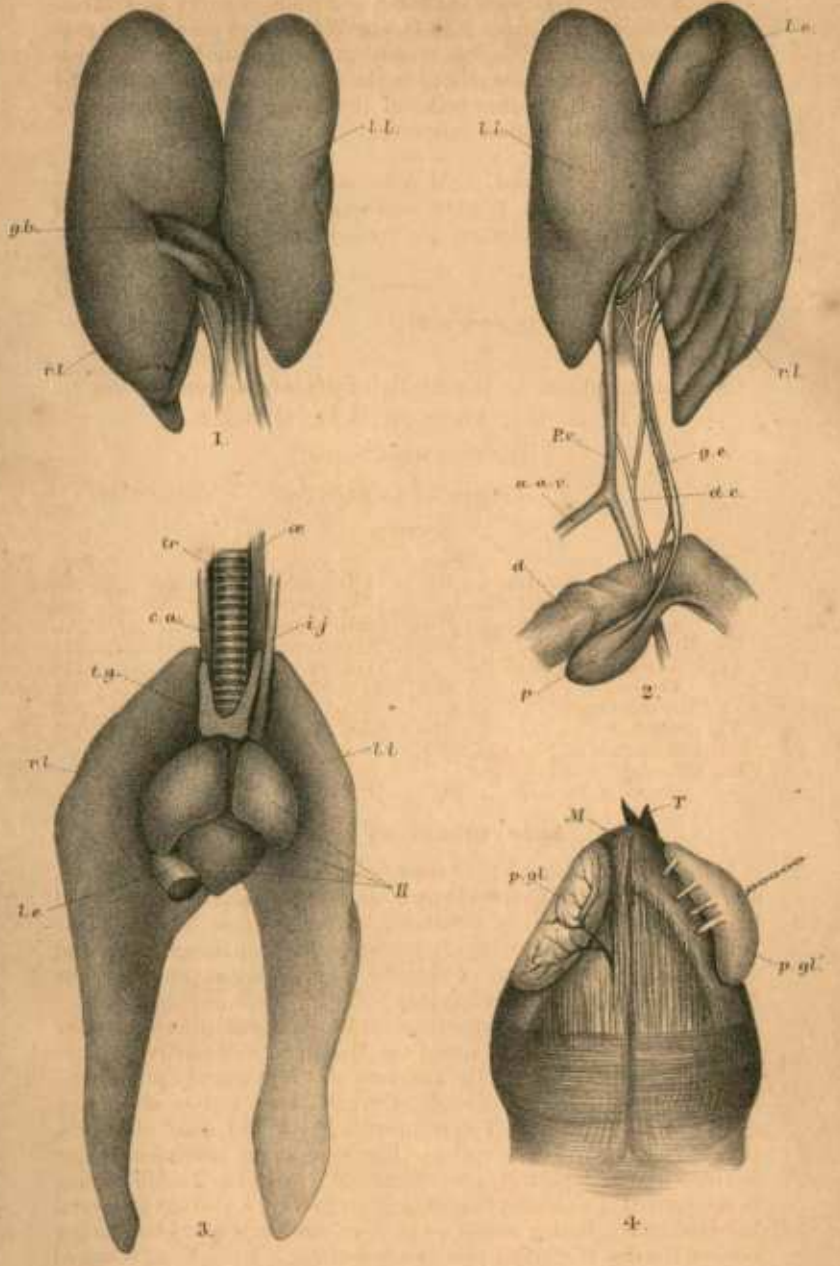
### I. Introductory Remarks.

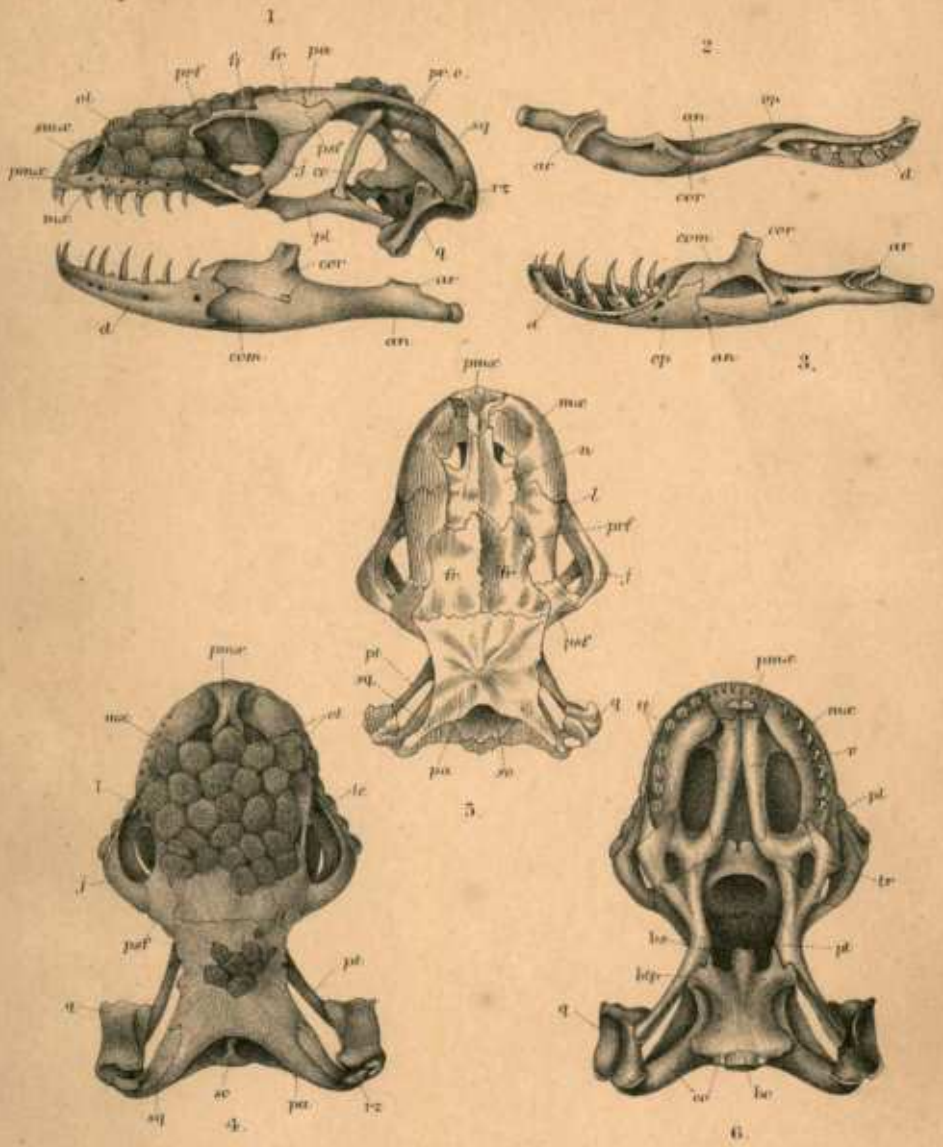
During the summer of 1887 the present writer came into possession of two very fine living specimens of *Heloderma suspectum* that had been obtained for him in Southern Arizona, in that section of the United States zoogeographically known as the Sonoran Region, and where the natural habitat of this, by far the largest of all of our North-American lizards, is located.

Never having been so fortunate as to have enjoyed the opportunity of studying the habits and life of the Heloderm in its native haunts, I can add nothing here to the accounts of others already published; nor am I familiar with the mode of reproduction in this interesting species of lizard, though I have heard it stated, by good observers, that it is an oviparous reptile. The two living specimens above referred to were separately packed each in a small box, and in coming to me arrived in excellent condition, after making a journey of several hundred miles, lasting six or eight days, and each lizard consuming only on the day of starting part of a boiled egg. Upon being removed from their boxes they drank freely of water, and afterwards each ate




R. W. Havfeldt ad nat. del. F. Smit. lith. Mintern Bros. imp.

ANATOMY OF HELODERMA SUSPECTUM.

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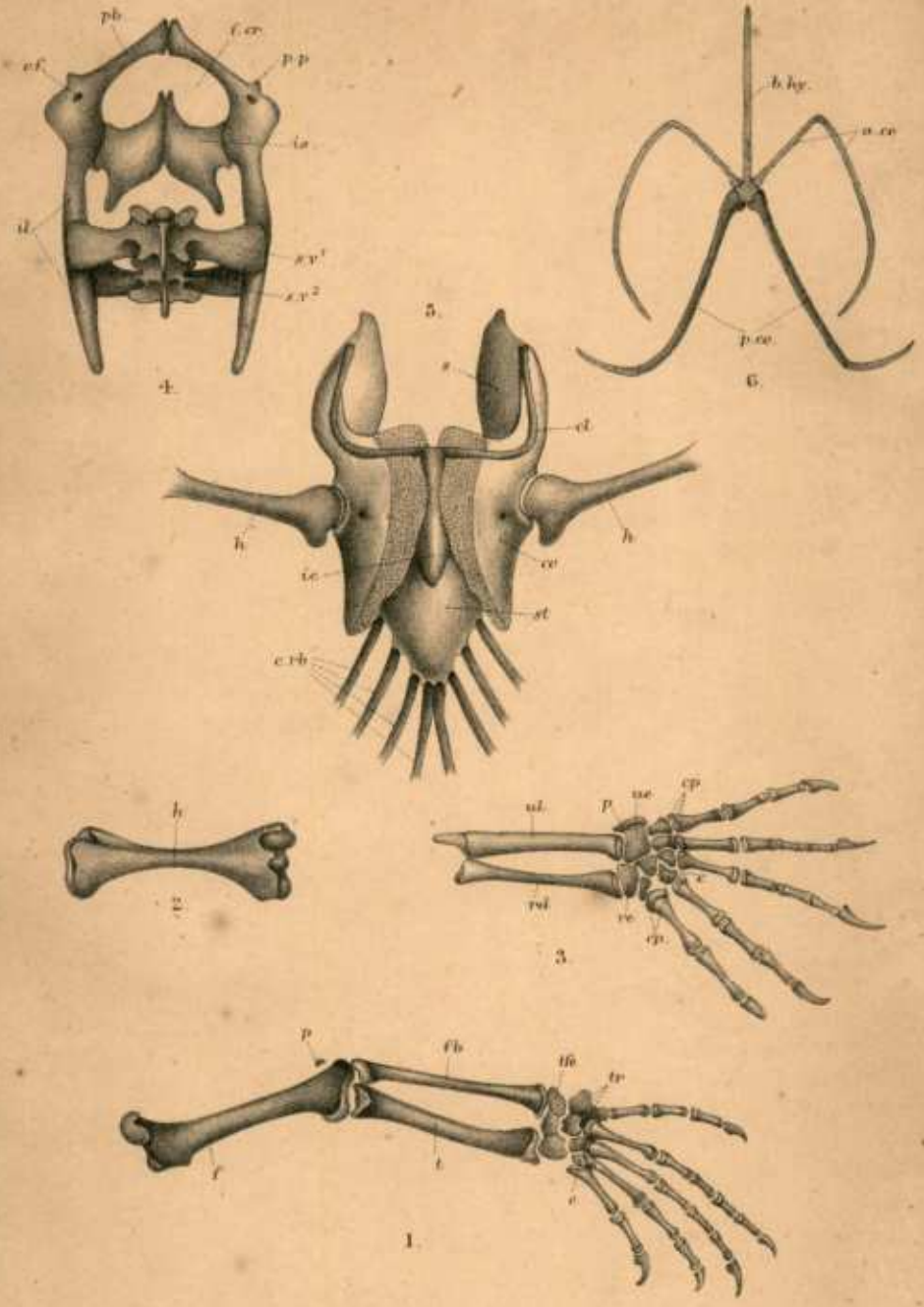
ANATOMY OF HELODERMA SUSPECTUM.




R.W. Shufeldt ad nat. del. P. Smit lith. Mintern. Bros. imp.

ANATOMY OF HELODERMA SUSPECTUM.

the best part of a hard-boiled hen's egg. Both of these acts, however, were performed with marked deliberation, so much so that one would little have suspected that the creatures were in any way particularly hungry. In eating they employ their broad, black, forked tongue to a considerable extent, protruding the organ slowly from the mouth, spreading it out, and licking the morsel well before it is taken into the mouth and swallowed. They may also, in drinking, occasionally be seen to lap the fluid with this organ, and still in a more or less deliberate manner. These two specimens have already been several months in my keeping and under my daily observation, during which time they have not eaten half a dozen hens' eggs between them, sometimes taking them hard-boiled, but as a rule seeming to prefer them raw; they have refused all other nutriment which has been placed before them.

I have shown elsewhere that another American lizard, *Phrynosoma*, is capable of enduring an absolute fast for a period of three months or more ('Science,' vol. vi. no. 135, Sept. 4, 1885, pp. 185, 186); and it is a well-known fact that other reptiles can do likewise. Moreover I am quite sure, from what I have seen, that a good healthy adult *Heloderma* would prove to be another representative in this category, capable of sustaining a prolonged period without taking any nutriment whatever into its system.

When one of these reptiles is placed on the open ground and left to itself, it soon takes itself off, and notwithstanding its rather awkward mode of progression makes withal very good time. Head, body, and tail are all kept in contact with the ground, while the alternate fore and hind limbs are thrown forwards as the animal takes its rather ample steps and keeps its way along, with no other apparent motive in its mind beyond making good its escape. In walking thus, it constantly protrudes, and again whips back into its mouth, its great black tongue, evidently to some degree using the organ as a detector of anything that may possibly stand in the road to impede its progress.

If you now suddenly check it, the animal quickly rears its body from the ground by straightening out its limbs, wheels about, opens its mouth widely, snaps its tongue in and out, and gives vent to a threatening blowing sound. The whole aspect of the reptile, taking its great size into consideration, is now quite sufficient to keep the best of us at bay at first, and the moment it is let alone it takes the opportunity to make off again, usually in another direction.

The bite of the *Heloderma* is now known to be venomous, and to small mammals soon fatal; but as the writer has elsewhere published accounts of this, the subject will not be renewed in the present connexion (see Am. Nat., Nov. 1882, pp. 907, 908; 'Nature,' Dec. 14, 1882, p. 154; and 'Forest and Stream,' Aug. 4, 1887, p. 24).

My two specimens seem to be quite attached to each other, and are never so well satisfied as when curled up together in a sunny corner of their cage; I am unable from their external characters to determine their sex, and this will only be possible later on, when we come to examine into their structure.

These lizards are, too, very fond of basking in the hottest of noon-

day suns, and I have satisfied myself that upon these and other occasions, when I have closely watched them, they possess to a certain extent chameleonic powers, for I have observed the orange part of their scaly armour pass from that colour to a decided salmon tint and *vice versâ*, remaining normally, however, at some shade of orange or yellow. When thus sunning themselves they have a habit of stretching their limbs backwards, even to the extent of having the feet with their dorsal aspects in contact with the ground, the palms and soles being directed upwards. They will then close their eyes and lay in this position for hours at a time. So far as their physical strength is concerned, it seems to be about equal to that of young Alligators of a corresponding size; they do not, however, possess the power of striking a blow with the tail, enjoyed by the latter reptile. And in getting over rough ground, where branches, large stones, or other obstacles stand in the way, Heloderms evince no little patience, ingenuity, and downright obstinacy in overcoming such barriers to their progress. By a series of simple experiments I have been enabled to satisfy myself that the senses of sight, smell, and hearing are all quite acute in these reptiles, and they are also sensitive to the sense of touch. As to their general intelligence, however, or such mental attributes as they may be possessed of, I have made no special investigations, but from my casual observations I am inclined to believe that they stand rather above the average reptile in both of these respects.

## II. On the Form and External Characters of *Heloderma suspectum*.

One of these reptiles in my possession is considerably larger than the other, and by an approximate estimate only of their respective lengths, for I intend to present exact measurements further on, I would say that the smaller of the two was, from tip to tip, about 28 centimetres long, while the other has a total length of about 41 centimetres. The smaller one is by far, both in its markings and general coloration, the handsomer of the two.

My large *Heloderma* has a total length of 41·3 centimetres and a mid-girth of 18 centimetres, but this latter, of course, is very variable, as the animal may alter it considerably by inspiration and expiration at its will.

Other measurements, which I have carefully taken, are presented in the accompanying table, and they will give a fair idea of the proportions of one of these reptiles. It will be seen also that the relative proportions vary with age. Moreover, as with all Vertebrates, these proportions may actually vary for each individual, just as we find robust and stout men to compare with slender and tall men.

*Table of Measurements.*

(Measurements in centimetres and fractions.)

| | Larger one. | Smaller one. |
|---|---|---|
| Total length..... | 41·3 | 29·2 |
| Mid-girth (variable) ..... | 18·0 | 12·1 |

*Table* (continued).

| | Larger one. | Smaller one. |
|---|---|---|
| Greatest width on top of head .... | 4·2 | 3·0 |
| Between the eyes ..... | 2·7 | 2·1 |
| Between the nostrils ..... | 1·2 | 0·7 |
| From chin to commissure of gape .. | 3·8 | 2·8 |
| Middle toe, fore foot ..... | 2·0 | 1·5 |
| Middle toe, hind foot ..... | 1·7 | 1·3 |
| Vent to tip of tail ..... | 12·5 | 9·0 |
| Mid-girth of tail ..... | 8·1 | 5·0 |
| Chin to vent ..... | 28·8 | 20·2 |
| From armpit to groin of same side .. | 17·1 | 12·5 |
| Width of vent ..... | 1·1 | 0·7 |

*Coloration.*—As I have elsewhere said, the two colours of *Heloderma suspectum* are black and some shade of yellow, orange, or salmon. No two specimens of this Lizard ever agree either in point of coloration or in the peculiar markings. Sometimes the black is intense and shiny; sometimes dull and almost of a brownish tint. It always brings out the two tints brilliantly to wet the animal in water. As a rule the muzzle, chin and throat, cheeks, and fore part of the head on top are jet-black; occasionally a few yellow scales will be distributed over the throat, and in my larger specimen there are over each eye two pale yellow tubercles. On the top of the head an imperfect cross can generally be made out, the arms of which are composed of a single row of tubercles, broken at the intersection, and with its anterior extremities reaching as far forward on either side as the regions over the roofs of the orbits, while the posterior ends extend back as far as the angles of the jaw. A few scattered black tubercles usually are to be found in the area between the entering angles of this cross. Passing next to the neck and body we find the markings of a very different character. Assuming the yellow or orange to be the ground-colour, we discover that these parts are generally surrounded at irregular intervals by some four or five broad, fantastic, transverse bands, composed of the black tubercles on the dorsal aspect and the flatter scales on the nether parts. These bands are not of an unbroken black colour, but have both irregular borders and bizarre figures of the orange or yellow ground-colour over their internal areas, composed for the most part of blotches, bars, and hieroglyphical patterns, and sometimes the figures of these black bands may become confluent with each other. The colours are duller and paler on the ventral parts than they are above, although the general configuration still prevails, with rather more marked confluence of the banding. In my larger specimen there are also found in the transverse orange interspaces a few scattered and small isolated spots of black, composed of, as usual, a few black tubercles which have merged at these localities. Generally the tail is marked by alternate bands of the same colours found upon the body; these are commonly four or five in number, of about equal widths, and arranged so as to have the tail terminate in a black tip.

These bands are unbroken in my smaller specimen, but in the larger one a single imperfect row of orange tubercles passes round the middles of the mid black bands, which are double on the black band next the body, while two or three scattered black tubercles are seen upon the intermediate orange bands.

From rather above the knees and elbows down to the tips of the several digits all four of the limbs in my smaller specimen are of a uniform shiny jetty black, which is not the case in the larger individual, where these parts are irregularly marked all over by both black and orange. At present I am unable to state whether or not these markings change at all with the growth of the animal, but I am rather disposed to think that they do not. Moreover, I have had Heloderms under my observation for two years at a time, and during that period never knew the animal to shed its skin, as do some other lizards and snakes. When I say this, I do not mean to imply that a shedding never takes place, because that would not be true, for at the present time (March 7th, 1888) the skin is shedding from the toes and soles of the feet of my larger Heloderm, leaving the scales bright and new as it comes away. What I do mean is that I have never observed it peel off in great pieces, as it is known to do in some of our Lacertilians, where I have frequently seen it slip off nearly entire, forming a tissue paper-like cast of the entire form of the lizard.

*Of the Form.*—For the first few years of its life, the Heloderm has a broad oval outline to its head, but as the animal matures this is superseded by the marked triangular form, where the angles at the muzzle and opposite the mandibular articulations are rounded off, and we may add that at all ages the head of this lizard is always much depressed, being quite flat on top, while considerable fulness pertains to the throat posterior to the mandibular symphysis. When the animal is asleep we may by close observation see his sides swell and collapse very slightly as he breathes, and at such times, too, the most lax and posterior part of this throat-region perceptibly pulsates in synchronism with the animal's respiration. Sometimes he has a way of taking several quick breaths in rapid succession, when all these movements become much more obvious. The body of this lizard is of an elongated ellipsoidal form, being depressed, so that on section at about its middle it would show an ellipse with its major axis horizontally disposed. The tail is large and heavy, being subconical in form, gradually tapering to a pointed tip; the posterior limbs spring from points at its junction with the body, and as the latter is considerably broader just beyond this point, it always gives the casual observer the impression that these hind limbs arise from the sides of the tail. No such deception ever strikes one upon viewing the anterior pair of limbs, as in that region the neck is proportionally of considerably larger calibre than is the root of the caudal appendage.

There is but very little difference either in the bigness or the length of any of the limbs, though it may be slightly in favour of the hinder pair, while for their entire lengths they are much of the same calibre, showing only slight constrictions therein at the knees and

elbows, and no very decided swells mark the sites of the muscular masses of the thigh or brachium. Manus and pes are both flattened from above downwards and of a subcircular outline, while from each, around its anterior periphery, spring the toes of this pentadactyle lizard. The digits are all of nearly the same length, but in the case of manus the mid-toe appears to be the longest and the pollex the shortest, while in the pes the mid-toe and the next one to its outer side are of about the same length, and again the hallux is the shortest. Each toe is terminated by a small, sharp-pointed, decurved claw, which is of a horn-colour before the moult, but which thereafter is seen to be a pure glistening white. These claws are generally much worn by the constant walking of these heavy reptiles over the rocks of their native haunts, and, indeed, in very old individuals the toes seem to be almost clawless, both ungual phalanx and its horny sheath having been worn down to the very base.

As will be seen by the above table of measurements, the external narial apertures are, comparatively speaking, situated rather far apart; they are, too, of good size, being of a subcircular outline, with a pale-coloured mucous membrane lining them within. *Heloderma* has fairly large eyes, in which the irides are of a dark snuff-brown, and the external lids, which can be closed completely, when open create an aperture broadly elliptical in outline. The opening of the mouth in this reptile is very capacious, and the commissures of the gape are situated at some distance posterior to vertical lines let fall, on either side, from the pupils of the eyes. The lower lip is rounded and is overlapped by the upper lip, the margins of which are sharp; but in the case of both the tissues are quite pliable and consist of nothing more than the flat scutes overlying the soft parts they cover.

Either external ear consists in an oblique slit, situated at some little distance from, but in line with, the commissure of the gape; its borders are rounded, and its lower angle is the anterior one of the two. Unlike some other Lizards, the tympanum is rather deeply situated, and is only brought into view by carefully opening the ear, by which I mean parting its margins. In front of the entrance to this aural meatus, the row of tubercles bounding it are of some considerable size, while those on the posterior margin of the aperture are comparatively minute, the latter being in continuation with those found beneath the throat.

This method of the arrangement of the scales or tubercles is repeated again in the vent of this animal, where we find a broad slit-like aperture transversely disposed and with a soft rounded posterior border, bounded by a row of very minute tubercles; while in front the opening is more rigid in character, which is largely due to the far greater size of the bounding scutes and their consequent greater immobility.

*Of the Teguments.*—Viewed as a whole, the external epidermic armour of this reptile consists in, for the entire dorsal aspect, a stuccoing of knob-like tubercles of various sizes, which, as they pass to the ventral surface of the body, gradually assume the flat type of scale, having different forms in different localities. These tubercles

are found to be largest on top of the head, more especially on the lateral parietal regions, and over the entire facio-frontal aspect; here, as in the case of the smaller mesial ones, they are crowded close together, are of varying outline, but in no specimen are they arranged upon any definite plan as they are in some other Lizards, in *Lacerta* for example. Moreover, they do not quite agree in any two specimens, a fact that, upon comparison, at once becomes evident. Tubercles of a similar character extend down upon either side of the head as far as the commissure of the gape, filling in the region between the eye and the aural entrance: these gradually become smaller as they near the throat, which latter space is entirely covered over by an even layer of closely-set tubercles of a very much smaller size and of a uniformly subcircular form. Here these peculiar scales are the smallest of the kind as compared with those anywhere else on the body of this reptile: they are all in contact with each other, unless the animal from some cause swells out its throat, when the skin may be seen in the evenly distributed interspaces. Upon studying the arrangement, number, and distribution of the circumocular, narial, and labial scales in these two specimens of mine, I find that in none of these particulars are they exactly alike. A large oblong rostral scute is present, with a smaller scute upon either side of it, while external to either of these is a quadrilateral subnarial scute. Next follow the superior labials proper, the marginal ones being usually nine in number on either side, which become gradually smaller as we proceed from before backwards. Above the anterior moiety of these labials, extending between eye and nostril, there is another row of smaller size, some five or six in number, which I am of the opinion will be pretty constantly found in that locality. Of this latter row the largest scute is just posterior to the nostril, while the smallest and most posterior one, triangular in form, is wedged in just beneath the suborbital row. Three large tubercles is the rule for the supraciliary scutes, with four suborbitals, and either one or two small post- and preorbitals. Normally, again, there seem to be two anterior nasal scutes, with a large postnasal one, and commonly one wedged in above and between these two. Passing next to the arrangement of these upon the mandible, we find always present a fair-sized chin-scute, followed posteriorly by four mental scutes, on either side of the median line, while the lower labials seem to average fourteen in number. Between these latter and the mental scutes, the interval is filled in by three oblique rows of flat scutes, those of the larger size being in the most external row, while the smallest occupy the inner one, and these latter gradually merge into the area of small tubercles which overlay the throat and which have been already described above.

We may now turn our attention to the scutation of this reptile's body, and we find upon the dorsal aspect that the tubercles gradually diminish in size as we pass backwards from the occipital region, although they maintain very much the same character and arrangement. Soon, however, they commence to dispose themselves in regular transverse rows and are of a pretty uniform size. This

state of things continues all the way to the root of the tail, with scarcely any perceptible difference in the size of the individual tubercles, although perhaps the larger ones may range along the middle of the back. They are so arranged that any single tubercle in one row stands opposite the interspace between two other tubercles either in the row in front of or behind it. When the Heloderm is fat and in good condition, the individual tubercles stand apart from each other, separated by a distance equal in any case to about the diameter of the base of the tubercle next to the space. And when the reptile is laying out perfectly straight and at rest, these several rows of tubercles seem to be separated from each other by crease-like lines marking the intervening skin; but the moment the animal twists to one side or the other, these transverse lines are immediately obliterated, while oblique ones, running straight down the concaved side, take their place. As I have already described above, these knob-like tubercles of the dorsal aspect of the Heloderm's body in passing down the sides gradually assume the flat scale-like type. From between the armpits and the groins these are of an even oblong form, arranged in regular transverse rows, being in contact with each other, while the individual scales of one row break joints with the scales in front of and behind them, much in the same manner as bricks in a building do. Between the legs in front these oblong scales gradually assume a rounded form, and in passing still more anteriorly they become still smaller, to eventually merge into the minute tubercles, already described, that cover the throat. These ventral scales also become more rounded as they pass between the hinder pair of limbs, as well as slightly smaller. The two middle preanal scales are markedly larger than the few remaining ones that make up this row upon either side of them; and, as I have already said, the tubercles on the posterior margin of the vent are quite minute in comparison. The tubercles covering the dorsal aspect of the great rounded tail of this reptile pass regularly from those on its back, having the same arrangement and character, only they are placed closer together, being nearly or quite in contact with each other. Further, as these caudal tubercles pass round to the underside of this appendage, they, too, become gradually flatter, but in their case only two middle rows running the length of the underside of the tail may said to be flat. The rows of small tubercles covering any one of the limbs are arranged much after the same fashion as are those upon the back, while upon the soles of the feet they are seen to be very much worn. Any single toe shows a transverse arrangement of its single row of oblong scutes, both upon its ventral and dorsal aspect, and between these, on either lateral surface of the digit, is another longitudinal row of rounded scales, all three being carried down so that the terminal ones surround the claw.

As has already been hinted at in a foregoing paragraph, in shedding but small patches of skin come away at a time, and these show a perfect casting of the scales or tubercles they originally covered.

*Of other Parts which may be examined externally.*—By the aid

of a lens and carefully going over the region immediately over the parietal foramen, I failed to discover any external traces whatever of a "parietal eye," described by Spencer as existing in *Sphenodon punctatum*, and which has been found in so many Saurians since by other observers. Indeed, the tubercles are placed so close together on the top of the head in *Heloderma*, that a depression of any kind would be recognized at once. It is possible we may find something of the kind when we come to examine the brain in these specimens of mine.

Passing to the ventral border of the thigh, on either side, careful scrutiny failed to reveal to me any evidences of the pori femorales, that series of apertures which are the external openings of certain cutaneous glands in some Reptiles. Nor from an external examination do I find any evidences of the large anal glands, such as were found by Günther to exist in *Sphenodon*. From an outer survey alone I would say that both of these specimens were females, but of course more extensive dissection will prove that point. Ossifications exist in the cutis of *Heloderma*, but the squamo-tuberculated skin of this reptile nowhere develops any special spines or similar appendages[1].

So far as I have been able to discover from the literature of the subject, little or nothing is as yet known of the reproduction of this lizard, beyond the fact that Captain Bendire, of the U. S. Army, found a number of eggs in a specimen of *Heloderma suspectum* that he opened (60). Indeed, there still remains much that it is very desirable to know in so far as the habits of this reptile are concerned; we may refer especially to the means it employs to secure its food, as well as the various kinds that go to make up its diet-list.

We find here and there authors referring to the nauseous odour emitted on the part of the *Heloderma*, and, although I have had them in captivity for a year or more together, I have never noticed any such characteristic as pertaining to them, and I have studied them under a great variety of circumstances. Professor Garman has remarked that, "As if better protected from below, the *Heloderma* is said to turn himself on his back when attacked." It never has been my fortune to have observed this habit in the case of *Heloderma suspectum*, and I am of the opinion that such is not the case with it.

[1] Just here I would say that a year has passed by since this monograph was completed up to the above point, or where the index reference to this footnote occurs; during that time my large specimen of the *Heloderma* has died and duly been placed in alcohol, while the writer's residence is no longer at Fort Wingate, N. Mexico, but at his home a few moment's ride from Washington, D.C., where all the libraries and collections are open to him and easy of access. Through the kindness of Professor G. B. Goode, the director of the U. S. National Museum, I have also had placed at my disposal another fine, large alcoholic specimen of the *Heloderma suspectum* from Arizona, as well as the loan of a handsomely mounted skeleton of the same reptile, from the collections of of that Institution. In view of these facts, I will not, in future pages of this memoir, refer to any particular specimen used in my work; for it is sufficiently extensive now to obviate the necessity of that course; with increased material comes a broadening of the field, permitting our passage from the description of a couple of specimens to more general observations in the premises.

Experiments made by a number of competent investigators during the past few years have satisfactorily demonstrated the fact to my mind that the venomous or non-venomous character of the bite of the *Heloderma* is placed beyond the peradventure of cavil, for there can be no doubt now but that its bite is soon fatal, at least to the smaller kinds of animals. Whether it has ever proved fatal in the case of man I believe still remains an open question, although I am inclined to believe that that, too, will sooner or later be substantiated.

With respect to the affinities of the *Helodermatidæ*, authors have entertained a variety of opinions; and, so far as I can ascertain, herpetologists are still considerably in doubt as to the position of these reptiles in the system, and which group constitute their nearest kin. The opinion has been very generally held that the Heloderms are more or less nearly related to the *Varanidæ* or perhaps to *Iguanidæ*. Cope, in his recent work (61), places them as a family between the *Xenosauridæ* and the *Anguidæ*; while Gill (56) has created a superfamily for them, ranging it as the *Helodermatoidea* next above his superfamily the *Varanoidea*, and the *Aniellidæ*, of his superfamily *Anielloidea*, immediately preceding them. Bocourt (34) recognizes the family *Helodermidæ*, and "associates with it under the family *Trachydermi*, Wiegm., several lizards to which it offers considerable zoological affinities; they differ from it in having smooth ungrooved teeth. Such a difference might at first seem to militate against their union with *Heloderma*, but this dental character, of great importance in the higher Vertebrata, has only a secondary importance among the Reptiles, as is exemplified by the serrated teeth of *Macroscincus coctæi*, D. & B." (Zool. Rec. 1878). A few years ago, Steindachner (35) described a new reptile from Borneo to which he gave the name of *Lanthanotus borneensis*, and which he claimed was related to the Heloderms. We are, however, of the opinion that that fact is by no means a settled one. Nevertheless, Boulenger has placed the genus *Lanthanotus* after the family *Helodermatidæ* in the Catalogue of Reptiles in the British Museum (55), but remarks that "Whether the following genus is to be placed here, or constitutes a distinct allied family (*Lanthanotidæ*, Steindachner), must remain doubtful until its anatomical characters are known. Its dentition was originally stated to be the same as in *Heloderma*, but this has been subsequently corrected by Steindachner." In the Catalogue we have cited, Boulenger has characterized the *Helodermatidæ* for us in a masterly manner, and in the same place he presents us with the characters of *Lanthanotus*, so far as they are at present known from Steindachner's description. It is evident, then, that a complete account of the anatomy of this Bornean reptile, one of the supposed affines of *Heloderma*, is very much to be desired; I am inclined to think, however, at present, that when its morphology comes to be fully known, its affinity with the *Helodermatidæ* will not be found to be a near one by any manner of means, judging, as I do, from some of its external characters.

## III. Of the Myology.

To assist me in the demonstration of the muscles of this lizard I have at my hand an excellent paper entitled "Notes on the Myology of *Liolepis belli*," by Alfred Sanders (P. Z. S. 1872, p. 154); also one entitled "Notes on the Myology of the *Phrynosoma coronatum*," by the same author (P. Z. S. 1874, p. 71); also the admirable memoir, "On the Myology of *Chamæleon parsonii*," by Professor St. George Mivart (P. Z. S. 1870, p. 850); and finally the more generalized contribution to the study of the muscles in Lizards presented us by Prof. C. K. Hoffmann in Bronn's 'Thier-Reichs' (45). With these I must likewise mention the studies of Professor Mivart upon the *Iguana* (P. Z. S. 1867); and other works on the muscles of reptiles by the same distinguished author. As to the names I here bestow upon the muscles of the Heloderm, I can say with Sanders, who remarked in his paper on the myology of *Liolepis*, that "With regard to the nomenclature, it must be regarded as merely a tentative expression of opinion, liable to be changed at any time on the demonstration of error." It is a long day yet before we can say in truth that our knowledge of the myology of reptiles is in any way complete, and a great many forms still remain to be worked out.

### *Muscles of the Head.*

1. *Mylo-hyoideus anterior.*—We find in the present subject this muscle to be but feebly developed; it arises, on either side, from the inner aspect of the lower border of the ramus of the jaw, for about its anterior moiety, and as far forward as the symphysis. Mesially, it indistinguishably blends with its fellow of the opposite side, making no median raphe. Postero-laterally it faintly overlaps the *mylo-hyoideus posterior*, while at the middle of the throat it almost seems to blend with that muscle: and this delicate, superficial plain of transversely disposed muscular fibres overlays a number of the group of the more deeply situated and true hyoidean muscles.

2. *Mylo-hyoideus posterior* is a far better developed muscle than the one I have just described, and apart from its greater size it differs from it in that it exhibits a fairly well-developed medio-tendinous raphe for nearly its entire length. Into this the muscle of either side merges. Springing from the occiput and the dense fascia at the antero-superior part of the neck, from the mandibular suspensorium, as well as from the inner aspect of the posterior moiety of the mandible itself, the posterior mylo-hyoid sends its fibres, for the most part, transversely to the middle line of the throat, where they blend with the delicate, longitudinal, raphenous line in a manner which I have already indicated. The posterior border of this muscle is well-defined and thickened: it crosses the throat just anterior to the region of the chest; while laterally the hinder margin of an aural aperture is formed by its free muscular edge. Anteriorly it is very thin where it meets the anterior mylo-hyoid in

a manner already alluded to. These two muscles seem to constitute the *platysma myoides* of Sanders, and from this it will be seen that *Heloderma suspectum* is one of those lizards wherein the mylo-hyoidean muscles are conspicuously developed. By removing them we at once expose the deeper set of the true muscles of the hyoid arches.

3. *Temporalis.*—Notably dense and bulky, this is one of the, if not the, most powerful muscles of the system to be found in this lizard's economy. It takes origin from the parietal, from the nether surface of the squamosal and postfrontal, and from the anterior aspect of the quadrate; from this extensive surface its fibres rapidly converge as they pass downwards and forwards, and becoming strongly tendinous they make insertion upon the postero-external border of the coronary process of the mandible; this constitutes its chief insertion, but beyond this its tendon also fastens itself to the outer surface of the coronary, extending to the corresponding aspect of the adjacent side of the mandible as far forward as the dentary element, and posteriorly to a slight extent towards the hinder end of the bone. It will be seen from this that the muscle quite fills the temporal fossa, its insertional margin being limited sharply above by the cranial bones that go to form the outer edge of the orbit; and it is between the posterior border of this muscle and the anterior margin of the *digastric* and *neuro-mandibularis* that we discover the subelliptical periphery of the ear, with its tympanic membrane tightly stretched over it.

In making my dissections of these parts, I find an interesting tendon which arises from near the posterior end of the mandible, and passing directly forwards, on a line with the upper edge of the lower jaw, commences to expand about opposite the coronoid process of that bone, and spreading out like a fan, thence on becomes intimately attached to the antero-lateral skin of the throat. It is superficial to all these structures, except of course the skin, where anteriorly it is attached, being in contact above with the poison-gland of the corresponding side. Now there are a few muscular fibres to be seen in the anterior portion of this tendon, so that upon contraction it will tend to press with some force the poison-gland against the mandible, and thus be auxiliary to forcing its secretion through the gland's ducts at the time this reptile makes its bite.

4. *Pterygoideus externus.*—Chiefly carneous, this is another large muscle of this region, which arises from the inferior aspect of the corresponding pterygoid to pass backwards and outwards in the form of a subelliptical bundle of fleshy fibres that take it upon themselves to completely envelop the articular extremity of the mandible, being inserted into the three elements that go to form that end of the bone. This muscle is somewhat tendinous at its origin, but almost entirely carneous at its insertion.

5. *Pterygoideus internus.*—More modest in its proportions than the last described, this muscle finds its origin upon the outer margin of the parietal bone, and the adjacent surface of the prootic, at the antero-external region of the orbit. From this point of origin its fibres

take on the same direction as the fibres of the *temporalis*, of which it seems almost to be the anterior part, and passing downwards and forwards, they are inserted, being somewhat tendinous, into the inner aspect of the ramus of the mandible, below and at the same time behind the coronary process[1].

6. *Neuro-mandibularis*.—Both this and the next muscle are but feebly developed in our present subject, and so much alike are they, both in their origins and insertions, as well as in the direction of their fibres, that one might easily mistake them for one and the same structure. The *neuro-mandibularis* is the more posterior of the two, and upon either side it arises from the hinder free margin of the parietal bone, from its mid-posterior point for a distance outwards of about four millimetres. It is thin and tendinous here, but soon gathers itself into a small, somewhat laterally flattened, bundle of fibres which pass directly downwards to the posterior tip of the mandible, where they make a firm tendinous insertion.

7. *Digastric*.—Is rather a smaller muscle than the *neuro-mandibularis*, being related to it as we have already described in the foregoing paragraph. It is the muscle of the deep layer which goes to form the posterior fleshy border of the aural opening, the *mylo-hyoideus posterior* being the superficial one. It arises from the point of meeting of the quadrate, squamosal, and parietal bones, at the postero-lateral aspect of the cranium, and passes directly downwards to make a common insertion with the *neuro-mandibularis* on the hinder end of the lower jaw.

Mivart does not allude to the *neuro-mandibularis* as occurring in either Parson's Chamæleon or in the Iguana, while Sanders describes it as being present in *Phrynosoma*, as well as in *Liolepis*. Hoffmann recognizes it in his general account of the myology of Lizards, while again Mivart (Elem. Anat. p. 311) figures *two digastrics* for *Menopoma*, the posterior one of which I take to be the *neuro-mandibularis*.

### *Muscles of the Hyoidean Apparatus.*

8. *Genio-hyoideus*.—This is a flat muscular sheet composed of fasciculi of coarse fibres, which, with the fellow of the opposite side, forms a substantial fleshy underflooring to the buccal cavity. Either genio-hyoid arises, carneous, from the entire anterior surface of the corresponding thyro-hyal of the hyoid, and its fibres, converging but very slightly, pass directly forwards to become inserted along the inner aspect of the ramus of the mandible for the middle third of its length. The deeper fibres of this muscle pass upwards to become inserted into the base of the tongue. This muscle is inclined to be more tendinous at its insertion than it is at its origin, where in front it is separated from its fellow by quite an interval.

9. *Cerato-hyoideus*.—By dividing the *genio-hyoideus* transversely through its middle and reflecting back the cut extremities, we expose the deeper set of the hyoidean muscles. The *cerato-hyoideus*

[1] I fail to find a "*superficial temporal*" in this lizard, as is described by Mivart in *Chamæleon parsonii* (P. Z. S. 1870).

consists of a loosely connected plain of coarse fibres, which arise from the outer half of the posterior cornua of the hyoid, from the under surface of the anterior horn of the same bone, and from the membrane of the floor of the mouth. Passing directly forwards it inserts itself, tendinous, into the inner aspect of the dentary element of the mandible posterior to the symphysis. From this it will be seen that this muscle is posteriorly broad and anteriorly narrow.

10. *Mandibularis.*—This is a muscle that, thus far, I have failed to find any published description of, although it was evidently seen by Fischer, who has presented us with an imperfect drawing of it, and apparently left the muscle unnamed (see fig. 1, Taf. xcvii. Bronn's 'Thier-Reichs,' Bd. vi., iii. Abth., 33 & 34 Lief. 1882). When I say an imperfect figure, I mean that the muscle does not interdigitate with the *m. genio-hyoideus superficialis* as Fischer has represented it, at least it does not in the several specimens of *Heloderma suspectum* wherein I have examined it. The *mandibularis* is a small muscle which has an origin for about half a centimetre on the inner aspect of the dentary element of the mandibular ramus just posterior to the point of attachment of the *cerato-mandibularis*. It is quadrilateral in form, and its fibres pass directly across the inter-ramal space to meet the muscle of the opposite side, which it does in a delicate fascia in the median line. It is deep to the *genio-hyoideus*, and I have provisionally bestowed the above name upon it, until its homologies are better known.

11. *Cerato-mandibularis.*—In this we have a muscle that appears to represent but a little more than the differentiated external margin of the *genio-hyoideus*. It arises, on either side, from the apex of the posterior cornua of the hyoid bone, and its fibres taking on the same direction as those of the *genio-hyoideus*, the muscle inserts itself by a delicate tendon into the antero-internal aspect of the mandible just posterior to the insertion of the *genio-hyoideus*, and upon the same plane with it. This muscle is the *cerato-mandibular* of Mivart, and, in part, the *mylo-hyoideus* of Sanders; it being the *cerato-mandibularis* of Hoffmann.

12. The *Omo-hyoideus* is a handsomely developed muscle in this lizard, arising for the most part from the anterior border of the clavicle of the same side, and from the summit of the interclavicle, and apparently by a single head. Its fibres form a flat band, which, passing forwards and inwards, insert themselves into the posterior surface of the basihyal, and the hinder margin of the corresponding thyro-hyal for the inner two thirds of its length. Mesially it meets the muscle of the opposite side for a limited distance in front, and for the most part is superficial to the next two muscles to be described. Externally it is overlapped by the *sterno-mastoideus*, and we note that passing obliquely across its middle a tendinous line is to be seen, from the external, and at the same time the most anterior, half of which its fibres are inclined to be more outwardly directed, before making their insertion into the thyro-hyal.

13. The *Sterno-hyoideus* is a much slenderer muscle than the last

described one, and in its characters it almost agrees with the same muscle in *Liolepis*, as described for us by Sanders. Arising from the summit of the interclavicle and the adjacent fascia, it takes a course directly up the middle of the neck, to become inserted into the basi-hyal and for a limited distance on the adjacent thyro-hyal, on their posterior margins. This muscle is almost in contact with the fellow of the opposite side for its entire length.

14. The *Sterno-hyoideus profundus* is situated deep to the two last-mentioned muscles, it taking origin from the interclavicle, the corresponding clavicle for nearly its entire length, and from the deep fascia of the neck adjacent to these parts. From this origin its fibres are directed upwards, forwards, and outwards, to finally insert themselves along the hinder border of the thyro-hyal of the same side, from its tip inwardly to the point of insertion of the *sterno-hyoideus*. At the postero-mesial point of origin this muscle and the fellow of the opposite side are in contact.

### *Muscles of the Shoulder-Girdle and the Upper Extremity.*

15. The *Sterno-mastoideus* in this lizard is a strong, broad, and flat muscle, which arises from the summit of the interclavicle at its external aspect, also from the adjacent fascia as far back as the shoulder-joint. Passing obliquely upwards, forwards, and outwards, it is inserted into the outer end of the squamosal of the corresponding side. At its insertion it is covered by the *neuro-mandibularis*. Posterior to this the *sterno-mastoideus* is attached to the superficial fascia overlying the deeper muscles of the back of the neck, as far back as the third cervical vertebra. In this locality the muscle becomes very thin. The anterior and posterior portions of this muscle are somewhat individualized, more especially the dorsal moiety of the muscle, where the cranial and cervical insertional parts are quite distinct.

16. *Trapezius*.—This muscle is comparatively feebly developed in *Heloderma*, being subtriangular in form, and overlapping behind the anterior portion of the *latissimus dorsi*. It arises as a thin sheet of tendon from the fascia that springs from the cervico-dorsal vertebræ at the summits of their neural spines, from about the last few cervical vertebræ, to include the first two dorsals. The fibres, forming a thin muscular plane, converge as they pass down towards the shoulder-joint, where they again become tendinous, and are finally inserted at the anterior portion of the outer aspect of the suprascapular of the same side, to the fascia below and posterior to this, and more anteriorly to the outer extremity of the corresponding clavicle.

17. *Latissimus dorsi* is a much better developed muscle than the last described, being a strong, flat, triangular fasciculus of rather coarse muscular fibres, which arise for the most part from the aponeurosis of the dorsum that is attached to the neural spines of the tenth to the twenty-first vertebræ inclusive, being adherent to the fascia covering the deeper muscles for some little distance outwards

from these points. Passing downwards and forwards it becomes inserted by a strong tendon into the proximal third of the corresponding humerus upon its ulnar aspect. The outer margin of this muscle develops a strong tendon, which, as the muscle itself passes between the heads of the triceps to its insertion, branches off to insert itself into the triceps, upon its inner head. Mivart found a similar tendon to this in *Iguana*, and Sanders in *Phrynosoma*; but the latter anatomist found it absent in *Liolepis*.

18. *Levator scapulæ*.—This is a flat, triangular muscle that arises fleshy from the external aspect of the anterior part of the scapular and suprascapular, and from the anterior margins of both of these bones. Its fibres converging as they pass directly forwards and passing between the deep muscles at the side of the neck, it is finally inserted by a strong tendon into the side of the atlas.

19. *Pectoralis*.—*Heloderma* has this important breast-muscle well developed; it arises from the external longitudinal half of the entire length of the interclavicle, from the posterior border of the inner end of the clavicle, from the ventral aspect of the sternum, from the corresponding surfaces of the last four costal ribs and the intercostal fascia, and finally posterior to these parts from the fascia of those muscles of the abdomen which are situated deep to the pectoralis.

From these several points of origin, a *pectoralis* of either side has its fibres converging to a point represented by the tuberosity of the humerus of the same side, and here they are inserted, tendinous, upon a line defining its mesial aspect, and for its entire margin.

20. *Deltoideus* in the species before us arises by two heads—the anterior head from the underside of the mesial extremity of the clavicle; the posterior head from the interclavicle close to the anterior head, and from the surface of the sternum immediately adjacent: these two heads are in contact for their entire lengths, and their fibres are sent directly to the corresponding humerus; passing backwards and outwards, they become inserted by a strong tendon upon the head of that bone, just anterior to the next-to-be-described muscle. It appears that Sanders found in *Liolepis* and in *Phrynosoma* only that part of the *deltoideus* which represents its clavicular portion present. I believe it has a double head in the *Iguana*.

21. The *Supraspinatus* is a flat, triangular muscle of the chest, which, in this lizard, arises from the anterior half of the mesial margin of the coracoid, by means of a strong aponeurosis; the fibres converge as they take their way to the humerus of the same side, and are inserted, tendinous, into the tuberosity of that bone, close to the insertion of the *pectoralis*.

Here in *Heloderma* the *supraspinatus* appears almost to be divisible into two parts, the anterior half of the muscle being connected with the posterior half by an easily separable fascia; but as their origins are continuous, as well as their insertions, the muscle could in no way be properly described as having two heads.

Hoffmann, who calls this muscle the *m. supracoracoideus*, informs us in his synonymy that it is the *subclavius* of Rolleston, the

*pectoralis* II. of Stannius, and the *epicoraco-humeral* of Mivart. Fürbringer also called it the *supracoracoideus*. As in *Liolepis*, the *supraspinatus* is covered by the *deltoideus* at least for its inner anterior part and anterior border. Mr. Sanders, who says that he has "seen Prof. Rolleston's paper (Trans. Linn. Soc. vol. xxvi. pt. 3), 'On the Homologies of certain Muscles connected with the Shoulder-joint,' in which he goes far to prove that the 'epicoraco-humeralis' (which was Dr. Mivart's name for the supraspinatus) corresponds to the subclavius; but these differences of interpretation are reconciled by Mr. Galton's paper 'On the Myology of the *Orycteropus capensis*,' in the same volume, in which the author shows that the subclavius in that animal has, among other insertions, one into the fascia covering the supraspinatus. Another piece of evidence bears upon this point; I believe that the nerve which in anthropotomy supplies the supraspinatus, arises from the same cord of the brachial plexus and close to the same one which supplies the subclavius, so that the muscle in question really corresponds to the subclavius at its origin, and to the supraspinatus at its insertion" (P. Z. S. 1872).

22. The *Infraspinatus* in *Heloderma* is a broad, thin, and fan-shaped muscle which arises from a curved line occupying a middle position upon the external surface of the suprascapula. From this point of origin its fibres tend immediately to converge to a point, but terminate in a strong, flat tendon which inserts itself upon the tuberosity of the humerus just beyond the insertions of the *deltoideus* and *supraspinatus*.

23. The *Teres minor* is one of the deeper muscles of this shoulder-girdle group, and it arises from the antero-external border of the coracoid and the adjacent margin of the scapula. Its fibres pass upwards, backwards, and outwards, when, becoming tendinous, the muscle inserts itself upon the proximal end of the humerus of the same side, just beyond its head. Not far from its insertion, the *teres minor* is bound down by a strong tendinous aponeurosis, which latter comes off from the tendon of the long head of the *triceps*, connecting this last with the head of the humerus. Fürbringer called this muscle the *scapulo-humeralis profundus*, in which he was followed by Hoffmann; and according to this latter author it represents the *supraspinatus* of Pfeiffer and Rüdinger, the *infraspinatus* of Mivart, the *suprascapularis* of Rolleston, and the *teres minor* of Sanders: may we not in truth believe that there is still work to be done in the myology of reptiles?

24. *Serratus superficialis*.—Two of the *serrati* muscles form an oblong fleshy mass upon the external aspect of the thoracic parietes, connecting the vertebro-costal ribs with the posterior border of the suprascapula. *Serratus superficialis* arises by two digitations, the most posterior of which springs from the outer surface of the posterior extremity of the second sternal rib, while the larger or anterior one comes off from a similar point upon the first sternal rib. Its fibres run forwards and upwards, and insert themselves upon the hinder border of the suprascapula, at its postero-inferior angle.

This muscle is superficial and closely applied to the *serratus profundus*, its fibres having the same direction almost throughout its length; it is so inserted, however, that the wider *s. profundus* extends beyond it, both beyond its superior and inferior borders posteriorly; while anteriorly, the lower margins of these two muscles are nearly in the same line, and the *s. profundus* expends its greater width above it, having a higher insertion upon the suprascapula.

25. *Serratus profundus.*—As I have already pointed out in the description of the *s. superficialis*, the present muscle lies immediately beneath the same. It arises from the superior extremities of the first two sternal ribs; from the lower end of the last cervical rib; and from the lower end of the first dorsal rib, as well as from the fascia stretching between these parts of the skeleton. Its fibres taking a course forwards and upwards, they become inserted upon the entire posterior border of the suprascapula, making slight encroachment upon the adjacent internal surface of the same bone.

26. *Serratus tertius.*—This is the third muscle of the *Serrati* group, and it arises by fleshy digitations from the fascia between the last two cervical ribs (this part of the origin is very weak), from the free extremities of the penultimate and next two anterior cervical ribs. From this origin the muscle is thrown upwards as a thin, fleshy sheet, covering the thoracic aspect of the corresponding scapula and suprascapula, to finally insert itself along the free, inner margin of the last-named bone, for the anterior four fifths of its superior edge.

27. *Sterno-coracoideus internus superficialis.*—To examine this muscle from the ventral aspect one must disarticulate the coracoid and the sternum, as the muscle lies within the thoracic cavity. It will be found to arise from the externo-dorsal surface of the sternum: from the anterior border of the same surface and from one or two of the sternal ribs and the fascia between them, upon the same side. From this origin its fibres pass directly forwards, converging somewhat as they do so, to become inserted into the coracoid, on its inner aspect and near its lower anterior border, immediately in front of the *subscapularis*.

28. *Sterno-coracoideus internus profundus.*—As its name indicates, this muscle is deep to the one just described. It arises from the inner chest-wall, and from the thoracic aspect of the posterior moiety of the sternum beyond it; when, converging, its fibres becoming tendinous, it finally inserts itself upon the inner surface of the coracoid, above and somewhat anterior to the *sterno-coracoideus internus superficialis*. Both these muscles were found to be present in *Liolepis belli* by Sanders, while Mivart describes but one of them as the "sterno-coracoid" as occurring in Parson's Chamælon. Following Fürbringer, they have also been termed the *m. sterno-coracoideus internus superficialis* and *m. sternocoracoideus internus profundus* by Hoffmann, who has said of them that "Die *Mm. sterno-coracoidei interni superficialis* und *profundus* werden in der Regel durch zwei an der Innenfläche des Brustbeins und ventralen

Brustgürtels gelegene Muskeln repräsentirt, die Sternum mit Coracoïdeum verbinden. Am einfachsten ist die Bildung bei *Platydactylus* .... Hier entspringt ein ansehnlicher Muskel von der Innenfläche und dem vorderen äusseren Rande des Sternum, sowie von den angrenzenden Enden der Sternocostalleisten und geht nach vorn zur Innenfläche des Coracoideum. Dieser *M. sterno-coracoideus internus* lässt an seinem insertiven Theile eine gewebliche Differenzirung erkennen, derart, dass die mediale Portion sehnig und weiter vorn sich inserirt als die laterale, welche fleischig sich an das Coracoideum ansetzt."

"Diese Differenzirung entspricht der ersten Anlage einer Trennung in zwei ganz selbständige Muskeln, *M. sterno-coracoideus internus superficialis* und *M. sterno-coracoideus internus profundus*, wie sich dieselbe in ausgebildeten Zustande bei den meisten typischen Sauriern findet."

"Der *M. sterno-coracoideus internus superficialis* entspringt von der Innenfläche der inneren Lippe der Coracoidfurche des Sternum und inserirt sich medial neben dem hinteren Theil des Ursprungs des *M. subcoracoideus*."

"Der *M. sterno-coracoideus internus profundus* entspringt von der Innenfläche des Sternum, namentlich im Bereiche des hinteren Abschnittes, sowie von den angrenzenden Enden der Sternocostalleisten. Er geht in eine lange und ziemlich schmale Sehne über, welche sich an der Innenfläche des Coracoideum inserirt."

"Bei den fusslosen Sauriern ist dieser Muskel in der Regel bis auf spärliche, seitlich gelegene Rudimente (*Pygopus*, *Pseudopus*, *Lialis*), die speciell dem *M. sterno-coracoideus internus superficialis* zu entsprechen scheinen, verkümmert oder total reducirt (*Ophiodes*, *Acontias*)." (Bronn's 'Thier-Reichs,' Bd. vi. 22–24 Lief. pp. 625, 626, 1881).

29. *Sternocosto-scapularis*.—This muscle, described by Fürbringer, is found to be well developed in *Heloderma*, and is seen to arise, fleshy, from the anterior surface of the outer extremity of the first sternal rib, and as a flattened and narrow fasciculus of fibres to pass directly forwards to the internal surface of the scapula. Here it is inserted, its insertion being found between the two divisions of the *suprascapularis* muscle. Mivart, who calls this muscle the "costo-coracoid," found it absent in *Chamæleon parsonii*, but present in *Iguana*; in the former, however, it is represented by a "sheet of membrane" (P. Z. S. 1870, p. 865). According to Hoffmann, it is entirely absent in *Platydactylus*. And this last-named author describes still another shoulder-girdle muscle for lizards, the "teres major," which I find to be lacking in *Heloderma*: of it he says, "Entspringt entweder von dem hinteren Abschnitt der Aussenfläche des Suprascapulare (*Uromastix*, *Stellio*, *Trachysaurus*), oder von dem hinteren Rande der Scapula und des Suprascapulare (*Euprepes*) und inserirt sich am Humerus in der Nähe des Processus medialis, entweder für sich (*Scincoiden*) oder mit dem Latissimus dorsi (*Uromastix*)" (*loc. cit.* p. 624).

30. *Subscapularis*.—As in the majority of true lizards, this muscle

is here divided into two parts: the most posterior part envelops the hinder border of the scapula and suprascapula in a fleshy mass, encroaching slightly upon the adjacent surface of the coracoid. After this it converges to form rather a strong tendon, which is subsequently joined by the weaker tendon from the second part. This latter arises from the inner surface of the corresponding coracoid, covering a longitudinally-placed, elliptical area, occupying the greater share of its lower third. As already intimated, its tendon joins the tendon of the first part, just beyond the border of the coracoid, when almost immediately they become inserted into the distal margin of the head of the humerus at its posterior aspect. Between these two divisions of the *subscapularis*, the *sternocostoscapularis* muscle is inserted, upon the mesial aspect of the shoulder-blade. Externally, the *subscapularis* covers by its origin about half of the scapula, extending but very slightly upon the suprascapula, and in this locality is covered for its anterior portion by the *infraspinatus*. Just before inserting its tendon upon the humerus, a portion of the former is deflected and so expanded as to become inserted into the juxtaposed capsular ligament of the shoulder-joint, and this part of the insertion of the *subscapularis* seems to be enjoyed by the muscle among most Lizards.

Fürbringer and Hoffmann term this muscle the *subcoracoscapularis*, but the name I here adopt for it is the one that has been used by Mivart, Sanders, Stannius, Pfeiffer, Rüdinger, and other anatomists.

31. The *Biceps* here arises but by a single tendon, of some considerable width, which has its origin upon the external surface of the coracoid of the same side, it being limited to a curved line on the posterior moiety of the bone immediately within the line of the sterno-coracoidal articulation. The muscle passes directly down to a point just in front of the elbow-joint. It is not until it gets opposite the head of the humerus, however, that the thin flat tendon of the *biceps* becomes carneous, and even here it does not show any disposition, as it does nowhere else throughout its extent, to divide so as to exhibit anything that might be compared to two heads. At the middle of the brachium the muscle is considerably bellied and fleshy. Opposite the elbow-joint it again becomes tendinous, and its tendon here is transversely disposed, binds down the anterior aspect of the *brachialis anticus* muscle, as it spans the interosseous space, and finally is inserted into both the ulna and the radius, the ulnar insertion being much the stronger of the two.

Sanders found that the *biceps* is only represented by its coracoidal head in *Liolepis*, while Mivart found that in Parson's Chamæleon its insertional slips arched over the *brachialis anticus* muscle, exposing the latter to view in front, and he says of it, that "Descending in front of the insertion of the pectoralis, it there becomes fleshy, and becomes more or less divisible into two bellies, which embrace the brachialis anticus in front, but leave part of the latter visible within and without the arm." As I have just said, here in *Heloderma* it covers the *brachialis anticus*, and simply spans the interosseous space in front of it as it makes its double insertion,

and it agrees with all these forms in possessing only its coracoidal head.

32. *Coraco-brachialis brevis.*—This is one of the deep muscles of the shoulder-girdle found upon the anterior aspect of the chest, and is here very well developed. It arises from the outer surface of the coracoid, between the rounded, posterior angle of that bone to a point anteriorly next to the origin of the *teres minor*. Its area of origin is luniform, the concavity being towards the humerus; and agreeing in form, posteriorly, with the coracoid, which in this locality it nearly covers. Its fibres converge as they pass towards the humerus, upon which bone the muscle is inserted, the insertion being upon a line extending from the head of the bone to a point at the junction of upper and middle thirds, on its anterior surface: the *coraco-brachialis brevis* also makes a partial insertion into the capsule of the shoulder-joint.

Posteriorly, this muscle is firmly overlapped by the thin, flat tendon of the *biceps*, while more anteriorly some of the superficial muscles cross it to the humerus.

33. *Coraco-brachialis longus.*—This is a very differently characterized muscle from the one I have just described, it being long and slender, passing parallel to the humerus for its entire length. It arises, upon either side, from the posterior rounded angle of the coracoid, making slight encroachment upon the adjacent posterior surface of the bone. From this origin this long and fleshy muscle goes directly to the internal condyle of the humerus, into which it inserts itself: its insertion also extends slightly up the shaft of the bone, while its fascia merges with the fascia of the shoulder-joint.

Sanders, Fürbringer, and Hoffmann all adopt the same names for these muscles as I have given them here, the first-named authority using them in the case of *Liolepis belli* as early as 1872. Both the *coraco-brachialis brevis* and *longus* are invariably present, so far as I am aware, in all true Lizards.

34. *Brachialis anticus.*—Comparatively larger than we find it in many Vertebrates, this muscle becomes one of the important ones of the arm, being even larger than the *biceps*. It arises, somewhat tendinous, from the entire antero-external aspect of the shaft of the humerus, from tuberosity to condylar extremity, being intimately associated with the *triceps* upon its inner side, and in contact with the *biceps* externally. Passing between the muscles of the forearm in company with the tendon of the *biceps*, it inserts itself, tendinous, into the proximal extremities of the radius and ulna, upon their anterior surfaces, being largely covered by the insertional tendon of the *biceps* in front.

Fürbringer terms this muscle the "humero-antebrachialis inferior," a name also adopted by Hoffmann; it being the *brachialis anticus* of Mivart and the *brachialis internus* of Rüdinger. It generally inserts itself into both bones of the forearm, but Mivart found that in *Chamæleon parsonii* this muscle inserted itself only into the ulna.

35. *Triceps.*—This thick and powerful muscle at the back of the arm, here in our present subject exhibits four points of origin, viz.:—

(1) Its first head, and distinctly the largest, arises from the entire posterior aspect of the shaft of the humerus, from the head of the bone to the condyles. This part of the origin of the *triceps* is comparatively carneous.

(2) Another, and a very much smaller, carneous head springs from a longitudinal line upon the posterior aspect of the shaft of the humerus, extending from the tuberosity to a point a little above the internal condyle. At the upper part of the shaft of the humerus the insertional tendon of the *latissimus dorsi* passes between these two heads.

(3) A strong, cord-like tendon of the *triceps* springs from the superior glenoid margin of the scapula, which merges into the fleshy part of the muscle after it passes the head of the humerus. We find given off from the proximal end of this tendon, a thin, though strong tendinous sheet, which passes across to the humeral head, binding down as it does so the insertional extremity of the *teres minor*.

(4) Finally, we find a long flat tendon of the *triceps* arising from the inner surface of the coracoid near its postero-inferior angle. This crosses over to the upper part of the belly of the muscle, and merges into it at a point immediately in front of the insertion of the *latissimus dorsi*. A tendinous connection is made between this last-named muscle and this coracoid-head of the *triceps* at the point we have indicated.

The *triceps* is inserted by a powerful tendon into the olecranon process of the ulna, but no sesamoid develops therein as was found to be the case in Parson's Chamæleon by Mivart, and in *Liolepis belli* by Sanders. This sesamoid is also alluded to by Hoffmann as the "patella ulnaris," in Bronn's 'Thier-Reichs' (*loc. cit.* p. 632).

### *Of the Musculature of the Antibrachium and Manus.*

36. *Supinator longus.*—This, one of the most important and conspicuous muscles of the forearm, arises semitendinous from the external condyle of the humerus, and immediately makes insertion along the entire length of the shaft of the radius, upon its supero-external aspect. Hoffmann has very truly remarked in reference to this muscle that "Man kann an diesem Muskel gewöhnlich zwei zuweilen drei oder selbst vier Portionen unterscheiden (letzteres bei *Iguana*, nach Mivart). Alle diese Portionen entspringen von dem Epicondylus s. Condylus externus humeri (bei *Platydactylus* auch noch von dem unteren Drittel des Humerus, bei *Liolepis* oberhalb des Condylus). Seine Insertion findet, wie gesagt, an der ganzen Länge des Radius statt." These remarks apply equally well to the *supinator* in *Heloderma*.

37. *Extensor digitorum longus.*—In this we have another muscle which is prominently developed in the forearm of our present subject. Arising by a strong tendon from the external condyle it passes down the limb to merge into a thin, flat tendon over the wrist-joint, beyond which it trifurcates, a slip going to be inserted

in each case into the base of the second, third, and fourth metacarpal bones. Just beyond its origin this muscle is very thick and fleshy, and in this locality fuses to some little extent with the *supinator longus*, while at its insertion a thin tendinous expansion more or less unites its slips of division, and spreads out over the back of the carpus.

38. *Extensor carpi radialis.*—Running parallel with the *extensor digitorum longus*, this muscle likewise arises, tendinous, from the external condyle of the humerus, and, as it approaches the carpus, it forms a slender tendon which inserts itself into the *os carpi radiale*.

This muscle has not more than a quarter the bulk of the *extensor digitorum longus*, with which it is quite intimately connected along its radial border.

39. *Extensor digitorum brevis.*—Superficially, on the back of the manus, we observe a divided set of muscles, which constitute the short extensors of the phalanges. Five-parted, but each slip more or less distinct, the *extensor digitorum brevis* arises from the dorsal aspect of the five metacarpal bones at their proximal extremities, and from the ossicles of the first row of the carpus. These slips are fleshy over the back of the hand, but become tendinous, each one at the bases of the digits, and a tendon runs along the back of each phalanx to the base of the ungual joint, where it is, in each case, inserted.

Proximally, these muscular slips are imbricated, while distally their tendons, as they pass over each phalangeal joint in the fingers, send down lateral tendinous slips on either side, which attach to the sides of the heads of the finger-bones.

40. *Extensor carpi ulnaris.*—Springing from the postero-external aspect of the external condyle of the humerus, in common with the *flexor carpi ulnaris*, by a strong tendon, this muscle passes down the side of the forearm; when opposite the radial side of the wrist it develops a strong tendon which, passing between the muscles of the hand on that side, finally inserts itself into the proximal end of the fifth metacarpal, upon its external surface.

41. *Ulno-metacarpalis pollicis.*—I propose this name for the present muscle in lieu of the "*Ulno-pollicialis dorsalis s. Abductor pollicis longus*" of Fürbringer, or even the "*M. ulno-metacarpialis I*" of Hoffmann. It is the *Abductor pollicis longus* of Stannius, the *Extensor ossis metacarpi pollicis* of Mivart and Sanders. It arises from the dorsal aspect of the lower third of the forearm; springing from the upper surface of the shaft of the ulna, it passes obliquely across the carpus, to finally develop a strong little tendon which is inserted into the proximal end of the pollex metacarpal, upon its dorsal side.

42. The *flexor carpi ulnaris* arises by two heads—one from the posterior surface of the radial condyle of the humerus, and the other from the side of the proximal extremity of the ulna and from the olecranon process of that bone. These are at first strong tendons, but soon become carneous and forming a flat, powerful muscle running down the outer side of the forearm, which again becomes tendinous at the wrist, to finally insert itself into the pisiform bone, upon the

ulnar side. To speak more strictly, this superficial muscle of the forearm does not altogether run down its outer side, but rather crosses the limb somewhat obliquely, from the proximo-radial side to the ulno-distal aspect.

43. *Flexor carpi radialis.*—This rather slender muscle, though it develops a strong tendon both at its origin and insertion, arises from the internal humeral condyle, and, passing down superficially, on that side of the forearm, it becomes inserted into the os carpi radiale, and furthermore sends a tendinous slip to be inserted into the proximal extremity of the pollex metacarpal.

44. The *Pronator radii teres* is a conspicuous muscle of some considerable bulk, which arises from the internal condyle of the humerus, by means of a strong tendon, and is inserted into the anterior surface of the shaft of the radius for fully half its length. It is fleshy at its insertion, and intimately related to the *flexor carpi radialis* for its entire length.

45. *Pronator accessorius.*—Mivart found this interesting muscle present both in the Iguana and in Parson's Chamæleon, but according to Sanders it is absent both in *Liolepis* and *Platydactylus*, and present in *Phrynosoma*. Hoffmann states that it is absent in *Goniocephalus*, and he terms the muscle the *M. ulno-carpalis*. Rüdinger termed it the *Pronator quadratus proprius*; Mivart gave it the name here adopted; it is the *Pronator radii brevis* of Sanders, and the *Ulno-navicularis* of Fürbringer. *Heloderma suspectum* has it arising from the anterior aspect of the internal condyle of the humerus by rather a slender tendon, whence it passes directly across to the radius to make a carneous insertion upon rather more than the middle third of the shaft of that bone, along a line upon its inferior aspect. The tendons of the *biceps* and the *brachialis anticus* pass between this muscle and the proximal third of the shaft of the radius, to their insertions.

46. *Pronator quadratus.*—Having removed the superficial layer of muscles from the anterior aspect of the forearm, we readily expose the present one. It is seen to be a fleshy plane of muscular fibres which obliquely span the inter-radio-ulnar space; arising from a line extending down the shaft of the ulna on its radial side, these fibres pass forwards to the radius and insert themselves on the entire length of its shaft, on the side opposite the ulna.

*Heloderma suspectum*, then, possesses all three of these *pronator muscles* in its forearm, but we see from what has gone before that some lizards may have but one of them, others only two, and still others all three: so, then, we may judge that when the morphology of these Vertebrates is better known, these differences may come into play, as one good set of characters, in their classification.

At the postero-external aspect of the distal end of the ulna, at the back of the carpus, there is found in *Heloderma* a concavo-convex bonelet which I take to be the "pisiform." Attention is drawn to this ossicle here as we shall have to refer to it in the description of our next muscle.

47. *Flexor perforans digitorum.*—Before rendering my account

of this muscle, and the next one to be described, in *Heloderma*, I would say that I have found fundamental differences in both of them as compared with the corresponding muscles in other Lizards, as they are described for us by the various authors before me, for a number of forms. So different, indeed, did I find the present one, that I dissected it out in three forearms of three separate individuals; not only that, but I was not satisfied until I had again gone over all the other muscles of the forearm, removing them one at a time until only the *flexor perforans digitorum* and the *flexor perforatus digitorum* remained. The present muscle was found to be the same in all of these specimens. It arises by a broad and common tendon, in two well-defined parts, from the internal condyle of the humerus. Of these the larger and more massive part arises on a line below the origin of the *flexor carpi radialis*, while the origin of the second part is to be sought beneath the tendon of origin of this last-named muscle. Nice discrimination is required to properly separate these muscles at their common origin; and Sanders found that in *Liolepis* the *flexor carpi radialis* and the *flexor perforans digitorum* were inseparable in this part of their course.

Returning to the first part of the muscle we have now under consideration, we find that it stretches between the internal humeral condyle and the pisiform bone of the carpus, its carneous portion forming a muscular mass, of no inconsiderable bulk, at the middle of the flexor aspect of the forearm. Its insertion covers the entire palmar surface of the pisiform bone, the insertion of the tendon of the *f. carpi ulnaris* being found to its outer side. At the middle of the forearm, over the interosseous space, this part throws off a flat, muscular slip, which, becoming tendinous just before arriving at the wrist, joins the tendons of distribution of the second part of the *flexor perforans digitorum*, and with them passes beneath the annular ligament of the carpus.

Now both of these parts of our present muscle not only have an origin from the internal condyle of the humerus, as I have already described above, but they both likewise arise from the entire length of the contiguous surface of the shaft of the ulna: this division of the origin is quite free from the belly of the smaller, or second part of the *f. perforans digitorum*, but it becomes far more intimate with it at the carpus, at the point where the tendon commences that passes beneath the annular ligament to go to the fingers. This last-mentioned tendon still remains to be described. A large, flat sesamoid occurs in the broad and compressed trunk of this as it passes over the wrist-joint. In the palm the tendon splits into five strong slips, and these are distributed in regular order to the five digits, each one passing to the end of its proper finger to be inserted into the base of the ungual phalanx, upon its flexor side. A triangular muscular slip of some considerable size is given off from this tendon as it passes over the wrist, and its fibres converging they become inserted into one or two of the mid-carpal bones. Sanders found a muscular development similar to this in *Liolepis*. The muscular slip that goes to the pollex digit apparently does not give off either

auxiliary muscular slips or tendons, but simply passes through the semitendinous tube developed for it by the *flexor perforatus digitorum*. At the point of bifurcation, from the dorsal aspect of the tendon-slip that goes to the second digit, we find two muscular slips given off: the one on the ulnar side distally forms a slender tendon which joins the corresponding tendon of the *flexor perforatus digitorum*; the one on the radial side inserts itself into the base of the proximal joint of the corresponding phalanx. This arrangement also obtains in the case of the third and fourth digits, and to a considerable extent with the fifth digit also.

48. The *Flexor perforatus digitorum*, as in so many lizards, is a muscle confined to the palm of the hand. In the reptile before us it arises by a common tendon from the pisiform bone and to some extent from the annular ligament of the wrist. From its point of origin it immediately radiates in the direction of the fingers, primarily dividing into five slips, each one going to its proper digit, and together forming a comparatively thick muscular pad for the palm of the hand. Each and all of these slips are quite distinct, and the one devoted to the pollex is especially thick: this latter at its insertion develops two small tendon-slips which attach, upon either side, to the proximal end of the first phalangeal joint at its latero-palmar aspect, and between these passes the tendon of the deep flexor which goes to this digit. A firm connective tissue both extensively and intimately surrounds the joint at this point, and has to be dissected away before the true relations of the parts can be clearly seen; and, further, we find that a tubular canal arises in this locality, stretching longitudinally along the nether aspect of the phalanx, being attached to its sides, and through it passes the digit-tendon of this finger furnished by the deep flexor. In the case of the second finger the arrangement is essentially quite different from what I have just described it for the thumb; and here, too, as already pointed out above, the power of the muscle is augmented by the reception, at its ulnar side, of an auxiliary slip offered on the part of the deep flexor. We also find the fibrous, tubular canal present, as already described, and in this finger, as is indeed the case with all of the remaining phalanges, this tube abruptly terminates at the middle of the joint next behind the ungual one, at its palmar aspect, while an inner secondary tube also presents a terminal aperture opposite the middle of the proximal phalanx. Returning, now, to the difference in the arrangement of the tendons in this finger, I would point out the following interesting structures: instead of the insertional tendon-slip of the *flexor perforatus digitorum* of the second digit becoming inserted on either side of the proximal joint at its base, as is the case in the pollex, and thus allowing the deep tendon of the *perforans* to pass between them, it splits, and allows the same to pass through the perforation, but after that this slip-tendon of the *perforatus* is inserted as a single cord into the base of the second phalanx of the digit.

Here I will also invite attention to some other structures, which perhaps more properly should have fallen under my description of

the *flexor perforans digitorum*, but they are more forcibly brought to our notice at this point in our dissections. In the case of the second digit, which we still have under consideration, it is seen that when the tendon of the *flexor perforans digitorum* has passed through the perforation of the *flexor perforatus digitorum*, it in turn sends off a very delicate tendon which is perforated in its turn by the tendon of the *f. perforatus digitorum*, and which thereafter becomes inserted into the base of the second phalanx immediately posterior to the insertion of the tendon of the same. Again, when the tendon of the *f. perforans digitorum* passes the second joint of this second finger it sends off still another delicate tendon, which this time becomes inserted into the phalanx just referred to, at a point just posterior to its head. Finally, I find upon closer observation that in the case of the muscular slips which are thrown off on the part of the slip-tendons of the *f. perforans digitorum* in the palm of the hand, and which go to be inserted into the bases of the proximal phalanges of the third and fourth digits, that they so divide that the muscular slip between the second and third, as well as between the third and fourth metacarpals goes partly to the base of one finger and partly to the other, on either hand, for insertion. We will now consider the method of insertion of that slip of the *f. perforatus digitorum* which serves the third digit. This is very peculiar. Its main tendon is inserted into the palmar aspect of the distal extremity of the second phalanx, and is duly perforated near its middle by the proper tendon of the deep flexor. In addition to this it throws forwards still another and a delicate tendon, which in turn is inserted into the *base* of the phalanx just mentioned. This last tendon is perforated at its middle by the tendon both of the first-described tendon of the *f. perforatus*, as well as by the tendon of the *f. perforans digitorum*. We find here, also, that the tendon of the deep flexor sends off a delicate slip opposite each phalanx of the digit under consideration, which, in every case, becomes inserted into the several phalanges immediately posterior to their heads. The arrangement in the case of the fourth digit is essentially the same as that we have just described as obtaining in the third. In the fifth digit it is also the same, but the *f. perforatus digitorum* does not possess the auxiliary perforated tendon.

Comparing this with what Sanders found in the corresponding parts in *Liolepis belli*, we find them to be quite different in many particulars, as the reader may see by referring to that anatomist's work upon the reptile to which I allude. On the other hand, I am unable to compare these parts with the corresponding ones in *Iguana tuberculata* as they are offered us by Professor Mivart, for the reason that that investigator omitted to give a full account of the details as to the manner of insertion of the deep and superficial flexors in the form he selected for their demonstration, and in his drawing of the same the integuments have not been removed from the phalanges (P. Z. S. 1867, p. 785, fig. 6).

One would hardly look for such a high degree of specialization in the matter of these flexors of the hand of *Heloderma* as the reptile

is not called upon to use that member, so far as the writer knows, for any particular operation requiring either marked flexibility or suppleness; it simply plods about, and neither runs up trees, grasping the smaller twigs, nor does it especially use its fore feet in feeding.

Before closing what I have to say about this muscle I would direct attention to the fact that Professor Mivart, in his 'Elementary Anatomy' (p. 331), has said, that in *Iguana* "this muscle can hardly be said to be inserted by definite tendons"; while, again, their mode of insertion in *Phrynosoma* seems, according to Sanders, to be very simple (P. Z. S. 1874, p. 80).

49. The *Abductor quinti digiti* arises, fleshy, from the anterior aspect of the pisiform bone, and, its fibres contracting to become tendinous distally, it inserts itself into the shaft of the fifth metacarpal bone, immediately proximad to its head and upon the palmar aspect.

50. The *Adductor quinti digiti* is here well represented, being a delicate, thin, little band of muscular fibres which arise from the inner side of the proximal end of the pollex metacarpal, and, passing obliquely across the palm of the hand, are inserted into the proximal extremity, on the inner aspect, of the proximal phalanx of the fifth digit. This very distinct and interesting muscle I examined with the greatest care, but it does not seem to be recognized by Hoffmann, nor does it agree with what Sanders found in *Liolepis*. In *Heloderma* it is at once brought into view the moment we cut across and turn back the *f. perforans digitorum*, and it is found to be wider across its middle part than it is either at its origin or its insertion.

51. The *Adductor quinti digiti proprius* is a thick muscle which arises from the two outer bones of the second row of the carpus, upon the ulnar side, and passing directly forwards and a little outwards, inserts itself, carneous, along the entire length of the fifth metacarpal, upon the inner aspect of its shaft. This may be the *Adductor quinti digiti* of Sanders as found by him in *Liolepis* (P. Z. S. 1872, p. 168), while the muscle I here describe as the *Adductor quinti digiti* may be his *Abductor quarti digiti* (*loc. cit.* p. 169); but even in that event they are essentially very different, since the *Abductor quarti digiti* of Sanders, as found by him in *Liolepis*, is inserted into the ulnar side of the last phalanx of the fourth digit.

52. *Abductor metacarpi pollicis* is the name I here propose for another very well-developed muscle in the palm of the lizard before us. It arises from the two outer bones of the second row of the carpus upon the radial side, and from the dense aponeurotic fascia of the same region. Passing forwards and a little outwards the muscle is inserted, carneous, along the entire length of the shaft of the pollex metacarpal, upon its inner aspect.

53. *Lumbricales.*—The auxiliary muscular slips which I described above when speaking of the *flexor perforatus* and *perforans digitorum* muscles undoubtedly represent the lumbrical muscles in this

reptile. There were found to be five of them, and they passed from the tendon-slips of the *f. perforans digitorum* in the palm of the hand to the corresponding tendons of the *f. perforatus digitorum* and the bases of the proximal joints of the digits, as already pointed out above. Professor Mivart has carefully described these as they occur in *Iguana tuberculata* (P. Z. S. 1867, p. 785).

54. *Interossei palmares.*—There are *three* of these in the palm of the hand of *Heloderma*; they are unusually handsomely developed, somewhat peculiar, and I have studied them with great care, aided by a powerful lens. They arise by three thin, though strong, tendons, from two bones of the second row of the carpus. The first one springs from the outer one upon the ulnar side; the second one from the same bone as well as from the second in the row; the third comes off entirely from the second bone of the row. The first-mentioned muscle enlarges and becomes carneous as it passes forwards and is inserted, fleshy, into the distal extremity of the shaft of the fourth metacarpal bone upon its palmar aspect and just behind its head. Number two, or the middle one of the three of these *interossei palmares*, possesses a similar form to the one just described, and makes a similar insertion upon the shaft of the third metacarpal. Finally, the one on the side of pollex is inserted in a like manner into the second metacarpal.

I am thus careful in presenting these insertions of the palmar interosseous muscles, for the reason that Professor Mivart found that in *Iguana tuberculata* they were inserted "one on each side of the proximal phalanx of each of the three middle digits" (P. Z. S. 1867, p. 786). From their position here, it will at once be seen that these muscles are not truly "interossei," but rather rest upon the palmar aspects of the metacarpal bones, and it is from their position in the hands of most mammals that the term has been derived.

55. *Interossei dorsales.*—The first of these arises from the radio-palmar aspect of the base of the second metacarpal, and passing obliquely forwards and outwards becomes inserted along the inner side of the shaft of the pollex metacarpal, and distally by a tendon into the base of the proximal phalanx of the same digit, at its internal latero-dorsal aspect. We also note a thin, but rather broad, tendon, stretching obliquely between the two metacarpals here referred to, at their further extremities, the insertion upon the second metacarpal being the higher on the shaft. The second dorsal interosseous arises from the base of the third metacarpal at a point corresponding to that, just described, on the second metacarpal as the origin of the first dorsal interosseous, and, passing obliquely across, is similarly inserted into the proximal phalanx of the second digit, and along the inner side of the shaft of its metacarpal bone. Similar interosseous muscles to these are found between the digits and their metacarpal bones of the third and fourth, and the fourth and fifth, phalanges, as are also the auxiliary oblique tendons referred to above; and thus it will be seen that *Heloderma* possesses four *interossei dorsales.*

*Of the Musculature of the Trunk and Tail.*

56. *Spinalis dorsi.*—*Heloderma suspectum* has this muscle quite powerfully developed, it being a firm, longitudinal welt wedged in between the neural spines of the vertebræ on the one hand and the *longissimus dorsi* muscle on the other, and extending the entire length of the back. Its thickest parts are in the cervical and dorsal regions, while down the latter half of the tail it gradually tapers away to a tendinous thread at the tip. Its structure is well seen in the mid-dorsal region, where superficially it is characterized by a series of oblique, closely juxtaposed, tendons, which, passing forward from the muscular mass, and stretching by nearly four of the vertebræ, are each in turn inserted into a neural spine of one of the same. Still more deeply situate we find other tendons somewhat similar to these last, which are inserted into the interspinous ligaments, the fascia, and more or less upon the sides of the neurapophyses themselves. All these I take to be tendons of insertion of the *spinalis dorsi*, and cutting down more deeply on the muscle we find its origin to be a system of tendons which arise from the anterior margins of the prezygapophyses of the vertebræ and by fleshy origins from the superior aspects of the same. Where the muscle passes over the pelvis, corresponding attachments are made to the sacral vertebræ. Following it into the cervical region, we find the *spinalis dorsi* still thick though more laterally compressed, and it is finally inserted, first by a tendon, having something of the character of a *ligamentum nuchæ*, into the middle of the posterior border of the parietal bone, mesiad to the *complexus*, into the supraoccipital which the latter overhangs, and also by stout carneous fasciculi into the posterior margins of the neurapophysis, the postzygapophysis, and to some slight extent into the ventral surface of the atlas vertebra. These insertions are not entirely fleshy, but semitendinous, and the neural spine of the atlas is much aborted. As we pass from sacrum to tip of tail the *spinalis dorsi*, as I have already said, gradually diminishes in size, while at the same time it comes to be more and more intimately blended with the *supracaudal* upon either side of it, as it is between these muscles that it is found in this part of its course. The muscles of the nuchal region of *Heloderma* are very much blended together, and consequently difficult of dissection and individualization. Hoffmann has also called this muscle the *spinalis dorsi*, but incorrectly quotes Sanders as having termed it the "*sphincter dorsi*" (Bronn's 'Thier-Reichs,' Bd. vi. Abth. iii. p. 618, quoting P. Z. S. 1872, p. 161).

57. The *Longissimus dorsi* may almost be considered as the direct extension forwards of the supracaudal muscles, for it is only at the leading sacral vertebra, superficially, that we can detect a semi-distinct, transverse, line of demarcation that seems to indicate the point where a blending takes place among the caudal muscles on the one hand, and the *longissimus dorsi* and the *sacro-lumbalis* on the other. Along the dorsum the present muscle is quite intimately united, by an intervening bond of semidense fasciæ, with

the mesially situated *spinalis dorsi*, and the *sacro-lumbalis* upon its outer side. And its origin seems to be in the sacro-lumbar region, where it arises, for the most part, from the diapophyses of the vertebræ; but as it passes to the middle of the back, and the cervical region beyond, its attachment becomes insertional, and by tendinous points of development it makes fast to the apices of the postzygapophyses, and to the dorsal surfaces of the ribs on their outer sides. Origin and insertion apparently are more or less blended in mid-dorsal region, but this muscle is distinctly insertional in the cervico-dorsal and cervical regions, while still more anteriorly the *longissimus dorsi* becomes specialized and goes to form muscles that will next be described.

58. *Complexus.*—This is a most powerful muscle here, constituting as it does the antero-median insertion of the *longissimus dorsi* upon the skull. We may consider it as coming off from more or fewer of the post-axial vertebræ, and it is inserted into the posterior border of the parietal bone, as well as into the hinder surface of the cranium below it. All these muscles of the neck are quite intimately blended, more especially the two or three at present under consideration.

59. The *Trachelo-mastoid* is another muscle which continues the *longissimus dorsi* forwards to the skull behind, being situated external to the last, and inserted principally into the *os occipitale externus.*

60. *Transversalis colli* is the last of the three muscular fasciculi which insert themselves into the posterior aspect of the cranium, as the forward prolongations of the *longissimus dorsi.* It attaches itself at a point lower than any of them, being inserted into the basioccipital near the *rectus anticus major*, and intimately associated on its outer side with the *cervicalis ascendens.* This muscle is the *complexus minor* of Mivart, as found by him in Parson's Chameleon.

61. *Sacro-lumbalis.*—In our present subject this muscle arises from the superficial aspect of the hinder end of the ilium of the corresponding side, and, passing as a narrow band over the pelvic region, it commences to broaden as it covers the ribs. From thence on to the neck it has a width greater than the *spinalis dorsi* and the *longissimus dorsi* together, but mesiad it is not so thick vertically, while it gradually becomes thinner as it passes outwards. As in the case of the two muscles just mentioned, the general direction of its fibres is directly forwards, and its insertion is found to be upon the dorsal surface of each rib, for more or less their inner thirds. These insertions are tendinous and very firm, while the ventral surface of the muscle itself is quite intimately blended with the intercostals, and more posteriorly with the *quadratus lumborum.* On its inner side, for its entire length, it is easily dissected from the *longissimus dorsi*, the two muscles being quite distinct, while anteriorly it merges into the *cervicalis ascendens*, a muscle which constitutes its proper continuation forwards.

62. *Cervicalis ascendens.*—This muscle is handsomely developed

here. It arises from the anterior border of the leading cervical rib, and passing forwards and slightly inwards it is inserted into the side of the centrum of the atlas vertebra. The tendon of the *levator scapulæ* of the same side is also attached there, just anterior to it.

63. *Rectus posticus major.*—Underlying the *complexus*, this muscle arises from the neurapophyses or neural spines of the first three or four cervical vertebræ, and passing directly forwards becomes inserted upon the posterior aspect of the cranium, into the supraoccipital bone. As the atlas is without neural spine, in its case the muscle only arises from the neurapophyses.

64. *Rectus anticus major.*—This is a very distinct and handsomely developed muscle; arising from the ventral aspects of the first eight cervical vertebræ, or, more strictly speaking, from the ventral aspects of the centra of these vertebræ, and also from the anterior borders of the third to the fifth cervical ribs inclusive, it passes forward to insert itself into the basioccipital bone of the base of the cranium. Its points of origin from the ribs are to be found close to the vertebræ.

65. A small *Scalenus anticus* is to be seen arising from the lateral aspect of the second cervical vertebra, and the next one or two that follow it, and its fibres passing backwards and outwards are found to be inserted into the leading two free ribs of the neck, while internally it also attaches to the centra of the fifth and sixth vertebræ. Sanders has said of this muscle in *Liolepis*, that "at its insertion it is continuous dorsad with the sacro-lumbalis, and posteriorly with the intercostales." The same may be said of it in *Heloderma*.

66. *The Caudal Muscles: the Supracaudal.*—Structurally the tail of this reptile is quite a remarkable part of its organization, as the following description will go to show. It will be seen that it is naturally divided by four muscular sulci. Of these, one is a supero-median longitudinal sulcus, that, as in the case of all the others, runs the entire length of the tail: there are two mid-lateral sulci, one upon either side; and, finally, an infero-median longitudinal sulcus. These grooves are carried clear down to the caudal vertebræ, each being lightly held together by connective tissue in life, except the superior one, in which feeble tendinous bands stretch across obliquely from side to side, that go to bind the supracaudals more closely together than any of the remaining tail-muscles.

From this arrangement it will be seen that each lateral half of the tail has two divisions, a supero-lateral and an infero-lateral one. Each of these is made up of certain caudal muscles, which, beginning muscular at the body, become more and more fibro-tendinous as they proceed towards the tip of the tail. Upon making a transverse section of one of these parts, the fact is revealed to us that internally it is composed of two longitudinally disposed compartments, divided by the muscle dipping down between them. Either of these compartments is large and conically tipped at its proximal extremity, from whence it gradually tapers to a point at its distal end. The eight compartments of the tail, thus formed, are

completely filled with fat, which, in this alcoholic specimen now under my investigation, is of nearly a pure white colour. Feeble fibrous divisions divide it apparently into irregular cells; these merge into a line along the vertebræ, any pair of compartments forming a single longitudinal, fibro-tendinous line, which blends with the tendinous insertional part of the enclosing muscle, that attaches along from vertebra to vertebra in the same locality. I fail to call to my mind at the present moment any other lizard that is thus supplied with a large store of adipose tissue in its tail, and it would almost seem that it was to serve the purpose of a storehouse commissariat, upon which the entire economy of this reptile could draw in times of need, during its brief period of hibernation in some regions of its range, or, as in torrid Arizona, when the food-supply becomes scarce or difficult for this clumsy lizard to capture.

The *supracaudal* muscle is the direct continuation backwards of the *spinalis dorsi*, and being but attached to the neurapophyses and neural spines of the tail-vertebræ, it is the smallest muscle of the group.

The tendons do not show superficially as do the tendons of the *spinalis dorsi* along the back, a feature that disappears as the two muscles merge into each other just posterior to the pelvic region. Indeed, when we come to first remove the integuments entirely from the tail of a large alcoholic specimen of *Heloderma*, the structure is quite devoid of any striking characters, and it is only when we come to use our scalpel that the sulci and other parts are revealed. No tendons or divisions are discernible upon first sight at all.

67. The *ilio-caudal* continues backwards to the end of the tail the *longissimus dorsi* and *sacro-lumbalis* muscles, and it practically in the tail fills the space between the neural spines and the diapophyses of the caudal vertebræ. For the last three fourths of its length this muscle fuses completely with the supracaudal, and the two together combine to form one of the double compartments described above, that are filled with fat.

68. *Infra-caudal.*—This is the largest muscle of the caudal group, and it ensheaths, on either side, two of the fat compartments alluded to in a previous paragraph. It arises from the posterior aspect of the transverse process of the last sacral vertebra of the same side, from the fascia of the muscles in the immediate post-anal region, from the tuberosity of the ischium by a long, cord-like tendon, and from the margin of the vent itself; it is inserted, *seriatim*, into the diapophyses and the chevron-bones of all the caudal vertebræ, to the end of the tail.

69. *Femoro-caudal.*—To expose the next set of caudal muscles we must make a submedian, longitudinal incision through the *infero-caudal* muscle of one side, following it upon a curve extending down through the other tissues to the tibio-femoral interarticular cartilage, then carefully dissect these muscles out. The one here to be considered arises from the dorsal aspects of the transverse processes of the four proximal caudal vertebræ; it soon becomes thick

and fleshy, although laterally compressed, and at first passing directly forwards, soon turns outwards, and becoming tendinous is inserted into the trochanter major of the femur of the same side. Before arriving at this insertion, the *femoro-caudal* throws off another tendon, which, passing down through certain other muscles of the thigh, is inserted into the hinder surface of the interarticular cartilage between the tibia and the femur. Professor Mivart found this second tendon of insertion likewise present in *Iguana*.

70. The *Ischio-caudal* muscle arises from the outer aspect of the chevron-bone of the eleventh caudal vertebra, counting from the sacrum, and, ensheathed in the fat that is surrounded by the *infero-caudal* of the same side, it passes directly forwards, as a sub-cylindrical, muscular cord of some size; running close to the vertebræ, it becomes bulbous just before arriving at the vent, and dipping down, and passing forward between the two layers of the *cloacal* muscle, is finally inserted into the tuberosity of the ischium.

71. *Cloacal muscle.*—This arises, almost carneous, from the ventral surfaces of the diapophyses of the fourth and fifth caudal vertebræ, and passing downwards and forwards as a moderately thin sheet of muscle it becomes inserted along upon the upper surface of the cloaca from its posterior lip forwards. As already stated above, the *ischio-caudal* passes between its layers on its way to its insertion. This cloacal muscle is situated to the outer side of the *femoro-caudal*, and internal to the *infra-caudal*.

72. *Transversus perinei.*—Superficial to all the muscles here described, and stretching transversely across the region just posterior to the cloaca, we find a thin muscular layer faintly divided into two by a median, longitudinal line. Either lateral half of this represents one of the present muscles, a *transversus perinei*. For the most part it is attached to the post-cloacal fascia of the region in question.

(From this point onwards we resume our descriptions of the muscles of the trunk.)

73. *Rectus abdominis.*—Arising from the xiphoidal extremity of the sternum, and from the costal rib that there articulates, either *rectus abdominis* passes down the entire length of the body to the anterior pelvic region, being throughout its course intimately united with its fellow of the opposite side. Posteriorly it becomes inserted into the ischio-pubic ligament and the neighbouring fascia.

74. *Pyramidalis.*—This muscle is formed by a strong triangular slip thrown off by the *rectus abdominis* just above the insertion of the latter. Its fibres converge, and passing outwards and slightly backwards they are inserted, upon either side, into the "hamular process" of the pubis. Sanders found this muscle present in *Liolepis*, but he does not award it a separate description (P. Z. S. 1872, p. 161).

75. *Obliquus abdominis externus.*—This broad and powerful sheet of muscle here arises by an anterior expansion from the inner surface of the skin overlying the chest; by means of strong digitations from all of the dorsal ribs, and from six or seven of the abdominal ribs that follow them; and, finally, by far less distinctly

defined digitations from the outer surfaces of the majority of the remaining abdominal ribs in a line along the external border of the *sacro-lumbalis* of the same side. For its entire length, mesiad, the muscle now under consideration apparently blends with the *rectus abdominis*, and I fail to find any other insertion for it. It is quite possible that the part I describe above as being attached to the integuments overlying the thorax, may more properly be considered as belonging to the *rectus*, as the fibres therefrom seem to extend down the body; the two muscles are quite closely blended here.

76. *Obliquus abdominis internus.*—In *Heloderma suspectum* the thirty-first to the thirty-third vertebræ, inclusive, bear very short ribs, and consequently upon the ventral aspect of its body there is a region which is devoid of special bony protection. It is here that the present muscle spreads out and by its muscular wall largely protects what would otherwise be a weak point. It arises by a strong tendon from the anterior border of the ilium of the same side, and, passing forwards and inwards, it gradually merges anteriorly with the lower part of the intercostals and the abdominal fascia of the region in question.

77. *Transversalis.*—The transverse fibres of this muscle are at once made apparent upon dissecting away the last-described muscle, and it is found also to be principally confined to the lower prepelvic region of the abdomen. It comes away as fascia from the external border of the *quadratus lumborum*, while, mesially, its strong fascia blends with the fascia of the *transversalis* of the opposite side, and is carried up beneath the *rectus* to a point nearly as high as the costo-sternal ribs.

78. *Quadratus lumborum.*—This muscle is beautifully developed in the reptile before us. It arises by means of a dense, sheet-like fascia from the anterior rim of the ilium of the same side, and from the adjacent border of the diapophysis of the first sacral vertebra as far in as its centrum. Soon becoming muscular, its fibres passing directly forwards insert themselves into the entire length of the posterior surface of the rib to the thirtieth vertebra. Ventrally, it also attaches itself to the dorsal surfaces of the so nominated "lumbar ribs," *en passant*, by tendinous anchorages.

79. *External intercostals.*—The internal and external intercostals are both separately and very strongly developed in our present subject. Together they fill in all the spaces among the vertebral ribs, as well as between the sterno-costal hæmapophyses.

Taken in mid-region, an *external intercostal* arises from the entire anterior surface of the rib, save from about half a centimetre of its vertebral extremity, and its fibres passing forwards and upwards they are inserted into the entire posterior surface of the next anterior rib, save for a short distance above its free extremity. Between the sternal ribs the fibres of the external intercostals pass directly forwards, and, in each case, very nearly fill in the entire space. We observe that from the sternum backwards through the pleurapophysial series there are muscular fibres coming away from the free ends of the ribs, for about half a centimetre of their lengths in

each case, that pass downwards and forwards. These appear to be so many separate origins of the *obliquus abdominis externus*, but they do not properly belong to the series of the intercostals. They pass across to become inserted into the transverse tendinous intersections of the abdominal muscle to which we have referred. Where the *external intercostals* are covered by the *sacro-lumbalis*, the two muscles are very intimately fused together, but careful dissection is all that is required to demonstrate their individual independence.

80. *Internal intercostals.*—These are quite as well developed as the external ones, and taken in mid-region they arise and are inserted in the same manner as the more superficial set; but in the present case the fibres pass forwards and downwards, thus leaving contrary-disposed vacuities at the vertebral and free ends of the ribs. With respect to the intersterno-costal spaces, the fibres of the present set of muscles are directed almost entirely inwards and but very slightly forwards.

81. *Retrahentes costarum.*—A large part of the thoracic parietes and, continuous with it, nearly all of the abdominal parietes are amply lined with strong, oblique muscular fasciculi. The first series of digitations are supplied by the *transversalis*, and these interdigitate, *seriatim*, with the fasciculi of the present muscle, and thus together they constitute a thick muscular lining to the internal body-wall.

The *retrahentes costarum* arise, upon either side, from the lateral aspect of the bodies of the vertebræ for nearly the entire length of the spine, from the post-cervical region down nearly to the sacrum, in which latter locality the *quadratus lumborum* fulfils their part. They pass obliquely forwards and outwards, to become inserted into the middle of the shafts of the ribs upon their internal aspects, interdigitating, as I have already said, with the fasciculi of the *transversalis*.

### *Muscles of the Hip-Girdle and of the Pelvic Limb.*

82. *Iliacus.*—A very interesting and broad sheet of muscle that arises from within the pelvis, being attached, for the most part, to the ventral and dorso-ventral surface of the pubis, as well as to the median fibrous band that stands as a raphe between it and the fellow of the opposite side. It may extend also slightly upon the ischium. The fibres converging and passing over the pelvic brim, are inserted into the anterior surface of the proximal extremity of the shaft of the femur of the corresponding side, as well as into its trochanter minor, and into that tendinous band seen to be crossing obliquely the caput femoris, and into the fascia overlying the femoro-pelvic articulation.

Mivart, in his work upon the myology of the *Iguana*, considered the present muscle to represent the *psoas* and the *iliacus* combined, and in describing it divides the same into some four or five parts. In *Heloderma* I find these several parts more or less distinctly indi-

cated, but believe with Hoffmann that the muscle can be very well described in its entirety, such as has been done in the present instance.

83. *Gracilis.*—This is a strong and rather thick ribbon of muscle that passes obliquely down the antero-inferior aspect of the thigh, its lower margin being in contact with the *sartorius* for its entire length. The *gracilis* arises from that process, immediately anterior to the acetabulum, which is crossed by the pubo-ischiadic suture, its origin being tendinous. For the most part it is inserted into the fascia covering the tibial side of the knee-joint, while a few of its fibres join those of the *sartorius*, the two muscles being very intimately united, here, at their insertion. Sanders found a *gracilis* as well as a *sartorius* muscle in both *Liolepis* and *Platydactylus*; but Hoffmann seems disinclined to recognize the existence of the latter in Lizards (Bronn's 'Thier-Reichs,' Rept. 22–24 Lief. 1881, p. 645). They are both undoubtedly handsomely developed here in *Heloderma suspectum*.

84. *Sartorius.*—In this we have a great muscular sheath that envelops nearly the entire ventral aspect of the thigh, and which arises from the hamular process of the pubis, as well as from the ilio-ischiadic ligament. Below, it is inserted into the proximal end of the tibia, upon its anterior aspect, just below the head of the bone.

85. *Pelvo-tibialis.*—There is a small muscle in this region that lies immediately beneath the *gracilis* for nearly its entire length, and which I will here describe under the name given it by Sanders. Prior to that writer, Mivart had designated it in the Iguana as the "*tibial adductor*," and subsequently Hoffmann termed it the "*M. pubo-ischio-tibialis lateralis.*" Of these several names I consider the one bestowed upon it by Sanders to be decidedly the best one. In *Heloderma* it arises by a single tendinous head from the ischium just in front of the acetabulum. Passing down the antero-ventral aspect of the thigh as a narrowish ribbon of muscle, it again becomes tendinous as it nears the tibia, enters the popliteal space, and is inserted, just below its head, upon the mesial aspect of the bone just mentioned.

86. *Semimembranosus.*—What I describe here as the ilio-ischiadic ligament is a tendinous ligamentous arch which arises from the tuberosity of the ischium, and passing round the inside of the thigh to the front is there inserted into the ilium. From this arch our rather slender *semimembranosus* arises and passes down to be inserted into the outer side of the proximal end of the tibia. I can find no origin for it upon the ischium in *Heloderma*.

87. *Semitendinosus.*—This muscle is handsomely developed in our present subject. It arises, tendinous, from the ilio-ischiadic ligament, posterior to the line of the shaft of the femur. Becoming carneous it forms a fusiform muscle which is concaved towards the thigh and convexed upon its opposite aspect. Opposite the femoral condyles its tendon appears, and this is bifurcated, one branch going to the inner side of the proximal end of the tibia for insertion, the

other, more cord-like, extends down the leg, where it is in relation with the *soleus muscle*.

88. The *Rectus femoris* arises by two thoroughly distinct heads; one of these, and by far the slenderer, has its origin upon the pelvis, just in front of the acetabulum, the tendon in this case being flat and of some length. At about the middle of the thigh this head, which has now become muscular, merges with the larger division of the *rectus*, although both it and its tendon can be easily traced as far as the patella. The larger head of the *rectus* arises from the pelvis immediately over the acetabulum by a broad tendinous origin. Soon becoming fleshy, the muscle passes directly down the dorsal aspect of the thigh, and, by a tendino-aponeurotic expansion, is inserted into the top of the patella, from which it is in turn reinserted into the outer surface of the head of the tibia, through the intervention of the *ligamentum patellæ*.

89. *Gluteus maximus*.—Although here a distinct muscle, it has pratically the same origin and insertion as the larger of the two heads of the *rectus femoris*, with which it is almost indistinguishably fused. It assists in covering the dorso-superficial aspect of the thigh posterior to the latter, and in its action aids the *rectus* in extending the leg upon the thigh, as in all Vertebrata where it is present. Upon its underside, this muscle, in the lower part of its course, exhibits a strong tendency to blend with the *vastus externus*, which lies beneath it.

90. *Pectineus*.—By transversely dividing at their middles the *rectus femoris* and the *gluteus maximus* and reflecting the mesial stump, we bring to view the more deeply situate muscles of the thigh, and the present one can be easily examined. It is here found to be of a triangular form, and arises from the ilium posterior to and above the acetabulum; it is also attached to the nether side of the tendon of the *gluteus maximus*, and more internally to the pubo-ischiadic ligament. Largely carneous in its organization, its fibres pass downwards and forwards to the shaft of the femur, where they are inserted upon a longitudinal line extending down the middle third of the same at its postero-ventral aspect.

91. The *Biceps femoris* is a perfectly straight, subcylindrical muscle of nearly uniform calibre throughout its length. Its single and only head arises from the outer surface of the ilium, at its anterior third, just behind and above the acetabulum, but posterior to the origin of the *pectineus*. It is inserted on to the outer aspect of the shaft of the fibula immediately below the head of the bone. At its origin it is fleshy, but it is inserted by a comparatively strong tendon, as is quite commonly the case in Lizards. Sanders found this muscle arising from the posterior end of the ilium in *Liolepis*; while Hoffmann, from his description of this muscle, seems to think that this is the only origin it can have (Bronn's 'Klassen,' *loc. cit.* pp. 644, 645).

92. *Adductor brevis*.—This is one of the smallest and at the same time one of the most deeply situated muscles of the thigh. In some respects it seems to correspond with either one or the other of the

gluteal muscles ascribed by Mivart to Parson's Chameleon; but as the comparative anatomy of the gluteals is still in a very unsatisfactory condition in so far as their exact determination is concerned, and as this is a short adductor, pure and simple, I prefer to provisionally bestow the above name upon it. It both arises and is inserted by tendon, while otherwise it is a short flat muscle of nearly uniform width, which has its origin upon the pubis, anterior to and above the acetabulum, from whence it passes directly to the anterior margin of the great trochanter of the femur, where it is inserted.

93. *Adductor longus.*—Here we have another one of the deep muscles of the thigh, being situated on its antero-inferior aspect. Apparently it arises entirely from the ilio-ischiadic ligament, which, however, is at this point strongly connected to the ischium. At first flat and thin, its fibres soon converge as they descend to their insertion, which is found upon a longitudinal line occupying the lower two thirds of the shaft of the femur, on its ventral aspect. This muscle seems to correspond very well with the "*adductor magnus*" of Mivart, as that distinguished anatomist describes it in the Iguana (P. Z. S. 1867, p. 791).

94. *Vastus externus.*—A number of Lizards have the *vasti* muscles very small, while here in *Heloderma* they are of considerable size. The *vastus externus* in the reptile before us is barely one fourth as large as the *v. internus*. It arises from the anterior aspect of the shaft of the femur, covering its middle third and a portion of its lower third; below, it becomes tendinous and merges with the tendon of the common extensor of the leg upon the thigh.

95. *Vastus internus.*—Comparatively, a great bulky muscle, that covers the shaft of the femur, from which it arises, from head to condyles, upon its antero-posterior aspect. As in the case of the *vastus externus*, its strong tendon below blends with the tendon of the *rectus femoris*, while the two *vasti* muscles themselves are practically almost fused into one.

96. *Pyriformis.*—The muscle I take to be the present one in *Heloderma* makes quite a remarkable departure from the *pyriformis* as it occurs in other Lizards. Indeed, it might here almost be called an *accessory femoro-caudal* in some particulars, as our description will go to show. The main part of the muscle arises fleshy from the ventral surface of the diapophysis of the first caudal vertebra, encroaching slightly upon the centrum of the bone. The fibres converge and are directed down the back of the thigh. As they come to an apex, this apex is joined by a small axillary muscle that arises from the tendinous arch of the ilio-ischiadic ligament. Together the muscles at once unite to form a delicate tendon, which, in its course towards the head of the tibia, is closely juxtaposed to the tendon of the *femoro-caudal* or rather to its branch tendon. At the lower third of the thigh this tendon of the *pyriformis* and the branch tendon of the *femoro-caudal* fuse into one cord, which is inserted into the tendon of the external head of the *gastrocnemius* muscle a few millimetres below the insertion of the latter into the external condyle of the femur.

In sequence with it, the above-mentioned larger part of the *pyriformis* seems to be the continuation forwards of the *cloacal muscle*, of the infracaudal group of muscles.

In different forms of Lizards we find the *pyriformis* muscle very differently constituted, and consequently very different descriptions of it extant; so when we come to consider the diverse nomenclature that has been awarded to it, the question of its study becomes quite puzzling. For instance the *pyriformis* of Sanders is said by Hoffmann to be the *femoro-caudal* of Mivart, while Hoffmann himself has called it the *M. coccygeo-femoralis longus s. Pyriformis*; while on the other hand the *pyriformis* of Mivart is the *coccygeus inferior* of Sanders, the *M. coccygeo-femoralis brevis* of Hoffmann, and which is the *subcaudalis* of Stannius. I still believe that the myology of reptiles demands fuller research at the hands of anatomists.

97. *Coccygeus inferior*.—A muscle which arises by a thin sheet of tendon from the hæmapophyses of the second, third, and fourth caudal vertebræ. Forming anteriorly a delicate slip of muscle, it is inserted into the ischium just posterior to the acetabulum. The *coccygeus inferior* lies to the inner side of the *femoro-caudal*, that is, it is mesiad to it, while the point of its insertion is internal to that of the *obturator externus*. Sanders found this muscle present in *Liolepis*, where it arises from the extremities of the hæmal spines of the caudal vertebræ from the tenth to the third.

98. *Coccygeus externus*.—Arising from the ventral aspects of the diapophyses of the second and third caudal vertebræ, this laterally compressed muscle passes directly downwards and slightly forwards to insert itself powerfully into the ilio-ischiadic ligament. It will be noticed that this muscle lies almost in the same plane with the *pyriformis* in front and the *cloacal muscle* posterior to it, the three being in sequence, their apposed margins in contact, and the whole situated to the outer side of the *femoro-caudal*. *Phrynosoma* possesses the *coccygeus externus* as is stated by Sanders.

99. *Obturator internus* is a large and powerful muscle in *Heloderma suspectum*, arising from the pubis and ischium at the ventral aspect of the pelvis. These fibres of origin start mesiad from the symphysial line, and, converging to some extent and becoming slightly tendinous, they are attached, by an extensive insertion, upon the summit of the shaft of the femur, on top of the trochanter major. The muscle as thus constituted is thick and covers over nearly all of the ventral aspect of the pelvis in front of and immediately beneath the acetabulum; the *iliacus* covering a strip along and beneath the pubis anteriorly.

100. *Obturator externus*.—With a bulk that is barely one third of that of the *obturator internus*, the present muscle arises, tendinous, from the tuberosity of the ischium, posterior to and below the acetabulum. Forming a strong, thick band it passes round the summit of the femur to make insertion by a powerful tendon at a point upon the proximal end of the shaft just below the *caput femoris*, upon the posterior aspect. This point is separated from the insertion of the *obturator internus* by a space of some three millimetres, the two in

this locality being nearly opposite each other. When the femur is articulated *in situ* these insertions of the *obturators* look to the outer side.

*Muscles of the Leg and Foot.*

101. *Gastrocnemius.*—Both heads of this muscle are here represented and strongly defined. The *external head* arises by a long, cord-like tendon from the outer aspect of the external condyle of the femur, and passing directly down the back of the leg, parallel to the shaft of the fibula, it becomes fleshy at the upper third of the leg and, forming a flat, thin, and rather broad muscle, goes to the tarsus for its insertion. It is inserted into that prominently projecting ossicle of the distal row of tarsal bones, nearly in line with the fibula.

The *internal head* of the *gastrocnemius* arises from the proximal third of the outer side of the shaft of the tibia, and passes obliquely across the back of the leg, where it is seen to be a broad, thin, and conspicuous muscle. It is inserted into the mesial edge of the belly of the external head of the muscle we have under consideration, a short distance above its insertion. At neither its origin nor its insertion is the internal head of the *gastrocnemius* inclined to be at all tendinous. We find the round cord formed by the fusion of the tendons of the *pyriformis* and the auxiliary tendon of the *femorocaudal* inserted into the tendon of origin of the external head of the *gastrocnemius* a few millimetres below the point from whence it arises. A very long and strong internal lateral ligament of the knee-joint is found in *Heloderma*, and it can be examined just above the origin of the internal head of the *gastrocnemius*, but it in no way overlaps the latter as Mivart states to be the case in Parson's Chameleon.

102. A *Soleus* is here but very feebly developed, consisting of only a few fibres and withal intimately attached to the inner surface of the external head of the *gastrocnemius*. It arises from the back of the tibia at its proximal end, and is inserted in common with the tendon of the *gastrocnemius* into one of the ossicles of the distal row of the tarsus. The internal margin of the *soleus* muscle is re-enforced by a tendon which is sent down by the *semitendinosus* muscle of the thigh.

103. *Peroneus secundus.*—This muscle arises from the antero-external aspect of the fibula, from a point corresponding to the insertion of the *biceps* to within a short distance of the external malleolus. Beyond this it forms a tendon, which, passing to the tarsus, becomes inserted into that bone that has been designated by Sanders as the "cuboid." Comparatively large and thick at its lower portion, it here gives off a fascia which, spreading over the back of the tarsus, is so attached that it forms a binder to hold in place the flexor tendons passing beneath it; above, it is closely associated with the *biceps*, the tendinous portion of its origin being just anterior to the tendinous portion of the insertion of the latter.

I have failed to find a *peroneus primus* present in *Heloderma*. Sanders found one present in *Phrynosoma*, and Mivart one in *Iguana*, and I believe it is usually present in Lizards.

104. *Extensor longus digitorum*.—Occupying a conspicuous and median position upon the anterior aspect of the leg, this muscle arises by a strong, flat tendon which comes off from the external condyle of the femur, passes down in front of the same, and below the femoro-tibial articulation becomes a comparatively flat and narrow muscle, continuing thus to the tarsus. In this latter locality its tendon begins to form, and, when over the metatarsus, this latter splits into two other delicate tendons. Mivart found the same bifurcation in *Iguana tuberculata*, and he has said that, "Of these two tendons, the peroneal one curves round tibiad, and is inserted into nearly the middle of the plantar surface of the third metatarsal;" the other one is similarly implanted into the second metatarsal. This agrees precisely with what we find in *Heloderma*.

105. The *tibialis anticus* is a muscle of the interno-lateral aspect of the leg in this reptile. Arising from the antero-lateral surface of the shaft of the tibia, from the side of the head of the bone, and to some extent from the fascia at the tibial side of the knee-joint, the *tibialis anticus* forms a fleshy muscle at the inner rather than at the anterior aspect of the leg. At about the middle of its course it is quite intimately connected with the internal head of the *gastrocnemius*, at the origin of the latter from the tibial shaft. Opposite the ankle the present muscle again becomes tendinous, and this, its tendon of insertion, passes to the distal extremity of the first metatarsal bone, where, upon the tibial side of its dorsal aspect, it is inserted.

It appears to be quite generally the case among Lizards that the *tibialis anticus* occupies an antero-lateral position upon the leg, rather than a mid-anterior one as it does in so many of the Mammalia.

106. *Extensor brevis digitorum*.—We find this muscle to some extent quite complicated, and it arises by several independent slips, which have diverse origins and insertions. Their disposition seems to be as follows:—

(1) An oblique fasciculus that arises from the anterior surface of the distal end of the fibula, and which, passing forwards and inwards across the top of the foot, is inserted into the superior surface of the proximal phalanx of the hallux.

(2) A smaller fasciculus than the last, also arises from the fibula below it but more particularly from the fibulare (of the co-ossified bones of the proximal row), and, passing directly forwards, becomes inserted upon the dorsal aspect of the proximal joint of the fifth digit.

(3) Fasciculus number three arises from the antero-superior surface of the mid-ossicle of the distal tarsalia, it passes between the bifurcated tendon of the *extensor longus digitorum*, and arriving at the third digit it makes an insertion upon the upper surface of its proximal phalanx.

(4) Arising from the next inner ossicle of the distal tarsalia, but *not* passing through the tendinous slips of the *extensor longus digitorum*, this has an insertion similar to the last, but here upon the second digit.

(5) The fourth digit is similarly supplied, only in its case the fasciculus arises from the extreme end of the fibula, and it has likewise two lateral slips, one upon either side, inserted upon the dorsal aspect of its proximal phalanx, and these arise on either side from the bases of the proximal joints of the third and fifth digits. So it will be seen that not only in this, but in other particulars, the present muscle differs from the corresponding one in *Iguana*, as described for us by Mivart (P. Z. S. 1867, p. 794).

107. *Popliteus.*—*Heloderma* has this muscle comparatively very large. It arises from the tibial side of the fibula, for about its proximal fourth, and passing obliquely downwards and inwards is inserted into the shaft of the tibia for nearly the entire length of its fibular aspect. At the back of the leg, at its origin and for some way beyond, it is somewhat intimately attached to the *flexor longus digitorum* that covers it; while in passing to its insertion it fills in much of the interosseous space with its flat, triangular muscular expanse.

108. *Peroneo-tibial.*—Anteriorly, and belonging to the deep set, we have this interesting muscle. It spans the inter-tibio-fibular space below. Arising from the lower third of the shaft of the tibia, its fibres pass across to become inserted into the corresponding extremity of the shaft of the fibula. Behind, it is largely covered by the *tibialis posticus*, as the latter passes to its insertion.

109. *Tibialis posticus.*—As is commonly the case among Lizards, this muscle possesses a triangular form with its apex above. It arises from the inner aspect of the fibular shaft, tibiad, for the distal half of its extent. Its fibres converge as they pass downwards and inwards, and when near the tarsus they become strongly tendinous, which tendon is powerfully inserted into the *tibial ossicle* of the co-ossified elements of the proximal row of the ankle. Over the lower part of the tibia, a firm fascia fuses with the tendon of this muscle, which there spreads out to cover to some extent the tarsal joint, to which it gives a certain strength and support.

110. *Flexor longus digitorum (perforans).*—Large and carneous in its upper part, this muscle arises from the posterior aspect of the external condyle of the femur; from the posterior aspect of the proximal half of the shaft of the fibula; and from the tendon of the external head of the *gastrocnemius* muscle. It is also quite intimately attached to the underlying *popliteus* at its origin. From these several points the *flexor longus digitorum*, as a muscle of some considerable bulk, passes down the back of the leg to become, near the ankle, quite suddenly flat and then completely tendinous. It passes dorsad of the tendinous arch at the ankle, and in the sole of the foot splits into five small tendons, which are distributed, one to each, to the five pedal digits. Each perforates the tendons of the *flexor brevis digitorum*, after which they send to the joints of the toes as they go to their distal inser-

tions slender accessory slips, all of which are much the same as we found to be the case in the hand, and which has been quite fully discussed above. We shall dwell more in detail upon these points when we come to describe further on the smaller and special muscles found in the sole of the foot.

111. *Flexor accessorius.*—Mivart describes a muscle, which is divisible into two parts, under this name in *Iguana* (P. Z. S. 1867, p. 797), but it is only its first part that in any way agrees with a muscle which I propose to call by this name in *Heloderma*. I find that it arises as a thin, small, fleshy muscle from the posterior aspect of the *fibular ossicle* of the co-ossified bones of the proximal row of the tarsus and to a limited extent from the adjacent surface of the distal end of the fibula. Soon forming a flat tendon it at once passes to the tarsal aspect of the tendon of the *flexor longus digitorum*, where, at a point about opposite the proximal row of tarsal bones, it fuses with it, and thus, as will be seen, constitutes a true accessory muscle to this deep flexor.

112. *Fexor brevis digitorum* (*perforatus*).—This arises, semi-tendinous, from the dense transverse fascia of the ventral aspect of the ankle, and also from the corresponding surface of the fibular side of the fused ossicles of the proximal row of the tarsal elements. Radiating, it divides into five muscular bundles, which pass in proper order to the five toes; the one belonging to the hallux being the smallest, while the one going to the little toe is the largest.

The short fasciculus that goes to the hallux is chiefly inserted into the proximal end of the first phalanx of that digit, and simply forms a tendinous tubular sheath through which passes the tendon of the deep flexor, and not a distinct insertional, perforated tendon as is the rule with this muscle in the case of the other toes. We note here that the tendon of the deep flexor sends off an accessory slip to every joint as it passes to the distal phalanx for insertion. In the case of the little toe the arrangement is quite similar to what we have just described for the hallux, while the tendon of the deep flexor does not send off any accessory slips to the joints of this digit. With respect to the three middle toes, the arrangement of the insertional tendons of the deep and superficial flexors corresponds with the structure of the same parts as we described them for the manus.

113. *Lumbricales.*—So far as I can discover it is only the tendons of the deep and superficial flexors going to the three middle toes that are supplied with lumbrical muscles, and these are arranged very much as we found them in the hand of the reptile we have under consideration, having quite similar origins and insertions.

In this connection we must observe another muscular slip: it arises from the distal surface of the fused ossicles of the proximal row of the tarsus, beneath the origin of the short flexor, and, passing forwards and inwards, it becomes inserted on to the plantar side of the broad tendon of the long flexor in the sole of the foot, before the former splits up to be distributed to the toes.

114. *Flexor fibulo-tarsalis.*—I find no muscle elsewhere described

that exactly corresponds to this. It occurs upon the flexor aspect of the leg, and arises from the end of the fibula, close to the origin of the *flexor accessorius*, and as a strong little bunch of fibres it passes directly across to the bone representing the proximal tarsal row, and is inserted thereupon, on its proximal surface.

115. *Abductor hallucis*.—A small muscle that arises, tendinous, from the distal surface of the consolidated bone of the first row, and passing forwards is inserted into the proximal phalanx of the hallux at its base. Mivart found this same muscle present in *Iguana* (P. Z. S. 1867, p. 797).

116. *Flexor minimi digiti*.—Decidedly more inconspicuous than the last, this muscle arises from the same bone upon the fibular side of the foot, and passing forwards it makes a similar insertion into the base of the proximal phalanx of the little or outer toe.

117. *Adductores digitorum*.—Deep to all the plantar muscles thus far described, this set consists of three flat, carneous, little strips which are superficial to the *interossei*. They have a common origin from the bone representing the first tarsal row, and, radiating forwards over the sole of the foot as three distinct fasciculi, they become inserted in their proper order into the bases of the proximal phalanges of the second, third, and fourth toes, on the fibular side in each case.

118. *Interossei plantares pedis*.—Differing from these muscles in the manus, the *interossei* of the plantar region are more numerous than those of the palm, while those of the dorsum are less so. Their origin and insertion, however, are essentially the same. There seem to be five of these fasciculi present in the sole of the foot of *Heloderma*—three central ones, and one each to the inner side of the outer toe and hallux.

119. *Interossei dorsales pedis* do not seem to exceed three in number, and they are devoted to the three middle digits. They are disposed much as we find them in the hand.

Mivart found *interossei* muscles also present in the pes of *Iguana tuberculata*, but the additional layer of fasciculi that he there describes, I take to be my *Adductores digitorum* (see P. Z. S. 1867, p. 797).

I find no muscles present in the pelvic limb of *Heloderma suspectum* other than those I have described above.

## IV. On an Examination of the Contained Organs of the Cœlom.

Cutting open the body-cavity by a median, abdominal incision, we at once bring into view the various organs that it harbours. It will be seen that these are covered by the reflected layer of the peritoneum, which in *Heloderma* is almost perfectly colourless, and being very thin can hardly be said to obscure the viscera from our view at all. This peritoneal layer differs from that membrane as we find it in *Iguana* and *Lacerta*, in that it is not deeply pigmented posteriorly and colourless anteriorly, as may be inferred from what

we have just said. In the submedian, longitudinal plane it constitutes the umbilical ligament, and this double fold of membrane partially divides the cœlom into right and left halves. Of unusual size, the *corpora adiposa* here lie between the internal muscular parietes and the peritoneal layers, while the kidneys are external to the latter, the reproductive glands internal to it, the two being separated by the horizontal portion of this membrane. Following the peritoneum to its attachments we find it to be fast all along the spinal column, while ventrally it is firmly attached mesio-longitudinally to the muscular wall of the cœlom. The parietal layer also makes fast to the tendino-fascial divisions, here and there, that indicate the lines of insertions of the digitations of the principal body-wall muscles. Other than this, both the visceral and parietal layers of the peritoneum in this Lizard are but loosely attached to the parts they cover, and may by gentle traction be easily detached. Thoracic and abdominal cavities are partitioned from each other by the usual reflection of this membrane, while below the liver the large anterior abdominal vein is seen to be borne in the ventro-parietal layer. Continued as the umbilical ligament, it passes between the lobes of the liver as a single layer, which in our present subject bears the ramifications of a large vein.

Beddard has called the visceral layer of the peritoneum, as it occurs in certain Lizards, the "horizontal membrane;" and this author, in a masterly paper upon this subject (P. Z. S. 1888, p. 99), has said that "In *Monitor* there is some little difference (from *Iguana* and *Lacerta*); when the body-walls are cut open and reflected, the alimentary viscera are not exposed as they are in *Iguana*. A loose membrane covers these viscera; the membrane looks as if it were simply the lining peritoneum of the abdominal cavity which had got separated and detached from the abdominal parietes; this is, however, not the case; an examination by the aid of the microscope showed clearly that a layer of peritoneum covers the abdominal musculature, and is quite distinct from the horizontal membrane; in *Varanus griseus* the peritoneal layer was particularly distinct, for the reason that it contained numerous pigmented corpuscles. For the greater part this membrane is free from the ventral parietes; anteriorly it is attached to the median ventral line; dorsally it is attached along the spinal column; here and there it is also attached to the lateral parietes by membranous bands. It passes over the lobes of the liver and the stomach, and shuts off the lungs from the abdominal cavity. The umbilical ligament dividing the two liver-lobes is present as in *Iguana*, and is attached to the dorsal side of the horizontal membrane. This horizontal membrane also separates the kidneys from the reproductive glands; the latter lie internally to it; the kidneys are placed outside it. The ventral surface of this membrane bears a vein of some size, the anterior abdominal vein. The fat-body, when present, lies below the membrane, and is therefore shut off from the abdominal cavity." In many forms, and Beddard gives us a list of some of them (*Lacerta*, *Uromastix*, *Cyclodus*, *Iguana*, and others), this horizontal membrane is for the greater

*adiposum* strongly impinges upon its right lobe. Composed of the usual hepatic tissue, the liver of *Heloderma* is, during life, of a deep brownish-red colour, but this turns paler after the organ has been placed in spirit, and it becomes tinged with a greenish hue. Ventrally, as a whole, this gland is convex over its surface, it being behind more or less concaved. Primarily, it is divided into two principal lobes; the right lobe has a length of about 7·5 centimetres and a width of 2·5 centimetres, while the left lobe is something like a centimetre less in both of these dimensions. Its borders are rounded, and it measures through its thick part, which is near its centre, about a centimetre.

Regarding it upon its ventral aspect (Plate XVI. fig. 1), we are to observe that the right lobe exhibits near its posterior apex one or two small fissures, while a small teat-like process of the glandular substance issues from the same lobe to cross towards the left behind the gall-bladder. This right lobe is likewise indented in such a manner that the gall-bladder is exposed to some considerable extent through an oblong aperture. Between the lobes, behind, issue the bile-ducts, and the portal vein makes its entrance.

Viewed upon its dorsal aspect (Plate XVI. fig. 2), the liver of this Lizard presents us with a number of interesting points for our examination. Chief among these is a small supplementary lobe which comes off from the anterior part of the right lobe near its mesial border. It projects freely, being subcylindrical in form with rounded apex, and in direction it is oblique, passing up close to the outer side of the heart. From this latter fact I propose to call it, in those specimens wherein it is present, the *lobulus cardiacus*. Other very much smaller lobuli are to be seen upon this aspect of the liver in the specimen before us, whether these are constant or not, I cannot at this writing say. Several of these occur at the apical extremity of the right lobe; two overlapping ones are seen at the hinder part of the *fossa cystidis felleæ*. In this latter fissure obliquely lies the gall-bladder, an organ which we will describe further along.

The *pons hepatis*, or the ligature that binds the right and left lobes of the liver, in *Heloderma* is very extensive and very thick, extending as it does from the fissure of the gall-bladder to a point anteriorly where the two lobes meet the apex of the heart.

The *portal vein* enters the left lobe of the liver at its lower part, as a single trunk. Its branchings take place after the vessel passes into the hepatic substance. At about 4 centimetres behind the liver the anterior abdominal vein joins the portal as its main tributary. Beddard figures the portal vein of *Varanus salvator* as entering the right lobe of the liver (P. Z. S. 1888, p. 104); but this does not agree with a specimen of *Varanus niloticus* before me, wherein the portal vein distinctly enters the left lobe of the liver, branching just as it does so[1].

[1] I am indebted to Professor Alexander Agassiz for the specimen of *V. niloticus* to which I refer, and to Professor Samuel Garman for his kindness in selecting it from the collections of the Museum of Comparative Zoology of Harvard College, and forwarding it to me.

*The Gall-bladder* is of a pear-shaped form and of comparatively large size. Its position has already been given above. Its own duct (*cystic*) passes down to the duodenum, being joined in mid-course by a biliary duct coming from the right lobe of the liver. Smaller ducts pass from it to enter the right hepatic lobe just mentioned, while upon its surface several minor branches seem to anastomose with each other. In addition to all these we make out an hepatic duct proper; this issues also from the right lobe of the liver, and passing down joins at mid-course the pancreatic duct. A branch joins also this hepatic duct with the gall-bladder. It was a long time before I could bring myself to believe that these several branching ducts were not anastomosing vessels borne in the peritoneum overlying the parts under consideration. I am now, however, fairly well satisfied, after the most careful examination that I could make, that the arrangement is as I have given it.

According to Beddard a somewhat similar condition of affairs is to be found in *Varanus salvator* (P. Z. S. 1888, p. 105, fig. 4). The structure is one that requires and will repay more extended and careful research, and to this end I should very much like to examine large living specimens of *Heloderma*, and if possible compare them with more specimens of *Varanus salvator*.

*The Pancreas.*—This organ is of proportionately good size in the reptile before us, and it is to be sought, as usual, in the loop of the duodenum. From its ventral aspect there arises an elongated papilla, and it is at the extremity of this that there enters the single hepatic duct formed by the two smaller ones which emerge from the sulcus in the right lobe of the liver; while lower down one of these latter appears to send a branch to the duodenum. For its middle third, one of these ducts exhibits a peculiar reddish enlargement, of no great size; I am at a loss to know whether this be normal or not. This enlargement is strung along on the duct for a distance of a centimetre or more, and has the appearance of a very narrow elongated gland through which the duct must pass before arriving at the pancreatic gland. From the apex of the pancreas the common duct, here very short, enters the gut.

Peculiar as this arrangement of the cystic, hepatic, pancreatic, and common ducts in *Heloderma* is, it is not without parallel among Vertebrates, for the arrangement is simulated in the Frog, where, too, a system of branching hepatic ducts coming from the liver unite to form a single duct that passes into the substance of the pancreas, where it eventually unites with the common bile-duct on its way to the duodenum[1].

In *Heloderma* the hepatic veins emerge from the liver at its anterior part and soon enter the postcaval vein, as the latter passes forwards to the right side of the heart.

[1] For a good drawing of these structures in the Frog, see Wiedersheim's 'Comparative Anatomy of Vertebrates,' translated by W. Newton Parker, 1886, p. 241, fig. 197. Compare also what Sir Richard Owen has to say upon this point in his 'Comparative Anatomy and Physiology of Vertebrates,' vol. i. pp. 448–454.

While in New Mexico, several years ago, I collected a large series of *Phrynosoma douglassii*, and I have an alcoholic specimen of one of these before me at the present time. Upon opening it I find that the greater part of its peritoneum, posteriorly, is deeply pigmented (almost or quite black), while it lacks the horizontal membrane dividing the cœlom, and so agrees with the *Iguana-Lacerta* group as pointed out by Beddard [1].

The liver of this *Phrynosoma* is very thin and broad, spreading out nearly across the abdominal cavity. Its left lobe is considerably the larger and the thinner; it extends well behind and laterally covering, for the most part, the neighbouring viscera. I find its gall-bladder subspherical in form, with very thin coats, while in the arrangement of its duct (for there is but one of them) and the hepatic duct it agrees with what T. J. Parker found in *Lacerta viridis*—that is, a "common bile-duct, running parallel to the portal vein and opening posteriorly into the duodenum: at its anterior end it is formed by the union of the cystic duct and the hepatic duct from the liver itself" [2].

Judging, then, from Professor W. N. Parker's figure of the Frog, we may have (1) several ducts leading from the lobes of the liver, and combining in a single duct that goes to the gall-bladder; (2) a duct from the gall-bladder to the pancreas; (3) a duct from the liver to the pancreas; (4) the proper hepatic ducts combining to form one that enters the pancreas and in it join a duct traversing that gland; (5) a common biliary-pancreatic duct passing from the end of the pancreas to the duodenum.

Judging from Beddard's description of *Varanus salvator*, we may have in that lizard:—(1) at least three ducts leading from the liver to the gall-bladder; (2) at least two proper hepatic ducts that unite before joining the common duct; (3) a cysto-hepatic duct that joins the cystic duct—a final union, posteriorly, with a single cystic duct and an hepatic duct to form the common duct; (4) an interlacement of cystic ducts upon the surface of the gall-bladder. The relations with the pancreas are not given by the writer quoted.

Judging from T. J. Parker's description of *Lacerta viridis*, we may have simply the cystic duct uniting with the hepatic duct to form the ductus communis choledochus which opens into the duodenum.

Judging from what we find in *Heloderma*, we may have:—(1) a cystic duct uniting with an hepatic duct to form a single duct that opens into the duodenum; (2) proper hepatic ducts that pass to the pancreas, usually two that unite in a single one before coming to that gland; (3) a common duct from the pancreas to the duodenum:

[1] Proc. Zool. Soc. 1888, p. 100. I am inclined to think that this character is going to prove to be of no little value in the study of the structure of Lizards in future researches.

[2] Parker, T. J., 'A Course of Instruction in Zootomy (Vertebrates),' 1884, p. 165. According to Owen, "In the *Iguana* there is a distinct hepatic duct which enters the duodenum about an inch from the pylorus, a cyst-hepatic duct which enters the side of the gall-bladder, and cystic ducts which leave the globose bladder abruptly" (*loc. cit.* p. 451).

(4) a few interlacing ducts, joined by one or two (?) hepatic ducts occurring on the surface of the gall-bladder or just near it.

In figure 2, of Plate XVI., I present a drawing of the liver (and other parts associated) of *Heloderma*, and although in that drawing the parts are of their normal sizes and lengths they are pulled rather downwards and forwards in order to show them off better.

*The Spleen.*—This peculiar organ is of a bright red colour in the living *Heloderma*, and, as in so many Lizards, is freely swung in the fold of the peritoneum known as the mesogaster. In form it is subovoid, being rounded at one end and rather pointed at the other, and lies about a centimetre from the concave curvature of the stomach. It measures in length, in a large specimen of the *Heloderma*, 1·4 centimetre, and has a width of about 8 millimetres. A large vein leads from it which joins the *portal vein*, while it is supplied with arterial blood by the *splenic artery*, which is a branch of the *dorsal aortic artery*. In its position it lies upon a crossing of a number of the vessels borne by the mesogaster, but in so far as I can see they seem to have no other special connection with this organ.

Very little seems to have been written about the spleen in Lizards. Dr. Günther has said that the "spleen and pancreas are very elongate and narrow" in *Hatteria*[1]. As referring to Reptiles, the word "spleen" does not even occur in the General Index (vol. iii.) of Sir Richard Owen's 'Anatomy of Vertebrata,' and I fail to find anything definite about that organ in the Reptilia in the same work. In *Rana* the spleen is placed near the anterior commencement of the rectum. Turner, who is pleased to notice the great value of work done in "comparative anatomy," has not a word to say upon the comparative morphology of the *spleen* in his article upon the general subject of Anatomy, and in that article confines what he has to say upon the organ under consideration to a few words having reference to the anatomy of the spleen in a single type representing but a single family of the Vertebrata (*Homo*)[2]. It is hardly to be expected that we shall ever possess a very complete knowledge of the physiology of this organ so long as we remain so ignorant of its comparative morphology. In this Lizard it has simply the appearance of a large, isolated lymphatic gland, and the remark of Huxley that "The spleen is substantially a lymphatic gland," may still bespeak the summation of our knowledge upon that point[3].

*The Alimentary Canal.*—In describing this we shall for the present pass by the tongue and certain other structures that pertain to the mouth-parts, and present what we have to say about them further along.

The *Œsophagus* consists of a straight tube extending from the buccal cavity to a point opposite the apex of the heart. In its pha-

[1] Günther, "Contributions to the Anatomy of *Hatteria* (*R hyehocephalus*, Owen)," Phil. Trans. pt. ii. 1867, p. 28.

[2] Turner, William, Article "Anatomy": Encyclopædia Britannica, 9th edition, vol. i. (see pp. 819 and 907).

[3] Huxley, T. H., 'The Anatomy of Vertebrated Animals,' p. 91.

ryngeal portion it is capacious, but it gradually narrows as it proceeds backwards, so that it becomes of very much diminished calibre before arriving at the cardiac extremity of the stomach, where its coats are markedly strong and thick. All the internal membranal lining of the mouth, the pharynx, and the œsophageal tube, down as far as a point opposite the base of the heart, is normally, in the living *Heloderma*, of a deep black colour, due to an abundant deposit of pigment in the mucous coat lining the parts in question. Below this, however, such colouring entirely disappears, and the internal coat again assumes its more natural tints. Strong, longitudinal rugæ already make their appearance here in the posterior fourth of the œsophagus, and these are continued on into the stomach; we also observe that both the circular and longitudinal muscular fibres of this division of the alimentary tract are well-developed as we come to examine its posterior portion.

The *Stomach*, in a full-grown lizard of this species, measures for its greatest length about 9·2 centimetres and at its greatest width about 2·5 centimetres; this last measurement is taken at the junction of the middle and the pyloric thirds. The anterior or the somewhat shorter border of the organ exhibits one general concave curvature that may be divided into two lesser and similar ones; the posterior and at the same time the longer border exhibits one general convex curvature for its length. Muscular fibres can plainly be made out upon its external surface running in the longitudinal direction adown its cardiac moiety, they being continuous with those of the œsophagus.

At the cardiac end of this gastric pouch the œsophageal tube gradually widens as it merges into it, and in reality no proper line can be drawn to define any exact cardiac orifice; but this does not strictly apply to the pyloric extremity, for there we can very well define the line of union between gut and stomach. Upon opening the latter, we have presented us for our examination the abundant longitudinal rugæ of the cardiac half of the sac, while these are generally reduced to two for the mucous lining of the pyloric moiety, and from these two well-defined ridges strong transverse rugæ branch off. These are continued to the "pyloric valve," an annular muco-muscular ridge which constricts the orifice of this end of the stomach where it joins the small intestine. A lens of moderate power will discover to us the gastric alveoli, but they are not conspicuous, and it would require a good microscope to make out such structures as gastric follicles and peptic glands if they exist in the internal mucous coat of this lizard, as they no doubt do.

The entire intestine, in this same specimen, measured from the stomach to the border of the anus, has a length of 40 centimetres, and it presents the usual Lacertilian characters[1]. The duodenal por-

[1] In the specimen under examination a complete invagination of the small intestine existed, which, however, did not in any way involve the duodenum, although it was very extensive below that point. The gut was but slightly thickened from the inflammatory process, and by gentle traction the inslipped or upper portion was easily pulled out, and this I did, wondering all the time whether such an accident often took place in lizards.

tion curves round the pancreas, and in it the coats of the tube appear to be thinner than in any other part of the tract. Both the stomach and the duodenum are connected to the spinal column by a broad fold of the peritoneum; in the case of the first it is known as the "mesogaster," and in the second as the "mesentery." These folds are absent in Man.

In all of the specimens I have examined, the "ileo-cæcal valve" is notably rudimentary in character, and indeed in this form the termination of the small intestine hardly seems to enter into that part of the tract, here spoken of as the rectal pouch, but which in part must also, for its anterior division at least, represent the *colon*. In *Heloderma*, too, the blind pouch that represents the *cæcum* is so shallow that it would hardly attract our especial attention were it not for the fact that it forms quite a conspicuous feature in a number of other species.

So far as the general calibre of the intestine is concerned, we are to note that this is the greatest along the duodenal division, and from this onwards to the point where it joins the rectal enlargement the alimentary tube gradually diminishes in its calibre, being very noticeably smaller for the last fourth of its length. It enlarges again slightly just before it terminates. Without giving it a special microscopical examination, the intestine seems to be composed of the usual coats, and upon cutting into it it struck me that the *intestinal villi* were comparatively very large, especially along its middle portion.

My big specimen of this lizard had a rectal sac some 9 cms. in length, and of a form that quite well agrees with that of a *Lacerta viridis*, as figured for us by Professor T. J. Parker in his 'Zootomy,' on page 160 of that work (*r*). The mesenteric fold of the peritoneum is continued backwards upon the rectum, and in this region it is spoken of as the *mesorectum*. From this it will be seen that the entire gastro-intestinal tract is supported, from one end to the other, by a continuous fold of the peritoneum, which latter attaches itself to the spinal column, along in the median line.

The blind pouch or *cæcum* of the rectum is here very small and scarcely definable. For instance, it is nothing like as prominent as Owen figures it for *Draco volans* (*loc. cit.* vol. i. p. 445, fig. 303, *h*).

*The Urogenital System.*—Unfortunately all the specimens of *Heloderma* at present to hand are females; consequently it does not lie within my power in this memoir to record anything relative to either the urinary system or the generative aparatus in the male.

In the urogenital system of the large specimen of this lizard mentioned above the following facts are presented for our consideration.

An elongated, large, pear-shaped *urinary bladder* with thin walls is to be observed. This has a length of 6 centimetres, measuring 2·5 at its widest part, and is supported by the usual tissues, and opens in the usual manner into the ventral wall of the cloaca. Parker (T. J.) found this viscus "bilobed" in *Lacerta viridis*, but I find no such condition in our present subject, its anterior fundus being uniformly rounded.

*The Heart and Great Vessels.*—Such examination as I gave this organ, and the vessels leading to and from it, revealed to me nothing that might be considered especially remarkable. Upon comparing the entrance and emergence of the principal veins and arteries as they take place from the cardiac cavities in the lizard before us, I find that the arrangement agrees rather with *Lacerta* than it does with *Varanus*. In making this assertion I am obliged to rely largely upon the two figures given in the 'Comparative Anatomy of Vertebrates' (p. 285, fig. 229, A & B), where the arrangement of the vessels is seen to be very different in these two types of Lizards.

With respect to the heart, the walls of the *atria* are markedly thin in *Heloderma*, while, on the other hand, the ventricular parietes are composed of thick muscle of a spongy nature, which renders the single cavity of that division of the heart especially small. The right auricle has nearly double the capacity of the left, and the left has nearly three times that of the ventricle. Nothing especial seems to characterize the *sinus venosus*, *sinu-auricular aperture*, the *septum auricularum*, or the *auriculo-ventricular aperture* or its valve, or the *musculi pectinati*, all of which structures I examined with great care.

Such notes as may seem to be required hereafter upon the general venous and arterial systems will be given, but it is my present impression they are not distinguished from the same, as we find them in ordinary Lizards, by any marked peculiarity.

*Of the Lungs and Air-passages.*—The *larynx* is seen to be placed dorsad to the base of the tongue, riding above it, as it were, while the deep-black integumental mucous membrane which lines the buccal cavity ensheaths them both. A sharp, thin, medio-vertical slit occurring on the front of the larynx represents the *glottideal aperture*; it is unguarded by any epiglottideal valve, but its lips are closely apposed to each other, and are thick, being so constructed that food is prevented from getting into the windpipe. There is a median membranous frænum connecting the anterior end of the tracheal tube to the base of the tongue, but beyond lying immediately over the hyoidean apparatus, the larynx seems to bear no special relation to the last-named structure. I mention this fact, for the reason that Professor W. N. Parker has said (in his translation of Wiedersheim's work), in speaking of the larynx of reptiles, "One point, however, must be specially noticed, viz., the close connection which obtains between the larynx and the hyoidean apparatus—more particularly the dorsal surface of the basi-hyal" (*loc. cit.* p. 255).

The structure of the *larynx* in *Heloderma* is quite simple: we have at its summit, upon either side, a movably articulated arytenoid bone, and postero-laterally, upon either side, outside the larynx, a cricoidal process. Extending from a cricoidal process to the anterior tip of the arytenoid bone of the same side, we have a *dilator muscle*, which by its contraction will open the glottis. Then, anteriorly, in the median line, dorsad, we find the larynx is roundly notched: a *constrictor muscle* arises from the base of this notch, one for either side, and passing round outside the larynx, becomes in-

serted into the posterior end of the corresponding arytenoid. The dilator muscle, upon either side, is superficial to the constrictor of the same side. The constrictors by their common contraction close the aperture of the glottis during the acts of respiration and deglutition. Dorso-laterally, the cartilaginous wall of the laryngeal box is ample and broad, while ventrally it is narrow; and its capacity is but slightly increased over that of the end of the trachea, which it surmounts.

In my female *Heloderma* the *trachea*, including the larynx, had a length of seven and a half centimetres, to the bifurcation of the bronchi, being composed of about 57 cartilaginous rings, each and every one of which are incomplete down the median dorsal line. Some few of these tracheal rings bifurcate, as we occasionally find them in Man. Either *bronchus* is unusually long, its rings being incomplete as they are in the trachea, which it lacks but little of having the same calibre. For instance, in this same specimen a bronchus measures three and a half centimetres in length, while its size changes but little from the bifurcation to its terminus, thus being nearly half as long as the trachea. According to Mivart, the bronchi in Lizards are usually "very short" (Encycl. Brit. vol. xx. p. 458), and to this rule *Heloderma* certainly forms an exception. A pulmonary vessel follows up either bronchus along its anterior aspect, as one does along the opposite side of the tube, each coming from the posterior portion of the lung.

Either lung is larger anteriorly than it is posteriorly, ending behind in a rounded tip (see fig. 3, Plate XVI.), while it is in the fore part only that we find a pulmonic tissue of the finer more spongy sort, as these sacs behind are covered by a serous coat of a denser texture, and are filled in by air-cells of the larger more open kind, as is the case very generally in this class of Vertebrates. These lungs are of about the same shape, size, and length in our present subject, and their extremities within the abdominal cavity take up but little room.

Now either bronchus curves slightly as it comes through the anterior moiety of the lung, and its rings are lost posteriorly in that part where the pulmonic tissue begins to become coarse. Bronchial branches are not definite, as communication is made with the lung-tissue by means of short-necked apertures found at a few points along their sides, principally anteriorly.

## VI. Notes upon the Oral Cavity and Associated Parts.

At the roof of the mouth we have presented us for examination, posteriorly, the *Eustachian pits*. These are large and deep, especially behind; they shallow out as we proceed mesiad and towards the front. At the back part of either one of them there is situated the subelliptical aperture that leads into the organ of hearing, and these apertures, in a large specimen of *Heloderma*, are nearly 3 centimetres apart. Anterior to the point where the Eustachian pits cease, the lining membrane of the roof of the mouth is not so deeply

pigmented; while it fits very closely to the superimposed bones of the skull, thus giving rise to several paired pits of greater or less depth, and an azygos one that stands between the *apertures of the posterior nares*.

These latter are of fair size, somewhat rounded in outline, and separated from each other by a transverse distance of nearly a centimetre in the adult. From either one there leads forwards a doubly curved slit-like groove, the lips of which are flexible and in contact by their edges for their anterior two-thirds. This groove terminates in front in a small, rounded opening, which is the mouth-entrance to the cavity containing the *Organ of Jacobson*. A line drawn perpendicular to the plane of one of the posterior narial openings would be found to be considerably in front of the eye of the same side, and still further in front of the brain. In the dried skull the direction of the narial chamber lies longitudinally; but in the living animal the external nostril is laterally situated, so that an angle is formed in the passage in front.

*The Tongue.*—Bocourt and Boulenger have given a superior view of the tongue in *H. horridum*, and it has been figured by other anatomists.

It is thick and broad at its base, rather thin and acutely but not deeply bifid anteriorly. It is more than twice as wide behind than it is in front, having rounded margins for its thicker parts. Peculiar papilla forming epithelium is seen covering the hinder two-thirds of its free surface, which is gradually developed from the smoother coat of the fore part of the organ. A faint medio-longitudinal groove marks its superior aspect, and it is bound down by a thick median frænum ventrally. Dissection shows it to be composed of two symmetrical halves, which are separated from each other by a thin fibrous septum, found in the medio-vertical plane. Posteriorly, extending deep into its base, we find the rod-like body of the hyoid, and about it considerable adipose tissue is deposited.

Either lateral half of the tongue possesses two special muscles that here require description:—

120. The *Lingualis*.—This is purely an intrinsic muscle of the tongue, which arises in the substance of its base, and, extending longitudinally through the entire dorsum, its fibres are gradually lost as it comes to the apex. It overlies the *genioglossus* and the *genio-hyoideus*.

121. The *Genioglossus*.—A muscle which must be considered but partly intrinsic to the tongue I propose to describe under this name. It is seen to arise, upon either side, from the inner aspect of the mandible near the symphysis, and its fibres passing backwards and upwards, spreading out as they do so, the muscle at once becomes entirely incorporated in, and devoted to, the tongue. Its insertion for the most part is limited to the hinder half of the organ, extending from the frænum to the base, and outwards as far as the lateral margin.

The broad, thick, fleshy, unensheathed and independent tongue of *Heloderma*, then, is a very different affair as compared with the

tongue in many other reptiles, or with such a lizard, as *Varanus* for instance, where the morphology of the structure is essentially very different[1].

*The Teeth.*—These appear to be embedded in the thick buccal membrane that overlies both jaws within the oral cavity in the lizard before us, and it is only in the dried skull that we are enabled to satisfactorily study them. In either jaw the curved line of teeth stand in a slit-like groove of the mucous membrane to which we refer, which is continuous all the way round, and, in addition to this, we find the teeth piercing the basic part of this groove and raising a kind of a papilla at the point of each individual puncture.

Bocourt has given us excellent figures of the sharp, curved, conical pleurodont teeth of *Heloderma* (34), and these have been copied by other naturalists; so it will be quite unnecessary for me to reproduce these now well-known structures here.

In a very fine mounted skeleton of a specimen of *Heloderma suspectum* in the collections of the Smithsonian Institution at Washington, which I have been permitted to study, I find the following to be some of the characters of the teeth of this reptile. From twelve to fourteen of these seem to be about the normal complement that are destined to ornament the mandible, while perhaps a pair more are to be found in the upper jaw. In front these teeth are tiny and small; they very considerably increase in size laterally, while posteriorly they are again smaller, especially in the upper jaw. The largest of all are to be found in the middle of the series in the mandible, the smallest in the premaxilla. Contrary to what I have always understood from published descriptions, I find all of the larger teeth, in both jaws, characterized by the peculiar grooving, although it is best marked in the large ones opposite the site of the poison-gland upon either side. Pleurodont to a less distinctive degree than we find in some other Lizards, these poison-fangs are firmly anchored through anchylosis by a broad base to the rather transversely-spreading ramus, in the case of the mandible, while in the case of the maxilla of the skull they are more laterally attached. When, through accident or otherwise, any of these teeth happen to be lost they are quite rapidly reproduced again, as I have seen from my own observation.

All curve more or less backwards, and Günther has said of them that "In the genus *Heloderma* the teeth are vertically grooved so as to remind us of their structure in Serpents. The teeth indeed are more grooved than in them, for one vertical groove passes down on the antero-inner side and another on the postero-outer side of each tooth" ('Encycl. Brit.' 9th ed. p. 457).

[1] For a good figure of the tongue, hyoidean arches, and associated parts of a *Varanus*, see Gegenbaur's 'Elements of Comparative Anatomy' (English translation), p. 553, fig. 310 (Lond. 1878). It is very evident that a bifid tongue, as in the case of a *short* humerus in a Swift and a Humming-bird, is by no means an index that all of the remainder of the structure in the compared forms will be more or less alike, and consequently point to affinities that in reality do not exist.

Just at this point I will pass from the consideration of those organs that are entirely contained either within the body- or mouth-cavities and record next a few brief notes upon some external structures, such, for instance, as the poison-glands and their ducts[1].

## VII. The Poison-glands. (Plate XVI. fig. 4.)

J. G. Fischer (44) has presented us with a fair drawing of the venom-organs of *Heloderma horridum* as they occur upon either side of the lower jaw. Of the ducts, of which there are four in the specimen I dissected, they passed, at a short distance apart, from the mesial aspect of the middle of the gland upwards each to its opening on

[1] Before parting company, however, with our researches upon the organs contained in the cœlom and the cavity of the thorax, I would like to say a word or two more in reference to the observations I have made concerning the system of hepatic, cystic, and pancreatic ducts; and, secondly, as to the description recorded of the thyroid gland of *Heloderma*. In the case of the first-mentioned structures I desire to repeat the statement that my opinion about them is not final, as I should very much like to see additional material and fully re-investigate structures that seem to be so notably different from the more usual arrangement of these ducts in other vertebrate forms. To be sure I devoted several hours to the careful examination of the ducts in question, and, as far as the circumstances would admit, I was satisfied in my own mind as to the peculiarities they presented; but that part of the vascular system of the specimen undergoing dissection was not injected, and this may have given opportunity for error. Notwithstanding the cautionary words I here give, both my description of these parts and my drawings of them may be absolutely correct; and if they be, why so much the better for the writer and his reputation. Speaking of these hepatic ducts I see that Professor Hoffmann found some interesting arrangement of them in Alligators and Crocodiles (see Bronn's 'Thier-Reichs,' Rept. Bd. vi. 33 & 34 Lief., 1882), and, according to him, the distribution of the ducts varies for *different species* of Alligators, as shown by the drawings in the work quoted (Taf. C). It must be evident, however, from what I have said upon a former page of this memoir, and from what Beddard found in a species of *Varanus* with regard to its biliary ducts, that further investigation into these structures in Lizards will well repay the labours of the morphologist.

As to the thyroid gland in *Heloderma*, and the description I have recorded in reference to it, I would say that I am aware of the position occupied by this structure in other Lizards, as in *Lacerta* it occurs as two separate lobes opposite each other on the sides of the trachea some little distance above the base of the heart. I examined with no little care the organ I have described as the thyroid in our present subject; it was firm and flexible, and under a lens of moderate power had all of the appearances that characterize glandular tissue. Be it noted, too, that the pericardial sac does not normally extend anteriorly beyond the base of the heart, nor connect with any other sac overlying the origin of the great vessels that I am at present aware of. Still, a small rupture had taken place in one of the thin auricles of my specimen and some blood had escaped into the pericardial sac, and this, stained with its own colouring-matter and hardened with the alcohol, had, I must confess, some little resemblance to the structure I have described as the thyroid; but it may have been a resemblance and nothing more. The parts were all particularly sound and perfect otherwise; furthermore, after carefully dissecting up both sides of the trachea, I utterly failed to find in my specimen any such thing as a thyroid in the locality wherein it occurs in *Lacerta*. Again, it may have been some pathological growth, but an examination of a few recently killed Heloderms would soon clear up all such doubtful points, and I sincerely trust that some day this will be done.

the outer surface of the mandible, where they entered. Fischer found in his specimen that these ducts branched as they quit the gland; this was not the case in the reptile examined by me. Each duct passes obliquely upwards and inwards through the lower jaw, and its internal opening within the mouth is found at the base of the tooth it supplies, near the termination of the groove of the tooth.

These glands resemble each other in size, shape, and position, and they in all probability have the same function. Either one of them lacks something of being rather less than two centimetres for its antero-posterior diameter, and is about a centimetre wide. Sub-elliptical in outline it will measure at its thickest part, which is at its centre, four or less millimetres, while the organ is held in its position by the firm connective tissue that surrounds it. Over its surface, superficially, it is easy to discern the ramifications of the vein that comes away from it and thereafter joins the internal jugular. A tendinous expansion, which arises from the outer surface of the superficial muscles near the hinder end of the mandible, is seen to spread out over this organ in large subjects. It is narrow and rather strong at its commencement, to become very thin and closely adherent to the skin as its fibres diverge anteriorly. There seems to be scarcely any muscular tissue in this tendon, but I am inclined to believe that by its contraction in the living reptile the venom of the gland can be forcibly jetted through the ducts and so along the grooves of the teeth at the time of its bite. In my specimen the four ducts serve the anterior moiety of the organ, its hinder half being without these glandular conduits.

Now, although the upper teeth of *Heloderma suspectum* are grooved, I fail upon dissection of the parts to find any gland present wherewith they might be supplied with poison. Indeed the skin overlying the latero-labial region is quite adherent to the skull along its margin, while just above it, between the eye and the external nostril, the bases of the dermal tubercles and the underlying bone often coossify.

There seems to be no reasonable doubt at the present time but that the secretion of these glands in *Heloderma* is of a poisonous nature, and that the injury caused by its injection into the circulation of living animals varies. Still further research is required before we can possess anything like a complete knowledge of its action upon different animals and under varying conditions. It is hoped that experiments tending to make clear such points will be undertaken by the scientific investigator from time to time.

## VIII. The Olfactory Cavities and the Organ of Jacobson.

With the very finest of wire saws I made both a transverse and a longitudinal section through the narial chamber of one side in a specimen of *Heloderma suspectum*. The operation brought the structures of the region plainly into view; but, so far as I was enabled to discover, it revealed nothing that seemed to depart in any

noteworthy way from the arrangement of the olfactory organ in the Lacertilia generally.

*Jacobson's Organ* appeared to be not as large, comparatively, as it has been found to be in some forms, as in *Lacerta viridis* for instance; it is, however, well-developed, and, as stated in a former paragraph, connects by means of a special tubular canal with the oral cavity, opening upon the roof of the mouth, anterior to the posterior narial aperture.

As for the olfactory organ itself it exhibits, as usual, an antero-external and postero-internal chamber, which are connected with each other by means of a mid-passage.

The postero-internal or true olfactory chamber presents for our examination a large, semi-rolled turbinal bone springing from its outer wall. This is covered with the usual mucous membrane, which supports the terminal ramifications of the nasal nerve.

Relying, as I do, upon the drawings made by Parker, Hoffmann, and others, which are before me, of the nasal chambers of *Lacerta viridis*, I am of the opinion that *Heloderma* differs from that form in these parts in that we find in the true postero-internal nasal cavity of the latter reptile a large turbinated, cartilaginous scroll hanging from, and at the same time attached to, the roof of the chamber in question. Externo-laterally this is connected with the lateral turbinal, the lining membrane passing from the one on to the other.

## IX. Notes on the Anatomy of the Eye.

My examination into the structure of this organ was by no means exhaustive, and only sufficient to bring the following points to my notice. Both eyelids seem to enjoy the usual movement of opening and closing, rather more especially the lower one. The aperture between them is horizontal. Small dermal tubercles fringe the margins of these eyelids, and somewhat larger ones cover their external surfaces. A very delicate tarsal cartilage is developed in the lower lid, but any such structure appears to be entirely absent from the upper one. By the aid of a lens of some power I succeeded in finding the Meibomian glands in the lower lid, where they seem to be best marked. A nictitating membrane is strongly developed, as is its governing tendon. In *Heloderma* this membrane is placed quite vertically, and in a state of rest is found covering the antero-internal part of the eyeball. In front of it there is to be seen a semi-elongated, though not large, *lacrymal gland*, the duct of which passes to open into the buccal cavity. Very much larger than this is the *Harderian gland*, the body of which in our present subject forms a thick, squarish cushion for the eye, resting upon the floor of the orbit. Anteriorly it becomes smaller, forming a kind of neck, which, crooked outwards upon itself and in contact with the eyeball, opens by a single duct upon the outer surface of the nictitating membrane. This anterior portion of the gland is crossed by the anterior rectus muscle, which holds it against the eye. Little or no fat was found in the orbital cavity. Having their usual origins and

insertions as seen in the Lizards generally, the following muscles were examined, viz:—

122. *Rectus anterior.*
123. *Rectus posterior.*
124. *Rectus superior.*
125. *Rectus inferior.*
126. *Obliquus superior.*
127. *Obliquus inferior.*
128. *Musculus choanoides.*
129. *Pyramidalis.*
130. *Levator palpebræ superioris.*
131. *Depressor palpebræ inferioris* (feebly developed).
132. *Orbicularis palpebrarum* (feebly developed).

The pupil is round, and the sclerotal plates are thin, these latter having each a form somewhat similar to what we find in Birds. Careful examination failed to demonstrate the presence of the *pecten* within the eyeball, though future specimens may go to show its presence. It is known to be absent in *Hatteria* and *Chelonia*[1]. Around the entrance of the optic nerve the sclerotic coat seems to occasionally slightly ossify. I have also found this to be the case in a variety of genera of Birds. We find the cornea to be not very markedly convex, while the lens is comparatively of good size, it being quite flat externally, and convex upon its internal aspect.

## X. Notes on the Anatomy of the Ear.

*Heloderma* has the tympanum of the ear large and fully developed, making the usual attachments to the parts and bones in the vicinity, thus creating a capacious meatus. Upon dividing this, the external ear-drum, all around at its periphery, and reflecting it, we bring into view the cartilagino-osseous chain of elements that connect the tympanum with the inner ear. Both the passage of the Eustachian tube and the cavity of the middle ear are capacious. Lying along the dorsal roof of this chamber, and close to it, we observe the well-developed columella auris; it passes forwards and inwards and very slightly upwards; the osseous rod-like portion being included in a fold of the common lining epithelium, as is likewise the infra-stapedial process in its own fold.

The middle ear is partially divided into two cavities by the inner edge of the quadrate bone, and we see that it is within the inner part of this cavity that the ossified medio-stapedial portion of the columella auris lies, while the outer cartilaginous extremity of the rod

[1] Since writing the above I have carefully examined an eye in very fair condition from an alcoholic specimen of *Heloderma suspectum*, and in it I discovered an extremely delicate fold of tissue extending from the capsule of the lens to a point near the entrance of the optic nerve. It was non-pigmented. This structure quite possibly represents the *pecten* or "falciform process," but it is here by no means so well marked as I have found it in many species of Birds.

Of course the demonstration of the presence of a *tapetum* in old alcoholic specimens of *Heloderma* is difficult, and I was not successful in any instance.

is found in the other. The latter develops the usual extra-, infra-, and suprastapedial processes, while the last-named sends off a small special apophysis of its own that lies in the epithelium lining the internal surface of the ear-drum. Mesially, the columella auris is slightly enlarged, tipped with cartilage and closely fitted into the fenestra ovalis. Upon properly opening the dense, flinty, osseous otic capsule, I find a sacculus of fair size and with the three semicircular canals disposed somewhat as they are in *Lacerta*. The lagena is moderately well developed, but shows barely any inclination to become spiriform. Beyond these casual observations I made no special note, in so far as the auditory organ was concerned. This apparatus widely varies in the Lacertilia, and to make correct and exhaustive dissections of these parts requires much time and abundance of material, neither of which are quite as I would have them at present.

### XI. A few brief Notes upon the Arterial System.

Upon examining the dorsal aorta below the heart, it is seen that in its branching it is inclined to throw off rather a generous supply of offshoots. At the point where the cœliaco-mesenteric is usually given off, two arteries arise—the hepatic, which thereafter gives off smaller mesenteric branches; and, secondly, a cœliac, which chiefly supplies the stomach, the spleen, and the pancreas. About a centimetre below the point where the cœliaco-mesenteric comes away there is given off a large mesenteric branch, which with its branches furnishes the principal arterial supply to the intestine and its supporting mesenteric membrane. A few smaller mesenteric offshoots are sent forth at irregular distances below this point. Branches from these, as well as from the dorsal aorta, still more posteriorly, supply the *retrahentes costarum* muscles and less important structures along the region of the spine. The ovarian branches exhibit no special peculiarities. There may be as many as seven renal branches upon either side; a generous supply of hæmorrhoidal arteries are also thrown off; while a vesical branch to the bladder is supplied by the right common iliac. Posteriorly, the dorsal aorta is continued to the end of the tail as the caudal aorta, and for the entire length of this appendage it passes between the arches of the chevron bones.

I made no especial research for the existence of the *retia mirabilia* along the caudal portion of the vertebral column in this lizard, but have reason to believe that if such vascular anastomoses there occur, in our subject, they will be found to be not very markedly developed in the region to which we have referred. It is generally understood that a rete mirabile is more likely to be discovered along the vertebral column in the tail of those forms of Lizards and Blindworms wherein that structure is often lost through some mishap and nature reproduces the appendage again. This is especially true of the Blindworms. It is not likely that our thick-tailed *Heloderma* often parts with that extremity of its body; it is nevertheless true, however, that when it does, nature supplies a new tail in precisely the same manner as we see it reproduced in other Lizards similarly gifted.

There is before me at the present moment a mounted skeleton of a *Heloderma suspectum* belonging to the U. S. National Museum, wherein the hinder third of the skeleton of the tail has been replaced by feebly developed cartilaginous nodules, and it is very evident that that specimen, in life, sometime or other lost that part of its economy.

The *Lymphatic system* of *Heloderma* has not been examined by me; that is beyond what I have given above in reference to the *spleen*.

## XII. Some Observations upon the Nervous System.

Although it possesses a peculiar *facies* of its own, the brain of *Heloderma suspectum* is quite typically Lacertilian in the majority of its parts. Either *olfactory lobe* is rather short, comparatively, and is of nearly uniform calibre throughout. The outer envelope of the brain ensheaths these lobes together, up to their anterior tips. Measuring from the posterior surface of the cerebellum to the tip of an olfactory lobe, the greatest length of the brain of this reptile is 2·3 centimetres, while is greatest width, taken through the cerebral mass transversely, is one centimetre. Each *cerebral hemisphere* is reniform in outline, full, and beautifully rounded. The posterior limbs of the somewhat slender *optic chiasma* are closely applied to the rather large *pituitary body*, which latter presents the usual *infundibulum*, and withal has a form much as we find it in *Lacerta viridis*. Upon opening one of the cerebral hemispheres we observe that the *corpus striatum* is large and rounded and occupies considerable space in the central cavity. A *choroid plexus* is easily made out. Turning to the *pineal body* we find it small and rather inconspicuous, and when the brain is in its case *in situ* within the skull this structure comes closely in contact on the ventral surface, in the middle line, with a large longitudinal venous sinus that is seen in this cavity in *Heloderma*. I have made no especial histological examination of the pineal body in our present subject, and consequently cannot with authority say at what stage the "parietal eye" may be: I am of opinion, however, that it is undoubtedly in a very rudimentary condition. It is a fact that a very considerable venous sinus stands between it and the cranial roof, and that not a vestige of a parietal foramen is to be found piercing the latter. This latter feature is well seen in a skull of *Iguana tuberculata* before me that belongs to the collections of the Smithsonian Institution (No. 12600). After reading Baldwin Spencer's announcement of his important discovery, it is quite natural that this point should specially interest me upon dissecting the brain of *Heloderma*[1].

Young Helodermas show no better development of this eye than do the adult specimens, in so far as I have examined them.

Passing to the *olfactory lobes*, we find them to be rather small in comparison with the size attained by the hemispheres in the Lizard before us, the two lobes together barely having a width equalling the width of one of the hemispheres.

[1] Spencer, W. Baldwin, "The Parietal Eye of *Hatteria*." 'Nature,' May 13th, 1886, p. 33.

The *cerebellum* is cup-shaped, smooth, and comparatively of large size; its anterior concavity entirely covers the hinder portion of the optic lobes. Behind it, the dorsal aspect of the *medulla oblongata* is much scooped out, while its ventral flexure is but fairly well-marked.

Upon carefully examining the roots of the cranial nerves, the foramen of Monro, the posterior commissure, the encephalic ventricles, and other minor structures of the brain-mass, I find nothing that might in any way be considered worthy of special record.

I will say here, however, that I felt a strong desire to work out the cranial nerves; they looked very tempting, but my material would hardly admit of it, as my dissections of the eye, ear, tongue, and muscles of the head had already made extensive inroads upon this part of the bodies of my several specimens, and in consequence the cranial nerves had to be frequently cut or broken up.

*Of the Sacral and Brachial Plexuses.*—Coming to the spinal nerves, the only ones to which we have paid any special attention in our subject are the branches that go to make up the brachial and sacral plexuses. These I observed quite closely. But upon studying the descriptions and examining the figures of these parts in a goodly number of species and genera of reptiles as given us by a great many anatomists, I have been forced to believe that these structures will never be anything more than uncertain ones in so far as they afford any reliable characters for classificatory purposes. Mivart speaks to the point in reference to this matter when he says, "As to the particular spinal nerves which go to form these plexuses respectively, and as to the mode of their interlacement and mode of giving origin to the limb-nerves, there is not only diversity between different genera of the same order and species of the same genus, but also between different individuals of the same genus, and even between the two sides of the same individual reptile"[1].

Regarding the brachial plexus in an adult specimen of *Heloderma* before me of the right side, I find that the fifth nerve that emerges from the spinal column, in addition to its sending off its smaller branches for muscular supply in its vicinity, also sends a long delicate branch which merges with the sixth spinal nerve, and so it constitutes the anterior part of the brachial plexus. The sixth, seventh, and eighth spinal nerves are very considerably larger than any of those that precede them or that immediately follow them, and they may be considered as constituting the main portion of the plexus. As they come out of the intervertebral foramina of the spine, the first two mentioned nerves pass over the posterior end of the *rectus anticus major* muscle, while the eighth spinal is still more extensively covered by the most anterior fasciculus of the *retrahentes costarum* series. Now the sixth spinal nerve as it approaches the shoulder-joint gives off four principal branches which supply various muscles of this region, and a little further on at its termination this is the fate of the main trunk itself. It, however, also sends off a short and rather thick branch that joins and merges with the trunk of the seventh nerve, before the latter anastomoses with the eighth. Following out-

[1] Encyclopædia Britannica, 9th edition, article "Reptiles," vol. xx. p. 460.

wards the trunk of the seventh spinal nerve, we observe that the first branch that it gives off is a short thick one, which it sends to join the main stem of the sixth, and this branch crosses the branch sent to the nerve now under consideration by the sixth, which is the branch described in the last paragraph. In other words, the sixth and seventh trunks are mutually joined to each other, near their middles, by rather short thick branches which cross each other. Below this point, and still following the trunk of the seventh spinal nerve, we note that it soon thereafter joins with and merges into the trunk of the eighth spinal nerve, and gives off no branches before so doing. No branches are given off from the trunk of the eighth spinal nerve before its mergence with the trunk of the seventh, and the two below that point constitute a still larger trunk, which upon arriving at the axilla passes on down the arm, breaking up as it does so into the more usual branches that go to supply the muscles of the brachium, antebrachium, and the hand.

It is hardly necessary to add that the vessels, the subclavian vein, and the brachial artery are situated ventrad to this nervous plexus of the brachium.

Upon comparing this arrangement of the nerves in the brachial plexus of *Heloderma* with the descriptions and figures as given us by Hoffmann (45) of such species as *Platydactylus ægyptiacus*, *Uromastix spinipes*, *Pseudopus pallasii*, *Chamæleon vulgaris*, or even *Crocodilus acutus*, I fail to find scarcely any agreement whatever, and it is only in such a form as *Uromastix* that we note any approach to what we find in *Heloderma*. This agreement refers to the number of nerves and their connections that go to form the plexus; but even in these particulars the two species are at variance, though in both four spinal nerves constitute the plexus, they being VI-IX in *Uromastix* and V–VIII in *Heloderma*.

Next we come to consider the *lumbo-sacral plexus*, and there is no doubt but that quite as much inconstancy of arrangement exists here as we noted above with reference to the brachial interlacement. Indeed, Mivart included the sacral plexus in his remarks as we quoted him above, and my own observations go to sustain the opinion he has expressed in the premises.

Using the same specimen of *Heloderma* as we did in our examinations of the brachial plexus, and still confining ourselves to the right side of the animal, the following arrangement of the nerves is to be made out. There are two vertebræ in the sacrum of this lizard, and there are three nerve-trunks that enter into the formation of the lumbo-sacral plexus. The spinal nerve that emerges from the intervertebral foramen between the last two lumbar vertebræ is a small one, and it immediately divides into two delicate branches. Of these the anterior one goes to supply the muscles in the vicinity, while the posterior branch trending backwards joins, at about its middle, a much larger spinal nerve that comes out from the spinal cord between the last lumbar and first sacral vertebræ. This latter, beyond this point, in turn merges with that spinal nerve that emerges from between the two sacral vertebræ; and the common trunk thus formed

passes out of the pelvis and down the pelvic limb, dividing up into branches to supply the muscles of the extremity. Either of the two posterior trunks of the sacral plexus distribute one or more nerve-branches to the pelvo-crural group of muscles, these branches being thrown off both prior and subsequent to their mergence with each other.

Now I am not familiar with any Lizard wherewith to compare *Heloderma* in the matter of its very simple mode of sacral nerve-interlacement. Gegenbaur, in his 'Elements of Comparative Anatomy' (English edition, p. 434), presents us with a diagram (fig. 227) intending to indicate the most usual arrangement of the sacral plexus in a reptile, and, although it is quite simple, it is not so simple as it is in the subject we have before us. On the other hand, according to Hoffmann (45), the sacral interlacement in such forms as *Alligator mississipiensis*, *Cyclodus boddaerti*, *Hydrosaurus marmoratus*, and *Monitor indicus* is conspicuously intricate, the more especially in such a form as the Alligator (see Taf. lxxxvii. in the work quoted). To a certain extent this must have its significance, as in the Crocodilia we recognize a group of Reptiles that structurally stand the highest of the class to which they belong, and in them the mode of interlacement of the spinal nerve-plexuses is complicated; and this would seem to point to the fact that in the case of *Heloderma*, wherein the interlacement of those plexuses is most simple, it is most probably affined with a far more lowly order of Reptiles, perhaps with some of the very lowest of existing North-American types.

## XIII. Of the Skeleton.

*The Vertebral Column.*—Upon counting the vertebræ composing the spinal column of an adult specimen of *Heloderma suspectum* I found that there were in all sixty-four of them. Of these eight belonged to the cervical division of the column, twenty-two to the dorsal, five to the lumbar, two sacral, and twenty-seven in the tail or caudal division. In character these vertebræ are procœlous, the more spherical cups and balls being seen in mid-cervical region, while those of the transversely elliptical pattern are best developed in the dorsal portion of the column; and, finally, the more rudimentary ones are devoted to the ultimate joints as we gradually pass to the end of the tail. Commencing with the *atlas* it is found to be composed of five separate pieces; three of these are devoted to the formation of its anterior cup for the cranial condyle. Of these three pieces, one is a mid-ventral one, while either of the others are ventro-laterally situated. Each side of the neural arch is formed by one of the two of the remaining pieces of the five of the component elements of this vertebra; and in a large specimen of this lizard none of these five parts had co-ossified. A *proatlas* does not seem to exist in *Heloderma*.

Turning to the *axis vertebra* we find it characterized by a very long and prominent neural spine; indeed, its length distinguishes it from any other vertebra in the column. Its odontoid process is conical

with rounded apex: a thin plate of cartilage, supported by the atlas, prevents it from being in contact with the condyle of the occiput during the life of the reptile. The postzygapophyses of this vertebra face almost directly downwards, articulating with the counterfaced prezygapophyses of the third cervical vertebra. From this point, backwards, this is essentially the direction assumed by these articular facets throughout the vertebral series. Passing next to the third vertebra, it is seen to possess a form that, in its main features, agrees with all the other vertebræ to the anterior sacral one. It is to be observed, however, that they grow almost imperceptibly wider as they are followed in that direction; the last lumbar being the widest, and the vertebra now under consideration the narrowest in its transverse diameter. This third cervical vertebra has a peg-like and conspicuous neural spine directed upwards and backwards. This is also characteristic of all the vertebræ as far back as to include the second caudal, from whence they gradually become thinner, more lofty and pointed—to again become reduced and gradually disappear as the few terminal joints of the tail are approached, wherein they are quite suppressed. Rudimentary pleurapophysial prominences exist, one upon either side of the fore part of the centrum of the third cervical vertebra, but it does not develop the autogenous hypapophysis, a character common to some lizards. Indeed there are no hypapophyses present upon the ventral aspects of the centra of the vertebræ in *Heloderma* until we arrive at the first caudal one that bears a chevron-bone. A subcircular intervertebral foramen is found between the vertebræ for nearly the entire length of the column, it being intended for the exit of the spinal series of nerves. It is of good size where the brachial plexus comes out, but the largest apertures are those between the last two lumbar vertebræ, or where the larger branches of the lumbo-sacral plexus emerge, one upon either side. The centra of the vertebræ, including the first caudal, are of average length, rather broad, and flat upon their ventral aspects; the tail series beyond become gradually narrower, and comparatively longer, as they diminish in size to the ultimate one. Facets for articulation with the heads of the free vertebral pleurapophyses (of those vertebræ that possess them) exist, one upon either side of all the centra at their anterior parts.

Choosing at random a dorsal vertebra from the middle of the series, we are to note upon its superior aspect the thin anterior edge of its neural spine and the almost equilateral outline that bounds its nearly horizontal superficies.

Apart from their largely developed lateral processes, the two free sacral vertebræ agree in the main in their forms with the first caudal vertebra. Their transverse processes are large, rounded, and thick, with dilated outer ends, the bigger pair belonging to the anterior vertebra. These outer extremities, upon either side, seize the ilium between them, the anterior one having the superior hold, the posterior one the under. Slender and rather conspicuous lateral processes also characterize the caudal vertebræ; they are probably pleurapophysial developments. Gradually diminishing in size from first to

last, to finally disappear altogether, they are seen to be sharp-pointed and stand directly outwards, the first pair being pierced by a foramen upon either side and near the middle of the process. Freely articulated and prominent, Y-shaped, chevron-bones exist throughout nearly the entire series of caudal vertebræ. They gradually diminish from first to last, disappearing altogether near the end of the tail, each being directed downwards and backwards and articulating as usual with the postero-inferior rim of the vertebra at its ventral aspect.

As I have already stated above, *Heloderma* reproduces that part of its tail that at any time may, through accident, be fractured off.

A pair of free *ribs* first occur upon the fourth cervical vertebra; they are about a centimetre long, slightly curved, flattened, and tipped with cartilage. The facet for their articulation upon either side is rather extensive, but the head of the rib does not bifurcate. Similar ribs characterize each and all of the remaining cervical vertebræ from the fourth to the last. They, however, grow gradually longer and more cylindrical; indeed, they simply intergrade in form imperceptibly into the thoracic series of the beautiful, strong, and curved ribs that are possessed by this lizard. Passing to the dorsal series we find that it is only the four leading anterior pairs that are connected with the sternum through the intervention of hæmapophyses. These latter are long and sweeping, and are preformed entirely in cartilage. The shortest pair are the anterior ones, the longest the posterior; the two mid pairs being regularly intermediate in their lengths, and for comparison we find the hinder pair about one third longer than the first pair. They articulate in little pit-like facets that are situated at nearly equal distances apart on the posterior borders of the sternum. The articular facets for the heads of the long hinder pair are found side by side occupying the apex of the postero-mesial extremity of the sternum. Pointed cartilaginous tips, ranging in length from eight to two millimetres, embellish the free extremities of all of the remaining dorsal ribs, from the fifth to the twenty-second inclusive. These ribs are beautifully and regularly curved; their vertebral heads are rather large and are non-bifurcated, while their bodies are subcylindrical in form. The longest pairs are found upon the 13th and 14th dorsal vertebræ. The first three pairs of lumbar ribs are short in comparison, each rib rarely measuring more in length than a centimetre, while the pair upon the fourth lumbar vertebra are rudimentary, and the last lumbar is entirely without them. Cartilaginous tips seem to be absent from the ends of these ultimate riblets of the series, a fact worthy of notice.

*Heloderma* possesses a comparatively small *sternum*, it being represented by a lozenge-shaped plate of cartilage, as is the case in the vast majority of ordinary lizards. Quite firmly attached to it and overlapping its anterior angle is seen the hinder end of the interclavicle, the latter being situated ventrad. Its mesio-posterior angle is occupied by two facets for a pair of the costal ribs, as already pointed out, while the contiguous borders to this angle are monopolized by the remaining hæmapophysial facets. Either anterior border is grooved for its entire length to accommodate in articulation

the sharpened edge of the corresponding coracoid. Such a form as *Lacerta viridis*, according to Mr. T. J. Parker, has in its sternum characters additional to the ones here described, for it will be observed that *Heloderma* lacks the "small central fontanelle" and the "two slender flattened cornua" which are produced posteriorly. Indeed, this simple type of sternum in our present subject does not seem to agree exactly with any other form in particular. And to satisfy one's self of this fact it is only necessary to compare the description offered above with the figures of reptilian sterna that have been collected together for us by Hoffmann in Bronn's Thier-Reichs (Rept. 18–21 Lief., 1881).

*The Skull.*—To complete the account of the axial skeleton a consideration of this important part of it still remains. The first thing that strikes one upon a general examination of the skull of *Heloderma suspectum* is what may be characterized as its peculiar solidity, a certain massive compactness. All the bones composing it are stout and strong. This appearance is still further enhanced by the fact that it is thickly studded for the anterior superficies of its roofing bones by the co-ossified dermal tubercles, and some of these may be found over the parietal region. Old oaken chests or various kinds of heavy furniture leave the same impression upon our minds, when they, too, have certain parts of them studded with round-headed, brass hob-nails.

Sutural traces can, but with difficulty, be made out in some instances, although in the mandible and in most other localities no such obliterations are met with. Except in front, the encephalic casket is well protected by bony walls, and this kind of protection is also nearly as well afforded to the orbits and the rhinal spaces; the bounding peripheral margins of these latter are quite circular in outline, while the antero-external narial apertures are very much of the same form. The form of the snout is broadly rounded, and the maxillary alveolar margins are strong and horizontally broad, thus creating a substantial base for the besetment of the teeth. Normally, the massive mandibular rami do not fuse by ossification at the mandibular symphysis.

What is one of the most remarkable facts, however, about the skull of this reptile is the now well-known circumstance that its zygomatic arch is almost completely atrophied, and further that by the union of the post- and prefrontal bones, the frontal is most completely prevented from participating in the formation of the orbital periphery.

In outline the comparatively large foramen magnum is a transverse ellipse, while the condyle of the occiput below it is reniform in shape and distinctly exhibits throughout life the sutural traces of the bones that enter into its formation. Spacious from side to side, but not lofty, the posterior temporal fossæ are much over-arched by the free posterior edge of the parietal bone. Either parotic process is stout, being directed upwards, backwards, and principally outwards, while the various infero-lateral foramina at or near its base are of comparatively large size: relatively larger, for instance, than we find them in the skull of a big *Iguana tuberculata* that I have at hand.

The posterior nasal fossæ are elongo-pear-shaped apertures with the bulbous ends directed backwards, while either palatine foramen is of an oval outline and of no great size. The inferior temporal fossa is capacious, and a firm thin plate of cartilage standing vertically in the median plane divides the orbital cavities internally. This is the *interorbital septum*.

Of fair extent, the *basis cranii* is nearly a horizontal surface, showing but a very slight general concavity over it. This is at variance with such a form as *Iguana tuberculata*, where the area to which we refer is considerably concaved. In a previous paragraph we have already sufficiently referred to the tympano-eustachian fossa and the characters of the columella auris.

Whatever may be the condition of the *parietal* ossifications in the very young *Heloderma*, they are in the adult reptile represented solely by a solidly ossified and dense plate of bone. This bifurcates behind, and either limb is directed backwards and outwards and slightly downwards to articulate with the squamosal of the same side as well as with the corresponding parotic process. Viewed from above the anterior margin of the parietal plate is represented by a finely serrated transverse line; the superior surface of the bone is nearly horizontal and usually supports a group of the ossified dermal tubercles, which have fused with it. Near the middle of its ventral surface is seen a small pit, which it would seem is situated too far back to represent the vestige of the parietal foramen. It by no means pierces the bone. At some distance within its external free margin, on either side, this bone develops a longitudinal ridge. This is most conspicuous near its middle, and resting here against its outer aspect are the upper ends of the columella and the prootic.

In old specimens of this Reptile, the *frontal bones* are indistinguishably fused together, and upon a superior aspect of the skull not a trace of the median suture that originally stood between them can be made out. And even within the cranium it is hardly to be discerned at all. By a straight transverse coronal suture, this frontal bone articulates posteriorly with the parietal; while we have already mentioned the fact as to how it is prevented from participating in the formation of the orbital periphery by the meeting of the pre- and postfrontal elements. Posteriorly, these united frontals are almost entirely masked from our view by the layer of fused and ossified dermal tubercles that overlie the entire fore part of the skull. One never meets with skulls of old individuals of *H. suspectum* as free from this feature, nor with the naso-frontal and fronto-parietal sutures anything like as clearly defined as is seen in the skull of *H. horridum* which is figured for us by Mivart (Encycl. Brit. 9th ed. vol. xx. p. 451, fig. 12 *f.*). Ventrally, the frontals of the skull of our present subject offer us a peculiar character. Opposite the orbits each one sends downwards and inwards a broad and curved plate of bone which mesially meets and fuses with a corresponding plate coming from the bone of the other side. This arrangement gives rise to a transverse osseous bridge, and the large mesial foramen it assists to form has passing through it certain

important structures which are on their way to the rhinal spaces. That is, during life such is the case. Passing next to a consideration of the *nasals*, they are seen to be fused together in a manner quite similar to that which has just been described for the frontals, and it is only upon the roof of the rhinal spaces that the sutural traces can be made out at all. Laterally, a *nasal* articulates with the corresponding maxillary and prefrontal; anteriorly the two unite to send forward a process that articulates with the premaxillary in the middle line; posteriorly the naso-frontal suture is seen to be represented by a deeply zigzagged line; and, finally, these fused nasals at their antero-inferior surface, mesially, meet the hinder ends of the septomaxillaries. They assist in the formation of the peripheries and upper parts of the external narial apertures.

Articulating with the nasals, the vomers, the maxillaries, and the septomaxillaries, the *premaxilla* presents a strong mid-process in front which is carried backwards as the nasal process. Its alveolar portion is rather broad and commonly bears upon either side four teeth. Behind these, and in the middle line upon the ventral aspect, are seen two small processes placed side by side. The united anterior apex of the vomers just reaches to them. A similar character to this is seen in a skull of *Iguana tuberculata* at hand, only in it the apices of these two little apophyses have fused together, thus forming a foramen between them.

Again viewing the fore part of the skull upon its externo-lateral aspect, we observe that the thickly set, fused osseous dermal tubercles are carried down over the maxillary and jugal bones upon either side. They do not, however, entirely cover the *maxillary*, for a narrow strip of its externo-alveolar portion is free from them, and this extends from the jugal all the way round to the narial aperture of the same side. As in so many other forms of Lizards, this smooth and narrow surface of the maxillary seen upon its external aspect, bounded below by its free alveolar margin, is characterized by a longitudinal row of some six or seven minute foramina; they pierce the bone opposite the teeth, or in some instances even between them.

Either one of the maxillaries articulates with a good many bones; it articulates with an os transversum, with a palatine, with a jugal, lacrymal, and prefrontal, with a septomaxillary and a premaxillary, with a nasal, and finally it may even come in contact with one of the vomers of the corresponding side. A maxillary forms the outer lateral wall of the nasal fossa, and also a part of the roof of the same cavity. It also, in *Heloderma*, contributes largely to the formation of the bony part of the roof of the mouth: and here upon its ventral aspect it is somewhat concaved, while along its alveolar edge the row of teeth are found. These latter are grooved in a manner similar to the teeth found in the mandible, notwithstanding the fact that they do not now seem to be intended to conduct a poisonous fluid at the time the reptile inflicts its bite.

*Septomaxillaries* are large and thoroughly ossified. They are in contact with the maxillaries, the premaxillary, the nasals, and the

vomers, and contribute largely to the osseous floor and inner wall of either narial aperture in front.

Parial *vomers* are found in the skull of *Heloderma*. They are represented by rather long stout ossifications; subcylindrical in form, and either one showing a partial groove down its dorsal aspect longitudinally. A septomaxillary notches a vomer on the same side, externally, near its anterior end. These vomers are in contact in front, but they gradually diverge from each other as they pass backwards to articulate with the palatine of either side. How different these bones are from the broad, flat vomers as we find them in *Iguana tuberculata*, where they are in contact with each other, mesially, for their entire lengths!

Either *jugal* is represented by a strong curved bone which forms the postero-ventral boundary of the external periphery of the orbit. Behind it articulates with the postfrontal, while anteriorly it is suturally connected with the lacrymal, the os transversum, the maxillary, and the prefrontal. True fusion has almost taken place among some of these sutures, notably the anterior ones. At its postero-inferior angle behind, the jugal develops a stumpy apophysis. Essentially this bone is a very different affair from what we find in a *Varanus*, wherein it is reduced to almost spiculiform proportions and curving upwards fails to reach the postfrontal [1].

Making extensive articulations by very firm sutures with the parietal, the prefrontal and frontal, and the jugal, a *postfrontal* bone is here a fair-sized ossification that forms the supero-posterior angle of the orbit, and completes the corresponding part of its periphery. Instead of being a small and comparatively unimportant bone, as indeed it is in some of the Lacertilians, the *prefrontal* in *Heloderma* constitutes one of the most essential elements at the fore part of the cranium. It is in sutural contact with the postfrontal and frontal, with the nasal and the lacrymal, with the jugal, the palatine, and finally with the maxillary. With the lacrymal it forms the anterior wall of the orbit, as well as its antero-superior margin. Internally, it bounds the lacrymal foramen, while its dorsal surface is largely covered by a lateral extension of the co-ossified dermal tubercles.

Forming the outer boundary of the osseous lacrymal duct or canal, and wedged in between or rather among the prefrontal, maxillary, and jugal bones, we find the small *lacrymal* ossification. Externally it is generally covered by one of the dermal ossifications that overlie the surface of the skull in front, and it fuses with it.

A *palatine* is seen to be a large tripronged bone that develops a transverse ridge upon its dorsal aspect. This ridge articulates with the prefrontal bone. The inner fork of the palatine articulates with the hinder end of the vomer of the same side; its posterior fork engages the antero-internal limb of the corresponding pterygoid;

[1] My thanks are due to Mr. F. A. Lucas for the loan of a skull of a specimen of *Varanus bengalensis*, as well as an imperfect skeleton of *Crotaphytus collaris*, both from the collections of the U. S. National Museum (Nos. 29226, 29151 respectively).

lastly, the external fork of a palatine articulates with the maxillary and the transpalatine or os transversum. With the pterygoid it completes the inner periphery of the palatine foramen; it forms its entire anterior boundary, as it does the posterior boundary of the internal narial aperture.

An *os transversum* is an important element in the lateral chain of bones at the base of the skull. It is deeply cleft behind in the horizontal direction, and into this closely fits the external limb of the corresponding pterygoid, which is wedged for the purpose. And it is thus that the pterygoid is extended to the maxillary, as through the palatine it is by its internal fork extended to the vomer of the same side. Articulating, then, with a palatine, with the maxillary and the pterygoid, and touching the jugal to its outer side, the os transversum completes the outer periphery of the palatine foramen; and also affords an important contribution to the osseous floor of the orbital cavity.

The *pterygoids* are a somewhat long and slender pair of bones. Either one presents an enlarged anterior moiety and a straight and slighter hinder shaft. These two portions form a curve which presents its concavity to the outer side, and pressing against its inner side at the middle is the extremity of the corresponding basipterygoidal process. This latter is stout and prominent, and has the appearance of pushing the pterygoid firmly against the quadrate of the same side, as the columella appears to prevent it from rising upwards. The pterygoid develops a small lip of bone at its ventral side, which, extending backwards, overlaps the basipterygoid process and thus prevents the slipping. As to its articulations, we are to note that a pterygoid meets the columella, the basipterygoid process the quadrate, while anteriorly it is powerfully wedged into the os transversum, suturally linked to the palatine, and barely touches the jugal. To some extent a pterygoid assists to complete the osseous flooring of the orbit, and it also completes the boundary of the palatine foramen behind.

Dr. Mivart has said in his article "Reptiles," in the 9th edition of the 'Encyclopædia Britannica (p. 451), that "The skull of *Heloderma* is very remarkable in that it has no zygomatic arch whatever."

And this is commonly the way in which this fact is stated. It is not, however, strictly true, for upon examining skulls of both old and young individuals of *Heloderma suspectum* I find at least a very substantial rudiment of the arch in question. It also has been noticed by Bocourt and by Troschel. It consists of a freely articulated conical ossicle standing on top of the quadrate, being moulded to the outer side of the posterior end of the squamosal, with which it also freely articulates. It is seen to be present upon both sides. That it is the osseous rudiment of the hinder end of the zygomatic arch in this reptile there cannot be the shadow of a doubt.

The *squamosals* are well developed and occupy their most usual position as seen in Lizards, being, upon either side, accurately moulded

on the posterior bifurcation of the parietal bone. Either squamosal articulates with the parotic process, the parietal, the rudiment of the zygomatic arch, and finally contributes in a very limited degree to the articulatory facette for the *quadrate bone*.

This last-named element of the lateral aspect of the cranium is large in *Heloderma*, and transversely unusually broad. Its outer moiety behind is concaved in the vertical direction, while its anterior face, though slightly convex, is nearly flat. Tubercular eminences and depressions finish off its summit, and two obliquely-placed articular facets, intended for the mandible, occupy its mandibular end.

Most Lizards have the *epipterygoid* (columella) extending between the pterygoid and the anterior edge of the prootic; in *Heloderma*, however, it quite reaches to the ventral surface of the parietal. In *Iguana tuberculata* it lacks a couple of millimetres of accomplishing this; in both of these reptiles it rests against the prootic above.

Already I have said that the *foramen magnum* is of good size, being a transverse ellipse in outline, and that the *occipital condyle* faintly shows the sutures upon its convexity throughout life.

And now we pass to a consideration of some of the bones that more directly enter into the formation of the brain-case. Presenting nothing worthy of special remark, the *basioccipital* is nevertheless interesting from the fact that the process it develops upon either side, below the optic aperture, is of rather unusual prominence and size. We have already alluded to the large parotic processes; each one is formed by the *exoccipital* and *opisthotic* of the corresponding side.

A character of some value is seen in the fact that the *supra-occipital* fails to reach the ventral surface of the parietal by not an inconsiderable interspace; this, of course, likewise applies to its lateral portions, the *epiotics*. More anteriorly, the *prootic* of either side articulates both with the under surface of the parietal, as well as with the superior end of the epipterygoid. The several otic bones mentioned appear to go to form the auditory capsule in the same manner as they do in all ordinary Lizards.

Every trace of the suture between the *basioccipital* and the *basisphenoid* has been absorbed in skulls of adult individuals; I find it persisting, however, in the skull of an old *Varanus benjalensis*, and according to Parker (T. J.) this is also the case with *Lacerta viridis*. This suture, when it persists, is generally a straight transverse line.

Strong *basipterygoid processes* with dilated ends are developed on the part of the basisphenoid, and they spring from their usual points, and articulate, in a manner already described above, with the pterygoids.

Ossifications representing the *parasphenoid*, as well as the *alisphenoids*, may be present in the skulls of fully-matured individuals. They are to be found in their usual positions.

No especial study was made of the openings that give exit to the cranial nerves from brain-case, other than to note the facts that

the vagus and condylar foramina are to be found at their most common sites as seen in ordinary Lizards. The anterior margin of the prootic is also notched for the passage of the 5th and 7th nerves, this notch being converted into a foramen by the membrane that helps to enclose the fore part of the cranial casket when the skull is normally complete. The 8th nerve emerges from the internal auditory meatus.

Next turning to the *mandible* I would add a few words to what I have already said in reference to the teeth. The ducts which lead from the poison-gland upon either side do not pass directly through the ramus of the jaw to the base of the groove of the tooth to be supplied, as one might naturally suppose. Rather this is the arrangement. Let us choose a large tooth from the middle of the series for an example. In the first place it must be noted that when the grooves upon the tooth are followed down to the base of the tooth it is not at that point that we find the internal foramen that is intended to transmit the poisonous fluid to the groove in question. The external duct enters by means of a foramen directly through the outer bony wall of the ramus. This leads into quite a cavity which exists in the body of the jaw and at the base of the tooth. Now the foramen that leads into the mouth and finally supplies the tooth with the venom makes its entrance, as I have already said, at the base of the structure, but by this I by no means intend to imply that the dental groove leads into this opening. On the other hand it is found exactly opposite the tooth and well towards the mesial plane. It will be seen that the base of the tooth slopes inwards and slightly backwards, and the reverse of this course indicates the direction of the internal division of the foraminal passage when followed from within outwards. From the structure of these parts, then, I am compelled to infer that the fate of the venom upon being jetted from the gland is this:—it passes directly, though somewhat obliquely, through the body of the mandible, and enters the mouth through the foramen at the extreme base of the tooth towards the median plane. The edges of the thickened mucous membrane on either side of the row of teeth form there a longitudinal gutter as it were; this is flooded full upon the venom being thrown into the buccal cavity, it surrounding the teeth in consequence. Then, simultaneous with this, when the reptile makes its bite, the grooves upon the teeth simply serve as conduits to conduct the venom into the wound. And when one comes to think of it, this is a very simple arrangement, the more especially so when compared with the more highly perfected poison-fangs of such a reptile as *Crotalus*.

*Heloderma* has a mandible to its skull that seems to be composed of the usual number of bones found in the make-up of lower jaws of all ordinary Lizards. There is a strong well-developed *articular*, with its large angular process directed posteriorly, and with its articulation for the quadrate, the latter showing two concavities facing upwards, backwards, and inwards. Upon the inner side of the ramus, between the articular and the coronary, there is to be

found a short longitudinal gutter with a foraminal pit at either end of it. *Meckel's cartilage*, as usual, is ensheathed by the anterior portion of the articular element of the mandible, from whence it proceeds forwards to the symphysis, being exposed along the inner side of the dentary for its anterior moiety. The *angular*, pointed behind and truncated in front, occupies nearly the middle third of the ventral border of the ramus. The two bones thus far alluded to are designated by Hoffmann as the *articulare* and the *angulare*, respectively. And it is my intention in the present connection to use the nomenclature for the ramal elements given us by that distinguished anatomist (see Broun's 'Thier-Reichs,' Rept. 22–24 Lief. 1881, Taf. lxvii. figs. 4–5), as his account of these ossifications is far more satisfactory than any other that I happen to have at my hand at the present moment. The *coronoideum* occupies its usual position, developing upon its mid-dorsal border a strong quadrate coronoid process, which takes on an upward and backward direction. This element articulates with the *dentale*, the *complementare*, the *operculare*, and the *articulare*. Forming the base of a fossa between the bifurcations of the coronoideum, upon the mesial aspect of the ramus, occurs a thin splint-bone, the *complementare*, and this is probably the "splenial" element of some authors. Beyond the ossifications thus far described we find an *operculare*; it is a flat, irregular shaped bone that stands between the dentale on the one hand and the coronoideum, complementare, and the angulare on the other, forming a fair share of the mid-portion of the surface of the inner aspect of the ramus.

Still more important is the *dentale*, which, as we know, bears the teeth. This is here quite a powerful bone forming the distal moiety of the mandible, being markedly concaved upon its mesial aspect, and correspondingly convexed both vertically and antero-posteriorly on its external surface. As I have already said, the symphysis of the two dentary elements is notably weak; indeed, the bones of the two sides are little more than in contact at the point in question.

Two small foramina pierce the operculare upon its inner aspect, as does one the angulare posterior to these. Externally there is also an opening of this character which is found in the suture between the coronoideum and the articulare, being vertically below the coronoid process.

The *hyoid apparatus*.—At its hinder extremity the slender *basihyal* is just sufficiently enlarged to admit of its articulation with the anterior and posterior cornua. Posterior to this point it does not send back any median process, while in front its delicate cartilaginous rod is continued forwards into the tongue. Upon either side of its hinder and slightly enlarged end it has articulating with it the mesial heads of the *anterior cornua*. These latter have their slender shafts at first directed, upon either side, forwards and outwards, when at a certain distance they are bent upon themselves, and then are directed outwards and backwards. At the point of flexion there appears to be some sort of a simple joint present.

The *posterior cornua* are represented by paired bony rods of a

subcylindrical form; they articulate with the basihyal posterior to the mesial heads of the anterior cornua. Curving backwards and outwards, their hinder ends are tipped with cartilage, which latter character reminds one of the thyro-hyals as seen in most birds—all ordinary existing birds. It is only the anterior joints of the posterior cornua of the hyoidean arches in this Lizard that ossify; all the remaining parts of the apparatus are cartilaginous, even in very old specimens.

From this brief description it will be seen that the hyoidean arches in *Heloderma* simply add another pattern of these structures to the various forms they assume among Lizards generally. According to Cuvier, Hoffmann, the Parker, and many other anatomists, these parts differ in a number of species of the Geckos, in *Gonyocephalus*, in *Iguana*, in *Scincus*, in *Chamæleon*, and in many other species and genera.

In such a species as *Lacerta viridis*, according to Professor T. J. Parker ('Zootomy'), all three cornua of the hyoid apparatus are present, the anterior, middle, and posterior, and such elements are represented as the hypo-hyal, the stylo-hyal, the cerato-hyal, and the epibranchial of the second branchial arch.

### *On the Shoulder-Girdle and the Pectoral Limb.*

A description of the simple form assumed by the sternum in *Heloderma* has already been presented above. This structural simplicity appears to be extended to the *shoulder-girdle*. A broad part of the mesial border of either *coracoid* remains cartilaginous, and this is wider in front than it is behind. Fusing with the corresponding scapula, the osseous part of the coracoid at a point upon the posterior margin of the girdle yields to the articular surface of the glenoid cavity its ventral moiety. Just anterior to this point is to be seen a small fenestra, that appears to indicate the original divisional space between the *precoracoid* and the coracoid proper. In rough outline the form of the coracoid simulates the sector of a circle, the apex being at the glenoid cavity. Anteriorly these bones overlap each other, while posteriorly the mesial margin of either one articulates with the groove occupying the antero-external border of the sternum. In a specimen before me it is the left coracoid that underlaps the right, while the clavicles and interclavicle tend to hold them in this position. It may not, however, be that the left bone is always positioned ventrad. From all this it will be observed that the coracoid in *Heloderma* having the form described, its several elements are so fused together that it remains only to make out the cartilaginous *epicoracoid* (mesial rim), the precoracoid and coracoid proper being indicated by the position of a small foramen only, while the *mesocoracoid*, if it ever exists as a separate ossification in this reptile, is here now completely co-ossified with the other elements.

Being rather less than one third the size of the coracoidal portion of the girdle, the *scapula* has its upper and lower extremities dilated,

the bone, as in the case of the coracoid, being transversely flattened. Its antero-ventral end fuses with the coracoid, while its postero-ventral end goes to help form the dorso-superior part of the glenoid cavity. Its antero-superior angle articulates with the outer end of the corresponding clavicle, and its dorsal border articulates, for its entire length, with the superimposed suprascapula.

The expanded dorsal part of the scapula is harmoniously extended by the still more dilated semi-osseous *suprascapula*. The dorsal border of this element of the girdle is markedly convex, the mid-point of its arc almost reaching to the transverse processes of the vertebræ of the spine above it. *In situ*, it is seen to be a thin plate resting upon the last four cervical ribs by its mesial flat surface, being connected with the rest of the girdle in the manner we have described.

The *Interclavicle* (episternum) is represented by an azygos bony bar, which is somewhat dilated and vertically compressed behind, while it is small and tapering in front, at which latter point it stands between the mesial ends of the clavicles, being slightly dorsad to them. Posteriorly its dilated extremity is attached to the ventral surface of the antero-mesial angle of the sternum, the union being through the medium of firm ligament.

Either *clavicle* is represented by a slender, subcompressed bone articulating in a manner already indicated above. When seen *in situ* it at first passes from its articulation with the interclavicle outwards. Near the middle point of its shaft it bends at a gentle angle upwards, and from thence goes to its facet, found at the antero-dorsal angle of the corresponding scapula. The mesial end of the clavicle is but slightly larger than its outer extremity, and the form of the bone thus affords a good classificatory character. Upon close examination, in some specimens, it may be discovered that its extreme outer tip may come into contact with the suprascapula at its antero-ventral angle.

*The Pectoral Limb.*—Averaging some 3·4 centimetres in length, the *humerus* presents a rather short subcylindrical shaft, with scarcely any curvature. Its extremities are markedly expanded, the imaginary planes in which they lie intersecting each other at an angle of about 35 degrees. The head of the humerus is an elongated facet, and throughout life the sutural trace showing where this is united with the rest of the bone is distinctly visible. To the radial side of this is a bony crest for muscular insertion, having a form much as we see it in ordinary existing birds. This crest is turned ulnad so as to make an angle with the rest of the head of the bone, which is also similar to what we find in this last-mentioned class. Distally, there is an ulnar and radial tubercle, condylar surfaces for articulation with the bones of the antebrachium. In their form these also remind us of the corresponding structures in birds, though here in this Lizard the epiphysial sutural trace is visible during the life of the individual. The epiphysis in question includes the entire articular portion. Above the radial tubercle, the side of the expanded end of the shaft develops a moderately prominent ridge several

millimetres long. At the middle of this, upon its dorsal aspect, is found a small pit that has the appearance of an incompleted foramen. This character is constant.

Both the *radius* and *ulna* long retain, at their distal and proximal extremities, the evidences of the epiphysial sutural traces. Subcylindrical in form, the shaft of the *radius* is but very slightly bent, and its enlarged distal end is moulded to articulate with the radial ossicle of the carpus. Its proximal extremity is also enlarged, cup-shaped at its summit, and flattened at the ulnar aspect of its head so as to be brought close against the corresponding extremity of that bone when the skeleton of the arm is properly articulated.

The *ulna*, nearly as large as the radius in point of size, has a compressed shaft, with a very conspicuous, semiglobular, articular condyle at its distal extremity. At the other end of the bone the olecranon is well-developed, and a "greater sigmoid cavity" handsomely excavated. What is interesting here is the fact that no "lesser sigmoid cavity" is formed to admit in articulation the head of the radius, which latter is placed at the expense of a flattening in order to articulate with an apposed flat surface on the ulna, which occurs at the site of the "lesser sigmoid cavity" as it is presented to us in anthropotomy. Thus it will be seen that a sliding movement is admitted of here, but not a rotary motion on the part of the head of the radius, as is the case in many of the higher Vertebrata.

Five *carpalia* represent the distal row of ossicles in the wrist of *Heloderma*, while proximally we find the *ulnare*, the *radiale*, and a *centrale*. Careful search, aided by a good lens, failed to discover any evidences whatever of the presence of an *intermedium*, much less the vestiges of any *rudimentary digit*. In a previous section, the large sesamoid that occurs in the great flexor tendon as it passes over the carpus has already been described; and ligamentously attached to the outer side of the ulna is a large pisiform. As to articulations, two of the carpalia extensively articulate with the ulnare and with each other, while the inner one of the two is in contact extensively with the middle ossicle of this distal row. This last-named one in turn engages the entire inner surface of the ossicle of the carpalia upon its radial side, while its proximal apex comes slightly in contact with the centrale. Number four of the carpalia engages the entire distal surface of the centrale, but barely touches the last ossicle of the distal row upon the radial side. This one is devoted to the radiale and also articulates with the centrale. Proximally, the centrale articulates with the ulnare and radiale. Finally, it is hardly necessary to mention that the carpalia, as a rule, each engage a metacarpal distally, while radiale and ulnare articulate with the radius and ulna, respectively.

The joints of the several *digits of the manus* remind us considerably of the corresponding parts as we find them in the toes of small ordinary existing birds, more especially the distal ones. Counting the claw in each case, we note that the first finger upon the ulnar side possesses three joints; the next one to it has five; the middle one has four; the next one, radial, has three; while, finally the radial

digit has but two. Passing from this last one, then, towards the ulnar side we observe that they stand 2, 3, 4, 5, 3.

Taken as a whole, this pectoral limb of *Heloderma* is a very well-developed one, and in the absence of the *intermedium* it agrees with the Crocodiles; it will be remembered, however, that aside from this point these latter have a very differently constituted carpus from the one we have just described in the Lizard before us.

### *On the Pelvis and the Pelvic Limb.*

In its general characters and in its outlines, the *pelvis* of *Heloderma* agrees with that part of the skeleton as it is found in all ordinary Lizard-forms known to us. The *acetabulum* is extensive but not very deeply excavated, it being formed in the usual way by the union of the three bones composing the os innominatum. The *ilium* contributes its share to the dorsal third of the acetabulum, and from this expanded portion it at first passes upwards, then curves upon itself to pass almost directly backwards, and only slightly upwards. All this last part of the ilium is stout in character and rod-like in form, being compressed from side to side. The manner in which it is seized by the two sacral vertebræ has already been described above when speaking of the vertebral column. Posteriorly the ilium is carried nearly a centimetre beyond its sacral articulation, terminating behind in a free blunt point. The *pubis* (or the pubic bone) represents the smallest element of either half of the pelvis, it being the antero-ventral one and forming the antero-ventral part of the acetabulum. Dorsally it is nearly straight from the last-named point to the *symphysis pubis*, while from side to side it is convex. In the same direction, ventrally, it is somewhat excavated. At its usual site it is pierced by the foramen for the passage of the *obturator nerve*, while just anterior to this point a fairly well-developed *pectineal process* is to be seen.

More irregular in form than either the ilium or the pubis, the *ischium* completes the postero-ventral part of the acetabulum. To describe it, one might say that it is composed of a broad flattened arm that passes downwards and inwards from the acetabulum, to merge, ventrally, into a quadrilateral plate, its second part; and that the mesial border of this plate forms the line of the *symphysis ischii*. This latter is slightly separated by a slip of calcified cartilage, and this is continued posteriorly, beyond the symphysis, into the ventral wall of the cloaca, as a small *os cloacæ*.

The anterior apex of the united ischia is but 5 millimetres distant from the posterior apex of the united pubic bones, and this is spanned by an azygos ligament, that, as usual, divides the not large *foramen cordiforme* into the two *obturator foramina*. Either one of these latter is of a subelliptical form. Immediately anterior to the pubic symphysis, we find a small nodule of cartilage that has been designated as the *prepubis*. And this is connected with the mesial pubo-ischiadic ligament, and even the hinder portion of this latter may in some instances chondrify.

*The Pelvic Limb.*—As in the case of the anterior limb, we find the long bones of this pelvic extremity culminating at their proximal and distal ends in epiphyses composed of calcified cartilage, and the sutural traces between them and the true bone of the shafts are visible throughout the life of the individual. One of these superadded pieces caps the trochanter of the *femur*, a bone which here has a length of about 3·5 centimetres. Its shaft is cylindrical in form and nearly straight; the head which surmounts it (mostly epiphysial) is a transverse ellipsoid, rearing somewhat above the process seen at the preaxial side of it, which represents the *trochanter*. A pit is seen for the *ligamentum teres*, and this is partly excavated at the expense of the epiphysis, and partly at the expense of the shaft adjacent. Distally, the condyles are rounded in front, with a shallow rotular channel between them; while upon the posterior aspect they are especially sculpt in order to articulate with the corresponding surfaces presented on the part of the proximal ends of the two bones of the leg.

A very small osseous *patella* is visible in the *ligamentum patellæ*, at a point opposite the knee-joint.

Transverse sections made at the proximal, middle, and distal parts of the shaft of the *tibia* are seen to be triangular, subcircular, and subtriangular, respectively. The head of this bone is much enlarged, less so its distal extremity, while its shaft is but slightly curved along its lower third. The *cnemial ridge* is pretty well marked, as are the tuberosities at its summit, intended for articulation with the femur.

Quite straight and slender, the *fibula* has a very small proximal extremity as compared with that of the tibia, while its distal end is transversely widened out, being markedly compressed in the antero-posterior direction. These two bones of the leg are of about equal length, each averaging 2·5 centimetres, or about one centimetre longer than the femur.

Returning for a moment to the knee-joint, we are to note the presence of the internal and external semi-lunar fibro-cartilages, but the osseous sesamoids found in these parts in some Lizards (*Lacerta*) are here only performed in cartilage. In this last statement, of course, I do not include the patella.

Co-ossification is extended to all the elements of the proximal row of the tarsus, but this fusion is not so complete as to entirely obliterate the original sutural landmarks. For even in fully adult specimens an examination of this now single bone reveals the limitations of three segments that compose it; these we take to be a *tibiale* (astragalus), a *fibulare* (calcaneum), and the *centrale*. The last-named one is very large, comparatively, and may include an *intermedium*, but there is no evidence of it. Proximally, this *tibio-fibulare* has a large facet upon either side to accommodate in articulation the fibula and the tibia, while distally it is in contact with the tarsalia and two of the metatarsals.

Passing to the consideration of the *tarsalia* themselves, we are to note that in the case of *tarsale* 1 and 2 they appear only to be

represented by an inconspicuous intercalated bit of thin cartilage, barely preventing the contact of the tibio-fibulare with the first two metatarsals. Proximal epiphyses of these latter, however, are moulded to meet the ends of perfect articulation. Subcuboidal in form, *tarsale* 3 is a well-ossified bonelet articulating with second and third metatarsals, with tarsale 2, and with the tibio-fibulare, or the co-ossified mass representing the elements of the proximal row. The basal ends of the 2nd and 3rd metatarsals are markedly smaller than they are in the 1st and 4th, indeed in the latter it has its proximal extremity very conspicuously expanded. *Tarsale* 4 is a larger nodule of bone that articulates with the tarsal elements upon either side of it, with the 4th metatarsal, and with the tibio-fibulare. Finally, more remarkable than any of the rest is *tarsale* 5; it is a wonderfully irregular bone in form, and peculiar in other respects. It articulates by merely a vertical line with the tibio-fibulare. Externally it sends forward a prominent process that, by a trochlear facet at its extremity, articulates with the basal phalanx of the 5th metatarsal. It also articulates with tarsale and metatarsale 4, while in the sole it sends downwards a strong process that serves for muscular and other attachments. This latter is augmented by the form assumed by tarsale 4 at its inner side, and it is this common apophysis that gives attachment to some of the short plantar muscles that, in my chapter on the myology (given above), may have been a little differently described, from the confusing propinquity of the ossicles in question. So that a knowledge of this fact will make clear in those premises what might otherwise be considered not an exact description. Professor T. J. Parker, in his studies of *Lacerta viridis*, considered tarsale 4 to be the "cuboid" (Zootomy, p. 152). Vestiges of a very rudimentary character appear to be present in one of my specimens of *Heloderma* of a sixth pedal ray, it being in connection with tarsale 5 upon the fibular side of the ankle.

The *metatarsals* differ in form but slightly from the metacarpals, and these differences pertain more especially to the proximal extremities, and these have already been pointed out above. Still more insignificant are the differences to be found between the corresponding joints of the digits of manus and pes, and their numerical arrangement is also similar. We saw in the hand that, passing from the radial to the ulnar side, the fingers possessed 2, 3, 4, 5, 3 phalangeal joints, respectively; now in the foot, in passing from the tibial to the fibular side these numbers exactly correspond, or we find 2, 3, 4, 5, 3 phalangeal joints to the toe respectively.

An excellent diagnostic character twixt pes and manus in this Lizard is to be found in the comparative size and form of the fifth metatarsal and the fifth metacarpal; in the case of the former it is notably short and small, while in the latter quite the reverse of these characters exists, for no especial curtailment of its length is to be noticed, and in bulk it rather exceeds any one of the middle three joints of the palm.

## XIV. A brief Synoptical Recapitulation of the more Salient Morphological Characters of *Heloderma suspectum*, selected from the researches set forth in the present Memoir.

Herpetologists have long been familiar with those topographical characters that are presented on the part of either *H. horridum* or *H. suspectum*. Bocourt, in characterizing the group he created to contain these reptiles[1], gave them tersely as follows:—"Parties supérieures du corps hérissées de tubercules semi-osseux, disposés sur le tronc et sur la queue en séries transversales très-rapprochées les unes des autres. Plaques ventrales plates et quadrilatérales. Pas de plicature de la peau formant un sillon le long des flancs. Dents maxillaires appliquées sur le bord interne des mâchoires et creusées d'une rainure longitudinale assez profonde. Langue non rétractile."

And for the genus (*Heloderma*):—"Tête forte et épaisse. Corps trapu. Membres et doigts courts, à peu près de même longueur. Queue arrondie. Ventre protégé par des plaques lisses, quadrilatérales, ne formant que des séries transversales. Des paupières. Une ouverture auriculaire. Pas de pores fémoraux." Essentially, these are the most available characters presented in the form of *H. suspectum*, and by dissection the following, more deeply situate, are brought to light:—

*Heloderma suspectum* will probably be found to be an oviparous reptile.

(1) And it has between the rami of its mandible a mandibularis muscle.

(2) With all three pronator muscles present in its forearm.

(3) With peculiar longitudinal cones of adipose tissue intercalated with the muscles and the other structures of the tail.

(4) With large corpora adiposa.

(5) With the horizontal membrane or the visceral layer of the peritoneum present and well developed.

(6) With an anastomotic arrangement of the bile and hepatic ducts, and with the same having a peculiar connection with the pancreas (?).

(7) With a rather large, pear-shaped, thoroughly isolated spleen present.

(8) With a bilobed thyroid gland present and situated just above the heart (?).

(9) With the walls of the atria of the heart thin, and with those of the ventricle thick, while the cavity of the latter is small and not divided.

(10) With the anterior end of the trachea placed dorsad to the base of the tongue.

[1] Sous-Famille.—Trachydermi glyphodonta.

(11) With a simple laryngeal apparatus and trachea, but with long bronchi.
(12) With a thick, fleshy, unsheathed, and slightly forked tongue.
(13) With curved, conical, grooved, sharp-pointed teeth: when this reptile bites, these teeth transmit the poison from the poison-glands to the wounds they inflict.
(14) With the secretion of either submandibular gland of a poisonous nature, and with the four ducts of the gland opening into the mouth by foramina situated beneath its lining membrane, near the bases of the teeth.
(15) With lacrymal and Harderian glands present in either orbit, and with the pecten present in either eye.
(16) With a fully developed tympanum for the ear.
(17) With sixty-four vertebræ in its spinal column, of which eight are cervical, twenty-two are dorsal, five lumbar, two sacral, and twenty-seven in the tail. They are of the procœlous type.
(18) With a sternum that is entire.
(19) With the dermal tubercles covering the fore part of the skull, co-ossifying therewith in the adult.
(20) With almost complete atrophy of the zygomatic arch, only a bit of its posterior extremity remaining.
(21) With the frontal bone excluded from participating in the formation of the superior margin of either orbital periphery, and this by the union of the post- and prefrontal bones.
(22) With a single parietal bone unperforated by a parietal foramen.
(23) With a stout epipterygoid that reaches the parietal roof above.
(24) With a free dorsal margin to the supraoccipital (*i. e.* that edge is not in contact with the ventral surface of the parietal).
(25) With clavicles that are of nearly uniform calibre throughout their lengths.
(26) With a straight interclavicle that is small and nodular in front, dilated behind. Anteriorly, it stands between the mesial ends of the clavicles.
(27) With only the ulnare, radiale, and centrale composing the proximal row of carpus, and with five carpalia in the distal row.
(28) With digits of manus and pes, in which, counting from first to fifth, inclusive, the number of phalangeal joints run 3, 2, 3, 4, 5, 3, respectively.
(29) With a well-developed pectineal process, upon either side, on the anterior margin of the pelvis.
(30) With a small os cloacæ.
(31) With a very small, but ossified patella in the pelvic limb.
(32) With a single bone forming the proximal row of the tarsus, but the sutural traces in it, standing among tibiale, fibulare,

and centrale, plainly visible throughout life. With three well-ossified bones in the distal row of the tarsus. These represent the tarsalia.

## XV. Concluding Remarks.

There were two prime objects the writer had in view when he undertook the present memoir; the one was to give an account of the anatomy of the reptile of which it treats, and the second, to point out, if possible, some of the forms to which it was related. *Heloderma* seemed to be deserving of a more complete chapter devoted to its structure than had, prior to the production of the present work, been awarded it. How well this has been accomplished it remains for the reader of the foregoing pages to decide for himself.

With respect to my having succeeded in throwing any light upon the probable affinities of *Heloderma*, it must be owned that such success as has been attained is by no means as complete as the writer had originally hoped for, and this has brought with it its due measure of disappointment. Failure in this direction has been due principally to the lack of proper material for comparison, material which it was found impossible to obtain, notwithstanding the fact that a great many earnest efforts were made to do so. Bocourt (34) has presented us with a sufficiently complete *résumé* of the opinion of authors as to the affinities of the *Helodermatidæ* down to the year 1878, so it will not be necessary to recapitulate that excellent piece of work here. My own studies of the *Varanidæ* convince me of the fact that *Heloderma* is far removed from that group, having very little structural affinity with it. This applies with equal truth to any true kinship that may have been entertained as existing between the *Helodermatidæ* and the *Iguanidæ*.

In so far as my opinions go in reference to such affinities as may exist between two such forms as *Lanthanotus borneensis* and *Heloderma suspectum*, they quite agree with those of Mr. Garman, and the affinity in that direction "seems to me rather fanciful." Perhaps a remote affinity may exist between *Lanthanotus* and the Crocodiles, but such interesting points can only be decided when Curators come to learn one point and practice another. In the first instance the ultimate fate of an important form of reptile should not be to place it in a jar of alcohol, stand it upon a shelf, and then ascertain how many years it will take to have nearly all its characters rot within a spirit-preserved skin; and in the second instance, the simple method of ascertaining many of the most important internal characters from such specimens, to the benefit of the specimen and the progress of science, should be more universally indulged in.

Personally, the writer has compared the skeleton of *Heloderma suspectum* with the skeleton of *Crotaphytus collaris*, but there is no affinity in that direction; and the fact of the matter is, there is far more to remind one of the skeleton of *Iguana tuberculata* in the osteology of such a species than there is to suggest anything to do with such a radically different type of structure as is presented in the

skeleton of a *Heloderma*. Indeed, if we take the skulls of *Iguana tuberculata* and *Crotaphytus collaris* it is not a difficult matter to pick out quite a number of points of near resemblance.

From all that I have seen in the works of other authors, I am strongly inclined to believe that when the morphology of such species that are now grouped in the genera *Xantusia*, *Xenosaurus*, and *Lepidophyma* is thoroughly worked out, no inconsiderable amount of light will be thrown upon the subject of the affinities of the *Helodermatidæ*. So far as our present knowledge of existing reptiles extends, I am convinced that it is in the direction that I have just indicated that we must look for the affines of our *Heloderma suspectum*.

When we come to consider the group of characters that are presented us on the part of the form to the anatomy of which the pages of this memoir have been devoted, there can be but one opinion in our minds as to the classificatory rank that should be awarded to the Heloderm in the system. For a great many years zoologists have met all the way through the animal series forms the taxonomic arrangement of which demanded a somewhat higher rank than the genus seemed to suggest. This need seems to have been quite thoroughly satisfied in the creation of the subfamily, as it is now generally employed and has been so long in use. On the other hand, at a considerably later date, the necessity for a group ranking higher than the family became apparent, and this was first met by Gill, who in 1872 introduced the use of Superfamilies[1]; and they have been steadily growing in favour with naturalists ever since. The same zoologist has already created a superfamily to contain the Helodermas. This he has termed the *Helodermatoidea*, and has selected the following characters to designate it, viz.:—"Eriglossate Saurians with concavo-convex vertebræ; clavicles undilated proximally, and post-orbital bony arches, but without post-frontosquamosal arches" (Smithsonian Report, 1885, pt. i. p. 800).

The *Helodermatidæ* is the only known family of this superfamily, and it, as we now know, contains but the two species which have been referred to in this memoir. They are the only ones at present known to science. To return to the taxonomy of them, the present writer is of opinion that the morphological characters presented on the part of these reptiles, which characters have been set forth in detail in this work, go to support the classification suggested by Gill, and it is proposed, in so far as it applies to the definition of the Heloderms in the system, that the arrangement be adopted. It is adopted here.

Many things have, during my studies of the *Helodermatidæ*, inclined me to believe that these reptiles are probably derived from a rather old stock, and that during comparatively recent times they have not changed much in their organization. And further, I doubt very much that we will ever meet among the more recent forms of existing types of reptiles any that will show in their morphology

[1] These were first used, by the author quoted, in a paper entitled "On the Characteristics of the Primary Groups of the Class Mammals," Proc. Am. Assoc. Adv. Sci. vol. xx. p. 291.

very close affinity with them. Günther has said [1] that "Central America possesses, besides, five other families, small in species and restricted in range (some belonging to the fauna of great elevations), but highly interesting types. These are the *Eublepharidæ*, *Xenosauridæ*, *Aniellidæ*, *Helodermatidæ*, and *Lepidophymatidæ*. Their localization and differentiation can be accounted for on the hypothesis that they are the remains of the fauna of the various islands into which Central America was broken up at a former period." This is likewise quite in the line of my thinking.

## XVI. Bibliography.

The following works are the principal ones that refer to the HELODERMATIDÆ, and the most important of them have been consulted by the writer in connection with the present monograph.

(1) 1651. Hernandez (Franciscus).—'Historiæ animalium et mineralium Novæ Hispaniæ liber vnicus'; Cap. p. 315.—(This is the first authority that alludes to *H. horridum*, and in the volume quoted we find a very fair description of the Reptile, the author stating that it was known to the Mexicans as the Acastelepon, but to the Spanish Créoles as the "Escorpion.")

(2) 1829. Wiegmann (Arend Fridericus Augustus).—Isis, pp. 627–629.—(Under the name of *Trachyderma horridum*, Wiegmann, in this place, presents us with rather a superficial description of a Mexican specimen of the reptile; see also the same work, p. 624, *H. horridum*.)

(3) 1830. Wagler (Joannes).—Natürliches System der Amphibien. P. 164.—(This naturalist places *Heloderma* among the *Thecoglossæ pleurodontes*.)

(4) 1833. *Idem*.—Descriptiones et Icones Amphibiorum. Fasc. 2.—(An unpaged description, in Latin, illustrated by an indifferently executed figure of *Heloderma horridum*, from an alcoholic specimen which had been brought to Berlin.)

(5) 1833. Schinz (Heinrich Rudolph).—Naturgeschichte und Abbildungen der Reptilien. Text and Atlas, 4to. Leipzig. P. 95; tab. 33.—(Wagler's drawing accompanied by a no better description in German.)

(6) 1834. Wiegmann (Arend F. A.).—Herpetologia Mexicana seu Descriptio Amphibiorum Novæ Hispaniæ. Berolini. Pp. 6, 7, and tab. i.—(Here this author's well-known suborder of the *Squamata* is divided into three series,—the *Leptoglossi*, the *Rhyptoglossi*, and the *Pachyglossi*. Of these the *Leptoglossi* is again subdivided into the *Brevilingues* and the *Fissilingues*, and in the last-mentioned group the *Heloderma* has been placed, in a family created for it, the *Trachydermi*. His coloured figure of *Heloderma horridum* is too brown in its colouring, and in form only presents us

[1] Encyclopædia Britannica, 9th ed. vol. xx. p. 470 (1886).

with a fair idea of the reptile. A drawing is also given of the superior aspect of the head.)

(7) 1836. Duméril (A. M. C.) and Bibron (G).—Erpétologie Générale ou Histoire Naturelle complète des Reptiles. T. iii. pp. 499–501.—(In this justly celebrated work a brief description of the *Heloderma* is given, which adds nothing to previous descriptions of other authors.)

(8) 1837. Gray (J. E.).—Proceedings of the Zoological Society of London. P. 132.—(Places the *Helodermatidæ* with the *Leptoglossæ*, a subdivision of the Saurians as proposed by Wiegmann.)

(9) 1838. Bonaparte (Charles Lucien).—"Synopsis Vertebratorum Systematis." Nuovi Annali delle Scienze Naturali. Anno i. Tomo ii. Bologna, pp. 105–133.—(On page 124, family 13 is represented by the *Helodermatidæ*, and subfamily 20 by the *Helodermatina*, the latter being the only subfamily ranged under the former. The cacography in either case is retained. The year, although given as above both on back of volume and the titlepage, should probably be 1839, unless Tomo iii. was published in 1839. Compare same work below.)

(10) 1840. *Idem.*—"Prodromus Systematis Herpetologiæ." Nuovi Annali delle Scienze Naturali. Anno ii. Tomo iv. Bologna, pp. 90–101.—(Here the Heloderms are placed with the *Leptoglossi* of this author, between the *Varanidæ* and the *Ameividæ* (Tribus 2); and upon p. 95 the following characterization of them is given: "Familia 13. *Helodermatidæ*. Lingua. . . . laminæ supraorbitales cutaneæ: oculi palpebrati; aures conspicuæ: membrana tympani superficialis; caput tuberculato-squamosum, depressum: corpus elongatum.

"Subfamilia 21. *Helodermatina*. Dentes aduati: cutis sulculis exarata: squamæ tuberculiformes osseæ: pori femorales nulli."

(11) 1840. *Idem.*—"Systema Vertebratorum." Trans. Linn. Soc. London; vol. 18. pp. 247–305. Separate, l. p. l. 58 pp. Helodermatidæ and Helodermatina, p. 294; Sep. 37.—(In the last place there occurs the same characterization of the *Helodermatidæ* and the *Helodermatina* as is quoted above from the Prodromus, with the exception that the words "Familia" and "Subfamilia" were not introduced, and owing to a certain re-arrangement the subfamily is 20 instead of 21 as above given.)

(12) 1845. Gray (J. E.).—Catalogue of the Specimens of Lizards in the Collection of the British Museum. P. 14.—(*Heloderma horridum* is here alluded to under the name of "The Caltetepon," and isolated as the representative of the family "Caltetepons" (*Helodermidæ*).)

(13) 1853. Troschel (F. H.).—Archiv für Naturgeschichte; t. i. p. 294.—(Taf. xiii. and xiv. present us with very good figures,

giving side and basal view of skull, the former showing the manner in which the dermal tubercles of the head eventually ossify and fuse with the skull; there are also given figures of the upper view of the tongue, the hyoid, the limbs, ribs, sternum, and pelvis.)

(14) 1856. Duméril (Auguste).—"Description des Reptiles nouveaux ou imparfaitement connus de la collection du Muséum d'Histoire Naturelle et Remarques sur la Classification et les Caractères des Reptiles." Archives de Muséum d'Histoire Naturelle. (Deuxième Mémoire.) T. viii. p. 491.—(Under his "Quatrième Famille: *Varaniens* ou *Platynotes*" occur the following remarks:—"Cette tribu des Thécoglosses est formée par la réunion de quatre familles. La première (*Palæosauri*) ne comprend que des genres fossiles; .... La deuxième enfin (*Helodermata*) ne se compose que d'un seul genre, celui que Wiegmann a établi sous le nom de *Heloderma*." This is followed by an allusion to the work of Troschel upon the structure of this form.)

(15) 1857. Gray (John Edward).—"On the Genus *Necturus* or *Menobranchus*, with an account of its Skull and Teeth." Proc. Zool. Soc. London, p. 62. (In the place quoted the following notes occur:—"The chief difference between the teeth of the Proteus of the Lakes and the fangs of Serpents is, that in the former the aperture of the cavity is nearer to the centre of the tooth, some distance from the apex, while in the fang of the Serpent it is generally near to the tip. I know of no other instance of a Batrachian having this structure of its teeth, nor do I know any instance, except in the Mexican Lizard, called *Heloderma horrida*, in which *all the teeth* are uniformly furnished with a basal cavity and foramen, and this Lizard is said to be noxious; but the fact has not been distinctly proved.")

(16) 1858. Girard (Charles).—United States Exploring Expedition during the years 1838–42, under Captain Charles Wilkes, U.S. Navy. Herpetology, p. 195.—(Refers to the Helodermas as belonging to the family *Varanidæ*.)

(17) 1859. Baird (Spencer F.).—Report of the United States and Mexican Boundary Survey. P. 11, pl. xxvi.—(The plate gives a left lateral view of what appears to be a specimen of *Heloderma suspectum*, indifferently figured. There is also on the same plate an under view of the head, the vent (enlarged), and the details of the toes.)

(18) 1859. *Idem*.—Pacific Railroad Reports; No. 4. Report upon the Reptiles of the Route, vol. x. pt. vi. p. 38.—(*Heloderma horridum* mentioned in a list of reptiles collected by the expedition.)

(19) 1862. Peters (Wilhelm).—"Über Cercosaura und die mit dieser Gattung verwandten Eidechsen aus Südamerica." Abhandlungen der königl. Akademie der Wissenschaften zu Berlin, p. 172. (On the page referred to, the following

remarks occur:—"Die *Gerrhonotus*, welche einige äussere Aehnlichkeit mit den *Cercosauri* haben, entfernen sich von ihnen durch die dachziegelförmige Beschuppung des Unterkinns, vorzüglich aber durch die eigenthümliche schwammige Zunge, welche mit zwei besonders geformten glatten Spitzen endigt, ganz ähnlich, wie es die treffliche Abbildung von *Heloderma horridum* zeigt, welche Hr. Troschel (Archiv für Natur. 1853, xix, 1 Taf. xiii. fig. 1) geliefert hat.")

(20) 1864. Cope (Edward Drinker).—Proceedings of the Academy of Natural Sciences of Philadelphia: p. 227.—(Makes a group *Pleurodonta* containing the *Iguania*, *Diploglossa*, *Thecaglossa*, and *Leptoglossa*, giving the characters of each, placing the *Helodermatidæ* with the *Anguidæ* and *Gerrhonotidæ* in the *Diploglossa*.)

(21) 1864. Sumichrast (F.).—'Annals and Magazine of Natural History.' Lond. xiii. pp. 497–500. (Considers the *H. horridum* as belonging to the *Varanidæ*; gives a very interesting account of its habits and other matters referring to the species. Speaks of the difficulty of studying this species from the fact that it is nocturnal in its habits: of how tenacious they are of life, and even after life is apparently extinct the muscles long respond to stimulation.)

(22) 1864. *Idem.*—"Note sur les Mœurs de quelques Reptiles du Mexique." Bibl. univers. et Revue Suisse, Arch. des Scien. Phys. et Nat. t. xix. pp. 45–61. (Places *H. horridum* in the family *Varanidæ*, and gives a brief account of its external appearance and of its habits. This paper seems to be substantially what had already appeared in the Ann. and Mag. of Nat. Hist., for which see No. 21 *antea*.)

(23) 1865. Kaup (J. J.).—"Einige Nachträge zur Gattung *Heloderma horridum*." Wiegm. Archiv für Naturgeschichte, pp. 33–40; pl. iii. figs. 1 and 2.—(The figures present us with very fair drawings of superior and inferior views of the skull of a *Heloderma horridum*.)

(24) 1866. Cope (E. D.).—Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 303, 311.—(*H. suspectum* referred to in a collection of Reptilia and Batrachia of the Sonoran Province of the Nearctic Region. The collection was made by Dr. E. Coues.)

(25) 1869. *Idem. loc. cit.* p. 5.—(This same author briefly refers to the characters of the *Helodermatidæ* in this place, and defines *H. suspectum* as a distinct species.)

(26) 1873. Gervais (Paul).—Journal de Zoologie, p. 453.—(There are three plates with this excellent paper, giving figures of many of the structural parts of *H. horridum*, this talented anatomist having secured a large specimen of the Reptile.)

(27) 1873. *Idem.*—"Structure des dents de l'Heloderme et des Ophidiens." Comptes Rendus, tom. lxxvii. p. 1069.—(A brief account of the teeth in *Heloderma*.)

(28) 1873. Sumichrast (F).—"Coup d'œil sur la distribution géographique des reptiles au Mexique." Bibl. univers. et Revue Suisse, Archives Scien. Phys. et Nat. t. xlvi. pp. 233–250.—(In speaking of certain reptiles and their distribution, he adds:— ..... "d'autres sont particulières à celle du Pacifique et parmi elles il faut citer d'abord l'Heloderme, *Hel. horridum*: ce curieux reptile que quelques naturalistes considèrent comme un membre de la famille paléotropicale des Varanides, mais qui formera sans doute plus tard le type d'un groupe particulier, le *Cyclura quinque-carinata* (*Enyaliosaurus*, Gray), etc.")

(29) 1875. Yarrow (H. C.).—Report upon the Collections of Batrachians and Reptiles made in portions of Nevada, Utah, California, New Mexico, and Arizona, during the years 1871, 1872, 1873, and 1874. U.S. Geographical Survey West of the 100th Meridian. (Lieutenant Geo. M. Wheeler, U.S.A., in charge). Pp. 562, 563.—(Refers to a specimen of *H. suspectum* taken on the Route of the Expedition, and disclaims any belief in the fact that its bite is poisonous or dangerous.)

(30) 1875. Blanchard (Em.).—"Observations sur les mœurs de l'*Heloderma horridum*, Wiegm., par M. F. Sumichrast; Note de M. Bocourt présentée par M. Em. Blanchard." Comptes rendus des séances d'Académie des Sciences, tom. lxxx. p. 676.—(Brief observations upon experiments with the bite of the Heloderm.)

(31) 1875. Cope (E. D.).—'Bulletin,' United States National Museum, No. 1, pp. 19 and 47.—(Places the *Helodermatidæ* (group *b. Diploglossa*) with his *Pleurodonta*; and on p. 47 gives the habitat of *H. suspectum* as the Sonoran region.)

(32) 1875. Bocourt (F.).—Comptes rendus des séances de l'Académie des Sciences, tom. lxxx. p. 676.—(Details of habits and experiments tending to show the venomous nature of the bite of this Lizard, from the observations of Sumichrast. This author also refers to the nauseous odour of *H. horridum*.)

(33) 1876. Wallace (Alfred Russel).—The Geographical Distribution of Animals. Vol. ii. p. 390.—(Notes upon the distribution of the *Helodermatidæ*.)

(34) 1878. Duméril (Aug. M. C.) and Bocourt (F.).—Mission scientifique au Mexique et dans l'Amérique Centrale. Pt. iii. pp. 287–302, pl. 20 E. figs. 1–13, and pl. 20 G. figs. 1, 3, 3 *a*, 3 *b*, 6, 6 *a*, 7, 7 *a*, 8–11 *a*.—(A very excellent account of *H. horridum*, with a brief *résumé* of all that appeared to be known of the reptile up to the date of issue of this work, and illustrated by valuable figures in the plates.)

(35) 1878. Steindachner (Franz).—Denkschriften der kaiserlichen Akademie der Wissenschaften (Wien), 38 Band, p. 95.—(In this place are described some reptiles new to science, and for one of them (*Lanthanotus borneensis*) a new family is created (*Lanthanotidæ*), of which the author of the

work says "Die in den nachfolgenden Zeilen beschriebene Art bildet den einzigen bisher bekannten Vertreter einer eigenen Familie (*Lanthanotidæ*), welcher sich zunächst an die *Helodermidæ* an den Mangel eines äusseren Ohres sowie durch die eigenthümliche Beschilderung des Rückens, welche jener gewisser Krokodile (z. B. *Cr. acutus*) ähnlich ist, sich wesentlich unterscheidet. Die Kieferzähne sind übrigens wie bei *Heloderma* hinten gefurcht, dagegen fehlen grosse plattenförmige Schilder am Mundrande."

This contribution presents us with a very good plate of *Lanthanotus borneensis* (Taf. ii. nat. Gr.), and a glance at it is sufficient for us to perceive how one could, through an opinion arrived at by the impression of the superficial resemblance that this lizard bears to a *Heloderma*, come to believe that such an affinity actually existed. Such a diagnosis, however, is sometimes arrived at in sober earnest, the more especially when the investigator is ignorant of the internal structure of at least one of the forms undergoing comparison.)

(36) 1878. *Idem.*—"Note" [über *Tejovaranus* und *Lanthanotus*] in "Ichthyologische Beträge (vii.)," Sitzungsb. k. Akad. Wissensch. (Wien) v. 78, 1 Abth. pp. 377–400 (p. 399). —(This observation reads as follows:—"Note. Bei dieser Gelegenheit erlaube ich mir zu bemerken dass *Tejovaranus branickii* m. mit *Callopistes maculatus*, Gravenh. = *Aporomera flavipunctata*, Dum. & Bibr., identisch und die Gattung *Tejovaranus* somit einzuziehen sei. Die Kieferzähne von *Lanthanotus borneensis*, m. (s. Denksch. Wien. Acad. Bd. 38, p. 95), endlich sind hinten nicht gefurcht, sondern im Durchschnitte ganzrandig; es zeigt sich somit in dieser Beziehung keine Ähnlichkeit mit der Gattung *Heloderma*, bei welcher die Zähne vorne gefurcht sind."—Appearing as this "Note" did at the end of a paper describing some Fishes of the Galapagos Islands (VIII. Ueber zwei neue Fischarten von den Galapagos-Inseln), it may have escaped the observation of many herpetologists, who, I feel confident, will be glad of the more general circulation that I have given it by publishing it in the present connection.)

(37) 1880. Sumichrast (F.)—Bulletin Société Zoologique de France, p. 178.—(Under "Helodermieus" presents a few notes in reference to small mammals dying from the bite of *H. suspectum*.)

(38) 1880. Packard (A. S.).—Zoology. N. York. P. 504.—(Popular reference to the *Helodermatidæ*.)

(39) 1882. 'The American Naturalist.' Philadelphia. P. 842. —(Editorial note: testimony as to the poisonous nature of the bite of *H. suspectum*.)

(40) 1882. Gunther (A. C.).—Encyclopædia Britannica, 9th Edition: Art. "Lizard," vol. xiv. p. 735.—(Refers to the bite of *H. horridum* as being poisonous, and cites cases.)

(41) 1882. Yarrow (H. C.).—Bulletin of the U.S. National Museum, No. 24, pp. 9 & 48.—(Name of *H. suspectum* occurs in list of N.-American Reptiles.)

(42) 1882. Sclater (Philip Lutley).—Proc. Zool. Soc. London, p. 630.—(Remarks:—"3. A Heloderm Lizard (*Heloderma suspectum*) from Arizona, presented by Sir John Lubbock, Bart., M.P., F.R.S., F.Z.S., July 16."

"This Lizard, which is new to the collection, is remarkable as belonging to the only positively known venomous form of the Lacertilian Order. It has been ascertained by actual experiment that its bite is fatal to small mammals.")

(43) 1882. Boulenger (George Albert).—*Loc. cit.* p. 631.—(Remarks:—"I may add that *Heloderma* is probably not the only poisonous lizard. *Lanthanotus borneensis*, a pretty close ally of this lizard, described four years ago by Dr. Steindachner, exhibits, according to that author, a similar dentition.")

(44) 1882. Fischer (J. G.).—Anatomische Notizen über *Heloderma horridum*, Wiegm. Verhandl. des Vereins für naturw. Unterhaltung zu Hamburg, Bd. v. p. 2, plate iii. —(Comments upon and gives drawings of the poison-glands in the *Heloderma*.)

(45) 1882. Hoffmann (C. K.).—Reptilien: in Bronn's Klassen und Ordnungen des Thier-Reichs. Bd. vi., iii. Abth. 30–32 Lieferung, pp. 890–892; and *loc. cit.* 33 and 34 Lieferung, Taf. lxxxxvii. fig. 2.—(The author reproduces Fischer's figure of the dissection of the poison-glands in a *Heloderma*, and comments upon them and the affinities of the Reptile.)

(46) 1882. Shufeldt (R. W.).—"The Bite of the Gila Monster (*Heloderma suspectum*)." The American Naturalist, Philadelphia. November; pp. 907, 908.—(The author of the paper was severely bitten by an adult specimen of the *Heloderma suspectum*, and although much pain and grave symptoms immediately supervened, the results passed entirely away in a few days with barely any treatment.)

(47) 1882. 'Nature.' London. Vol. xxvii. No. 685; Dec. 14, pp. 153, 154, fig. 28.—(Some very excellent remarks upon the two species of *Heloderma*, and also a good woodcut of the reptile.)

(48) 1882. Fayrer (Sir Joseph).—Proceedings of the Zoological Society of London, p. 632.—(Has reference to the poisonous effects of the bite of the *Heloderma*.)

(49) Garman (Samuel).—The Reptiles and Batrachians of North America. Published by the permission of the Kentucky Geological Survey. P. xi.—(In some respects a good account of *Heloderma*, but a few of the statements made in reference to its habits do not apply, at least to *H. suspectum*.)

(50) 1883. Mitchell (S. Weir) and Reichert (Edward T.). —Medical News, Feb. 10, and Science, vol. i. no. 13, p. 372. —(Celebrated papers upon the examination of the poisonous effects of the bite of *Heloderma*.)

(51) 1883. 'The American Naturalist.' Philadelphia. P. 800.—(Editorial, referring to the experiments of Mitchell and Reichert.)

(52) 1884. Sclater (P. L.).—Proc. Zool. Soc. London, p. 475.—(Under noticeable additions to the Zoological Society's Gardens for the month of July, remarks:—"1. A second specimen of the Heloderm Lizard (*Heloderma suspectum*), received in exchange from the Central Park Menagerie, New York, U.S.A., July 3rd.")

(53) 1884. Boulenger (G. A.).—Annals and Magazine of Natural History, (5) xiv. p. 120.—(Characterizes the *Helodermatidæ*, and places them between the *Aniellidæ* and *Varanidæ*.)

(54) 1884. Garman (Samuel).—The North-American Reptiles and Batrachians. A List of the Species occurring North of the Isthmus of Tehuantepec, with references: p. 12.—(Characterizes the family *Helodermidæ*, and alludes briefly to *H. horridum* and *suspectum*.)

(55) 1885. Boulenger (G. A.).—Catalogue of the Lizards in the British Museum. Vol. ii. pp. 300–302.—(Presents the characters of the Family, and of the two species known to science.)

(56) 1885. Gill (Theodore).—Smithsonian Report, Part I. p. 800.—(Proposes the superfamily *Helodermatoidea*, containing the only known family *Helodermatidæ*; both are briefly characterized.)

(57) 1885. Günther (A. C.).—Biologia Centrali-Americana. Reptiles, pl. xxvi.—(Figures a young specimen of *Heloderma horridum*.)

(58) 1886. Günther (A. C.) and Mivart (St. George).—Encyclopædia Britannica, 9th Edition, Art. "Reptiles." Vol. xx. pp. 439, 451, 458, figs. 12 & 27.—(The *Helodermidæ* are placed in the Suborder (1) Lacertilia vera (group B), between the Aniellidæ and the Varanidæ. Bocourt's figures of skull and teeth reproduced. Characters of the skull are alluded to, and the nature of the teeth and other points.)

(59) 1887. Shufeldt (R. W.).—The Gila Monster. Forest and Stream: New York. Aug. 4; p. 24, figure (life-size) of the reptile.—(A popular account of *H. suspectum*.)

(60) 1887. Bendire (C. E.).—'Forest and Stream' (newspaper). Aug. 18; pp. 64, 65. Under title of "Whip Scorpion and the Gila Monster," describes the eggs removed from a specimen of *H. suspectum*:—"If I remember rightly, this specimen contained about eight fully formed eggs, all about three quarters of an inch in length by one third of an inch in width, bluntly pointed at each end, resembling the egg of an Alligator in shape, but with a smooth, soft, white skin instead of a hard, glossy shell like the latter.")

(61) 1887. Cope (E. D.).—Bulletin of the U.S. National Museum, No. 32, p. 40.—In a Catalogue of Batrachia and

Reptilia of Central America and Mexico, places the Helodermidæ between the Xenosauridæ and the Anguidæ.

(62) 1888. YARROW (H. C.).—Bite of the Gila Monster. Forest and Stream, New York, June 14th. Vol. xxx. no. 21, pp. 412, 413.—(This is part vi. of this writer's series of papers on "Snake Bite and its Antidote," in the same newspaper.)

(63) 1888. *Idem.*—A Reference Handbook of the Medical Sciences, embracing the entire range of Scientific and Practical Medicine and Allied Science. By various writers. Illustrated by chromolithographs and fine wood-engravings. Edited by ALBERT H. BUCK. New York (William Wood & Co.). Vol. vi. p. 171, pl. 28.—(Plate 28 is a chromolithograph of *Heloderma suspectum*, and illustrates the article contributed by Dr. Yarrow, entitled "Reptiles, poisonous," pp. 165–174—a few brief remarks on p. 171, within the title, being devoted to the *Heloderma*.)

(64) 1889. MITCHELL (S. WEIR).—The Poison of Serpents. The Century Illustrated Monthly Magazine, vol. xxxviii. no. 4. New York, August 1889, p. 505.—(A popular account of venomous reptiles, wherein an allusion is made to the poisonous saliva of *Heloderma suspectum*; an indifferent figure of the reptile illustrates the article.)

## EXPLANATION OF THE PLATES.

### PLATE XVI.

All figures reduced ⅔.

Fig. 1. Direct ventral view of the liver, gall-bladder, and ducts, &c. of an adult specimen of *Heloderma suspectum*. *g.b.*, gall-bladder; *r.l.*, right lobe of liver; *l.l.*, left lobe of liver.

2. Direct dorsal aspect of the same specimen as is shown in figure 1 with additional parts added. *l.c.*, lobulus cardiacus; *P.v.*, portal vein; *d.c.*, common duct; *a.a.v.*, anterior abdominal vein; *g.c.*, a structure that appeared like a ganglionic enlargement upon the pancreatic duct in the case of the specimen examined; *p.*, pancreas; *d.*, duodenum.

3. Direct ventral view of the heart, lungs, thyroid gland, and other parts of *Heloderma suspectum*. The various organs are *in situ*, but the pericardium and other serous membranes have been removed with the exception of *l.c.*, lobus cardiacus. *t.v.*, trachea; *c.a.*, carotid artery; *t.g.*, thyroid gland; *r.l.*, right lung; *l.c.*, anterior cap of the peritoneum (cut short) in which the *lobulus cardiacus* of the liver is lodged were that organ represented in the drawing *in situ*; *œ.*, œsophagus; *i.j.*, internal jugular; *l.l.*, left lung; *H.*, heart (showing the ventricle and the two auricles).

4. Ventral view of the head of an adult specimen of *Heloderma suspectum* with the integuments removed, and showing the poison-glands. The tip of the tongue (*T*) is protruding from the mouth, and the mandible (*M*) is partially seen through the superficial layer of muscles. The left poison-gland (*p.gl*) is represented as being drawn outwards by means of a small dissecting hook and chain, to expose its four ducts which lead through the mandible to the bases of the teeth. On the right side the gland is shown *in situ* (*p.gl.*), as well as the vein that returns the blood from it and afterwards joins the external jugular.

PLATE XVII.

Fig. 1. Left lateral view of skull and mandible of a specimen of *Heloderma suspectum*, the latter disarticulated; life-size from the specimen (adult). *mx.*, maxillary; *pmx.*, premaxillary; *smx.*, septomaxillary; *ol.*, co-ossified dermal tubercles; *prf.*, prefrontal; *fr.*, frontal; *pof.*, post-frontal; *j.*, jugal; *pa.*, parietal; *co.*, columella; *pr.o.*, prootic; *sq.*, squamosal; *pt.*, pterygoid; *rv.*, vestige or rudiment of zygomatic arch; *q.*, quadrate; *d.*, dentary; *com.*, complementare; *cor.*, coron-oideum; *ar.*, articulare; *an.*, angulare.

2. Superior view of the right ramus of the mandible of *H. suspectum*. *op.*, operculare. Other letters as in Fig. 1.

3. Mesial aspect of the right ramus of the mandible of *H. suspectum*. Letters as in Fig. 1.

4. Superior aspect of the skull of *H. suspectum*, the mandible removed. *l.*, lacrymal; *l.c.*, lacrymal canal; *so.*, supraoccipital. Other letters as in Fig. 1.

5. Superior aspect of the skull of *H. horridum*, mandible removed. (After Bocourt.) Lettering as in Fig. 1.

6. Ventral aspect of the skull of *H. suspectum*, mandible removed; life size. *tt.*, teeth; *v.*, vomer; *pl.*, palatine; *tr.*, transpalatine (os tranversum); *bs.*, basisphenoid; *btp.*, basipterygoid process; *eo.*, exoccipital; *bo.*, basioccipital. Other letters as in Fig. 1.

PLATE XVIII.

Fig. 1. Dorsal aspect of the right pelvic limb of a specimen of *H. suspectum*, natural size. *f.*, femur; *p.*, patella; *t.*, tibia; *fb.*, fibula; *tfe.*, tibio-fibulare; *tr.*, distal tarsalia; *e.*, epiphysis on proximal extremity of metatarsal of the second toe.

2. Ventral aspect of right humerus of a specimen of *H. suspectum*, natural size. *h.*, humerus.

3. Dorsal aspect of the antibrachium, carpus, and manus of the right pectoral limb of *H. suspectum*, natural size. *ul.*, ulna; *rd.*, radius; *ue.*, ulnare; *re.*, radiale; *p.*, pisiforme; *c.*, centrale; *cp.*, distal carpalia.

4. Direct dorsal view of the pelvis and sacrum of *H. suspectum*, natural size. *ph.*, pubis; *of.*, foramen for the passage of the obturator nerve; *il.*, ilium; *f.cr.*, foramen cordiforme; *p.p.*, pectineal process; *is.*, ischium; $sv^1$ and $sv^2$, the two vertebræ that go to form the sacrum, the first and second respectively.

5. Ventral aspect of the sternum and shoulder-girdle and associated parts of *H. suspectum*, natural size. *s.*, scapula; *cl.*, clavicle; *co.*, coracoid; *ic.*, interclaviele; *st.*, sternum; *c.rb.*, costal ribs.

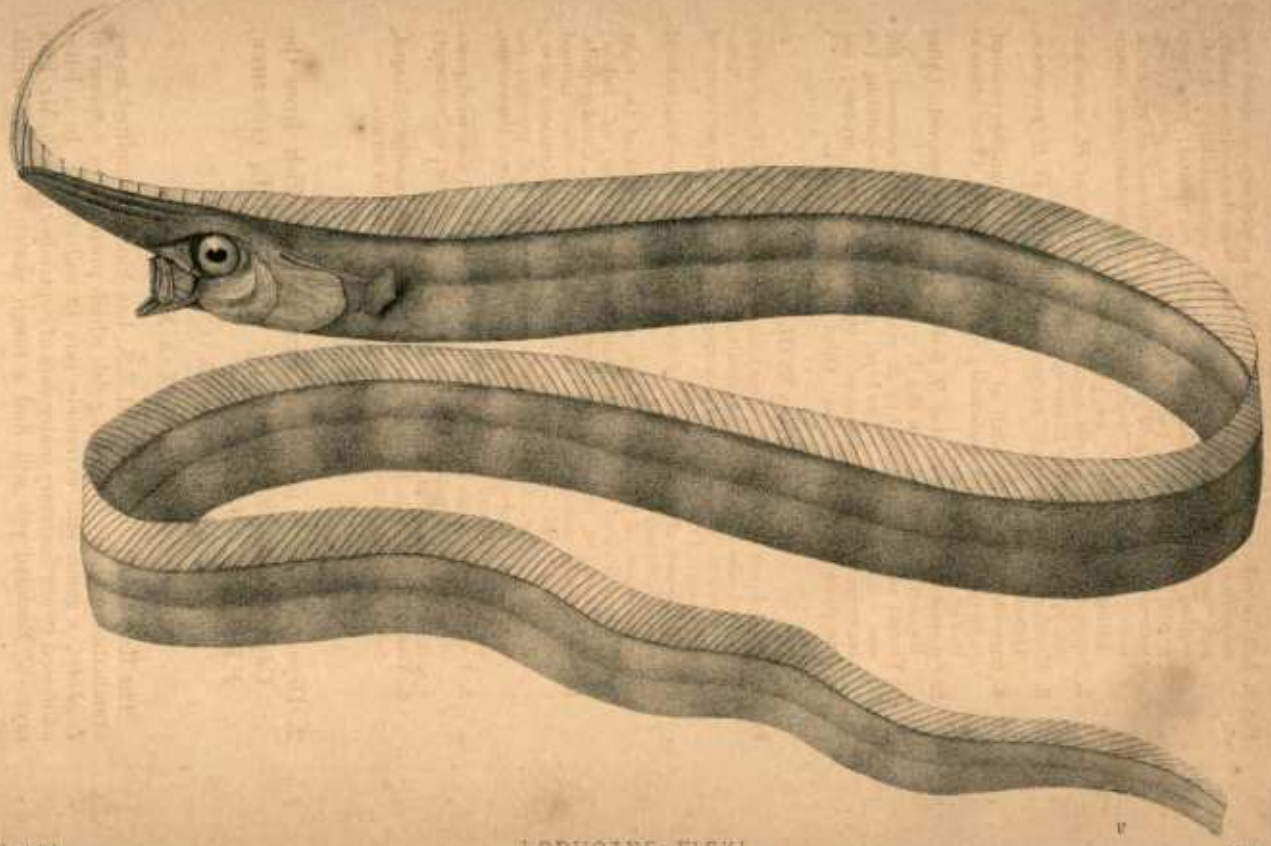
6. Ventral aspect of the hyoid arches of *H. suspectum*, somewhat enlarged. *b.hy.*, basihyal; *a.co.*, anterior cornua; *p.co.*, posterior cornua.

## 2. Description of a new Species of Deep-sea Fish from the Cape (*Lophotes fiski*). By Dr. A. C. L. GÜNTHER, F.R.S.

[Received March 14, 1890.]

(Plates XIX. & XX.)

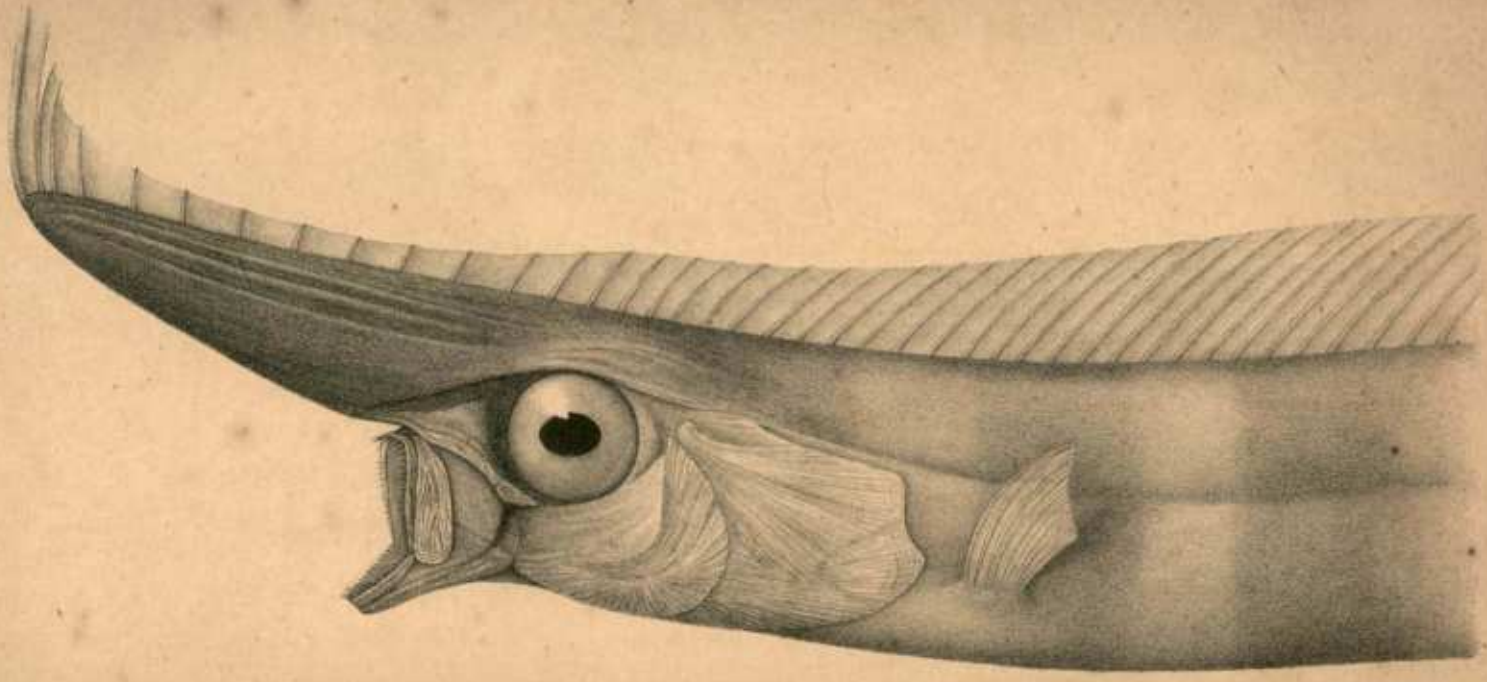
The Rev. G. H. R. Fisk, C.M.Z.S., has kindly submitted to my examination a highly interesting fish which proves to be a species of *Lophotes*, a genus still extremely rare in collections. In a letter addressed to our Secretary under date of September 9, 1889, Mr. Fisk says:—"Enclosed you will find a rough sketch of a fish which



F. Mintern, del. et lith.

LOPHOTES FISKI

Mintern Bros. imp.



F. Mintern, del. et lith.

Mintern Bros. imp.

HEAD OF LOPHOTES FISKI

about ten weeks ago was [illegible] up on the shore of Kalk Bay (which is situated in False Bay). [illegible]rtunately it was much injured and broken by people before it [illegible]t into spirits. Mr. Percy Nightingale, who was on a visit to [illegible]y, obtained possession of it and very kindly brought it to me. I am unable to identify it by any books. It is unknown at the South-African Museum, and, so far as I have been able to ascertain, no one has seen an example of it before at the Cape. The fishermen at Kalk Bay do not recognize it. If new to Dr. Günther, and he wishes to see it, I would gladly send it to him to be at his disposal."

The sketch which accompanied this letter was sufficiently exact to enable me to recognize in the specimen a fish allied to *Lophotes*, in spite of the extraordinary forward prolongation of the parietal crest, which renders the appearance of the head still more bizarre than in the typical species of the genus. But as it seemed desirable to ascertain also other points of its organization which could not be shown in the sketch, and also to give a detailed description and figure of so extraordinary a fish, I sent a request to Mr. Fisk to let me have the specimen for the British Museum, with which he most kindly complied in due course.

In the typical *Lophotes* the crest is elevated above the head, and not pushed forwards beyond the snout; it is also covered with soft integuments and a muscular layer. In the new species the crest is covered with a thin film of epidermis, leaving the sculpture of the bone exposed. This is merely a difference of form, and cannot, by itself, constitute a generic distinction, reminding us of similar modifications of the cranial excrescences in Chameleons. In the typical *Lophotes* a minute and rudimentary ventral fin, consisting of several rays[1], but evidently functionless, is present; in the new species this rudimentary organ has entirely disappeared—a difference which, in my opinion, is equally unfit for generic distinction. On the other hand, it is very unfortunate that the caudal extremity has been mutilated (apparently during life) in the Cape specimen, so that we cannot be certain whether it possessed a separate small anal and caudal fin like the type, or whether the caudal extremity was tapering and without those appendages—a structure well compatible with the greatly elongate form of the fish.

The few specimens of *Lophotes* which have fallen into the hands of naturalists were obtained in the Mediterranean, off Madeira, and in the Japanese Sea; and referred to three species—*Lophotes cepedianus*, *Lophotes capellei* (Schleg.), and *Lophotes cristatus*, the latter having been described in the Proceedings of this Society by Mr. Johnson (1863); possibly all three are of the same species. A very small fish believed to be the young of *Lophotes* is described and figured in the Report on the Pelagic Fishes of the 'Challenger' Expedition.

The fishes of this genus have been long regarded as bathybial forms, although, probably, not extending to the great depths inhabited

[1] In the specimens in the British Museum it is much smaller than it is represented in Cuvier and Valenciennes's figure.

by the true Ribbon-fishes (*Trachypte*[redacted]. The fish described here, however, approaches the Ribbon-fish[redacted]ossessing the characteristics of bathybial organization in a[redacted]hat higher degree: the bones of the head are thinner, more [redacted] sculptured, more flexible, and the muscular system is less deve[redacted]ed than in *L. cepedianus*; on the other hand, the vertebræ are firmly united by ligamentous tissue.

I take great pleasure in naming this interesting fish after Mr. Fisk, to whom we are indebted for so many additions to our knowledge of the Fauna of South Africa.

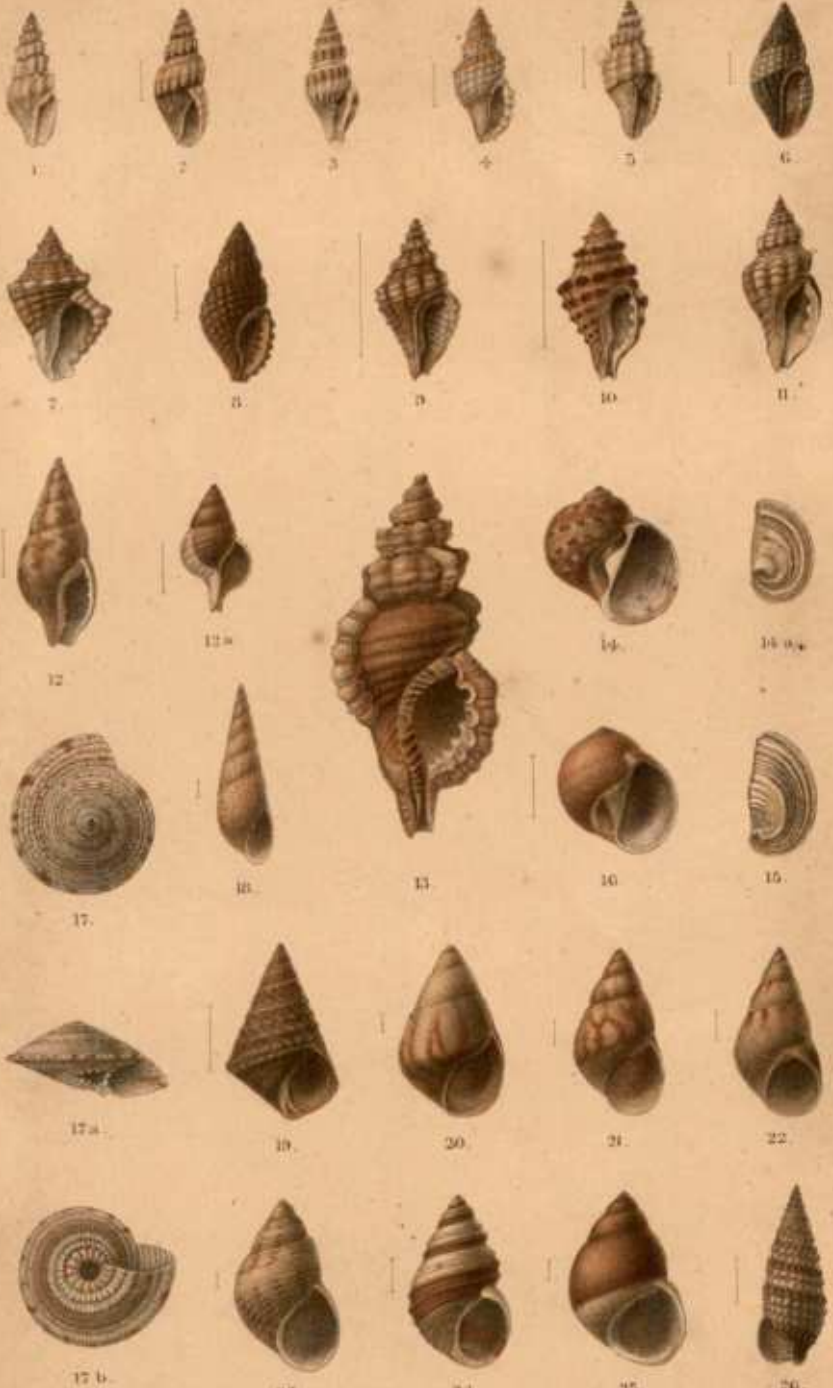
LOPHOTES FISKI. (Plates XIX. & XX.)

The body of this fish is very elongate and strongly compressed like that of a *Regalecus*; it is nearly of uniform depth throughout, and gradually narrowing in its posterior fourth. It is impossible to say whether it possesses a separate caudal fin or tapers into a point, the extremity of the tail being mutilated. As in the other species of the genus, the vent (Plate XIX., *v.*) is at a short distance from the extremity of the tail, but no anal fin can be made out, possibly on account of the mutilation of this part. The head is scarcely deeper than the body, strongly compressed; its upper part forms a low crest which is prolonged forward into an extraordinary sword-shaped process which projects far beyond the snout. Like the other bones of the skull, this process is flexible and deeply longitudinally sculptured; thin as the blade of a knife, it is sharp-edged above and below. The dorsal fin commences on the extreme point of this process with an extremely long and compressed ray. I am unable to give the exact length and form of this ray, as only a fragment about as long as the head remains; probably when complete it was three or four times that length and may serve either as a tactile or an attractile organ. It is connected with the following rays by membrane; these are not of unusual length, but the succeeding rays, which are attached to the upper edge of the cephalic process, are short and widely set. From above the eye the rays become longer again, forming a fin which is about half as deep as the body underneath, and which is continued to the end of the tail.

To return to the description of the parts of the head, we notice, in the first instance, the large eye, which is longer than the snout and possesses a transversely oval pupil. The mouth is rather small, obliquely ascending forward and with its cleft extending backwards to below the anterior margin of the eye. The maxillary is elongate, lamelliform, broader than the suborbital ring, which consists of two bones only. Both jaws are armed with a series of small uncinate teeth laterally, which series become double anteriorly. The opercular bones much dilated and overlapping each other.

Gills well developed, a short slit behind the fourth arch. Six branchiostegals. The pectoral fin consists of thirteen rays, inserted on a broad horizontal base, and points upwards.

The skin is scaleless and contains a rather thick deposit of a silvery pigment, which in some parts assumes a blackish hue, and seems to




Mintern Bros. lith. et imp.

Mintern Bros. Chromo. imp.

MOLLUSCA OF St HELENA.

1.

2.

3.

3a.

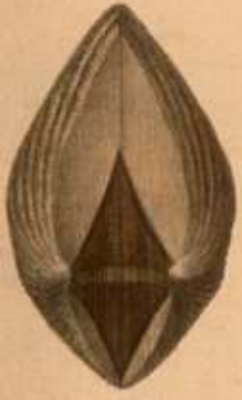
6.

7.

4.

5.

8.



8a.

8c.

8b.

9.

10a.

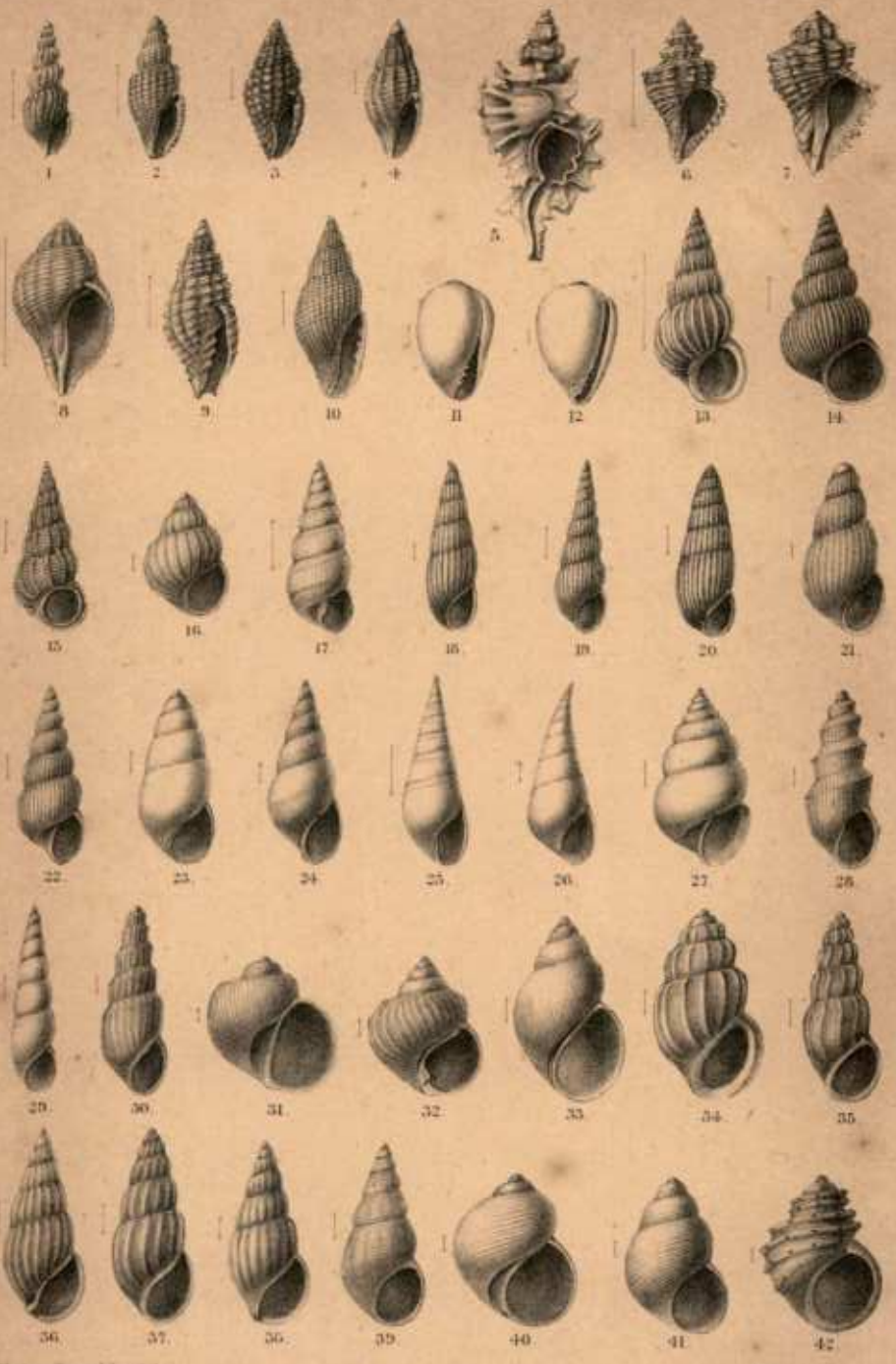
8b.

10.

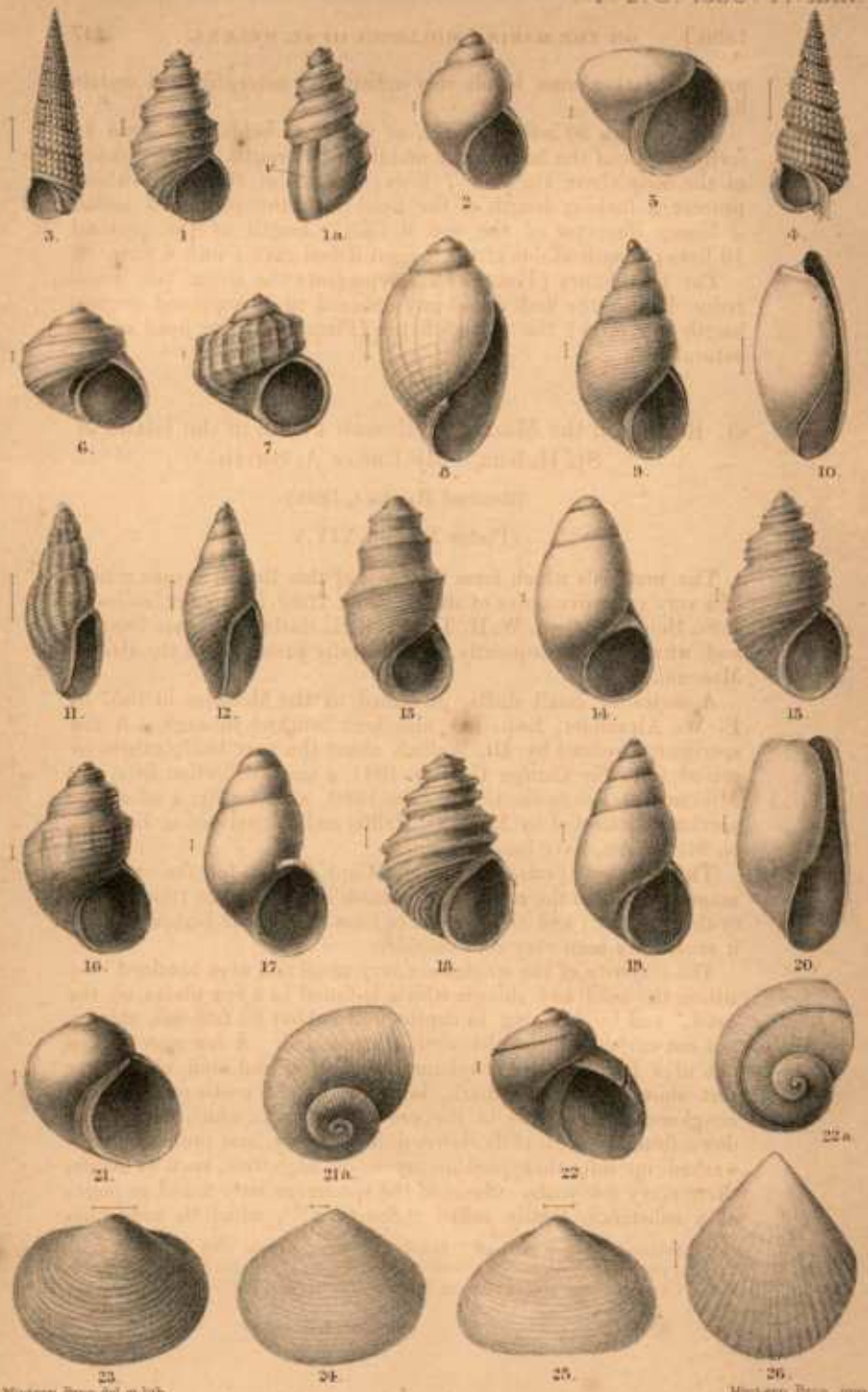
Mintern Bros. del. et lith.

Mintern Bros., Chromo. Imp.

MOLLUSCA OF St HELENA.



MOLLUSCA OF St. HELENA.




Mintern Bros. del. et lith.

Mintern Bros. imp.

MOLLUSCA OF St HELENA.

produce darker cross bands very indistinctly perceptible in certain lights.

Total length 50 inches; depth of the body behind the head $1\frac{3}{4}$ inch; depth of the body in the middle of the length $1\frac{1}{4}$ inch; depth of the body above the vent 7 lines; length of the head without process 3 inches; length of the head with the process 5 inches 3 lines; diameter of the eye 9 lines; length of the pectoral 10 lines; length of one of the longest dorsal rays 1 inch 6 lines.

The first figure (Plate XIX.) represents the entire fish, much reduced, with the first dorsal ray restored to its supposed original length and form; the second figure (Plate XX.) the head of the natural size.

## 3. Report on the Marine Molluscan Fauna of the Island of St. Helena. By Edgar A. Smith.

[Received March 14, 1890.]

(Plates XXI.–XXIV.)

The materials which form the basis of this Report consist mainly of a very extensive series of shells, about 2500 in number, collected at St. Helena by Capt. W. H. Turton, R.E., during the years 1884–6, and which he subsequently most liberally presented to the British Museum.

A series of small shells, presented to the Museum in 1857 by E. W. Alexander, Esq., has also been worked through. A few specimens dredged by Dr. Wallich about the year 1857, others received from Sir George Grey in 1841, a small collection from the Museum of Economic Geology in 1860, and, finally, a set of the specimens collected by Mr. J. C. Melliss and enumerated in his book on St. Helena, have been examined.

The greatest praise is due to Capt. Turton for the excellent manner in which the collection was made and put up for transmission to this country; and the amount of time and labour bestowed upon it must have been very considerable.

The majority of the species are very small and were obtained "by sifting the sand and shingle which is found in a few places on the coast," and by dredging in depths up to about 80 fathoms, chiefly, but not exclusively, off the north of the island. A few were picked out of a hard kind of conglomerate of shells and sand, about four feet above high-water mark, in a bay on the north coast. This conglomerate is found in the crevices of rocks which have fallen down from the high cliffs above, quite recently, and probably it got washed up into that position by some high tide, such as occurs there every few years. Some of the specimens were found on pieces of a substance, locally called "*Sea-horn*"[1], which is sometimes

[1] Doubtless these pieces of "Sea-horn" are portions of a large species of Tangle, probably *Eckloniæ buccinalis*, which is very thick and horny, and occurs at the Cape of Good Hope, whence these fragments had drifted.

washed ashore on the windward or south side of the island. These specimens will be enumerated in an Appendix, as they cannot be regarded as belonging to the St. Helena fauna. In nearly every instance in which it has been possible to associate them with known species, they prove to be South-African forms, thus clearly showing that they have been drifted northwards from the Cape by the prevailing south-east trade-winds and oceanic currents.

Capt. Turton observes in his notes that some of them were alive when taken, and this was generally the case when the "Sea-horn" was only recently washed up, or was secured from a boat. Notwithstanding this fact, it is remarkable that scarcely any (*exclusively*) South-African species appear to survive and become established at St. Helena; indeed, *Gadinia costata* is the only species in this collection, not found on "Sea-horn," the distribution of which has hitherto been restricted to South Africa. A few species such as *Triton olearium*, *Triforis perversa*, *Cingulina circinata*, *Saxicava arctica*, *Mytilus edulis*, *M. magellanicus*, *Arca domingensis*, *Pinna pernula*, and perhaps one or two others, are found at both localities, but they mostly have a wide distribution.

As it is seen that many species are drifted from the Cape to St. Helena, the question arises whether some of those dredged by Capt. Turton, or found by him and others upon the shore, may not have become detached from the floating seaweed.

In one or two cases it is pretty certain that this has occurred, as specimens of *Mytilus magellanicus* and *M. edulis* (?) were obtained alive attached to floating weed and also dead upon the shore. Two dead specimens of *Patella compressa*, a well-known Cape species, were also collected on the shore, there being every probability of their having been carried there attached to seaweed.

The molluscan fauna of St. Helena appears most to resemble that of the West Indies; for, of the known species[1] in this collection, just fifty per cent. are common to the two localities.

About five-and-twenty species, or thirty per cent., are identical with Mediterranean forms, and about half a dozen occur at all three localities. About thirteen species are also met with on the West-African Coast, between the Gulf of Guinea and Morocco.

What proportion of species are common to St. Helena and the west coast of Africa, south of Guinea, it is difficult to ascertain at present, as comparatively little is known of the Mollusca of that part of the coast.

However, in Dunker's list of shells from Lower Guinea, eight species are quoted which are common to St. Helena. The similarity between the fauna of St. Helena and that of the West Indies is undoubtedly, in a great measure, due to oceanic currents.

According to various maps an important current flows from near the centre of the South Atlantic past Ascension Island along the north coast of South America to the West Indies, a return current passing in an easterly or south-easterly direction towards the Gulf of Guinea. These and the great Gulf-stream in all probability have

[1] Pelagic forms are not included.

tended to assimilate, to some extent, the faunas of the West Indies and West Africa by transmitting from place to place the pelagic fry of some of the species, and the adult forms and the ova of others attached to floating sea weed.

Not more than fourteen species in this collection belong to forms which occur in the Indo-Pacific region. This comparative paucity of species common to these two regions is probably, in a great measure, attributable to the cold Antarctic currents, which, flowing northward to the Cape of Good Hope, bar the emigration of species from the Indian Ocean into the Atlantic. Semper[1] refers to the sudden and marked change in the fauna on rounding the Cape, the result of different currents and temperature.

The only list of species from St. Helena which has yet appeared is that prepared by Jeffreys[2], which was based upon a collection made by Mr. Melliss, who, in his book on St. Helena (pp. 113–128), has reproduced and somewhat amplified it. In this list only forty-one marine species are enumerated, the majority consisting of shells of fairly large dimensions, which, with one exception (*Ostrea cristagalli*), were all picked up on the shore.

This list did not contain all the species which had been previously recorded from the island, at least half a dozen forms being omitted.

The large proportion of new species hereafter described, most of them very small, is not therefore altogether surprising, as so little was previously known of this fauna.

Thanks to Capt. Turton's energy, as many as 138 additional named species are now added to the list, bringing up the total of known forms to 178.

This number, however, does not at all approximate the total of the species which really exist around St. Helena; for, in addition to those which I have been able to determine, there is a considerable number, nearly a hundred species, which, on account of their immature or bad condition, could not be satisfactorily identified or described. Besides, whenever more extensive dredging is carried on, many additional species will doubtless be discovered[3].

A certain number of species have been described from St. Helena which in reality do not inhabit that region. This mistake has arisen from the misspelling of St. Elena on the west coast of America. The species are:—(1) *Cancellaria tessellata*, Sowerby; (2) *C. obtusa*, Kiener (non Deshayes)=*C. solida*, Sow.; (3) *Marginella granum*, Kiener=*Erato scabriuscula*, Gray; (4) *Purpura undata*, Lamarck, partim=*P. biserialis*, Blainv.; (5) *Ostrea columbiensis*, Hanley; (6) *Circe fluctuata*, Sow.; (7) *Strombus granulatus*, Gray[4].

[1] Animal Life, p. 278. [2] Ann. Mag. Nat. Hist. 1872, vol. ix. pp. 262–4.

[3] Specimens of *Cypræa testudinaria*, *C. moneta*, *C. arabica*, and *Placuna sella* were obtained by Capt. Turton as St. Helena shells; but he shrewdly doubted their genuineness. He observes, "ships from all parts of the world touch here, often bringing shells which are got by the natives, and then offered as island shells." This is evidently the true explanation of the presence of these species at St. Helena.

[4] Species 1 to 4 are quoted from Kiener's 'Icon. Coq. Viv.,' and 5, 6, and 7 from Reeve's 'Conch. Icon.'

*Purpura turbinoides*, Blainville, quoted by Kiener from St. Helena, occurs at the Phillipine Islands and in the Pacific.

The following Table will show at a glance the distribution of each species, which, in some instances, is very remarkable. Doubtless many of the new species, which are indicated by an asterisk *, will eventually be discovered in other localities.

TABLE OF DISTRIBUTION.

| Complete List of known Species. | West Atlantic. | | | East Atlantic. | | | | | | | | Localities, chiefly Extra-Atlantic. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W. Indies. | Fernando Noronha. | Brazil. | S. Africa. | St. Helena. | Ascension. | W. Africa. | Cape Verde I. | Canary I. | Azores. | Mediterranean. | British. | |
| Conus testudinarius | ... | ... | ... | ... | * | ... | * | * | ... | ... | ... | ... | E. coast of South and Central America (*Weinkauff*). |
| —— sp. | ... | ... | ... | ... | * | | | | | | | | |
| —— irregularis | ... | ... | ... | ... | * | ... | * | | | | | | |
| Pleurotoma (Clavus) amanda | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) prolongata | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) albobalteata | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Drillia) turtoni | ... | ... | ... | ... | * | | | | | | | | |
| —— (Mangilia) subquadrata | ... | ... | ... | ... | * | | | | | | | | |
| —— (——) gemma | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) mellissi | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Clathurella ?) commutabilis | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) multigranosa | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) usta | ... | ... | ... | ... | * | | | | | | | | |
| Murex (Chicoreus) adustus | * | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | Japan, Philippines, Indian and Pacific Oceans. |
| * —— (Ocinebra) sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) patruelis | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) alboangulatus | ... | ... | ... | ... | * | | | | | | | | |
| * Lachesis helenæ | ... | ... | ... | ... | * | | | | | | | | |
| * Cantharus (Tritonides) albozonatus | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) consanguineus | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) lævis | ... | ... | ... | ... | * | | | | | | | | |
| Columbella (Anachis) decipiens | * | ... | ... | ... | * | | | | | | | | |
| —— (Mitrella) cribraria | * | ... | ... | ... | * | * | * | ... | ... | ... | ... | ... | Java, Panama, Mazatlan. |
| —— (——) pusilla | * | ... | ... | ... | * | | | | | | | | |
| * —— (——) sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| Nassa sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| —— cinctella | ... | ... | ... | ... | * | | | | | | | | |
| * Coralliophila erythrostoma | ... | ... | ... | ... | * | | | | | | | | |
| * —— atlantica | ... | ... | ... | ... | * | | | | | | | | |
| —— bracteata | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | * | | |
| Purpura helena | * | ... | ... | ... | * | * | ... | * | | | | | |
| * Mitra (Cancilla) turtoni | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Turricula) innotabilis | ... | ... | ... | ... | * | | | | | | | * | |
| * —— (Pusia) sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Thala) pleurotomoides | ... | ... | ... | ... | * | | | | | | | | |
| Marginella (Volvaria) cinerea | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) consanguinea | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) atomus | ... | ... | ... | ... | * | | | | | | | | |

TABLE (*continued*).

| Complete List of known Species. | West Atlantic. | | | East Atlantic. | | | | | | | | | Localities, chiefly Extra-Atlantic. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W. Indies. | Fernando Noronha. | Brazil. | S. Africa. | St. Helena. | Ascension. | W. Africa. | Cape Verde I. | Canary I. | Azores. | Mediterranean. | British. | |
| Cassis testiculus | * | ... | ... | ... | * | ... | * | | | | | | |
| Triton tritonis | * | ... | ... | ... | * | ... | ... | * | * | ... | * | ... | N. Australia, Pacific I. |
| —— olearium | * | ... | * | * | * | ... | ... | ... | ... | ... | * | ... | Australia, Japan, &c. |
| * —— turtoni | ... | ... | ... | ... | * | | | | | | | | |
| Ranella cælata | ... | ... | ... | ... | * | * | * | ... | ... | ... | ... | ... | Panama. |
| —— thomæ | * | ... | ... | ... | * | ... | ... | * | * | ... | ... | ... | Mauritius. |
| * Natica turtoni | ... | ... | ... | ... | * | | | | | | | | |
| —— dillwynii | * | ... | ... | ... | * | ... | ... | ... | ... | ... | * | ... | Mauritius, S. Pacific I. |
| * —— sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| —— (Polinices) porcellana | ... | ... | ... | ... | * | ... | ... | * | * | | | | |
| Ianthina communis | | | | | | | | | | | | | Pelagic forms throughout the Atlantic. |
| —— globosa (*fide Lesson*) | | | | | | | | | | | | | |
| —— pallida | | | | | | | | | | | | | |
| —— umbilicata | | | | | | | | | | | | | |
| —— exigua | | | | | | | | | | | | | |
| Scalaria confusa | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | Philippines, Sandwich [I., N.W. Australia. |
| —— fragilis | * | ... | ... | ... | * | | | | | | | | |
| * —— mellissi | ... | ... | ... | ... | * | | | | | | | | |
| * —— sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| * —— commoda | ... | ... | ... | ... | * | | | | | | | | |
| * —— atomus | ... | ... | ... | ... | * | | | | | | | | |
| —— multistriata ? | * | ... | ... | ... | *? | ... | ... | ... | | | | | |
| Obeliscus dolabratus | * | ... | ... | ... | * | ... | * | ... | ... | ... | ... | ... | Red Sea, Indian and [Pacific Oceans. |
| * —— sanctæ-helenæ | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Syrnola) pumilio | ... | ... | ... | ... | * | | | | | | | | |
| * Turbonilla haroldi | ... | ... | ... | ... | * | | | | | | | | |
| * —— assimilans | ... | ... | ... | ... | * | | | | | | | | |
| * —— truncatelloides | ... | ... | ... | ... | * | | | | | | | | |
| * —— brachia | ... | ... | ... | ... | * | | | | | | | | |
| * —— eritima | ... | ... | ... | ... | * | | | | | | | | |
| Cingulina circinata | ... | ... | ... | * | * | ... | ... | ... | ... | ... | ... | ... | N. China, Japan, Port [Jackson. |
| —— (Mathilda) quadricarinata | ... | ... | ... | ... | * | ... | ... | ... | * | ... | * | | |
| * Odostomia glaphyra | ... | ... | ... | ... | * | | | | | | | | |
| * Eulima fuscescens | ... | ... | ... | ... | * | | | | | | | | |
| * —— atlantica | ... | ... | ... | ... | * | | | | | | | | |
| —— subconica | ... | ... | ... | ... | * | | | | | | | | |
| * —— germana | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Subularia) fuscopunctata | ... | ... | ... | ... | * | | | | | | | | |
| * Amaurella canaliculata | ... | ... | ... | ... | * | | | | | | | | |
| Cioniscus unicus | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | * | * | |
| * Aclis angulata | ... | ... | ... | ... | * | | | | | | | | |
| * —— simillima | ... | ... | ... | ... | * | | | | | | | | |
| * —— didyma | ... | ... | ... | ... | * | | | | | | | | |
| Solarium placentale | * | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | California. |
| * —— ordinarium | ... | ... | ... | ... | * | | | | | | | | |
| —— hybridum | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | * | ... | Indian Ocean, Japan, |
| —— architæ | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | * | | [Philippines, E. |
| Cypræa lurida | ... | ... | ... | ... | * | * | * | * | * | * | * | | [Australia, &c. |

TABLE (*continued*).

| Complete List of known Species. | West Atlantic. | | | East Atlantic. | | | | | | | | Localities, chiefly Extra-Atlantic. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W. Indies. | Fernando Noronha. | Brazil. | S. Africa. | St. Helena. | Ascension. | W. Africa. | Cape Verde I. | Canary I. | Azores. | Mediterranean. | British. | |
| Cypræa spurca | * | ... | ... | ... | * | * | * | * | * | * | * | ... | Mauritius. |
| Littorina miliaris | ... | ... | ... | ... | * | * | | | | | | | |
| * —— helenæ | ... | ... | ... | ... | * | | | | | | | | |
| Modulus modulus | * | ... | ... | ... | * | | | | | | | | |
| Planaxis lineatus | * | ... | * | ... | * | * | | | | | | | |
| —— eboreus | * | ... | ... | ... | * | | | | | | | | |
| * Lacuna pumilio | ... | ... | ... | ... | * | | | | | | | | |
| Fossarus ambiguus | ... | ... | ... | ... | * | ... | * | * | * | * | * | | |
| * —— (Couthouyia) dentifer | ... | ... | ... | ... | * | | | | | | | | |
| * —— (——) læviusculus | ... | ... | ... | ... | * | | | | | | | | |
| * Diala fuscopicta | ... | ... | ... | ... | * | | | | | | | | |
| * Rissoina mellissii | ... | ... | ... | ... | * | | | | | | | | |
| * —— turtoni | ... | ... | ... | ... | * | | | | | | | | |
| * —— decipiens | ... | ... | ... | ... | * | | | | | | | | |
| —— bryeria | * | ... | ... | ... | * | * | ... | ... | ... | ... | ... | ... | Mauritius. |
| * —— congenita | ... | ... | ... | ... | * | | | | | | | | |
| * —— helenæ | ... | ... | ... | ... | * | | | | | | | | |
| * Rissoa cala | ... | ... | ... | ... | * | | | | | | | | |
| * —— ephamilla | ... | ... | ... | ... | * | | | | | | | | |
| * —— glypta | ... | ... | ... | ... | * | | | | | | | | |
| * —— eritima | ... | ... | ... | ... | * | | | | | | | | |
| * —— agapeta | ... | ... | ... | ... | * | | | | | | | | |
| * —— compsa | ... | ... | ... | ... | * | | | | | | | | |
| * —— wallichi | ... | ... | ... | ... | * | | | | | | | | |
| * —— perfecta | ... | ... | ... | ... | * | | | | | | | | |
| * —— varicifera | ... | ... | ... | ... | * | | | | | | | | |
| * —— pseustes | ... | ... | ... | ... | * | | | | | | | | |
| * Barleeia congenita | ... | ... | ... | ... | * | | | | | | | | |
| Cæcum jucundum | * | ... | ... | ... | * | | | | | | | | |
| —— imbricatum | * | ... | ... | ... | * | | | | | | | | |
| —— (Meioceras) nitidum | * | ... | ... | ... | * | | | | | | | | |
| Cerithium (Bittium) gibberulum | * | ... | ... | ... | * | | | | | | | | |
| Triforis perversa | ... | ... | ... | * | * | ... | * | ... | * | * | * | * | California. |
| —— melanura | * | ... | ... | ... | * | | | | | | | | |
| * —— atlantica | ... | ... | ... | ... | * | | | | | | | | |
| * —— recta | ... | ... | ... | ... | * | | | | | | | | |
| * —— bathyraphe | ... | ... | ... | ... | * | | | | | | | | |
| Cirithiopsis rugulosa | * | ... | ... | ... | * | | | | | | | | |
| —— neglecta | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | Panama. |
| Hipponyx antiquatus | * | * | ... | ... | * | * | * | | | | | | |
| —— grayanus | ... | * | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | W. coast of C. America [and Sandwich I. |
| * Teinostoma? abnorme | ... | ... | ... | ... | * | | | | | | | | |
| Turbo (Collonia) rubricinctus | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | Sandwich I. |
| * —— (——) admissus | ... | ... | ... | ... | * | | | | | | | | |
| Phasianella tessellata | * | ... | ... | ... | * | | | | | | | | |
| * Liotia arenula | ... | ... | ... | ... | * | | | | | | | | |
| * —— admirabilis | ... | ... | ... | ... | * | | | | | | | | |
| Gena asperulata | * | ... | ... | ... | * | | | | | | | | |
| Emarginula elongata | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | * | | |

TABLE (*continued*).

| Complete List of known Species. | West Atlantic. | | | East Atlantic. | | | | | | | | | Localities, chiefly Extra-Atlantic. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W. Indies. | Fernando Noronha. | Brazil. | S. Africa. | St. Helena. | Ascension. | W. Africa. | Cape Verde I. | Canary I. | Azores. | Mediterranean. | British. | |
| Fissurella gibberula? | ... | ... | ... | ... | * | ... | * | ... | * | ... | * | ... | Spain, Portugal. |
| Patella plumbea | ... | ... | ... | ... | * | ... | * | | | | | | |
| Williamia gussonii | ... | ... | ... | ... | * | * | ... | ... | * | * | * | ... | Sandwich I. |
| Bulla striata | * | ... | * | ... | * | ... | * | ... | ... | * | * | | |
| Cylichna cylindracea | ... | ... | * | ... | * | * | * | ... | * | ... | * | * | |
| * —— atlantica | ... | ... | ... | ... | * | | | | | | | | |
| —— bidentata | * | ... | ... | ... | * | | | | | | | | |
| Tornatina recta | * | ... | ... | ... | * | | | | | | | | |
| Philine quadrata | ... | ... | ... | ... | * | ... | ... | ... | ... | * | ... | * | Massachusetts Bay. |
| Haminea hydatis | ... | ... | ... | ... | * | * | ... | ... | ... | ... | * | * | [Greenland. |
| * Actæon semisculptus | ... | ... | ... | ... | *? | | | | | | | | |
| * Leucotina minuta | ... | ... | ... | ... | * | | | | | | | | |
| Umbrella mediterranea? | ... | ... | ... | *? | *? | ... | ... | * | ... | ... | * | | |
| Tylodina citrina | ... | ... | ... | ... | * | ... | ... | ... | * | * | * | | |
| Pedipes afer | ... | ... | ... | ... | * | ... | * | ... | ... | * | ... | ... | Madeira. |
| Gadinia costata | ... | ... | ... | * | * | | | | | | | | |
| Cadulus jeffreysii | ... | ... | ... | ... | * | ... | * | ... | ... | * | * | * | New England. |
| Venus (Ventricola) effossa | ... | ... | ... | ... | * | ... | * | ... | * | * | * | | |
| —— (Chione) pygmæa | * | ... | ... | ... | * | | | | | | | | |
| Cytherea (Caryatis) rudis | ... | ... | ... | ... | * | ... | ... | ... | * | ... | * | | |
| Tellina antonii | * | ... | ... | ... | * | | | | | | | | |
| Semele cordiformis | * | ... | * | ... | * | ... | * | ... | ... | ... | ... | ... | West Colombia. |
| Ervilia subcancellata | * | * | * | ... | * | | | | | | | | |
| Corbula swiftiana | * | ... | ... | ... | * | | | | | | | | |
| Cardium (Fragum) speciosum | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | China Sea. |
| —— (Papyridea) bullatum | * | ... | * | ... | * | ... | ... | ... | ... | * | ... | ... | W. coast of C. America. |
| Rocellaria dubia | ... | ... | ... | ... | * | ... | ... | * | * | ... | * | * | Madeira. |
| Chama sp. | ... | ... | ... | ... | * | | | | | | | | |
| —— gryphoides (*fide Jeffreys*) | ... | ... | ... | ... | * | ... | ... | ... | * | ... | * | | |
| * Basterotia oblonga | ... | ... | ... | ... | * | | | | | | | | |
| Lasæa adansoniana | ... | ... | ... | ... | * | ... | * | | | | | | |
| * Lucina inconspicua | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Codakia) compacta | ... | ... | ... | ... | * | | | | | | | | |
| Verticordia ornata | * | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | California, China Sea, |
| Mytilus exustus | * | * | * | ... | * | | | | | | | | [United States. |
| Lithodomus biexcavatus? | * | ... | ... | ... | *? | | | | | | | | |
| * Arca sanctæ-helenæ | ... | ... | ... | ... | * | * | | | | | | | |
| —— (Acar) domingensis | * | ... | ... | * | * | * | ... | * | ... | ... | ... | ... | Red Sea, Japan, Australia, Indian and Pacific Oceans. |
| Pinna rugosa | ... | ... | ... | ... | *? | ... | ... | ... | ... | ... | ... | ... | ? Bay of Panama. |
| —— pernula | * | ... | ... | * | * | ... | ... | ... | ... | ... | ... | ... | Madeira. |
| Avicula hirundo (*fide Jeffreys*) | ... | ... | ... | ... | * | ... | ... | ... | * | * | * | * | |
| Pecten corallinoides | ... | ... | ... | ... | * | ... | * | * | * | * | | | |
| * —— atlanticus | ... | ... | ... | ... | * | | | | | | | | |
| * —— (Janira) tortoni | ... | ... | ... | ... | * | | | | | | | | [tugal. |
| Limea sarsii | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | * | * | W. of Ireland to Por- |
| Ostrea crista-galli (*fide Jeffreys*) | ... | ... | ... | ... | * | ... | ... | ... | ... | ... | ... | ... | Indian Ocean. |
| —— sp. | ... | ... | ... | ... | * | | | | | | | | |

## I. CEPHALOPODA.

An undetermined species of *Octopus* and the shells of *Argonauta argo* are mentioned by Mr. Melliss. The former "is plentiful in the nooks and rocky holes on the coast, about high-water mark." The *Argonauta* is occasionally washed ashore at Sandy Bay, on the south coast; this species also occurs at the Cape, in the Mediterranean, North Atlantic, Indian and Pacific Oceans.

## II. PTEROPODA.

Shells of the following species[1] were dredged in 50 to 80 fathoms:—

1. Cavolinia tridentata (Forskål).
2. Cavolinia longirostris (Lesueur).
3. Cavolinia quadridentata (Lesueur).
4. Cavolinia uncinata (Rang).
5. Cavolinia gibbosa (Rang).
6. Cavolinia inflexa (Lesueur).
7. Diacria trispinosa (Lesueur).
8. Clio pyramidata, Linné.
9. Styliola subula, Quoy & Gaimard.
10. Styliola recta, Lesueur.
11. Styliola virgata, Rang.
12. Triptera columella, Rang.
13. Limacina bulimoides, D'Orbigny.
14. Limacina inflata, D'Orbigny.
15. Limacina antarctica, Woodward.

## III. GASTROPODA.

Conus testudinarius, Martini.

Two specimens were obtained by Mr. Melliss.

Conus irregularis, Sowerby.

The specimens from St. Helena are of a shorter growth than those figured by Sowerby (Thes. Conch. iii. pl. 104. figs. 418, 419); they are broader at the shoulder and more suddenly contracted anteriorly. They also are more highly painted, exhibiting a considerable amount of olive-brown longitudinal streaks, which are interrupted at the

[1] For the synonymy and distribution consult Pelseneer's Report on the Pteropoda of the 'Challenger' Expedition.

middle by the bluish-white irregular zone dotted and spotted with olive-brown. The spire is either almost uniformly dark chestnut-brown, or else white, blotched with that colour.

Some small specimens, about $\frac{3}{4}$ inch long, which I believe to be the young of this species, are still more brightly coloured, being more or less copiously blotched with brown-black; and the spire is radiately lined and spotted with the same tint.

CONUS sp.?

A single much-worn shell is all that was obtained. In general form it is very like *C. tinianus*, but seems to be thicker and more strongly striated transversely. It is livid in colour, and marked with longitudinal and transverse bands of an olive-brown tint, which are not, however, sharply defined, but blend at the edges into the ground-colour of the shell. The whorls of the spire are dark livid on the upper half and pale beneath, forming a light spiral zone which revolves up the spire above the suture.

PLEUROTOMA (CLAVUS) AMANDA, Smith. (Plate XXI. fig. 1.)

*Pleurotoma* (*Clavus*) *amanda*, Smith, Ann. & Mag. Nat. Hist. Sept. 1882, p. 207.

The locality of this species was unknown at the time it was described. The fresh specimens from St. Helena have the transverse zone of a brighter tint, somewhat pinkish red. In certain examples it is interrupted between the ribs, and occasionally a fine reddish line occurs at the upper part of the whorls a little below the suture.

This species is very closely related to *P. sinuosa*, Montagu, and may eventually prove to be merely a variety of it.

PLEUROTOMA (CLAVUS) PROLONGATA. (Plate XXIII. fig. 1.)

*Testa elongata, turrita, alba vel rubescens; anfractus* 6–7, *duo apicales læves, magni, globosi, sequentes superne vix concave declives, in medio angulati, inferne conspicue contracti, costis obliquis flexuosis circa* 12 *instructi; apertura parva, brevis, longit. totius* $\frac{1}{3}$ *adæquans; anfr. ultimus costa valida variciformi longe pone labrum munitus; labrum tenue, haud incrassatum; sinus profundus, magnus; columella rectiuscula, callo tenui labro juncta; canalis brevissimus, latus.*

*Longit.* 6 *millim., diam.* 2.

This species is remarkable for the great length of the spire in proportion to that of the aperture. Besides the ribs, the surface exhibits fine wavy striæ of growth.

PLEUROTOMA (CLAVUS) ALBOBALTEATA. (Plate XXI. fig. 2.)

*Testa parva, fusiformi-ovata, pallide fuscescens, circa medium anfr. superiorum et ad basim anfr. ultimi albida; anfr.* 6, *primi duo læves, convexi, cæteri paulo excavati, ad latera convexiusculi, costis crassis* 10–12 *superne subobsoletis, ad suturas indistincte*

*subnodosis (in anfr. ult. infr. medium evanidis) instructi; apertura parva, longit. totius ⅓ haud æquans; labrum ad marginem tenue, costa ultima valida extus incrassatum, superne leviter sinuatum.*

*Longit.* 5 *millim.*, *diam.* 2.

Although the general appearance of this little species as regards colour is as above described, still, on closer examination, the style of ornamentation proves to be less simple; the white band is seen to be subdivided by a fine line of the same colour as the rest of the shell, and a few wavy darker brown lines flow down the lower portion of the body-whorl.

One specimen has the brown colour replaced by a pinkish or vinous tint.

PLEUROTOMA (DRILLIA) TURTONI. (Plate XXI. fig. 3.)

*Testa breviter fusiformis, flavescens, inter costas fusco tincta, infra suturas alba, circa anfr. ultimi medium albo zonata; anfr.* 10½, *primus convexus, lævis, duo sequentes in medio carinati, ceteri superne concavi, deinde convexi, costis brevibus circiter* 12 *superne obsoletis lirisque spiralibus* 4–6 *inter costas fuscis decussati, infra suturam corrugati; anfr. ultimus inferne contractus; apertura angusta, longit. totius ½ paulo minor; labrum ad marginem tenue, extus costa variciforme arcuata incrassatum, intus denticulatum; columella alba, denticulis transversis pluribus munita; sinus profundus; canalis brevis, recurvus.*

*Longit.* 18 *millim.*, *diam.* 6.

The colouring of this species is very pretty. The spire has the appearance of being alternately zoned with white and yellow, the yellow zone, falling upon the lower and costate portion of the whorls, is interrupted by a brown stain between the ribs. The lower half of the body-whorl, excepting the pale extremity, is yellowish, and has the appearance of being dotted with brown.

This species belongs to that section of the genus which includes *Pl. intercalaris*, Carpenter, *Pl. spurca*, Hinds, and a few others. These species have the columella and the interior of the labrum more or less denticulated.

PLEUROTOMA (MANGILIA) SUBQUADRATA, Smith. (Plate XXI. fig. 4.)

This species was described in the Ann. & Mag. Nat. Hist. 1888, vol. ii. p. 313.

PLEUROTOMA (MANGILIA) GEMMA, Smith. (Plate XXIII. fig. 2.)

*Pleurotoma* (*Mangilia*) *gemma*, Smith, Ann. & Mag. Nat. Hist. 1884, xiv. p. 322.

The specimens obtained by Mr. Turton are larger and in fresher condition than those originally described, and show that the upper ends of the costæ are not constantly red alternately, as some of these examples have all of them of a reddish colour. The largest speci-

men has eight whorls, of which the three apical are white, convex, and ornamented with subdistant, very oblique, arcuate, and very slender liræ. The remainder of the shell is of a whitish-wax tint. The length is $7\frac{2}{3}$ millim., the diameter 3.

The more extended series of specimens at hand now shows that *Pl. helenensis*, which I described at the same time as *Pl. gemma*, is only a variety of this species, differing chiefly from the typical form in colour.

Some examples are entirely white, others of a uniform rich brown, whilst others are of intermediate tints. Some have all the upper ends of the costæ of a reddish colour, some only the alternate ones; and the transverse zone on the body-whorl is not constantly present in all specimens; indeed it appears to be mostly wanting in the yellowish and brownish examples. *Pl. lavalleana*, d'Orbigny, is the West-Indian representative of this species, from which it differs in the position of the colour-band, its more attenuated body-whorl, and in the different position of the angle of the volutions.

Pleurotoma (Mangilia) mellissi. (Plate XXI. fig. 5.)

*Testa parva, fusiformi-ovata, dilute fuscescens ad suturas fusco tincta, circa medium anfr. ultimi fusco zonata; anfractus* $6\frac{1}{2}$, *primi* $2\frac{1}{2}$ *convexi, læves, tertius convexus, obliquiter tenuissime liratus, cæteri superne declives et angulati, costis tenuibus circa* 14 *et liris gracilioribus spiralibus (in anfr. superioribus* 3, *in ultimo* 16–20) *cancellati, undique minute squamoso-striati; apertura angusta, longit. totius* $\frac{1}{2}$ *vix æquans; labrum incrassatum, intus læve; sinus haud profundus.*

*Longit.* 5 *millim., diam.* 2.

The microscopic structure of this species is very like that occurring in *Pl. subquadrata*, and appears under the microscope to consist of numerous spiral series of very minute grain-like scales, which, at times, are arranged one under the other, so as to produce the appearance of longitudinal series also. It may be known from *Pl. subquadrata* by its finer cancellation and the more central position of the colour-zone upon the body-whorl, which also is not contracted in the same way below the middle.

Pleurotoma (Clathurella?) commutabilis. (Plate XXIII. fig. 3.)

*Testa parva, fusiformi-ovata, aut alba, flavescens, aut lilacea, costis longitudinalibus ad* 12 *lirisque transversis (in anfr. superioribus* 2–3, *in ultimo* 8), *fortissime cancellata; anfractus* $5\frac{1}{2}$, *primi* $1\frac{1}{2}$ *vitrei, peculiares, superne carinati et concavi, quasi truncati, reliqui* 4 *convexiusculi; apertura parva, angusta, longit. totius* $\frac{2}{5}$ *adæquans; labrum vix incrassatum; canalis brevissimus, latus; sinus parvus, inconspicuus; columella rectiuscula, tuberculis duobus prope medium munita.*

*Longit.* 4 *millim., diam.* $1\frac{1}{2}$.

This species is very distinctly characterized by its form and the coarse style of its sculpture. The ribs and liræ are about equally

thick, produced into acute nodules at the points of intersection, and the quadrate interstices are very deeply pitted.

PLEUROTOMA (CLATHURELLA?) MULTIGRANOSA. (Plate XXI. fig. 6.)

*Testa parva, fusiformi-ovata, nigrescens vel rufescens, supra medium anfractuum albo zonata, undique granulis albis et nigrescentibus aut rufis ornata; anfractus* 5½, *nucleares* 1½ *læves, cornei, superne concavi, carinati, cæteri planiusculi, costis ad* 14 *lirisque spiralibus supra costas granosis instructi; liræ in anfr. superioribus tres, suprema minima, in ultimo* 13–14; *apertura angusta, longit. totius* ½ *subæquans; columella rectiuscula, in medio tuberculis minutis duobus instructa, callo tenui induta; labrum vix incrassatum, superne brevissime sed distincte sinuatum.*

*Longit.* 4½ *millim., diam.* 2.

This species is larger than *Pl. commutabilis*, differently coloured, and more closely sculptured. The costæ and liræ are so near together that the granules almost touch one another.

PLEUROTOMA (CLATHURELLA?) USTA. (Plate XXIII. fig. 4.)

*Testa minuta, fusiformi-ovata, nigricans vel rufescens, interdum serie granulorum albidorum paulo infra suturam ornata; anfract. 5, primi* 1½ *lævigati, cæteri leviter convexiusculi, costis* 12–14 *paulo obliquis instructi, sulcisque angustis transversis (in anfr. superioribus* 4, *in ultimo circiter* 15) *sculpti; apertura elongata, angusta, dimidium longit. totius vix æquans; columella leviter obliqua, callo tenui induta, in medio interdum indistincte incisa; labrum probabiliter leviter incrassatum, superne vix sinuatum.*

*Longit.* 2¾ *millim., diam.* 1½.

The sulci cut through the costæ and produce a somewhat granular appearance. The lira beneath the first sulcus below the suture is that which is white upon the riblets in the black variety.

MUREX (CHICOREUS) ADUSTUS, Lamarck.

*Hab.* West Indies, Japan, Philippines, Indian and Pacific Oceans.

In the 'Annals and Magazine of Natural History,' 1875, vol. xv. p. 419, I expressed an opinion that *Murex despectus* of A. Adams, said to have come from the West Indies, was identical with this species, which is known as an inhabitant of Eastern seas. At the time I doubted the accuracy of the locality given by Adams, but now I am inclined to believe it correct, as so many West-Indian shells have also been found on the eastern side of the Atlantic at St. Helena, Ascension Island, and on the west coast of Africa.

MUREX (OCINEBRA) SANCTÆ-HELENÆ. (Plate XXIII. fig. 5.)

*Testa fusiformis, alba, varicibus tribus obliquis, compressis, dentatis, et liris spiralibus (in anfract. superioribus duobus, in ultimo*

5–6) *pone varices maxime elevatis instructa; anfractus circa* 10, *superne concavi, dein angulati, inferne constricti; apertura parva, irregulariter circularis, marginibus fere continuis prominentibus circumdata; canalis mediocriter elongatus, angustus, subclausus, tortuosus, recurvus.*

*Longit.* 30 *millim., lat.* 16.

This species is remarkable for the prominent character of the spiral ridges just behind the varices and the deep pits between them. They are produced in a somewhat radiating manner, and form tooth-like projections, giving the edge of the varices a pretty festooned appearance. Although four varices can be counted in any individual whorl, still, as the fourth from the labrum falls very close but not exactly above it, and so on in the other whorls, three disjointed varices are thus formed, and pass *very obliquely* up the spire.

MUREX (OCINEBRA) PATRUELIS. (Plate XXIII. fig. 6.)

*Testa brevissime fusiformis, dilute fuscescens, inferne vix rimata; anfract.* 7–8, *convexi, in medio angulati, costis longitudinalibus circa* 9, *mediocriter fortibus, lirisque transversis, elevatis, squamosis, inæqualibus* (*in anfr. penult.* 5–6, *in ultimo circiter* 13) *instructi; apertura elongata, subpyriformis, longit. totius ½ adæquans, intus pallide fuscescens; columella supra parum arcuata, inferne oblique tortuosa; canalis brevis, recurvus.*

*Longit.* 10 *millim., diam. max.* 6½. *Apertura* 5½ *longa,* 2¾ *lata.*

This little species is very like *M. diadema* of Aradas and Benoit, but has not the liration at the angle of the whorls produced into hollow spines upon the costæ. The liræ, also, are more numerous, and the nuclear whorls are differently sculptured. None of the few specimens at hand are quite mature, so I cannot state whether the labrum is smooth or denticulate within.

MUREX (OCINEBRA) ALBOANGULATUS. (Plate XXI. fig. 7.)

*Testa brevissime fusiformis, rufo-fusca, ad angulum anfractuum et basim anfr. ultimi alba; apex rufescens; anfr.* 7, *apicales* 3 *convexi, liris tenuissimis longitudinalibus numerosis, paucisque transversis sculpti, cæteri superne declives, infra medium acute angulati, costis crassis circa* 10, *lirisque fortibus spiralibus squamulatis* (*in anfr. penult.* 5, *in ultimo ad* 11) *instructi; anfr. ultimus paulo infra medium contractus; columella callo albo incrassata; apertura albida, longit. totius ½ subæquans; labrum incrassatum, intus denticulatum.*

*Longit.* 8 *millim., diam. max.* 5½.

This species has the general aspect of certain *Coralliophilæ*, and might be placed with that group provisionally until the animal and operculum are known. It differs from *M. patruelis* in having smaller apical whorls, in coloration, and in sculpture, the transverse or spiral ridges being somewhat finer and more squamose.

LACHESIS HELENÆ. (Plate XXI. fig. 8.)

*Testa fusiformi-ovata, saturate fusca, interdum pallide flavo zonata; anfractus* 6, *nucleariscorneus, convexus, lævis, cæteri convexiusculi, sutura profunde sejuncti, costis crassis obliquis circa* 13, *lirisque spiralibus, fortibus, supra costas granosis (in anfr. superioribus* 3, *in ultimo ad* 9) *cancellati; apertura parva, longit. totius* ½ *vix æquans; labrum incrassatum, intus denticulis senis munitum; columella leviter arcuata, callo tenui, inferne ad canalem brevem obliquum albo induta.*

*Longit.* 7 *millim., diam. max.* 3½. *Apertura* 3¼ *longa,* 1½ *lata.*

This species is broader than most of the European forms. Of the three liræ upon the upper whorls, the uppermost is rather more slender than the other two. A fourth liration is occasionally visible at the lower part of the whorls. The oblique ribs are more or less regularly continuous up the spire.

CANTHARUS (TRITONIDEA) ALBOZONATUS. (Plate XXI. fig. 9.)

*Testa breviter fusiformis, saturate purpureo-fusca, circa medium anfractuum albo zonata, lirisque supra costas albo nodosis, cincta; anfr.* 7–8, *superne concavi, deinde convexi, costis crassiusculis ad* 8, *et liris spiralibus, supra costas nodulosis, instructi; liræ in anfr. superioribus* 3–4, *duæ prope medium albæ, aliis majores, in ultimo* 9–10; *apertura elongate pyriformis, longit. totius* ½ *æquans, intus lilacea, zona alba ornata; labrum intus tenuiter liratum, liris elongatis, longe intrantibus, haud ad marginem attingentibus; canalis angustus, obliquus, paulo recurvus; columella supra medium arcuata, purpureo-fusca, callo tenui, superne tuberculata, munita, inferne alba.*

*Longit.* 16 *millim., diam. max.* 8.

Var. *Testa brevior, saturate purpureo-fusca, nodulis flavescentibus supra costas, præter duas albas prope medium anfractuum, ornata.*

*Longit.* 11 *millim., diam. max.* 6.

This species varies considerably in form and colour. The smaller variety has the ribs rather more numerous and is of much stumpier growth, but the series of specimens at hand is sufficiently large to clearly connect the two varieties. The Mediterranean *C. orbignyi* is a larger shell, has the white zone lower down, and differs in colour and in the aperture.

CANTHARUS (TRITONIDEA) CONSANGUINEUS. (Plate XXI. fig. 10.)

*Cominella lugubris*, Jeffreys (non C. B. Adams), Melliss's St. Helena, p. 124.

*Testa fusiformi-ovata, pallide rufescens, liris transversis, nigrescentibus cincta; anfractus* 8–9, *apicales* 3½ *convexi, lævesæteri superne concavi, in medio obtuse angulati, costis levibus circa* 10, *lirisque supra costas nodulosis, instructi; liræ in anfr. penultimo* 3–4, *una ad suturas, una vel duæ contiguæ*

*circa medium ; anfr. ultimus inferne contractus, subrimatus, liris præcipuis* 6–7, *aliisque tenuibus, intercalentibus, cinctus ; apertura parva, albida vel lilacea, cum canali longit. totius dimidium superans ; columella callo tenui, superne tuberculo parvo munito induta ; canalis obliquus, angustus, recurvus ; labrum intus incrassatum, liris* 6–7 *instructum.*

*Longit.* 14 *millim., diam. max.* 8.

This species has much of the character of two species—the one *Can. nodulosus* from the West Indies, and the other *C. lugubris* from Panama, both described by C. B. Adams. The spire of the latter species seems to be rather longer than that of the present species; its aperture is consequently proportionally shorter, and the coloration is not the same. *C. nodulosus*, which is very closely allied to the present form, besides being differently coloured, is a somewhat more robust species and has a shorter canal, and the whorls seem to be rather less angular.

These three forms are difficult to locate generically; and although I have considered them as belonging to the *Tritonidea* section of *Cantharus*, they might with equal propriety be associated with *Sistrum*.

CANTHARUS (TRITONIDEA) LÆVIS. (Plate XXI. fig. 11.)

*Testa fusiformi-ovata, alba, lineis transversis saturate fuscis ornata, interque costas fusco tincta ; anfr.* 10, *apicales tres convexi, læves, flavescentes, sequentes superne concavi, in medio angulati, infra angulum convexiusculi, costis crassis* 9, *ad angulum acutis, instructi ; anfr. ultimus elongatus, prope medium contractus, inferne subrimatus ; apertura alba, cum canali longit. totius* ½ *superans ; labrum extus valde incrassatum, intus denticulis ad* 6 *munitum ; columella callo albo, tenui induta ; canalis elongatus, obliquus, recurvus.*

*Longit.* 23 *millim., diam. max.* 10; *apertura cum canali* 12 *longa,* 4½ *lata.*

This pretty species recalls certain forms of the genus *Siphonalia*. It is unlike most species of *Cantharus* in having no tubercular sculpture, on which account I have called it *C. lævis*.

COLUMBELLA (ANACHIS) DECIPIENS (C. B. Adams).

*Buccinum concinnum*, C. B. Adams, Proc. Bost. Soc. Nat. Hist. 1845.

*Columbella decipiens*, C. B. Adams, Contrib. Conch. p. 55; Reeve, Conch. Icon. pl. xx. fig. 111.

*Col. crassilabris*, Reeve, l. c. pl. xxviii. fig. 177 *a–b*.

*Hab.* Jamaica (*C. B. Adams*).

In the Museum are the type of *C. crassilabris* and the specimen of *C. decipiens* figured by Reeve. They unquestionably belong to the same species. The figure of the former is not good as regards form, and is very greatly enlarged, although no indication of this appears on the plate. The only specimen from St. Helena forms part of a collection made by Mr. J. Macgillivray many years ago.

COLUMBELLA (MITRELLA) CRIBRARIA, Lamarck.

This species has a very remarkable distribution. Java Seas, Ascension Island, St. Helena, Goree, Guinea, Cuba, Barbadoes, Panama, and Mazatlan have been ascribed to it; and the British Museum, besides specimens from Goree, St. Helena, Ascension, Panama, and Mazatlan, contains series from St. Vincent's, West Indies, Guatemala, and Amboyna. Those from Guatemala were described by Reeve under the name of *C. delicata* (Conch. Icon. pl. xxvii. fig. 171), but whether from the eastern or the Pacific coast is not stated. The series from Amboyna have that locality attached to them, but I am unable to discover the source whence they were obtained, and therefore cannot vouch for the correctness of the habitat. Dr. P. P. Carpenter, in his Catalogue of Mazatlan Shells, cites among the synonymy of this species the following:—*Voluta ocellata*, Gmelin; *Buccinum parvulum*, Dunker; *Columbella mitriformis*, Broderip and King; and *C. guttata*, Sowerby.

This appears to be a species which varies much in size. All the specimens from Ascension and St. Helena are small, averaging about eight or nine millimetres in length. They are almost invariably decollated, and have but four whorls remaining. The largest specimen from St. Vincent's, consisting of an equal number of whorls, is 12 millimetres long. The specimens from Goree, Amboyna, and Panama are, as a rule, broader, larger, and more solid than West-Indian or St. Helena examples.

COLUMBELLA (MITRELLA) PUSILLA, Sowerby.

*Col. pusilla*, Sowerby, Thes. Conch. vol. i. p. 144, pl. xl. figs. 182, 183; Reeve, Conch. Icon. pl. xx. figs. 109, 110, 112.

*Hab.* West Indies (*Sowerby*), island of St. Vincent, West Indies (*Reeve*).

This species closely resembles *C. lunata*, Say, but is a trifle more slender, marked somewhat differently, has a more thickened labrum, and a more distinct sinus above. The apex of this species is invariably brown, and the lip, especially the sinus, is usually tinted with the same colour along the edge. The single specimen from St. Helena was collected by J. Macgillivray.

COLUMBELLA (MITRELLA) SANCTÆ-HELENÆ. (Pl. XXI. fig. 12.)

*Testa fusiformi-ovata, parva, albida, dilute fusco lineata vel maculata, frequenter infra suturam et circa medium anfr. ultimi niveo notata; anfr.* 8–9, *primi* 3–4 *convexi, læves, cæteri parum convexi, striis spiralibus, subdistantibus insculpti, incrementi lineis striati; anfr. ultimus infra peripheriam rotundatam contractus, oblique tenuiterque sulcatus; apertura angusta, longit. totius* ½ *haud æquans; labrum mediocriter incrassatum, intus denticulis* 7–8 *munitum; columella callosa, prope medium tuberculo pliciforme instructa; canalis obliquus, brevis, recurvus.*

*Longit.* 7½ *millim., diam. max.* 3.

The spiral subdistant striæ will readily distinguish this species

from some others which closely approach it in outline. Most of the specimens are rather smaller than that of which the dimensions are given above, and have an average length of 6½ millimetres and a diameter of 2¾. All of this smaller form are blotched irregularly with pale brown, and have a more or less distinct interrupted pallid zone at the periphery, and white spots below the suture. The larger form is ornamented with numerous longitudinal light brown lines, which vary in thickness, and are connected, more or less, by short transverse ones, producing somewhat the appearance of an indistinct network.

NASSA SANCTÆ-HELENÆ, A. Adams.

A series of about forty specimens of *Nassa* from St. Helena makes it extremely difficult to decide to which species they should be assigned. Some exactly resemble Adams's type (Reeve, Conch. Icon. fig. 188), whilst others appear altogether different, the form and sculpture being very variable. The typical form may be thus described:—Shell elongate, with a rather acutely produced spire, of a dirty whitish colour, with a dark brown line interrupted by the costæ around the middle of the body-whorl, also one above near the suture, and another round the base, both being less clearly defined and not so regularly interrupted as the median line; whorls 8, the three apical smooth, glassy, very convex, the rest narrowly somewhat excavated or concave above, then moderately convex at the sides; sculpture consisting of 10–12 slightly oblique strongish costæ, a little nodose at the angle of the concavity, and of spiral sulci, which are well defined and cover the whole of the spire, but become a trifle obsolete on the central part of the body-whorl; outer lip thickened by a broad external varix, marked with a brown spot, the termination of the central interrupted line, and furnished within with about a dozen fine liræ; columella covered with a callus, with a small elongate narrow tubercle above and several irregular transverse rugosities and tubercles from thence downwards. Length 12 millim., greatest diameter 6½. The principal variations consist of differences of form and colour, in the number of costæ, and in the greater or less development of the spiral grooving. When the spiral sulci are strongly marked, the costæ become somewhat nodulous as in *N. incrassata*, Ström, with which species Jeffreys, in his account of Mr. Melliss's shells, associated two specimens obtained at St. Helena, and placed in the British Museum by that gentleman. Not one of the St. Helena shells has the canal stained with black like the majority of specimens of *incrassata*.

NASSA CINCTELLA, A. Adams.

*Hab.* St. Helena, 20 fathoms, sandy mud (*Adams*).

The two specimens in Mr. Cuming's collection are all I have seen of this species. It is rather like the West-Indian *N. ambigua* of Montagu in its short squarish form, but differs in having less tabulated whorls, and stronger or coarser spiral sculpture.

CORALLIOPHILA ERYTHROSTOMA. (Plate XXIII. fig. 7.)

*Testa brevis, alba, brevissime fusiforme; anfractus* 6, *tabulati, in medio angulati, costis* 8–9 *paulo obliquis et liris spiralibus pulcherrime squamulatis* (*in anfr. superioribus ad* 6, *in ultimo circa* 15) *instructi; anfr. ultimus inferne angustatus, rimam angustam umbilicalem exhibens; apertura pyriformis, longe intus rufescens; labrum album, intus sulcatum; columella superne parum arcuata, infra medium obliqua; canalis mediocris, paulo recurvus. Operculum ignotum.*

*Longit.* 22 *millim.; diam. max.* 15, *min.* 12. *Apertura* 14 *longa,* 6 *lata.*

This species is chiefly distinguished by its short broad-shouldered form, and the reddish interior of the mouth. The liration upon the costæ at the angle is rather acutely produced, giving it a pretty festooned appearance.

CORALLIOPHILA ATLANTICA. (Plate XXIII. fig. 8.)

*Testa fusiformi-ovata, rimata, alba, mediocriter crassa; anfr.* 6, *convexi, costis obliquis circiter* 11, *plerumque parum elevatis, lirisque spiralibus, minute squamatis* (*in anfr. superioribus circa* 4, *in ult. ad* 20 *irregulariter alternatim majoribus*) *instructi; apertura subpyriformis, alba, longit. totius ½ superans; labrum intus sulcatum; columella rectiuscula; canalis brevis.*

*Longit.* 17 *millim.; diam.* 11. *Apertura* 11½ *longa,* 4½ *lata.*
„ 13 „ „ 8½ „ 7½ „ 3½ „

This species is chiefly distinguished by the roundness of the whorls and the slight development of the costæ; in some specimens they are all but obsolete.

CORALLIOPHILA BRACTEATA (Brocchi).

*Hab.* Mediterranean.

The two little specimens from St. Helena of this variable species belong to var. 4 as described by Monterosata (*vide* 'Nuova revista Conch. Medit.' 1875, p. 40, as *Pseudomurex*). *Murex gravesii*, Broderip (Proc. Zool. Soc. 1836, p. 44), as pointed out by Tryon, is another synonym of this variety.

PURPURA HELENA, Q. & G.

? *Purpura undata*, Lamarck, Anim. s. Vert. vol. vii. p. 238.

*Purpura helena*, Quoy & Gaimard, Voy. Astrolabe, Zool. vol. i. (1832) p. 573, Atlas, pl. 39. figs. 7–10.

*Purpura bicarinata*, Blainville, Nouv. Ann. du Muséum d'Hist. Nat. vol. i. (1832) p. 215.

*Purpura fasciata*, Reeve, Conch. Icon. vol. iii. pl. ix. fig. 45.

*Purpura undata*, Kiener (partim), Icon. Coq. Viv. pl. 34. figs. 81 *a–c*.

*Cuma carinifera*, Tryon (partim), Man. Conch. vol. i. pl. 62. fig. 324.

*Hab.* West Indies (*Küster, Higgins & Marrat*, and *British*

*Museum*); Ascension Island (*Conry*); Cape Verde Islands (*MacAndrew*).

The specimens collected by Mr. Melliss at St. Helena and named by Jeffreys *P. rudolphi* (Ann. & Mag. Nat. Hist. 1872, April, p. 264) belong to this species. St. Helena examples are generally of a darker colour than those from the West Indies, but they agree in nearly always having a purple-brown stain on the edge of the columella bordering the canal. This seems to be a fairly constant character. *Purpura forbesii*, Dunker (Index Moll. Guinea, p. 22), is very close to, if not the same as, this species.

The shell described by Quoy and Gaimard is scarcely half-grown, and has a very different appearance from the adult worn specimen figured in the 'Conchologia Iconica' as *P. fasciata*. The series of specimens in the British Museum clearly shows, however, that both are merely different stages of one and the same species.

MITRA (CANCILLA) TURTONI. (Plate XXII. fig. 1.)

*Testa fusiformis, dilute olivaceo-fusca, spiraliter crebre lirata et sulcata, in sulcis longitudinaliter striata; anfractus* 10, *apicales tres aut quatuor lævigati, pallidi, cæteri leviter convexi; apertura rubescens, longit. totius* ½ *æquans; columella paulo obliqua, plicis* 4–5 *in medio instructa.*

*Longit.* 27 *millim., diam. max.* 8; *apertura* 13½ *longa, fere* 3 *lata.*

This species is considerably like *M. gambiana*, Dohrn, as regards form, but differs in colour and sculpture, the sulci being deeper, and the intervening liræ narrower. The fine longitudinal striæ are chiefly visible in the grooves, but they do to some extent cross the riblets.

MITRA (TURRICULA) INNOTABILIS. (Plate XXIII. fig. 9.)

*Testa parva, fusca, lira alba circa medium anfr. ultimi ornata; anfractus* 6, *nucleus magnus, convexus, nitidus, anfr. sequentes paulo convexi, costis obliquis circa* 12, *lirisque spiralibus, supra costas nudulosis* (*in anfr. superioribus* 3, *ultimo circiter* 12) *instructi; apertura angusta, longit. totius* ½ *haud æquans; columella triplicata, callo tenui amicta; labrum tenue, intus lævе.*

*Longit.* 7 *millim., diam* 2½.; *apertura* 3 *longa,* 1 *lata.*

The cancellation is coarse for so small a shell. The whorls have a slightly turreted appearance, being divided by a deep suture. The white liration is the third from the top of the whorls.

MITRA (PUSIA) SANCTÆ-HELENÆ. (Plate XXII. fig. 2.)

*Testa parva, brevis, ovata, alba, inter nodulos nigro fasciata; anfractus* 5, *primus lævis, globosus, nigrescens, cæteri convexiusculi, sutura subprofunda sejuncti, costis confertis, granulosis, sulcis spiralibus sculptis instructi; costæ circiter* 16, *vix obliquæ, fere ad basim anfr. ultimi productæ; sulci angusti, subæquales, in anfr. superioribus* 2–3, *in ultimo* 10–12; *apertura parva,*

*longit. totius ½ æquans; labrum leviter incrassatum, intus denticulatum; columella triplicata.*

*Longit.* 5 *millim., diam* 2½.

This species at first sight looks very like the shell previously described as *Pleurotoma multigranosa*, but, of course, is perfectly distinct. It is remarkable for its small size, the minutely beaded ribs, the dark apex, and the style of coloration. Allied to *M. albocincta*, C. B. Adams.

MITRA (THALA) PLEUROTOMOIDES. (Plate XXIII. fig. 10.)

*Testa parva, breviter fusiformis, albida, interdum lutea-tincta; anfractus sex, duo supremi læves, superne acute carinati, plani, quasi truncati, cæteri convexiusculi, costis longitudinalibus circiter* 16, *lirisque transversis* (*in anfr. penult.* 5–6, *in ultimo* 18–20) *granose clathrati; apertura parva, angusta, longit. totius ½ adæquans; labrum leviter incrassatum, denticulis circiter sex intus munitum, postice distincte sinuatum; columella rectiuscula, leviter obliqua, in medio plicis duobus instructa, callo tenui superne labro juncto induta.*

*Longit.* 5 *millim., diam.* 2.

This species is remarkable for the peculiar truncate apex, the Pleurotomoid labral sinus, and the columellar plaits being two only in number. Fischer (Man. Conch. p. 612) has pointed out that Mitras of the group *Thala* have much affinity with the shells of *Clathurella* and *Mangilia*. I might point out that one species, *Thala solida*, was described by Reeve[1] as belonging to the latter genus, and another, *Thala todilla*, was originally published by Mighels[2] as a species of *Pleurotoma*. It therefore still remains doubtful to which family, *Pleurotomidæ* or *Mitridæ*, this group should be referred.

MARGINELLA (VOLVARIA) CINEREA, Jousseaume.

The type of this species, *M. semen* of Reeve, not of Lea, described by Reeve (Conch. Icon. pl. xxvi. fig. 145), is now in the Museum, having been presented by Mrs. Lombe Taylor after the death of her husband. It is incorrectly said by Reeve to have four plaits on the columella, for on careful examination only three are discernible, nor is this number exceeded in any of the specimens, nearly twenty in number, from St. Helena. Reeve's figure does not accurately represent the form of the spire, and the sutural line is too low down. No locality has previously been quoted for it.

MARGINELLA (VOLVARIA) CONSANGUINEA. (Plate XXIII. fig. 11.)

*Testa minuta, ovata, alba, nitida, pellucida; anfractus* 3–4; *spira brevissima, obtusissime conica; anfr. ultimus elongate ovatus, in medio labri levissime constrictus; apertura angustissima; labrum paulo incrassatum, inflexum, arcuatum, intus lævе,*

[1] Conch. Icon. (*Mangelia*), sp. 64.
[2] Proc. Bost. Soc. Nat. Hist. 1845, vol. i. p. 24.

*superne suturam haud attingens; columella inferne triplicata, plica suprema minima, interdum subobsoleta.*

*Longit.* 2½ *millim., lat.* 1½.

*M. lavalliana* of d'Orbigny, a common West-Indian species, appears to more closely resemble this than any other. That form is, however, a little more solid, hardly so narrow, and has four or more folds on the columella.

MARGINELLA (VOLVARIA) ATOMUS. (Plate XXIII. fig. 12.)

*Testa minuta, pyriformi-ovata, alba, pellucida, lævis; spira obtusissima, vix elata; apertura angusta; labrum paulo inflexum et incrassatum, superne suturæ junctum, intus haud denticulatum; columella quadriplicata, plica suprema minutissima.*

*Longit.* 1½ *millim., lat.* 1.

This species might almost be regarded as a small form of the Australian *M. angasi*, from which it seems to differ chiefly in size. The columella of that species is not quite the same, however, being furnished with a few additional denticles or plicæ at the upper part.

CASSIS TESTICULUS, var.

*Hab.* West Indies.

The St. Helena form of this species is that named *C. crumena* by Bruguière. From the series of specimens examined, I am inclined to think that it cannot be held distinct. It appears to exist on the eastern side of the Atlantic, and has not, I think, been recorded from the western parts. The typical form, however, of *C. testiculus* is known from the West-African coast, and a specimen from that region was presented to the Museum by F. P. Marrat, Esq.

TRITON TRITONIS (Linné).

*Hab.* W. Indies, Mediterranean, N. Australia, Pacific Islands.

A single specimen in a very worn and broken condition, and which, when perfect, must have been about twelve inches in length, is all that was found by Capt. Turton at St. Helena. Mr. Melliss "obtained two living specimens which came ashore at Lemon Valley." The species occurs also at the Canary and Cape de Verde Islands, and it is well known from the West-Indian region. *T. seguenzæ*, Aradas and Benoit, is, in my opinion, the Mediterranean variety of this species.

TRITON OLEARIUM (Linné).

*Hab.* New Zealand, Port Jackson, Japan, Tahiti, West Indies, Mediterranean, &c., &c.

The distribution of this species is truly remarkable, and has been ably discussed by Lischke[1].

The specimens from St. Helena have the spiral ridges much more prominently nodose than usual, the varices are thicker, and the labrum not effuse, but very solid and strong as in *T. aquatilis*. In

[1] Japan. Meeres-Conchyl. part i. p. 48.

colour, however, the columella and the denticles within the outer lip exactly resemble *T. olearium*. *T. aquatilis* (Reeve, Conch. Icon. fig. 24) has a great affinity with *T. pilearis* (Reeve, *l. c.* fig. 23), and both have an equally wide range. Both occur at the Philippine Is., Japan, the Red Sea, and the West Indies; and the general structure of the two forms is so very similar, that I am inclined to think that eventually, when large series can be re-examined, it will be impossible to distinguish them. The shell in the d'Orbigny collection marked "*T. martinianum*, d'Orb."[1], is quite a typical *aquatilis*, and his three examples of *T. americanum*[2] from Rio Janeiro, which he formerly considered *T. pilearis*[3], certainly belong to *T. olearium*.

The largest specimen from St. Helena, which is much broken, when perfect must have measured about four and a half inches in length.

TRITON TURTONI. (Plate XXI. figs. 13, 13 *a*.)

*Testa elongata, fusiformis, turrita, rufescens, varicibus albidis, rufo-zonatis, instructa; anfr.* 11, *embryonales* 6 *pallide fusci, convexi, cæteri superne tabulati, angulati, inferne ad suturam valde constricti, liris spiralibus, costis longitudinalibus, nodosis, rotundatis, varicibusque paucis instructi; costæ ad angulum prominentes (in anfract. penultimo* 7), *in ultimo infra medium obsoletæ; liræ transversæ, inæquales; apertura longe intus lurida, cum canali longit. totius* ½ *æquans; labrum intus album, liris circiter* 6 *instructum, ad marginem paribus senis denticulorum partim fusco-tinctorum armatum; columella in medio arcuata, plus minus purpureo-nigra, rugis transversis, gracilibus, albis ornata; canalis intus albus, recurvus.*

*Longit.* 49 *millim., lat.* 20.

This is a very distinct species, and well characterized by the angled tabulated whorls which are much constricted at the lower suture. On the five normal whorls there are only four varices, two on the body-whorl and two on the penultimate. Of the spiral ridges, one marking the angle and one below it, and which are nodose upon the costæ, are most conspicuous.

RANELLA CÆLATA, Broderip.

This species is common on the coast of Panama, and it is extremely remarkable that it should occur at St. Helena. The single specimen collected by Mr. Melliss[4], and presented to the British Museum, corresponds in every particular with Panama examples; but those obtained by Capt. Turton partly belong to the same variety, and partly to that named *R. pustulosa* by Reeve, from Ascension Island, which differs from the Panama type in having fewer and larger tubercles. A specimen collected by Staff-Surgeon

[1] Sagra's Hist. Cuba, Mollusques, vol. ii. p. 162.
[2] Voy. dans l'Amér. Mérid., Moll. p. 711.
[3] *Ibid.* p. 449.
[4] *Vide* Jeffreys, Ann. Mag. Nat. Hist. 1872, vol. ix. p. 264.

T. Conry at Ascension, and presented by him to the British Museum, has, however, tubercles as in *R. cælata*. The number of the nodules seems to be very variable, and a character of no specific importance. With this species may also be united *R. ponderosa*, Reeve, the locality of which was unknown to its author, and some shells labelled *R. quercina*, Mörch [1], in Cuming's collection, said to have come from Guinea, evidently belong to the same species. As I have been unable to consult the work of Schröter, referred to by Mörch, who gives no description of his species, I cannot say whether these specimens are correctly identified. They are peculiar in having the nodules on the upper whorls as in typical specimens.

Ranella thomæ, d'Orbigny.

*Hab.* St. Thomas (*d'Orbigny*); Madeira (*Watson*); Canary Islands ('*Challenger*'); Cape Verde Islands (*Brit. Mus.*); Mauritius (*Robillard*).

D'Orbigny's description of this species (Sagra's Hist. Cuba, Moll. vol. ii. p. 164) was based upon an old dead specimen, entirely devoid of colour, now in the British Museum. In fresh examples the aperture is tinted with pale rose, and the varices and spiral ridges are irregularly spotted and dotted with brown. The enlarged figure in the above-mentioned work (pl. xxiii. fig. 23) is not at all good. The labrum is not so bulging, the granules are not so bead-like, the body-whorl is more constricted below, the varix on the left, and the basal canal is directed to the right and not to the left. The largest specimen in the Museum is from St. Vincent, Cape Verde Islands, and measures 22 millim. in length.

This species also occurs at the Mauritius, and has been named *R. bergeri* [2]. This distribution supports Tryon's opinion, that *R. thomæ* should be considered to be the same as *R. rhodostoma*, and indeed, excepting that the brown dotting is more conspicuous and the colour of the aperture different, there is little to found specific distinction upon. I cannot, however, agree with that author in considering *R. cruentata* and *R. rhodostoma* forms of one and the same species.

Natica turtoni. (Plate XXI. figs. 14, 14 *a*.)

*Testa globosa, late umbilicata, rufescens, plus minus radiatim strigata, zonis quatuor albis, maculis saturate fusco-rufis, quadratis, interruptis, cincta, striis incrementi, ad suturam leviter plicatis, sculpta, epidermide decidua, sublamellata, induta; anfractus 4–5, celeriter accrescentes, convexi, sutura profunda sejuncti, ultimus magnus, aperturam versus leviter expansus vel tubiformis; umbilicus albus, magnus, callo mediocriter tenui in medio instructus; apertura dilatata, semicircularis, intus albida, coloribus externis leviter conspicuis.*

*Diam. maj.* 19 *millim.*, *min.* 14, *alt.* 18.

[1] Cat. Conch. Yoldi, p. 106.

[2] Canefri, Mém. Soc. Malac. Belgique, 1880, vol. xv. p. 50, pl. 2. figs. 1, 2.

*Operculum calcarium, ex anfractibus duobus constitum, interne lævo, incrementi lineis striatum, extus porcis spiralibus septenis valde inæqualibus, sulcis interjicientibus profundis, instructum.* (Plate XXI. fig. 14 *a*.)

In *style* of coloration this species resembles *N. tæniata*, the well-known species from the Indian Ocean and the Philippines. It is, however, of a slightly different form, and the colour, both externally and within the aperture, is dissimilar. The two forms are at once distinguishable by the opercula.

The operculum of *N. tæniata* (Plate XXI. fig. 15) is externally grooved and ridged, like that of *N. turtoni*, but the ridges are more numerous and more equal in size. The figures on Plate XXI. show at a glance the difference. The operculum of *N. tæniata* has not previously been described. The specimen figured was collected at Aden by the Rev. A. W. Baynham, who, in 1885, presented to the British Museum a very interesting series of shells from that locality.

NATICA DILLWYNII, Payraudeau.

*Hab.* Mediterranean in many places; Mauritius (*Robillard*); South Pacific Islands (*B. B. Woodward*).

After carefully comparing Maltese specimens of this species with examples of the West-Indian *N. proxima* of C. B. Adams, I am quite convinced that they all belong to one and the same species. Philippi (see Küster's Conch.-Cab. Monog. *Natica*, p. 123) holds them distinct, observing that *N. proxima* is more ovate in form, and that the umbilical ridge is much thicker and situated below the middle of the umbilicus. In answer to this, I would observe that these differences do not exist in specimens in the Cumingian Collection, sent by C. B. Adams himself. None of the St. Helena specimens are full-sized, but several are very brightly coloured.

In the British Museum is a single specimen sent direct from the Mauritius by M. Robillard, which is absolutely identical with West-Indian examples with which I have compared it, and specimens from the South-Pacific Islands shown to me by Mr. Woodward seem to belong undoubtedly to this species.

NATICA SANCTÆ-HELENÆ. (Plate XXI. fig. 16.)

*Testa parva, umbilicata, globularis, nitida, albida, zona interrupta rufo-fusca infra suturam cincta, lineis pallidioribus, ziczac-formibus, prope umbilicum saturatioribus, zonam indistinctam formantibus, ornata; anfractus* 5, *rapide accrescentes; spira parva, parum prominens; umbilicus parvus, callo columellari albido semiobtectus; apertura semicircularis.*

*Alt.* 9 *millim., diam. max.* 9.

This species probably attains a larger size than the above dimensions indicate. It resembles *N. alderi* of Forbes in form, excepting that the tip of the spire is scarcely so pointed, but the style of markings may be sufficiently different to distinguish it. Besides the rich brown, more or less interrupted zone beneath the suture, and the less distinct one around the umbilicus, the angles of the zigzag

lines also form two or three spiral bands. The thickened border of the umbilicus is not stained with brown so distinctly as in *N. alderi*. The operculum is at present unknown.

NATICA (POLINICES) PORCELLANA, d'Orbigny.

*Hab.* Teneriffe, Madeira, Cape Verde Islands.

This species and *N. uberina* of the same author from the West Indies are very closely related, but the majority of specimens of the latter have a differently formed callus. The figure in Sagra's 'Hist. Cuba' (pl. xvii. fig. 19) represents an umbilical callus very like that of *N. porcellana*, but in most West-Indian specimens it has not got such a central prominence at the termination of the umbilical ridge, and consequently a less marked sinus above it.

All the specimens from St. Helena are much smaller than the type figured by d'Orbigny (Webb & Berthelot's Hist. Nat. Canaries, Mollusques, pl. vi. figs. 27, 28).

The umbilicus also in these specimens is unusually large, the groove within it deep, and the curved ridge is rather sharp. In the specimen of *N. porcellana* figured by Reeve (Conch. Icon. figs. 102 *a*, *b*) the umbilicus is much narrower and the callosity more developed. In the Museum Collection there are two specimens from Goree, named *N. loveni*, Dunker, which undoubtedly belong to this species, but at present I have not met with any description of that species. The operculum is thin, horny, and reddish. In his list of St. Helena shells Jeffreys quotes *N. nitida*, Donovan. We did not receive this shell from Mr. Melliss; but it is possible it may have been the present species, which is not unlike Donovan's figure.

IANTHINA COMMUNIS, Lamarck.

*Hab.* East and West Atlantic.

This species appears in Jeffreys's list of Mr. Melliss's St. Helena shells under the name of *I. fragilis*. The form and colour varies considerably in the seven specimens from the shores of St. Helena. Some are as depressed as *I. cærulea*, Reeve (Conch. Icon. figs. 7*a*, 7*b*), and similarly coloured, whilst others are much more elevated, nearly as high in the spire as *I. africana*, Reeve, fig. 8 *a*, *b*, and white above as in that species, which is also considered but a variety of the present species by Sowerby (Thesaurus, v. p. 56). *I. bicolor*, Lesson[1], also described and figured from St. Helena specimens, belongs to this species.

IANTHINA GLOBOSA, Swainson.

*Hab.* St. Helena (*Lesson*).

This species is described and figured by Lesson, from examples taken at St. Helena, under the name of *I. prolongata*, Blainville (*vide* Voy. Coquille, Zool. vol. ii. p. 366).

[1] Zool. Voy. Coquille, vol. ii. p. 365.

IANTHINA EXIGUA, Lamarck.

*Hab.* South Atlantic; "New Zealand, New South Wales, and S. Australia" (*Hutton*).

I have compared New-Zealand specimens in the Museum with the one from St. Helena, and can discover no distinction.

IANTHINA UMBILICATA, d'Orbigny.

*Ianthina umbilicata*, d'Orb. Sagra's Hist. Cuba, Mollusq. vol. ii. p. 85, Atlas, pl. xx. figs. 22, 23 (bad!); id. Voy. Amér. Mérid. vol. v. p. 414; Reeve, Con. Icon. figs. 22 *a*, *b*; Sowerby, Thesaurus, pl. 444. fig. 22.

*Testa parva, violacea, infra suturam albo anguste zonata, anguste perforata; anfractus 5, primi duo (nucleus) obliqui, parvi, papilliformes, pellucidi, cæteri convexi, nitidi, ultimus in medio obtuse angulatus et sulcatus, incrementi lineis, in medio angulatis, sculptus; apertura mediocris, inferne anguste effusa; columella rectiuscula, paulo reflexa; labrum profunde et acute incisum.*

*Alt.* 9½ *millim.*, *diam.* 8.

The British Museum received many specimens of this species from Mr. Nuttall in the year 1855, under the name of *I. bifida*[1]. They were obtained at the Sandwich Islands. The shell figured by Reeve under that name is altogether different, and seems to me but a form of *I. exigua*, as suggested by Sowerby. Besides the lines of growth, which are perhaps a trifle coarser on the under surface than upon the spire, there are indications of feeble spiral striæ, chiefly upon the base.

The figure given by d'Orbigny is not good, and does not accord with his description. The labrum is described as acutely sinuated, and the surface as smooth, or scarcely marked with faint lines of growth, yet the figure depicts no sinuation, but represents rather well-marked incremental striæ. In d'Orbigny's South-American shells are preserved three or four specimens of this species, marked *I. umbilicata* in his own handwriting. These certainly agree with the single specimen from St. Helena and the large series from the Sandwich Islands. The figure in Reeve's 'Conchologia' represents the form correctly, but does not show the deep labral notch. D'Orbigny describes the colour as uniform deep blue, but his specimens have the pale infrasutural line as described above.

All the specimens of this species which I have examined are of small size, none exceeding the dimensions above given.

IANTHINA PALLIDA, Harvey.

*Hab.* Ireland (*Thompson*); Straits of Magellan (*Jeffreys*).

The single St. Helena specimen, half an inch in length, agrees very closely with Forbes and Hanley's figure (Brit. Moll. pl. 69. figs. 10, 11).

[1] Blanford, 'Geology and Zoology of Abyssinia,' p. 463, gives off the S.E. coast of Arabia as a locality for this species.

SCALARIA CONFUSA.

*Scalaria turricula*, Sowerby, partim, Thes. Conch. vol. i. p. 92.

*Hab.* Catanuan, Isle of Luzon, Philippines (*Cuming*); Sandwich Islands (*Mus. Cuming*); N.W. Australia (*Capt. Beckett in Brit. Mus.*).

Sowerby seems to me to have included two species under the name *S. turricula*—the one a distinctly striated shell with unequal varices; the other, which I now name *S. confusa*, being smooth and with more regular riblets. The true *turricula* is represented by figure 88[1] in the 'Thesaurus,' where the thick varix on the penultimate whorl shows the spine or tooth-like projection at the upper end, a feature not occurring in *Sc. confusa*. It is only the thick riblets (former peristomes) which have the spine. 'Thesaurus,' fig. 61, fairly represents the form of the present species, but the colour is too red, the varices not fine enough, and the interstices should be smooth and not spirally striated. Fig. 59 in the 'Conch. Icon.' also gives a coarse idea of this species. The St. Helena specimens have the lower half of the whorls light brown, and the upper half dirty white, with oblique faint brown blotches, and all the riblets are white throughout. In comparison with the three specimens from N.W. Australia, those from St. Helena are a trifle more suddenly tapering; but as both exhibit the same glossy surface similar colour, and varices, I feel convinced that they should be considered as belonging to one and the same species.

SCALARIA FRAGILIS, Hanley.

*Scalaria fragilis*, Hanley, Conchologist's Book of Species, p. 63 (1842); Sowerby, Thesaurus, vol. i. p. 88, pl. xxxiii. figs. 64–66 (1844); id. Conch. Icon. pl. v. fig. 29.

*Scalaria albida*, d'Orbigny, Sagra's Hist. Cuba, Moll. vol. ii. p. 17, pl. x. figs. 24, 25.

*Hab.* St. Vincent's and Cuba.

Of the five St. Helena specimens, three are rather less slender than the majority of West-Indian examples, but the two others have quite the same form. Species of *Scalaria* appear to vary in respect of proportional dimensions.

The figure in Hanley's work is not good, but I nevertheless believe that it represents the same species as that described by Sowerby. The latter is, however, certainly identical with *S. albida* of d'Orbigny, proved by a comparison of the types.

SCALARIA MELLISSI. (Plate XXIII. fig. 13.)

*Testa* Sc. trevelyanæ *similis, sed paulo robustior, lamellisque longitudinalibus simplicibus, superne haud subspinosis.*

*Longit.* 14 *millim., diam.* 4½.

The shells here described were collected by Mr. Melliss, and appear in his list under the name of *S. modesta* of C. B. Adams.

[1] I retain this as the type because in both of his diagnoses the author refers to the minute spiral striation.

That species has, however, rather stronger ribs and distinct spiral striæ, which at once separate it from the present species.

*S. mellissi* is of a livid colour, and glossy between the white ribs, which are thirteen or fourteen in number, and are very like those of *S. trevelyanæ*, but have not the short projection near the upper end. It may be described as a stumpier species than that shell, the spire being less slender.

Scalaria sanctæ-helenæ. (Plate XXIII. fig. 14.)

*Testa parva, albida, turrita, gracilis, imperforata; anfractus* 8–9, *primi* 3–4 *lævigati, nitentes, convexi, pellucidi, cæteri convexi, contigui, lamellis numerosis, (in anfr. ult.* 26–28) *tenuissimis, paulo obliquis, instructi; apertura subcircularis, inferne obscure effusa.*

*Longit.* 4½ *millim., diam.* 1½.

The number of whorls, and their steady enlargement, incline me to believe that this species does not attain a much larger size. It seems to approach *S. pulchella*, Bivona, but the riblets are finer and the whorls not quite so high.

Scalaria commoda. (Plate XXIII. fig. 15.)

*Testa parva, angusta, elongata, albida, imperforata; anfractus* 9, *sutura undulata sejuncti, primi tres convexi, nitidi, rufescentes, cæteri convexi, costis crassis circa* 11, *leviter obliquis, lirisque tenuibus, pluribus, cancellati, incrementi lineis minutissime decussati; anfr. ultimus lira crassa inferne cinctus; apertura ovato-circularis, superne quam basi angustior; labrum valde incrassatum.*

*Longit.* 5 *millim., diam.* 1½.

This minute species is well characterized by its reddish apex, the strong ribs extended upward, so as to form a wavy sutural line, and the spiral liræ, producing a cancellated appearance.

Scalaria atomus. (Plate XXIII. fig. 16.)

*Testa minima, brevis, anguste umbilicata, alba; anfractus* 4½, *perconvexi, sutura profunda sejuncti, primus lævis, cæteri costis tenuibus circiter* 18 *instructi; apertura oblique ovata, basi paulo subeffusa; peristoma in exemplis adultis continuum, margine columellari subreflexo.*

*Longit.* 1½ *millim., diam.* 1.

The shells here described, although so small, *appear* to be full-grown; such may not, however, be the case.

Scalaria multistriata, Say?

*S. multistriata*, Say, Amer. Conch. pl. 27; Sowerby, Thes. Conch. vol. i. p. 108, woodcut; Gould, Invert. Mass. 1870, p. 313, cut.

*Hab.* U. States, W. Indies, Mediterranean.

A single specimen from St. Helena and one from the Canary Islands, in the Museum, apparently belong to this species. They are a trifle narrower in the body-whorl than the above-cited figures.

Obeliscus dolabratus (Linné).

*Hab.* West Indies; Cuba, Guadeloupe, and St. Lucia (*d'Orbigny*); Island of Annabon, West Africa (*Dunker*); Red Sea; Indian and Pacific Oceans.

Several specimens were dredged in shallow water, 5–20 fathoms, off the north of the island, and this I believe is the only record of the appearance of this species on the eastern side of the Atlantic with the exception of Annabon Island mentioned above.

Obeliscus sanctæ-helenæ. (Plate XXIII. fig. 17.)

*Testa elongata, subpellucido-alba, linea flavescente interdum cincta, nitida, perforata; anfractus normales 7, convexiusculi, sutura mediocriter profunda separati; nucleus convexus, involutus; apertura inverse subauriformis; columella recta, supra umbilicum reflexa, superne plica valida instructa.*

*Longit.* 6½ *millim., diam.* 2¾.

This species is characterized by being perforated, by its convexish smooth whorls, and the distinct twist or plait on the upper part of the columella. In most of the specimens at hand the slender coloured line which revolves round the middle of the body-whorl and up the spire, just above the suture, is very faint, but in a few fresher specimens it is much more distinct. Some examples which have the lip broken away, thus permitting a further view within the aperture, exhibit two very fine spiral plaits or liræ on the columella, below the uppermost stouter one. It becomes therefore a link, as it were, between the typical species of *Obeliscus* with three distinct folds on the columella, and *Syrnola* with only one, agreeing with the latter genus in general form and style of ornamentation.

Obeliscus (Syrnola) pumilio. (Plate XXII. fig. 3.)

*Testa elongata, gracilis, nitida, alba, lineis paucis spiralibus pellucidis ornata, lineaque unica rufescenti cincta; anfractus* 8–9, *leviter convexi, lente accrescentes, sutura simplici paulo oblique sejuncti; nucleus globosus, pellucidus, obliquus, sinistrorsus; apertura inverse subauriformis, basi vix effusa; columella paulo reflexa, superne plicata, inferne arcuata.*

*Longit.* 6½ *millim., diam.* 1¾.

This species at first sight looks like a miniature of *S. cinctella*, A. Adams, from the Korea Straits. It is, however, proportionally more slender, the aperture is longer, and is ornamented with a few spiral pellucid zones.

Turbonilla haroldi. (Plate XXIII. fig. 18.)

*Testa elongato-oblonga, alba, superne leviter coarctata; anfractus* 6, *planiusculi, turriti, sutura profunda sejuncti, ad marginem superiorem incrassati, costis longitudinalibus suberectis, fere æqualibus (in anfr. ult. circiter* 16–18) *instructi, in interstitiis minute spiraliter striati; apertura inverse subauriformis, superne acuminata; peristoma continuum, margine columellari*

*paulo reflexo, rimam umbilicalem angustam semiobtegente; plica columellæ haud perspicua.*

*Longit.* 2½ *millim., diam. fere* 1.

The fold or twist of the columella in this minute species is high up and not conspicuously developed.

TURBONILLA ASSIMILANS. (Plate XXIII. fig. 19.)

*Testa elongata, gracilis, alba, nitida, subpellucida; anfractus* 9–10, *convexi, lente accrescentes, costis tenuibus, gracilibus,* (*in anfr. penult. circiter* 20) *leviter obliquis, instructi, lirisque spiralibus paucis circa partem inferiorem inter costas ornati; apex magnus, globosus; anfr. ultimus costis basim versus obsoletis; apertura parva, subovata; columella leviter torta.*

*Longit.* 4½ *millim., lat.* 1.

*Turbonilla acicularis*, A. Adams, from the Philippine Islands, and *T. pusilla*, C. B. Adams, from Jamaica, have very much the same form as the present species. The latter, however, is rather more slender, and has fewer riblets than *T. assimilans*, whilst the former has flatter whorls and coarser costæ.

TURBONILLA TRUNCATELLOIDES. (Plate XXIII. fig. 20.)

*Testa elongata, solidiuscula, alba, linea flavescente circa medium anfractuum ornata; anfract.* 7, *primus* (*apex*) *pellucidus, globosus, cæteri levissime convexi, sutura profunda sejuncti, costis longitudinalibus* 15–16 *crassis, interstitiis latioribus, instructi; anfr. ultimus linea secunda flavescenti infra medium cinctus; apertura subpyriformis; columella superne plicata; peristoma continuum, margine columellari leviter reflexo.*

*Longit.* 4 *millim., diam.* 1½.

This species agrees in its general appearance with the section *Mormula*, but has a rather more distinct fold than *M. rissoina*, the type of this so-called genus.

TURBONILLA BRACHIA. (Plate XXIII. fig. 21.)

*Testa minima, brevis, turrita, pellucida, albida, nitida; anfractus* 4½, *apicales læves, convexi, tres sequentes convexiusculi, sutura profunda paulo obliqua sejuncti, costis bene arcuatis circiter* 20 (*in anfr. ultimo inferne attenuatis*) *instructi, paulo infra suturam, sulco inconspicuo, costas secanti, sculpti; apex maximus, obtusus; apertura ovalis, superne acuminata, longit. totius* ⅓ *adæquans; columella leviter reflexa, spiraliter torta, labro callo tenui juncta.*

*Longit.* 1½ *millim., diam.* ½.

The short stumpy form, the very large obtuse apex, the much curved ribs, and the deep suture are the principal distinguishing features of this little species.

TURBONILLA (DUNKERIA) ERITIMA. (Plate XXIII. fig. 22.)

*Testa subulata, pellucida, vitrea, nitida; anfractus normales* 6, *convexi, liris longitudinalibus numerosis, arcuatis* (*in anfr.*

*ultimo circiter 22, inferne obsoletis) sulcisque duobus transversis, circa partem inferiorem, instructi; apex parvus, globosus, involutus; apertura irregulariter ovata, basi subeffusa; columella vix torta, leviter reflexa.*

*Longit.* 3 *millim., diam. fere* 1; *apertura* 1 *longa,* ½ *lata.*

Besides the two spiral sulci which encircle the lower part of the whorls between the riblets, some microscopic spiral striæ are observable at the upper part, and also upon the base of the body-whorl. The little glassy nucleus is uncoiled and at a right angle to the axis of the shell.

CINGULINA CIRCINATA, A. Adams.

*Cingulina circinata*, A. Adams, Ann. & Mag. Nat. Hist. 1860, vol. vi. p. 414; Angas, Proc. Zool. Soc. 1867, p. 201.

*Hab.* North China, Japan, and Port Jackson.

Several small specimens of this species were obtained at St. Helena. After a very careful examination under a microscope, I cannot detect any difference whereby they can be distinguished from this eastern form. The sculpture consists of three subequal spiral ridges on each whorl, and a very fine thread borders the suture. The nucleus is convex and sinistral, as in *Mathilda*, which I regard as a subgenus of *Cingulina*. The finest specimen from Japan which has been examined is 12 millim. in length, and consists of thirteen normal whorls, whilst the largest St. Helena example is only 5 millim. long and has eight volutions; but had this shell been permitted to go on growing, it would, by the addition of 5 more whorls, have attained a length fully as great as the Japanese example.

CINGULINA (MATHILDA) QUADRICARINATA (Brocchi).

*Hab.* Mediterranean, Bay of Biscay, Madeira.

The distribution and references of this beautiful species are given by Jeffreys in his report on the Mollusca of the 'Porcupine' Expedition (Proc. Zool. Soc. 1884, p. 364). He observes that the sculpture "varies considerably, and this has, of course, given rise to several synonyms, including *Eglisia macandreæ* of A. Adams." This latter species was described by H. (not *A.*) Adams[1] and has six spiral liræ and more numerous and more delicate longitudinal raised lines of growth. Until further specimens are obtained which may connect the two forms I prefer to keep them separate.

The three specimens from St. Helena are small, the largest measuring 13½ millim. in length. They appear to be a trifle more slender than the 'Porcupine' specimens and that figured by Kobelt (Jahrbüch. deutsch. Mal. Gesell. 1874, pl. xi. figs. 2, 2*a*). The sculpture, however, is precisely similar.

The question has been raised by Mr. Watson ('Challenger' Gasteropoda, p. 499), whether the genus *Mathilda* is the same as *Cingulina* of Adams; but I cannot adopt the conclusion at which he arrives namely, "either to suppress *Cingulina* altogether, or to retain it

[1] Proc. Zool. Soc. 1865, p. 753.

merely as a subgenus of *Mathilda*." It certainly either is or is not the same; and presuming them to be identical, *Cingulina* must be retained, having been published five years previous to *Mathilda*; but should it be considered that they differ sufficiently in sculpture to be placed in different sections, *Mathilda* and *not Cingulina* should take subgeneric rank. I have this advantage over Mr. Watson in knowing that the character of the apical whorls is the same in both, as one of the specimens of *Cingulina circinata* in the Museum still retains its nucleus.

The sculpture of this species, the type of the genus, is certainly very unlike that of most of the known species of *Mathilda*, consisting of strong spiral ridges, with only feeble lines of growth in the interstices. *C. spina* of Crosse and Fischer is very closely related, but quite distinct. Owing to the more cancellated surfaces of *Mathilda*, it may be convenient at present to retain it as a section or subgenus.

ODOSTOMIA GLAPHYRA. (Plate XXIII. fig. 23.)

*Testa ovato-cylindracea, albo-pellucida; anfractus* 5–6, *apicalis convexus, involutus, cæteri parum convexi, lævigati, sutura mediocriter profunda, vix obliqua, sejuncti, ultimus penult. latitudine subæquans; apertura parva, inverse auriformis, longit. totius ⅓ subæquans; columella plus minus leviter contorta, in exemplis adultis callo tenui labro juncta.*

*Longit.* 2½ *millim., diam.* 1.

Although under an ordinary lens this species appears to be smooth, it is in fact finely spirally striated. It is sufficiently pellucid to allow of the columella being indistinctly visible up the spire, the apex of which is large and obtuse.

EULIMA FUSCESCENS. (Plate XXIII. fig. 24.)

*Testa parva, acuminata, recta, pallide fuscescens, polita; anfractus octo, levissime convexi sutura simplice vix obliqua sejuncti, ultimus ad medium magis convexus, mediocriter elongatus; apertura ovata, superne acuminata; perist. tenue, inferne leviter effusum, margine columellari paulo reflexo, superne callo tenui labro juncto.*

*Longit.* 2½ *millim., lat. fere* 1; *apertura* ⅔ *longa,* ½ *lata.*

This little species is peculiar on account of its colour, a rare feature in this genus, and its short erect form.

EULIMA ATLANTICA. (Plate XXIII. fig. 25.)

*Testa nivea, elongata, aut recta aut superne plus minus dextrorsum vel sinistrorsum curvata; anfractus* 11–12, *fere plani, sutura levi sejuncti; ultimus in medio curvatus, subbrevis; apertura parva, ovata, superne acuminata; columella paulo incrassata, reflexa, labro callo tenui juncta; labrum in medio prominens, prope suturam haud profunde sinuatum.*

*Longit.* 7⅓ *millim., diam.* 2; *apertura* 2 *longa,* 1 *lata.*

This species has a less slender spire than *E. intermedia*, Cantraine, is of a shorter and stumpier growth, and the reflection of the colu-

mella is different. It is very like *E. aciculata*, Pease, of which *E. retrorsa*, Sowerby, is a synonym. It differs in the following respects:—the lip is more sinuated above and more prominently curved below, the spire is rather less acutely produced, and the semipellucid zone beneath the suture is not so broad in proportion to the rest of the whorl beneath.

EULIMA SUBCONICA.

*Eulima conica*, Sowerby (non C. B. Adams), Conch. Icon. fig. 44.

Both the figure and the description of this species are misleading, for Mr. Sowerby was careless, especially when engaged with small forms. He describes the last whorl as "angulated," and a decided angle is depicted in his figure. The type has a much less pronounced angulation; the specimens from St. Helena are more like the figure, but still not quite so bulging at the periphery. The apical portion of the spire is sometimes straight, occasionally curves to the left, or, as in the type, turns to the right, not as drawn by Sowerby, who has reversed the direction.

The aperture is neither "*rather square*" nor "*acuminated beneath.*" It should have been described as *obliquely oval* and a trifle more acuminate *above* than below. The columella is not "*rather tortuous*," but slightly curved and reflexed over the umbilical region. Mr. Sowerby apparently drew a bad figure and then based his description upon it.

There are thirteen whorls in the type, which is four and a half millimetres long. They are separated by a distinct suture, and the semipellucid margin, beneath it, occupies a little less than one-third of the whorl. The few uppermost are a trifle convex, the rest almost, but not quite, flat.

The name *conica* was already in use for a Jamaican species of this genus, described by C. B. Adams in his 'Contributions to Conchology,' p. 110. His diagnosis applies very closely to the St. Helena specimens; but, as I have not a specimen of this species for comparison, I, for the present, prefer to consider them a distinct, but closely allied form, on which account I have proposed the name *subconica*.

EULIMA GERMANA. (Plate XXIII. fig. 26.)

*Testa minima, nitida, pellucida, plus minus leviter arcuata; anfractus 9, planiusculi, sutura distincta vix obliqua discreti; apertura ovata, superne acuminata, longit. totius ⅓ subæquans; labrum prominens, arcuatum; columella obliqua, curvata, antice incrassata.*

*Longit.* 2½, *diam.* 1 *millim.*

Of this very little species, two specimens were obtained by Capt. Turton, one somewhat more curved than the other. This same specimen also exhibits a continuous series of varices upon the right side. The pellucid zone beneath the suture in the penultimate whorl is about half as broad as the space between it and the top of the body-whorl.

EULIMA (SUBULARIA) FUSCOPUNCTATA. (Plate XXI. fig. 18.)

*Testa minuta, subulata, pellucida, punctis fuscis irregulariter notata, nitida; spira acuminata, apice mediocriter acuto, convoluto; anfractus 9, tres apicales convexi, cæteri subplani, elongati, sutura obliqua sejuncti; apertura elongata, ovata, superne anguste acuminata, longit. totius ⅓ paulo superans; columella obliqua, leviter incrassata et reflexa.*

*Longit.* 2¾ *millim., diam.* ¾; *apertura* ¾ *longa,* ½ *lata.*

This minute shining little species is remarkable for the minute brownish scattered dots, which do not appear to be arranged in regular series.

AMAURELLA CANALICULATA. (Plate XXIII. fig. 27.)

*Testa parva, tenuis, hyalina, umbilicata, ovato-turrita; anfr. 7, convexi, ad suturam profunde canaliculati, læves; apertura ovata, paulo obliqua, longit. totius ⅓ æquans; peristoma tenue, margine columellari leviter dilatato, inferneque subeffuso.*

*Longit.* 3 *millim., diam.* 1½.

This remarkable shell has the first three or four whorls narrow in proportion to the others, so that the spire has a suddenly contracted appearance towards the top. The umbilicated base, smooth surface, and channelled suture well distinguish this species. In describing the genus *Amaurella*, Adams states incorrectly that it is "*imperforata*," for the typical species *A. japonica* is distinctly perforate, although more narrowly than that now described.

CIONISCUS UNICUS (Montagu).

*Hab.* British Islands, west coasts of France, and some parts of the Mediterranean.

The three specimens of this beautiful shell from St. Helena have the whorls the least trifle shorter than British specimens with which they have been compared, but agree in all other respects.

ACLIS ANGULATA. (Plate XXIII. fig. 28.)

*Testa minuta, elongata, turrita, alba; anfr. 6, primi duo magni, convexi, læves, cæteri superne oblique declives, in medio acute carinato-angulati, infra angulum contracti, lineis incrementi conspicuis, elevatis, confertissimis, regularibus, sculpti; anfr. ultimus ad peripheriam obtusissime rotunde angulatus; apertura obliqua, irregulariter ovata; peristoma continuum, haud incrassatum, supra angulum, prope suturam, leviter sinuatum.*

*Longit.* 2 *millim., diam.* ⅔.

This little species is remarkable for its angular whorls, the regular close-set raised lines of growth, and large apex.

ACLIS SIMILLIMA. (Plate XXIII. fig. 29.)

*Testa minuta, gracilis, alba, nitida, pellucida; anfractus normales 7, convexiusculi, sutura obliqua profunde sejuncti; nucleus magnus, convolutus, elevatus; apertura lata, inverse subauriformis;*

*peristoma fere continuum, margine columellari paulo prominente, superne torto.*

*Longit.* 2½ *millim., diam.* ½.

This minute species is very like *A. nitidissima* of Montagu, but has decidedly less convex whorls, the aperture is broader, and the columellar twist different. The heterostrophe apical coil is also very similar in both forms.

Aclis didyma. (Plate XXIII. fig. 30.)

*Testa minuta, turrita, albida, imperforata; anfractus* 6, *supremus lævis, convexus, obtusus, cæteri superne declives, subexcavati, dein obtuse angulati, inferne planiusculi, longitudinaliter striati, ad angulum subplicati; apertura parva, ovata, longit. totius* ⅓ *adæquans; columella levissime reflexa, superne subtorta.*

*Longit.* 2½ *millim., diam.* ¾.

Owing to the large size of the nuclear whorl, this species has very gently converging outlines. The columella does not unite above with the outer lip, but appears to be slightly spirally intorted.

Solarium placentale, Hinds, var.

*Hab.* Bay of Magdalena, California. Off Barbados in deep water (Dall for *S. peracutum*).

Three specimens in excellent condition, one alive with the operculum, were dredged by Capt. Turton. This is another instance of remarkable distribution in this genus. After a careful study and comparison of these examples with the types of *S. placentale*, and Mr. Dall's description and figures of *S. peracutum* [1], although slight differences are noticeable, I can but regard all of them as forms of one and the same species. The St. Helena specimens are a little paler in colour than the type; the periphery is perhaps very slightly more acute, as is the case with *S. peracutum*; the crenulations bordering the umbilicus finer, and the spiral sculpture, more especially on the upper surfaces, is rather more inclined to be granular.

The operculum consists of six whorls, which rapidly increase from a central nucleus, and, on the external surface, have the outer margin elevated, forming a sutural keel and thus giving them a concave aspect. The inner surface is glossy and furnished with a strong whitish central elevated process, from which a conspicuous curved ridge arises, forming rather more than a semicircle.

The figure of *S. placentale* in the 'Conchologia Iconica' is a mere caricature, being both out of drawing and exaggerated in colour and sculpture. The figures in the 'Voyage of the Sulphur' (pl. xiv. figs. 5, 6) are good and of the natural size.

The acuteness of the peripherial keel is variable, for, in a second specimen of the typical form, received by the British Museum from Sir E. Belcher, it is sharper and flatter above.

Solarium ordinarium. (Plate XXI. figs. 17–17 *b*.)

*Testa orbiculo-conoidea, depressa, mediocriter umbilicata, albida*

[1] Bull. Mus. Comp. Zool. Harvard, vol. xviii. p. 275, pl. xxxiii. figs. 2, 5.

*vel lilacco tincta, rufo punctata; anfractus 5, vix convexiusculi, liris quinque, oblique granosis cincti, ultimus ad peripheriam acute angulatus, plerumque lilaceus, concentrice sulcatus et cingulatus, cingulo circa umbilicum maximo, fortiter crenato, cæteris quoque plus minus crenulatis vel subquadrate granulatis; apertura trapeziformis, ad columellam bicanaliculata.*

*Diam. max.* 13 *millim., alt.* 6½.

The liræ on the upper surface, which do not vary much in size, are cut across by deep oblique lines of growth, so that the granules have an oblique appearance. Those on the ridges of the under surface are squarer, as the incremental striæ are radiating.

The granules on the stout lira bordering the umbilicus are much the coarsest, those on the other ridges becoming finer the more remote they are from the centre.

This species has less convex whorls than *S. granulatum*, Lamarck, from the West Indies, not such a deep suture, and considerably finer granulation. It seems to be larger than the Mediterranean *S. moniliferum*, Broun [1], to have a different kind of granules, and the aperture is distinctly channelled both at the lower and upper end of the columella.

Solarium hybridum, Linné.

*Hab.* China Sea, Philippine and Malacca Islands, Java, Ceylon, Moreton Bay, Queensland, and New South Wales.

In separating the Mediterranean from the Australian form of *S. luteum* under the name of *S. conulus*, Weinkauff [2] appears to have been mainly influenced by difference of locality. The same might be done in the present instance, for this is, I believe, the first record of *S. hybridum* from the Atlantic Ocean. Only two small specimens are in the collection; but these undoubtedly belong to this species, possessing all the characters of colouring and sculpture met with in eastern examples.

Solarium architæ, Costa.

*Hab.* Throughout the Mediterranean and in the Atlantic, off the coast of France and Portugal.

This well-known Mediterranean species has not been previously recorded from so southern a locality as St. Helena. I have carefully examined the type of *S. soverbii*, Hanley, and agree, with Monterosato [3] and Jeffreys [4], in considering it the same as this species.

Cypræa lurida, Linné.

This species, which occurs in the Mediterranean, at the Azores, the Canary and Cape Verde Islands, and on the African coast, as far as Guinea, has not been met with further south than St. Helena. It has also been recorded from Ascension Island by Lister, and was obtained there by Dr. Conry. Dunker has quoted it from Annabon Island.

[1] Monterosato, Notizie Solarii Mediterr. p. 5.
[2] Conch. Mittelmeer. vol. ii. p. 261.
[3] Notizie Solarii Mediter. p. 11. [4] Proc. Zool. Soc. 1885, p. 39.

CYPRÆA SPURCA, Linné.

The distribution of this species is similar to that of the preceding, excepting that it also occurs at the West Indies (d'Orbigny and others). The single shell received from Mr. Melliss, and named *C. turdus* by Jeffreys, is merely a small specimen of *C. spurca*.

LITTORINA MILIARIS, Quoy and Gaimard (var.).

*Hab.* Ascension Island (Q. & G.); also R. Trimen and Dr. Conry in British Museum.

The specimens from St. Helena do not agree exactly with those from Ascension. In them the last whorl is rather less ventricose; the spire longer, and consequently more acutely conical; the aperture is a trifle more effuse at the base, and the tuberculation much less pronounced; indeed, in some instances, the surface is all but smooth. Jeffreys and Melliss have classed the St. Helena forms under the name of *L. striata*, King, but, in my opinion, they are certainly more closely related to *L. miliaris*. In connexion with this species I would observe that *L. granularis*, Gray, and *L. nodosa*, Reeve (not of Gray), are synonymous. Some remarks by Watson (Voy. 'Challenger,' Rep. Gasteropoda, p. 576) and Lischke (Japan. Meeres-Conch. ii. p. 70) have been given concerning the synonymy of *L. granularis*. After a very careful comparison of Gray's much worn type with specimens of *L. miliaris* from Ascension, I feel convinced of their identity; but I rather incline with Lischke to hold Dunker's *L. exigua*, from Japan, as distinct from *L. granularis*, Gray, with which it is united by Watson.

It is not surprising that Lischke should consider Reeve's *L. granularis* a distinct species from Gray's, seeing that the latter author's type is in such worn condition, so that neither the colour nor sculpture could be accurately described; and, moreover, it was from an unknown locality.

The very young specimens from St. Helena have quite a different aspect from the adult Ascension examples, having an angular body-whorl and an effuse columella at the base; still, in a large series of different ages, the transitions or links are observable.

LITTORINA HELENÆ, Melliss. (Plate XXI. fig. 19.)

*Littorina helenæ*, Melliss's St. Helena, p. 125.

*Testa parva, trochiformis, fusco-nigra, inferne regionem versus umbilici pallidior; spira elevata, conica, acuta, lateribus rectilinearibus; anfr.* 8, *plani, seriebus granulorum tribus ornati, striisque intercalatis paucis sculpti; anfr. ultimus subacute angulatus, ad angulum serie tuberculorum duplici instructus, inferne liris concentricis tenuibus cinctus; apertura parva, rotunde quadrata, longit. totius* $\frac{1}{3}$ *adæquans, intus saturate castanea, linea basali albida interrupta; columella pallida, inferne castanea et subacuminate effusa.*

*Longit.* 9 *millim., diam. fere* 6.

Among the shells presented to the British Museum by Mr. Melliss

no such species as *L. helenæ* occurs, nor is it enumerated by Jeffreys in the list in the 'Annals and Magazine of Natural History.' All he says concerning it is that it is "a small periwinkle, found abundantly alive and sticking to the rocks all round the sea coast at and above high-water mark."

I am inclined to believe that the shells which I have associated with *L. miliaris* are the more common species; but as that was the only species of this genus received from Mr. Melliss, I have concluded that his *L. helenæ* must be the little conical form described above.

It is remarkable for its elevated, straight-sided, conical spire, small aperture, and angular body-whorl. The pale zone on the base is situated about the middle, so that a small central portion is left of a rich brown colour. The tubercles on the spire are not closely packed, but are often separated by spaces wider than themselves.

MODULUS MODULUS, var.

*Hab.* West Indies generally; Florida for var. *floridana*.

The St. Helena specimens most closely approach that form of this species which has been named *M. floridanus* by Conrad. None of them, however, are nearly so large as his figure (Amer. Journ. Conch. vol. v. pl. xii. fig. 6). The radiating ribs are less numerous and not so regular; the spotting on the basal ribs, which are finer, is less distinct, and the concentric furrow near the middle of the base, which is more conspicuous than the rest, is rather more noticeable.

The considerable variation among the specimens from St. Helena has induced me to regard them as variations of this American species rather than as a distinct species. Had they, on the contrary, been constant in their characters, I believe enough differences might be indicated to entitle them to specific rank.

PLANAXIS LINEATUS (Da Costa).

*Hab.* West Indies, St. Vincent's, Jamaica, St. Thomas, St. John's, St. Martin.

All the specimens from St. Helena are dead shells, and faded, but seem to belong to this species. It was also obtained at Ascension Island by Dr. Conry. A very similar species, *P. hermannseni*, Dunker, occurs on the West-African coast at Benguela.

PLANAXIS EBOREUS, Smith.

*Hab.* St. Thomas and St. Vincent.

The two specimens from St. Helena agree in all respects with West-Indian examples.

The colouring of the figure of this species (Conch. Icon. vol. xx. pl. v. fig. 33) is simply absurd. In the copy of the work before me the entire shell is of a lemon-yellow tint, varied with a few spiral red lines. All this is imaginary, as the colour is pure white, with the exception of the brownish apex and the dots on the edge of the labrum.

Lacuna pumilio. (Plate XXIII. fig. 31.)

*Testa minuta, albida, late umbilicata, subglobosa, incrementi lineis obliquis striata, aliis spiralibus obsoletis subcancellata; anfractus tres, convexi, ultimus supra tabulatus et subangulatus, inferne carinis duabus cinctus; apertura irregulariter ovata, magna, longit. totius ¾ adæquans; columella fere rectilinearis, anguste reflexa, inferne producta, carinæ umbilicum circumdanti juncta.*

*Longit.* 1½ *millim., diam.* 1½.

Although so small, this does not look like a young shell. Of the two keels on the base of the body-whorl, that bordering the umbilicus is the more conspicuous, and unites with the lower extremity of the columella; the other runs into the base of the aperture, a little farther off, and the space between is somewhat flat.

Fossarus ambiguus (Linné).

*Hab.* Many parts of the Mediterranean, the coast of Morocco, Cape Verde Islands and Senegal, Madeira and the Canary Islands.

The specimens from St. Helena, which I believe belong to this species, present a very great variation in form. Some closely resemble Adanson's figure (Sénégal, pl. 13. fig. 1), but are rather more widely umbilicated. The majority, however, have the spire scarcely elevated above the body-whorl, the mouth large, and the umbilicus very open, so that, in many cases, the body-whorl is detached from the preceding for a short distance.

The spiral keels, also, are very variable in number and thickness, but all specimens exhibit very much the same kind of fine spiral striæ upon and between the ridges. I see no reason for separating *F. cumingii* of A. Adams from this species; and *F. bicarinatus* of the same author may also be an extreme form of it.

Fossarus (Couthouyia) dentifer. (Plate XXIII. fig. 32.)

*Testa parva, alba, minute rimata, solida, haud nitens; anfractus 5–6, apicalis globosus, involutus, cæteri convexi, superne obsolete angulati, lineis incrementi rugosis obliquis striati; anfr. ultimus magnus, globosus, liris spiralibus distantibus paucis (circiter sex) cinctus; apertura subcircularis, longit. totius ½ adæquans; labrum tenue, superne haud sinuatum; columella arcuata, callosa, infra medium transverse plicata, infra plicam late excavata.*

*Longit.* 2 *millim., diam. max.* 1¾.

The general character of this shell seems to refer it to this genus, but it differs from other species in having a columellar denticle.

The genus *Plicifer* of H. Adams (Proc. Zool. Soc. 1868, p. 293) was founded for a small white shell with a somewhat similar tooth or fold on the pillar. *P. nevilli*, however, has a posterior sinus to the labrum, and differs in other respects from the present species.

Fossarus (Couthouyia) læviusculus. (Plate XXIII. fig. 33.)

*Testa parva, anguste umbilicata, ovata, superne acuminata, alba,*

*tenuis; anfractus* 5, *convexi, microscopice spiraliter striati, sutura subprofunda sejuncti; apertura ovata, superne paulo acuminata, longit. totius* ½ *subæquans; peristoma tenue, continuum, margine columellari anguste reflexo.*

*Longit.* 3¼ *millim., diam.* 1⅔.

The spiral striæ are so fine that they can only be seen under a compound microscope. Under a simple lens the surface appears smooth. *Couthouyia plicifera*, A. Adams, has the aperture more distinctly channelled anteriorly, and the umbilicus defined by a carinate margin.

Diala fuscopicta. (Plate XXI. fig. 20.)

*Testa minuta, imperforata, conica, tenuis, nitens, albo-pellucida, strigis fuscis longitudinalibus, et zona interrupta lactea ad peripheriam picta; anfractus* 5, *vix convexiusculi, primi duo spiraliter tenuiter striati, cæteri læves, ultimus in medio rotunde angulatus; apertura mediocriter magna, longitudinis totius* ½ *vix æquans; labrum tenue; columella rectiuscula, leviter obliqua, antice subeffusa.*

*Longit.* 2¼ *millim., diam.* 1⅓.

This pretty little shell has the surface smooth, with the exception of the first two whorls, which are finely spirally striated. The upper extremities of the brown stripes do not extend quite to the suture, and on the body-whorl pass between the opaque-white row of dots at the periphery.

Rissoina mellissi. (Plate XXIII. fig. 34.)

*Testa ovato-turrita, alba, solidiuscula; anfractus sex, supremi duo convexiusculi, spiraliter striati, cæteris superne tabulati et rotunde angulati, costis validis circiter* 11 (*in anfr. ultimo ad basim continuis*) *instructi, striisque spiralibus tenuissimis sculpti; apertura oblique ovata; labrum incrassatum, duplex, superne subsinuatum; margo columellaris callo reflexo, superne labro juncto, indutus.*

*Longit.* 3 *millim., diam.* 1½.

This is a strongly costate species, with very fine transverse striæ on and between the ribs. The outer basal margin of the aperture has a double lip, and the ribs are more or less regularly continuous up the spire.

Rissoina turtoni. (Plate XXIII. fig. 35.)

*Testa gracilis, turrita, alba; anfractus* 6–7, *convexi, sutura obliqua sejuncti, primi duo spiraliter lirati, cæteri costis longitudinalibus* 10–12 *tenuibus, oblique curvatis, instructi, transversim inter costas tenuissime striati; apertura obliqua, parva, longit. totius* ⅓ *vix æquans, ad basim late effusa; labrum mediocriter incrassatum, intus longitudinaliter striatum; columella obliqua, parum arcuata.*

*Longit.* 3 *millim., diam.* 1.

The spiral liræ upon the apical whorls are peculiar, and the apex itself is large in proportion to the size of the shell.

Rissoina decipiens. (Plate XXIII. fig. 36.)

*Testa* R. bryeriæ *simillima, sed anfr. ultimo inferne transversim striato, et apertura antice distincte subcanaliculata differt.*

*Longit.* 4½ *millim., diam.* 1½.

This species, unless critically examined, might easily be taken for *R. bryeria*. It differs in having spiral striæ around the lower part of the body-whorl, and the aperture is produced in front into a decided oblique sinus or channel, giving a longer appearance to the mouth. Three specimens of this species were presented to the Museum by E. W. Alexander, Esq., in 1857.

Rissoina bryeria (Montagu).

*Turbo bryerius*, Montagu, Test. Brit. vol. ii. p. 313, pl. 15. fig. 8.

*Rissoina bryeria*, Schwartz v. Mohrenstern, Denkschr. k. Akad. Wissensch. Wien, 1861, vol. xix. p. 139, pl. v. fig. 36.

This is a common West-Indian species, and is also said by Schwartz von Mohrenstern to occur at the Mauritius. The two specimens from St. Helena are intermediate in size between average examples of this species and *R. chesneli*, and one of them exhibits a distinct indication of the labral tooth of the latter species (*vide* Schwartz, *l. c.* fig. 39).

No mention of this denticle is made by Michaud, the author of the species; but in the figure given by Schwartz von Mohrenstern, taken from a specimen furnished him by Michaud, it is clearly depicted. This feature and its smaller size alone separate it from *R. bryeria*, and I am inclined, from an examination of a large series of specimens, to believe that neither of these characters are at all reliable, for a perfect gradation in size and in the development of the tooth is observable. I am therefore of opinion that both forms should be regarded in the light of variations of one and the same species.

Rissoina congenita. (Plate XXIII. fig. 37.)

*Testa* R. bryeriæ *similis, sed minor, costis tenuioribus, magis obliquis instructa, inter costas transversim striata; labrum minus incrassatum.*

*Longit.* 3⅝ *millim., diam.* 1½.

The ribs are sharper and more oblique than in *R. bryeria* or the variety *chesneli*. The spiral striation is very fine, and chiefly apparent between the costæ; if, however, the shells were in very fresh condition, it would doubtless pass over the ribs also.

Rissoina helenæ. (Plate XXIII. fig. 38.)

*Testa parva, albida, subpellucida, ovato-turrita; anfractus* 6, *duo supremi lævigati, perconvexi, cæteri mediocriter convexi, sutura profunda sejuncti, costis oblique curvatis* 15–16 *instructi, undique minute spiraliter striati; apex peculiaris, magnus; apertura obliqua, subpyriformis, longit. totius* ⅓ *sub-*

*æquans; columella basi incrassata producta; labrum incrassatum.*

*Longit.* 2⅔ *millim., diam.* 1.

The apex of this species is very peculiar, being large, smooth, and somewhat uncoiled.

Rissoa cala. (Plate XXI. fig. 21.)

*Testa ovato-pyramidalis, nitida, mediocriter tenuis, albida, lineis vel strigis longitudinalibus undulatis irregularibus picta; anfractus* 6, *leviter convexi, lævigati; apex subacutus, spiraliter tenuissime striatus; anfract. ultimus ad basim albus, haud variegatus, in medio obsolete rotunde subangulatus; apertura rotundata, intus albida; columella fusco tincta; labrum tenue, album.*

*Longit.* 3 *millim., diam.* 1½.

The brownish markings are irregular in shape and direction, and give most of the specimens the appearance of being mottled with brown and white. Some examples, however, which have only a brownish zone round the middle of the body-whorl, bear considerable resemblance to *Barleeia rubra*, Montagu. That species has not the same spiral striation on the upper volutions.

Rissoa ephamilla. (Plate XXI. fig. 22.)

*Testa ovato-pyramidalis, lævigata, albida, infra suturam opaco-albo et rufo-fusco maculata; anfract.* 6, *vix convexi, ultimus ad basim lineis radiantibus fuscis ornatus; apertura rotundata, longit. totius ⅓ subæquans; columella fusco-purpureo tincta; labrum vix incrassatum.*

*Longit.* 4 *millim., diam.* 2.

This species must not be confused with *R. cala*. It is a little larger, somewhat more solid, has rather less convex whorls, and is not coloured in the same way. Both have the columella stained with a brown or purplish-brown colour, and united to the outer lip above by a thin callus.

Rissoa glypta. (Plate XXIII. fig. 39.)

*Testa ovato-pyramidalis, alba vel rufescens, imperforata, nitida; anfractus* 6, *apicales læves, convexi, cæteri superne declives, interdum paulo excavati, in medio aut obtuse vel subacute angulati, infra angulum contracti, liris spiralibus tenuibus cincti, interdum ad angulum plus minus longitudinaliter plicati; apertura rotunde ovata, longit. totius ⅓ adæquans; peristoma continuum, margine basali subeffuso, columellari anguste reflexo.*

*Longit.* 3¼ *millim., diam.* 1½.

In some specimens the walls are much more angular than in others, and the longitudinal plicæ vary also very much in development.

Rissoa eritima. (Plate XXIII. fig. 40.)

*Testa ovata, umbilicata, albo-pellucida, nitida; anfractus* 4, *sutura profunda discreti, convexi, duo supremi lævis, cæteri striis spiralibus tenuissimis sculpti, ultimus magnus, subglobosus; umbilicus falciformis, in medio lira tenuissima instructus; apertura rotunde ovata, superne acuminata, longit. totius* ½ *æquans; peristoma continuum, vix incrassatum, ad basim columellæ subeffusum vel indistincte subcanaliculatum.*

*Longit.* 1¾ *millim., diam.* 1.

This is more widely umbilicated than *R. soluta*, Philippi, is more regularly spirally striated, has a slight indication of a sinus at the base of the columella, and also differs in other particulars.

Rissoa agapeta. (Plate XXI. fig. 23.)

*Testa ovata, imperforata, nitida, subpellucida, lineis spiralibus fuscis interruptis ornata; anfractus* 5, *convexi, duo supremi minutissime subpunctati, cæteri spiraliter sulcati, sutura profunda sejuncti; apertura ovata, superne leviter acuminata, longit. totius* ½ *haud æquans; peristoma tenue, margine columellari anguste reflexo, superne labro callo tenui juncto.*

*Longit.* 1¾ *millim., diam. fere* 1.

The microscopic sculpture of the apical whorls has a very pretty shagreened appearance. The spiral sulci are about five in number on the penultimate volution, and twelve on the last. The uninterrupted brown lines fall on the ridges between the grooves. *R. depicta*, Manzoni, from Madeira, is an allied but larger form.

Rissoa compsa. (Plate XXIII. fig. 41.)

*Testa ovata, inperforata, parum nitida, albida vel dilute fuscescens; anfractus* 5, *convexi, sutura profunda discreti, sulcis spiralibus fortibus (in anfr. penult. circiter* 5, *in ultimo ad* 12) *sculpti; apertura rotunde ovata, superne leviter acuminata, longit. totius* ½ *haud æquans; peristoma continuum, vix incrassatum, ad basim obsolete expansum.*

*Longit.* 2 *millim., diam.* 1.

When placed side by side, this species is seen to be a trifle larger than *R. agapeta*, and a little smaller than *R. depicta*. It also differs from both in colour, and is more strongly grooved than either.

Rissoa wallichi. (Plate XXI. fig. 24.)

*Testa ovata, solida, alba, interdum zona rufa cincta, imperforata; anfractus* 5–6, *primi duo spiraliter tenuiter striati, cæteri planiusculi, carinis volventibus prominentibus (in anfr. superioribus tribus, in ultimo* 7–8) *instructi, sutura profunda sejuncti; apertura ovata, longit. totius* ¼ *paulo superans; peristoma continuum, margine externo leviter incrassato, columellari antice subdilatato.*

*Longit.* 3 *millim., diam.* 1½.

The red zone, when present, occupies the central part of the last

volution and the lower portion of the upper whorls; it is often dotted with white.

Rissoa perfecta. (Plate XXIII. fig. 42.)

*Testa brevis, ovata, nitida, pellucida, cornea, supra carinas rufo vel fusco punctata, imperforata; anfractus* 4, *primus lævis, cæteri superne tabulati, carinis fortibus* (*in anfr. superioribus* 2, *ultimo* 5) *instructi, sutura marginata discreti; apertura oblique rotundo-ovata, longit. totius* ½ *haud æquans; peristoma continuum, margine externo extus incrassato, columellari leviter reflexo.*

*Longit.* 2 *millim., diam.* 1.

This charming little species is at once recognizable by the strong red-dotted spiral ridges. The dots usually fall under one another, forming longitudinal series.

Rissoa varicifera. (Plate XXIV. figs. 1, 1 *a*.)

*Testa ovato-acuminata, imperforata, alba, flavescens vel rufescens; anfractus* 5, *supremi duo convexi, tenuiter spiraliter lirati, sequentes convexiusculi, sutura profunda sejuncti, carinis spiralibus* (*in anfr. superioribus* 3, *in ultimo* 7–8) *instructi; striis microscopicis spiralibus sculpti; apertura parva, ovata, longit. totius* ¼ *adæquans; peristoma continuum, margine externo tenui, varice valido paulo remoto instructo, columellari obliquo, anguste reflexo.*

*Longit.* 1¾ *millim., diam.* ¾.

The little varix at a short distance from the extreme thin edge of the labrum is of a convex swollen character. A series of specimens from Madeira, presented to the British Museum by the Rev. R. Boog Watson, very closely approach this species; they are referred to by him (Proc. Zool. Soc. 1873, p. 374) under the name *R. subcarinata*.

Rissoa pseustes. (Plate XXIV. fig. 2.)

*Testa ovata, subrimata, tenuis, fascescenti-cornea, nitida, pellucida; anfractus* 4, *convexi, duo apicales striis microscopicis spiralibus striati, cæteri fere læves, infra suturam rufescentes, distincte marginati; apertura ovata, postice angustata, longit. totius* ½ *paulo minor; peristoma tenue, continuum, margine columellari rufescente, anguste reflexo.*

*Longit.* 1½ *millim., diam.* ¾.

This minute species, of which there are four specimens, has rather the look of an embryonic shell. It may prove to be a *Jeffreysia*. It is very like *R. perminima*, Watson (? not of Manzoni), Proc. Zool. Soc. 1873, p. 383, but seems rather shorter and has no basal striæ.

Barleeia congenita. (Plate XXI. fig. 25.)

*Testa solida, obtuse ovato-conoidalis, lævis, saturate rufa, infra suturam albo marginata vel maculata, infra medium anfract. ultimi alba; anfr.* 5, *convexiusculi, ultimus ad peripheriam obtuse rotunde angulatus; apertura rotundata, superne leviter*

*acuminata, intus rufescens; columella reflexa, fusco tincta, superne labro juncta; labrum vix incrassatum, pallidum.*

*Longit.* 2½ *millim., diam. fere* 1½.

This species is considerably like *B. rubra* of the British coast. It is, however, of a stumpier form, the spire being less produced, and the body-whorl longer in proportion to the spire.

Cæcum jucundum, de Folin.

*C. jucundum*, de Folin, Fonds de la Mer, vol. i. p. 20, pl. 2. figs. 6, 7.

*Hab.* Guadeloupe.

Cæcum imbricatum, Carpenter.

*Cæcum imbricatum*, Carp. Proc. Zool. Soc. 1858, p. 422.

*Hab.* West Indies.

Cæcum (Meioceras) nitidum, Bean.

*Meiocerus nitidum* (Bean), Carp. P. Z. S. 1858, p. 438.

*Hab.* W. Indies.

Cerithium (Bittium) gibberulum, var.

*Cerithium gibberulum*, C. B. Adams Proc. Bost. Soc. N. Hist. 1845, vol. ii. p. 5; Sowerby, Thes. Conch. vol. ii. p. 876, pl. 184. figs. 210, 211; id. Reeve's Conch. Icon. pl. 18. fig. 123.

*Hab.* Jamaica.

The specimens from St. Helena are much paler than those from the West Indies. The varix on the back of the body-whorl is whitish in all, and usually has some short brown lines on the transverse liræ behind it, and a dark brown spot in front.

Triforis perversa (Linné).

*Hab.* Mediterranean, North Sea, English Channel, Atlantic coasts of France and Portugal, North-west Africa and Madeira, Canary Islands and the Azores.

The specimens from St. Helena are as variable in form as those from other localities, some being very much more slender than others. The minute bead-like granules are pale in colour, and contrast strongly with the rich brown dots between them. The central row of granules on the penultimate and preceding volutions is almost as large as the others in the majority of the specimens.

Triforis melanura (C. B. Adams).

*Cerithium melanura*, C. B. Adams, Contrib. Conchol. p. 117.

*Hab.* Jamaica.

A few specimens of a whitish colour, with the exception of the four apical whorls and the cauda of the last, which are brown, possibly belong to this species. For the most part, however, they have the central spiral series of granules on the penultimate and one or two preceding whorls rather finer than the others. In other respects they accord with Adams's description.

TRIFORIS ATLANTICA. (Plate XXI. fig. 26.)

*Testa haud perelongata, alba, livido-fusco inferne zonata; anfractus* 13, *anguste turriti, supremi minute cancellati, cæteri plani, granulorum seriebus duobus vel tribus cincti, ultimus seriebus quinque, infima minus tuberculata, ornatus; cauda brevis, carina valida instructa, fuscescens; apertura obliqua, ovata, superne canaliculata; peristoma superne leviter incisum, inferne columellæ callo crasso junctum.*

*Longit.* 6 *millim., diam.* 2.

The outlines of this species are a little convex. Only the penultimate and antepenultimate whorls have three distinct rows of granules, and of those the central one is the smallest. The granules of the lowermost series, or rather the interstices between them, are brown and the uppermost series is white.

TRIFORIS RECTA. (Plate XXIV. fig. 3.)

*Testa elongata, gracilis, fuscescens, ad apicem pleramque pallida; anfractus* 13, *primi duo bicarinati, cæteri liris tribus, granosis, subæqualibus, cincti, ultimus liris duabus simplicibus infra medium instructus; linea suturalis canaliculata; apertura parva, ovalis; labrum superne leviter sinuatum; columella callo incrassato indata; canalis brevissimus, haud clausus.*

*Longit.* 5 *millim., diam.* 1¼.

This species is more slender than any of the others from St. Helena, and remarkable on account of the sculpture of the apical whorls, which is not fine as in *T. melanura* and *T. perversa*, but consists of two strong spiral keels on each whorl. The above-mentioned species also have only two series of granules on the whorls towards the apex, whereas in the present species there are three.

TRIFORIS BATHYRAPHE. (Plate XXIV. fig. 4.)

*Testa haud perelongata, albida vel pallide fusca; anfractus* 11, *convexiusculi, sutura profunda sejuncti, liris spiralibus tribus subæqualibus, lirisque longitudinalibus circiter* 26 *granose cancellati; anfr. ultimus liris sexcinctus; apertura rotunde ovata; labrum tenue, superne ad suturam anguste sinuatum, inferne columellæ junctum; cauda brevis, leviter recurva.*

*Longit.* 5½ *millim., diam.* 2.

This species is peculiar on account of the deep suture and the distinct cancellation of the surface. The whorls, too, are convex, so that the central row of granules are most prominent. It is a much stouter shell than *T. recta* and has a different aperture.

CERITHIOPSIS RUGULOSA (C. B. Adams).

*Cerithium rugulosum*, C. B. Adams, Contributions to Conch. p. 121; Sowerby, Thes. Conch. pl. 184. fig. 237 (237 * ?).

*Hab.* Jamaica (*Adams*); St. Vincent's (*Brit. Mus.*); Algiers (*Sowerby*)?

In the Cumingian Collection there is a single specimen of this species and one of *C. vicinum*, which were received from Adams himself. On examination they seem to me to belong to one and the same species, the difference in thickness of the spiral and transverse ridges being very slight. Some of the St. Helena examples exceed the dimensions given by the author, having a length of 6 millimetres, and they consist of ten normal and three nuclear whorls. The slightly elevated spiral line mentioned by Adams is at the top of the whorls just below the suture, and the "*fourth*" spiral nodulous slender ridge on the body-whorl should have been termed the *fifth*.

CERITHIOPSIS NEGLECTA (C. B. Adams).

*Cerithium neglectum*, C. B. Adams, Panama Shells, p. 154.

*Hab.* Panama (*Adams*); Algiers (*Sowerby*).

This is a minute dark brown granulated shell, consisting of about twelve whorls, of which the three or four apical are transparent, glossy, smooth, and separated by a brown sutural line. Adams observes that there are two additional spiral ridges on the lower part of the body-whorl, whereas I distinctly count three, both in Panama and St. Helena specimens. With this exception, no fault can be found with his diagnosis. Sowerby's figures (Thesaurus Conch. pl. 184. figs. 235, 236) either represent another species, as each whorl has but two rows of granules, or else have been carelessly drawn.

HIPPONYX ANTIQUATUS (Linné).

*Hab.* West Indies, Fernando Noronha, island of Trinidad in the South Atlantic, and Ascension Island; Loanda (*Dunker*).

HIPPONYX GRAYANUS, Menke.

*Hab.* West coast of Central America, Sandwich Islands, Fernando Noronha.

I have given the distribution of this and the preceding species, also references and synonymy, in my account of the Mollusca of Fernando Noronha, which will be published in the Journal of the Linnean Society.

TEINOSTOMA ? ABNORME. (Plate XXIV. fig. 5.)

*Testa minuta, alba, pellucida, subglobosa, imperforata; anfractus* 3, *rapide accrescentes, sutura canaliculata sejuncti; anfract. ultimus magnus, minute spiraliter striatus, in regione umbilicali callo crasso instructus; spira plana, haud elevata; apertura magna, ovata, inferne effusa; columella arcuata, callo crasso reflexo induta.*

*Longit.* 1 *millim., diam. max.* 1.

Although so minute, the above measurements probably represent the adult size of this species. It does not agree with the typical forms of *Teinostoma* in the shape of the aperture; but in texture and colour it is very similar.

TURBO (COLLONIA) RUBRICINCTUS, Mighels, var.

*Turbo rubricinctus*, Mighels, Proc. Bost. Soc. Nat. Hist. 1845, vol. ii. p. 22.

*Leptothyra rubrilineata*, Garrett; Martens, Donum Bismarkianum, p. 48, pl. ii. fig. 15.

*Turbo* (*Collonia*) *rubricinctus*, Sowerby, Thes. Conch. vol. v. p. 212, pl. 13. fig. 157.

*Collonia rubrilineata*, Pease, MS., Sowerby, *l. c.*

*Collonia multistriata*, Pease, MS., Sowerby, *l. c.*

*Hab.* Sandwich Islands.

None of the specimens from the Sandwich Islands, which I have seen, appear to be quite as large as those from St. Helena. The former have a rosy apex to the spire, whilst in the latter it is pale. Dr. von Martens (Don. Bism. p. 48) considers this species the same as *Collonia verruca*, Gould. The difference in size and colour at once distinguishes them. Some of the St. Helena specimens are coloured like the type-forms, whilst others are reddish brown, with a few pale interruptions on the spiral ridges.

TURBO (COLLONIA) ADMISSUS. (Plate XXII. fig. 4.)

*Testa minuta, anguste umbilicata, conico-globosa, alba, radiatim rufo-fusco lineata vel flammulata, punctis rufis minutis tessellata; anfractus 5, superne declives, dein angulati, ad angulum carinati, liris tenuibus paucis cincti, ultimus infra medium subangulatus, carina circa umbilicum instructus; apertura subrotundata, longit. totius ⅓ adæquans; columella arcuata, alba, leviter reflexa.*

*Longit.* 2½ *millim., diam. maj.* 2.

The generic position of this pretty minute species is at present somewhat uncertain, as the operculum is unknown. On account of its small size and non-nacreous interior, I believe it to belong to *Collonia*. One specimen is of a pinkish tint, and all show a more or less distinct darkish zone on the lower surface of the body-whorl. The minute dots fall upon the fine spiral liræ.

PHASIANELLA TESSELLATA, C. B. Adams.

*Phasianella tessellata*, C. B. Adams, Contrib. Conch. p. 67.

*Hab.* Jamaica.

The coloration of this species is variable, but the "fine, rather distant, parallel, spiral lines of brown, which descend more rapidly than the whorls," appear to be quite constant. In young fresh specimens more or less spiral striation is discernible.

LIOTIA ARENULA. (Plate XXIV. fig. 6.)

*Testa minuta, depresse globosa, anguste umbilicata, alba; anfractus 3–3½, superne subplani, in medio rotunde angulati, microscopice spiraliter striati, radiatim plicati, transversimque lirati, ultimus carinis vel liris spiralibus sex, lirisque obliquis numerosis cancellatus; sutura profunda, canalicu-*

*lata; apertura rotundata; peristoma leviter incrassatum, marginibus continuis, dextro subpatulo.*

*Longit.* ½ *millim., diam. maj.* 1⅛.

The beauty of this species can only be seen under the microscope. The cancellation of the body-whorl is strongly developed, so that the pittings between the cross-ridges are deep and striking. The uppermost of the six revolving liræ borders the channelled suture, and the umbilicus is encompassed by a swollen ridge, which is in addition to the six liræ referred to. The microscopic striæ are seen upon the liræ.

LIOTIA ADMIRABILIS. (Plate XXIV. fig. 7.)

*Testa minuta, profunde umbilicata, depresse globosa, alba; anfractus* 3½, *superne declives, planulati, in medio angulati, infra angulum plani, cancellati, ultimus carinis transversis quinque, lamellis longitudinalibus paulo obliquis circiter* 16 *instructus; apertura circularis; peristoma incrassatum, continuum, marginibus callo tenui junctis.*

*Longit.* 1 *millim., diam. maj.* 1¼.

This very minute species is a strongly sculptured shell like *L. asteriscus*, Gould, and *L. speciosa*, Angas. It is, however, much smaller than either.

The uppermost of the keels on the body-whorl revolves up the spire and forms the angle on the upper volutions; the lowermost carina borders the umbilicus, and the next occupies the middle of the under surface. The longitudinal lamellæ are continuous on and between the keels.

GENA ASPERULATA, A. Adams.

*Gena asperulata*, A. Adams, Proc. Zool. Soc. 1850, p. 38; Thes. Conch. vol. ii. p. 831, pl. 173. figs. 28, 29; Sowerby, Conch. Icon. pl. ii. fig. 16.

*Hab.*—? (*Adams*); St. Thomas (*Brit. Mus.*).

The colour of this species is very variable. Some specimens are pink, tessellated with white; others are olive-brown with white spots; some have few spots, others many. None of the St. Helena shells are marked like the type, but they agree with it in form and sculpture, which is peculiar, and in having the apex of the spire white.

EMARGINULA ELONGATA, Costa.

*Hab.* Mediterranean.

A single small specimen, 5 millim. in length, apparently belongs to this species. The cancellation of its surface is, however, a little finer than usual. *E. maculata*, A. Adams, from Japan, also closely resembles this specimen in form and sculpture.

FISSURELLA GIBBERULA, Lamarck?

Several specimens, the largest of which is hardly ten millim. long, appear to belong to this species. *F. variegata*, Sow., and

*F. arcuata*, Sow., may also be forms of it. The distribution and synonymy is given by Weinkauff (Conch. Mittelm. vol. ii. p. 394). The specimens collected by Mr. Melliss were named *F. arcuata*, Sow., by Jeffreys[1], but in sculpture they more nearly resemble the typical form of *F. gibberula*. In *F. arcuata* the costæ are very closely approximated to one another. Young specimens, in which the capuliform apex has not been absorbed, have the appearance of the genus *Puncturella*.

Patella plumbea, Lamarck.

*Patella plumbea*, Reeve, Conch. Icon. pl. iii. figs. 5 *a–b*.
*Patella cærulea*, Quoy & Gaimard, Voy. Astrolabe, Moll. vol. iii. p. 342, pl. 70. figs. 4–6.
*Patella cyanea*, Lesson, Voy. Coquille, vol. ii. p. 417.
*Patella canescens*, Reeve, *op. cit.* pl. 34. figs. 103 *a–b*.

*Hab.* St. Helena (*Q. & G., Lesson*); Senegal (*Lamarck*).

If, as I am inclined to believe, *P. canescens* be a variety of this species, it shows that it is a very variable form. A considerable number of very young shells were collected by Capt. Turton, which probably are the early stages of different varieties of this species. They are extremely variable in colour, but it is impossible to distinguish them on that account alone.

Williamia gussonii (Costa).

*Ancylus gussonii*, Costa, Cat. Test. due Sicil. pp. 120 & 125.
*Patella pellucida*, Philippi, Moll. Sicil. vol. i. p. 111, pl. 7. fig. 7.
*Patella gussonii*, id. l. c. p. 255, vol. ii. p. 84.
*Patella radiata*, Pease, Proc. Zool. Soc. 1860, p. 437.

*Hab.* Some parts of the Mediterranean, Madeira, Canary Islands, Ascension Island.

The specimens from St. Helena and Ascension Island are precisely similar, and agree exactly with the shells in Cuming's collection marked *Patella radiata*, Pease, and which, I presume, are the types described, and supposed to have come from the Sandwich Islands. Examples from the Canaries have the apex more excentric than the majority of St. Helena specimens, and they are less distinctly rayed. The radiating ribs mentioned by Pease are very indistinct. In his list of shells collected by Mr. Melliss at St. Helena (Ann. Mag. Nat. Hist. 1872, vol. ix. p. 264) Jeffreys has quoted this species under the name of *Tectura virginea*, Müller. The latter species, however, I believe is quite distinct.

Bulla striata, Bruguière.

*Hab.* Mediterranean, West Indies, Brazil, West Africa.

With this species I unite *B. media* and *B. adansonii*, Philippi, respectively from the West Indies and West Africa. I do not think the slight differences pointed out by Philippi possess more than varietal value. I have seen specimens from both localities with the superior as well as the inferior striæ.

[1] Ann. & Mag. Nat. Hist. 1872, vol. ix. p. 264.

CYLICHNA CYLINDRACEA (Pennant).

*Hab.* This species occurs throughout "the whole north-east Atlantic, from the Lofotens to the Mediterranean, at the Canaries and Mogador" (*Watson*). It was also obtained by the 'Challenger' at Ascension Island and Tristan da Cunha, and the British Museum possesses specimens collected at Whydah on the west coast of Africa. Several of the specimens belong to the variety "*linearis*" (Jeffreys, Brit. Conch. vol. iv. p. 416).

CYLICHNA ATLANTICA. (Plate XXIV. fig. 10.)

*Testa ovato-cylindracea, tenuis, pellucido-alba, nitens, rimata, ad verticem anguste perforata, transversim (præsertim supra et infra) tenuissime striata; apertura superne angustissima, antice leviter dilatata; labrum tenue, supra verticem anfr. ultimi productum; margo columellaris callo tenui reflexo indutus, inferne obsolete subtruncatum.*

*Longit.* 5½ *millim., diam.* 2½.

This species has more curved outlines than *C. cylindracea*, has a perforate apex, and an umbilical chink. The thin columellar callosity extends up the whorl, and joins the upper extremity of the outer lip.

CYLICHNA BIDENTATA (d'Orbigny.)

*Bulla bidentata*, d'Orbigny, Sagra's Hist. Cuba, Moll. vol. i. p. 125, pl. 4. figs. 13–16.

*Hab.* West Indies.

The specimens from St. Helena agree in all respects with this species, except that the lower columellar tooth, or fold, is less developed. Similar variation occasionally occurs in West-Indian examples.

TORNATINA RECTA (d'Orbigny).

*Bulla recta*, d'Orbigny, Sagra's Hist. Cuba, vol. i. p. 131, pl. 4 bis. figs. 17–20.

*Hab.* West Indies.

A single specimen is all I have seen from St. Helena. It has the spire rather less elevated than d'Orbigny's type.

PHILINE QUADRATA, Searles Wood.

*Hab.* North Britain, Norway, Greenland, Massachusetts Bay, Azores.

A single specimen was dredged in 50–80 fathoms. It has the transverse sculpture rather finer than usual.

HAMINEA HYDATIS (Linné).

*Hab.* British Coast, Mediterranean, &c.

None of the specimens from St. Helena exceed 10 millim. in length; they therefore are probably not full-grown.

ACTÆON SEMISCULPTUS. (Plate XXIV. fig. 8.)

*Testa ovata, turrita, parva, nitida, nivea, angustissime rimata, superne levis, infra medium subdistanter transversim punctato-striata ad basim confertius striata, sulcis paucis longitudinalibus indistinctis, crenatis, distantibus sculpta; anfractus quatuor, leviter convexi, sutura anguste canaliculata sejuncti; apex involutus; apertura inverse auriformis, longit. totius ½ paullo superans; columella anguste reflexa, plica parva prope rimam munita.*

*Longit.* 4 *millim., diam.* 2½.

The spiral transverse punctured striæ do not extend above the middle of the body-whorl. The longitudinal narrow and shallow indistinct sulci apparently indicate lines of growth.

LEUCOTINA MINUTA. (Plate XXIV. fig. 9.)

*Testa minuta, oblonga, alba; anfractus 5, primus (nucleus) rotundatus, introversus, spiraliter liratus, ceteri convexi, liris tenuibus spiralibus (in anfr. penult. circiter 7) instructi, in interstitiis, liris paulo angustioribus, lineis longitudinalibus tenuissimis sculpti; apertura ovata, superne acuminata, inferne cum columella arcuata et dilatata leviter effusa; plica columellæ centralis, distincta.*

*Longit.* 2¼ *millim., diam.* ⅝. *Var. brevior* 2¼ *longa*, 1 *lata.*

The apex of this interesting species is peculiar, being introverted as it were, and partly enveloped by the succeeding whorl. It is not smooth, as is frequently the case in other species, but obliquely spirally lirate. The raised lines in the grooves between the ridges produce a subpunctate appearance.

The genera *Myonia* and *Leucotina* were described by A. Adams in the 'Annals and Magazine of Natural History,' 1860, vol. v. p. 406. On examining the diagnoses a great similarity is observable, and, indeed, with the exception of a slight difference in form, there seems to be very little, if any, distinction. I therefore would propose that these genera be united, in which case *Leucotina* may be retained, *Myonia* being preoccupied. *M. japonica*, A. Adams, I have not seen; but *Actæon modesta*, A. Adams, *Monoptygma casta* = *M. concinna*, both of A. Adams, and *Daphnella casta*, Hinds, all typical forms of *Myonia*, have been examined, and they do not offer any characters which will separate them generically from *Leucotina niphonensis*, A. Adams, *L. dianæ*, A. Adams (described as an *Actæon*), &c.

One of the species of this genus, *L. casta*, A. Adams, has been referred by Watson ('Challenger' Report of Gasteropoda, p. 487) to the section *Parthenia* of *Odostomia*; but this location is not correct, I think—*Parthenia*[1], comprising longitudinally-ribbed shells, being apparently synonymous with *Chemnitzia*, d'Orbigny, or *Turbonilla*, Risso, 1826. Judging from the shell-characters, I should

[1] This name was proposed by Lowe in 1840. It had previously (1830) been used by Robineau-Desvoidy for a genus of Insects.

be inclined to place this form in the *Actæonidæ*, as recommended by Adams, rather than in the *Pyramidellidæ*.

Some confusion appears to exist with regard to the genus *Monoptygma*, judging from the variety of shells which have been placed in it. The original type described by Lea under the name of *M. alabamensis* is a fossil, and evidently allied to *Ancillaria*, with which it is associated both by Tryon and Fischer in their recent Manuals. A. Adams published a monograph of this genus in the 'Proceedings of the Zoological Society' for 1851 (reproduced in Sowerby's 'Thesaurus Conchyliorum,' vol. ii.), including in it a number of species, none of which, in fact, have any relationship with *Monoptygma*. He subsequently removed all of these species to other genera, with the exception of *M. striatum* and *M. fulvum*. A species very closely allied to these forms has since been described by Lischke from Japan, under the name of *M. eximium*. As far as I can ascertain, no generic or subgeneric division has been proposed for these species. If as much latitude in variation of form be allowed in the genus *Leucotina* as in some other genera (e. g., *Murex*, *Triton*, *Mitra*, &c.), there is no occasion to establish a new division for these three and allied species, for, with the exception of being more elongate than typical species of the genus, they do not offer any material differences in regard to the aperture, sculpture, or the apical whorls.

UMBRELLA MEDITERRANEA, Lamarck?

This well-known Mediterranean shell also occurs at Madeira and the Cape de Verde Islands, but it has not previously been recorded from so southern a locality as St. Helena. Krauss[1] quotes *U. indica* as a Cape species, so that I am uncertain whether the two young shells from St. Helena should not be referred to that species, if in reality it is distinct from the Mediterranean form. It is stated by Eydoux and Souleyet, in the 'Zoology of the Bonite,' that the animals do not differ, and, as far as I have studied the shells, the two typical forms appear to pass one into the other.

TYLODINA CITRINA, Joannis.

*Tylodina citrina*, Joannis, Mag. de Zool. 1834, pl. 36; Grube, Ausflug Triest und Quarnero, pp. 58 & 120.

*Hab.* Mediterranean (*Joannis*, *Grube*, *Monterosato*, *&c.*); Canary Islands (*M'Andrew*, teste *Weinkauff*).

Only some small specimens, about 7 millim. in length, were obtained. They agree in every particular with the apical portion of large Mediterranean examples with which I have compared them. The minute nucleus consists of about two spirally-coiled whorls, is glossy, vitreous, and laterally inclined.

[1] Südafr. Moll. p. 62.

PEDIPES AFER (Gmelin).

*Hab.* Portugal, Azores, Madeira, Salvages, and some parts of the shore of West Africa.

This well-known species has not been previously recorded from St. Helena. None of the specimens obtained by Capt. Turton were living, but were found in the hard kind of conglomerate of shells and sand mentioned in the introductory observations.

GADINIA COSTATA (Krauss).

*Mouretia costata*, Krauss, Südafr. Moll. p. 57, pl. 4. fig. 1.
*Gadinia costata*, Dall, Amer. Journ. Conch. vol. vi. p. 11.

*Hab.* Cape of Good Hope.

The St. Helena specimens have more colour than most of the South African shells I have seen. In other respects they are similar.

The following HETEROPODA were obtained by dredging:—

OXYGYRUS KERAUDRENII, Lesueur.

ATLANTA PERONII, Lesueur.

ATLANTA INCLINATA, Eydoux & Souleyet.

The synonymy and distribution of these species are given in my Report on the 'Challenger' Heteropoda.

## IV. SCAPHOPODA.

CADULUS JEFFREYSII, Monterosato.

The synonymy and distribution of this species are given by Jeffreys (Proc. Zool. Soc. 1882, p. 665). I have carefully compared the series of specimens from St. Helena with others obtained by the 'Porcupine' Expedition in the Atlantic, and can find no difference, except in size. Those from St. Helena are a trifle smaller.

## V. PELECYPODA.

VENUS (VENTRICOLA) EFFOSSA, Bivona.

*Venus effossa*, Bivona, Pfeiffer, Conch.-Cab. p. 197, pl. 32. figs. 1–4.

*Hab.* Sicily, Naples, Corsica, Algeria, Canary Islands, Azores.

The largest of the specimens from St. Helena is twenty-five millimetres long and high, and twenty-three in diameter. None of them have the lunule quite as deep as the Mediterranean shells figured by Pfeiffer and Philippi (Moll. Sicil. vol. i. pl. iii. fig. 20). *V. toreuma*, Gould, is very closely related to this species, but may be distinguished by its finer concentric ribs, which are more or less granular. *V. effossa* is radiately striated, especially at the anterior and posterior ends. The colour of the specimens at hand is similar to the above-cited figure in the 'Conchylien-Cabinet.'

VENUS (CHIONE) PYGMÆA, Lamarck.

*Venus pygmæa*, Lamarck, An. s. Vert. ed. 2, vol. vi. p. 337; Hanley, Cat. Recent Shells, p. 110, pl. 16. fig. 13; Sowerby, Thes. Con. vol. ii. p. 707, pl. 156. figs. 69–72; Reeve, Con. Icon. pl. 26. fig. 138 *a–c*.

*Hab.* West Indies.

Of this well-defined species I have seen only a single specimen from St. Helena. It is not rayed with pink, as is frequently the case, but merely presents a few brown spots, disposed in rays upon a whitish ground, and a few cross-lines on the excavated hinder dorsal area.

CYTHEREA (CARYATIS) RUDIS (Poli).

*Cytherea rudis*, Pfeiffer, Conch.-Cab. p. 34, pl. 11. figs. 9, 10.

*Hab.* Mediterranean, Adriatic and Black Seas, Canary Islands.

The shells from St. Helena are rather strongly concentrically sculptured. The largest is 22 millim. in length, and none have a coloured lunule.

TELLINA ANTONII, Philippi.

*Hab.* Guadaloupe, West Indies.

As far as I can ascertain the above is the only locality quoted for this species. In the British Museum "East Africa" and "Amboyna" are attached to some specimens which undoubtedly belong to this species; but I regard both with suspicion. The three valves from St. Helena are long and narrow, being 55 millim. in length and 23 in height. They agree in form with *T. cumingii*, as figured in Reeve's 'Conchologia Iconica,' fig. 179 *a*, and, indeed, I question if the limits of that and the present species can be clearly defined.

The *form* is subject to considerable variation, even among specimens which have identical sculpture, some being much narrower than others. The radiating striæ also differ much in development, and although their presence in *T. cumingii* is not mentioned by Hanley, they have been detected by Römer; and in all the specimens which I have examined their presence, especially in the right valve, is undeniable. *T. cumingii* has been recorded from the west coast of Central America by Hanley, C. B. Adams, and others, so it may be presumed that that is its true locality, and *not* the Red Sea, quoted by Sowerby in the 'Conchologia Iconica.'

SEMELE CORDIFORMIS (Chemnitz).

*Tellina cordiformis*, Chemn. Conch.-Cab. vol. xi. figs. 1941–2.

*Amphidesma cordiformis*, Reeve, Conch. Icon. pl. 5. fig. 30.

*Hab.* West Indies, Georgia, Florida, Brazil, West Africa, West Colombia.

With this species I unite *Amphidesma orbiculata* and *A. radiata*, both of Say, *A. subtruncata*, Sowerby, *A. reticulata*, Sowerby, *A. decussata*, Wood, *A. luteola*, A. Adams, *A. lenticularis*, Sowerby, and *A. modesta*, A. Adams. I believe these so-called species merely

represent varieties and different stages of the same shell. The locality "Indian Ocean" given by Reeve to *Am. cordiformis*, which he assigns to Sowerby, is evidently incorrect. Say's species were from Georgia and E. Florida, *A. reticulata*, *subtruncata*, and *decussata* from the West Indies, *A. lenticularis* from West Colombia, and *A. modesta* from West Africa.

The shells from St. Helena are only young specimens, 18 millim. in length, and agree with *A. modesta* as figured by Reeve (Conch. Icon. fig. 35 *b*).

ERVILIA SUBCANCELLATA, Smith.

*Ervilia subcancellata*, Smith, 'Challenger' Lamellibr. p. 80, pl. vi. figs. 2–2 *b*.

*Hab.* West Indies; Fernando Noronha; Brazil; 25–675 fathoms.

The concentric sculpture is much coarser in some specimens than in others, and the radiating striæ, as formerly pointed out, also vary. Young specimens, which are pellucid, exhibit on each side towards the end of the dorsal margin a small brown spot, also occasionally observable in more adult shells.

CORBULA SWIFTIANA, C. B. Adams.

*Corbula swiftiana*, C. B. Adams, Contrib. Conch. p. 236.

*Hab.* Jamaica, St. Thomas, Hayti.

CARDIUM (FRAGUM) SPECIOSUM, Adams & Reeve.

*Cardium speciosum*, Adams & Reeve, Voy. 'Samarang,' p. 77, pl. xxii. fig. 9.

*Hab.* China Sea (*Ad. & Ree.*).

After a very careful comparison of the St. Helena specimens with the type of this species preserved in the British Museum, I have no hesitation in pronouncing them one and the same form. In shape and sculpture they are identical, but differ in having about three more ribs. The locality assigned to this species is possibly, or probably, erroneous, and I think it likely it may have been obtained at St. Helena on the voyage home, for, as stated by Mr. Adams in the preface to the 'Voyage,' p. vi, the 'Samarang' touched at St. Helena. Whether this species should or should not be regarded merely as a variety of the West-Indian *C. medium*, Linné, I cannot now determine, not having a sufficient series of either for studying their variation or constancy. *C. medium*, however, has a less oblique form, and seems to be a broader shell, or, in other words, has a longer ventral margin, which is not so obliquely upsloping in front. The ribs, too, are usually flatter, and sculptured with much coarser curved striæ.

CARDIUM (PAPYRIDEA) BULLATUM, Chemnitz.

*Hab.* West Indies, Brazil, and west coast of Central America. St. Vincent, Cape Verde Islands (*Dunker*).

The synonymy of this species I have given in the Report of the

'Challenger' Lamellibranchiata, p. 161. It has not previously been met with so far south in the eastern parts of the Atlantic.

ROCELLARIA DUBIA (Pennant).

*Hab.* Mediterranean, Red Sea, North Sea, Madeira, Canary Islands, Cape Verde Islands.

St. Helena is, I believe, the most southern locality known for this species.

CHAMA, sp.

Several specimens of a species of this genus were collected by Capt. Turton. The young examples exhibit short spines on both valves, but the adult shells are too worn to be determined. The interior is white, more or less stained with brown, especially towards the margins. Length of largest specimen 75 millim.

*C. gryphoides*, Linn., appears in Jeffreys's and Melliss's lists of St. Helena shells. I have not seen the specimens which they examined, but doubtless they belonged to the same species as those collected by Capt. Turton. It is probable that they are correctly identified, but in such a difficult group as *Chama* one hesitates to pronounce a positive opinion without a special study.

BASTEROTIA OBLONGA. (Plate XXII. figs. 5, 5 *a*.)

*Testa oblongo-subquadrata, valde inæquilateralis, albida, concentrice striata; valvæ æquales, ab umbone ad extremitatem posticam obtuse angulatæ; margo dorsi posticus fere rectus, ventralis subrectilinearis, vel in medio leviter incurvatus; latus anticum breve, obliquum, infernè rotundatum, posticum oblique curvatum, ad extremitatem acute rotundatum; umbones parvi, acuti, antemediani, circiter in $\frac{1}{5}$ longitudinis siti; dens cardinalis in utraque valva prominens, acutus; pagina interna nitida; cicatrices bene impressæ.*

*Longit.* 8½ *millim., alt.* 5, *diam.* 4½.

This is a more oblong species than *B. carinata* or *B. gouldii* and some others.

This group of shells was first recognized by Gray in 1842 (Synopsis Contents Brit. Mus. p. 78) and named *Harlea*. His description runs thus:—"The *Harlea* are oblong, subquadrate, thin shells, with a sharp keel from the umbo, and conical hinge-teeth."

This diagnosis applies perfectly to the type marked by Gray himself as *Harlea*, and this was described the year following (1843) by Hinds as *Corbula quadrata*. This species also forms the type of Récluz's genus *Eucharis* (1850), and Hörnes in 1859 described a fossil species belonging to the same group under the generic name *Basterotia*. Considering the imperfection of Gray's description, and the fact of his not citing any species, I think it would be advisable to ignore his genus *Harlea*, although, personally, I am sure what group he intended to include under that name.

A genus *Eucharis* having been published by Latreille in 1804, this name cannot be employed for the present group of shells. We

are therefore compelled to designate it *Basterotia*, the name given by Hörnes, who appears to have been ignorant of the fact that, not only Gray, but Récluz also, had previously recognized the existence of this generic group.

LASÆA ADANSONIANA (Récluz).

*Poronia adansoniana*, Récluz, Rev. Zool. 1843, p. 174; id. in Chenu's Illus. Conchyl. pl. i. figs. 1 *a–g*.

*Hab.* Senegal.

LUCINA INCONSPICUA. (Plate XXII. fig. 6.)

*Testa minima, altior quam longa, mediocriter convexa, inæquilateralis, solidiuscula, albida, concentrice regulariter tenuiter striata, striisque radiantibus vix conspicuis sculpta; umbones acuti, antrorsum curvati; lunula profunda, parva; margo dorsi posticus leviter excurvatus; pagina interna nitida, ad marginem minute denticulata; dentes cardinales et laterales validi.*

*Longit.* 3 *millim.*, *alt.* 3½, *diam.* 2.

This species, although so small, is conspicuously solid. The umbones are well curved forward, producing a beaked appearance to the apex. The radiating striæ are excessively fine and only visible in certain lights, and seem to be lines below the surface.

LUCINA (CODAKIA) COMPACTA. (Plate XXII. fig. 7.)

*Testa æquilateralis, mediocriter globosa, alba vel dilute citrina, concentrice et radiatim tenuissime et confertim lirata, minute cancellata; umbones leviter prominentes; lunula angusta, parva, mediocriter profunda; latus posticum obtusum, anticum rotundatum; margo inferior intus striatus, subcrenulatus; ligamentum internum.*

*Longit.* 10 *millim.*, *alt.* 9½, *diam.* 6.

The dentition and the muscular impressions of this species are normal. The sculpture is so fine that it is almost invisible to the naked eye. Specimens were collected both by Capt. Turton and Mr. Melliss. It appears to be a common species.

VERTICORDIA ORNATA (d'Orbigny).

The three odd valves from St. Helena agree precisely with those described in my Report on the Lamellibranchiata of the 'Challenger' Expedition, p. 166. The synonymy and distribution of this species are there given. St. Helena is the most southern known locality.

MYTILUS EXUSTUS, Linn.

*Mytilus exustus*, Reeve, Conch. Icon. fig. 10; Clessin, Conch.-Cab. ed. 2, pl. 16. figs. 7, 8.

*Hab.* West Indies, Brazil, U. States as far north as Charleston.

A few small odd valves, received in 1865 from the Museum of Economic Geology, apparently belong to this species.

LITHODOMUS BI-EXCAVATUS, Reeve?

*L. bi-excavatus*, Reeve, Conch. Icon. pl. 4. figs. 22 *a*, *b*.

*Hab.* St. Thomas, West Indies.

The shells obtained at St. Helena by Mr. Melliss and named *L. lithophagus*, Linn., by Jeffreys, do not belong to that species. They may be considered a variety of *L. bi-excavatus*, in which the two depressions are not quite so distinct as in the type. The chalky incrustation which invests them has a more openly reticulated or spongy appearance at the posterior end.

ARCA SANCTÆ-HELENÆ. (Plate XXII. figs. 8–8 *b*.)

*Testa oblonga, crassa, albida, rufo-strigata et variegata, inferne haud hians; valvæ solidæ, antice oblique curvatæ, postice paulo latiores, curvatim truncatæ, radiatim costatæ, lineisque tenuibus concentricis et transversis decussatæ; costæ inæquales, subnodosæ, anteriores et posteriores crassæ, medianæ tenuiores; pagina interna alba, ad marginem saturate purpureo-fusca postice fortiter dentata; umbones remoti, incurvati, prominentes; ligamenti area lata, concava; ligamentum subrhomboidale, fuscum, sulcis paucis sculptum.*

*Longit.* 66 *millim.*, *diam.* 47, *alt.* 36.

This is a strong, heavy species, belonging to the same group as *A. noæ*, *A. navicularis*, and the like.

It is more solid than either of the above-named species, has the posterior end unsinuated, and the margins of the valves are peculiarly dentate posteriorly, and, when closed, interlock like the valves of *Ostrea crista-galli* and some others. A few of the ribs near the posterior angle of the valves are very large and strong, and separated by very deep grooves.

The form is rather like that of *A. subquadrangula* of Dunker, but the posterior end is not so truncate and the costæ are different.

ARCA (ACAR) DOMINGENSIS, Lamarck.

*Hab.* West Indies, Cape Verde Islands, S. Africa, Red Sea, Indian Ocean, South Pacific Ocean, Japan, Australia, &c. (*Lischke*).

PINNA RUGOSA, Sowerby.

*Pinna rugosa*, Sowerby, Reeve, Conch. Icon. pl. 26. fig. 50.

*Hab.* Isle of Rey, Bay of Panama (*Cuming*).

Capt. Turton remarks as follows respecting the single broken valve obtained:—"It measured when perfect 19 inches, but I cannot be sure of this identical shell being an island one, as I bought it; but I have seen another just like it, 16 inches long, which was fished up alive and bought by another officer before I heard of it, so this is probably an island one too."

Is there some mistake here, or does this species really occur at Panama?

PINNA PERNULA, Chemnitz.

*Pinna pernula*, Chemn., Reeve, Conch. Icon. pl. 12. figs. 22 *a*, *b*.

*Hab.* St. Croix, West Indies (*Chemnitz*); Madeira (*Brit. Mus.*).

AVICULA HIRUNDO (Linn.).

*Hab.* On the sea-beach, St. Helena (*Melliss*).

PECTEN CORALLINOIDES, d'Orbigny.

*Pecten corallinoides*, d'Orb. in Webb & Berthelot's Hist. Nat. Canaries, Mollusques, p. 102, pl. 7*b*. figs. 20–22; Sowerby, Thes. Conch. vol. ii. p. 65, pl. 12. figs. 3, 4.

*Hab.* Canary Islands, Cape Verde Islands.

This striking species has not previously been recorded from so southern a locality.

PECTEN ATLANTICUS. (Plate XXII. figs. 9–9 *b*.)

*Testa obliqua, inæquilateralis, æquivalvis, mediocriter convexa, albida vel flavescens, supra costas rufo vel roseo tincta et maculata, costis rotundatis circiter* 16, *sulcos immaculatos modice profundos æquantibus, instructa, inter et supra costas liris tenuibus, minute squamosis, ornata; auriculæ parvæ, inæquales, postica valvæ dextræ oblique declivis, liris tenuibus radiantibus* 5–7 *instructa, antica paulo major, radiatim lirata, minute squamosa, inferne vix sinuata; auriculæ valvæ sinistræ liris tenuibus, paucis, squamatis, ornatæ; pagina interna flavo-albida, plus minus rubicunda.*

*Longit.* 29 *millim., diam.* 15, *alt.* 29.

This species is remarkable on account of its oblique form, which is produced by the posterior slope being longer than the anterior. The angle at the apex, formed by the dorsal slopes, is about equal to a right angle. The surface is rough to the touch through the beautiful wavy lines of growth which everywhere adorn the surface, and, upon the ridges, become minute scales.

PECTEN (JANIRA) TURTONI. (Plate XXII. figs. 10, 10 *a*.)

*Testa rotundata; valva plana leviter concava, rufescens vel rosacea, maculis albis, lineisque gracilibus, zigzagformibus, purpureis, ornata, costis radiantibus, tenuibus, aurantio-rufis, circiter* 17–19, *instructa, lineis incrementi confertis, elevatis, pulcherrime lamellata; valva convexa, mediocriter profunda vel purpurea, apicem versus pallida vel albida, inter costas purpureo tincta, costis paulo latioribus et planioribus quam in valva superiore; auriculæ parvæ, plus minus purpureo tinctæ; pagina interna valvæ profundæ alba, fusco-purpureo marginata, v. planæ in medio aurantio vel roseo, et ad marginem purpureo tincta.*

*Longit. et latit.* 32–34 *millim.*

The fine ribs, the comparatively small auricles, and the beautiful raised lamelliform lines of growth are the chief distinguishing

features of this species. It probably attains larger dimensions than those given above. The angle formed by the divergent dorsal slopes is about 116 degrees.

LIMEA SARSII, Lovén.

*Limea sarsii*, Lovén, Index Moll. Scandin. p. 32.

*Lima sarsii*, Jeffreys, Brit. Conch. vol. ii. p. 78, vol. v. p. 169, pl. 25. fig. 1.

*Lima* (*Limatula*) *sarsii*, Jeffreys, Proc. Zool. Soc. 1879, p. 562.

*Limatula crassa* (Forbes), Sars, Moll. Reg. Arct. Norv. p. 26.

*Hab.* North Sea; Mediterranean; Atlantic from west of Ireland to Portugal.

A number of odd valves were dredged in deep water by Capt. Turton. The occurrence of this species so far south has not been previously noted.

OSTREA, sp.

A species of oyster occurs in very shallow pools on the east coast of St. Helena, which, possibly, has not been previously described. The same form is met with at Cape Verde Islands. It is thick, solid, irregularly rounded, with the surface ridged and the margin dentate and interlocking like *O. folium* and other species. The interior is dirty whitish, stained more or less with olive-brown or yellowish olive, and the outer margin is finely wrinkle-striated.

OSTREA CRISTA-GALLI, Linn.

*Hab.* St. Helena, 50–60 fathoms (*Melliss*).

I have not seen the specimens collected by Mr. Melliss and identified by Jeffreys as belonging to this species, which is usually regarded as an Indian-Ocean form. I think it probable that they belong to the same species as those collected by Capt. Turton, which I have not ventured to identify. Having strongly dentate margins to the valves, they may have been mistaken by Jeffreys for the Linnean species.

## APPENDIX.

The following species were all taken at St. Helena upon floating seaweed, but, as I have already shown[1], are to be regarded as South-African forms.

### I. GASTROPODA.

PLEUROTOMA (MANGILIA) ATLANTICA. (Plate XXIV. fig. 11.)

*Testa elongata, pallide fusca, linea alba cincta; anfractus 5, primus maximus, globosus, nitidus, albidus, ceteri convexiusculi, plicis longitudinalibus* 10–12 *instructi, liris striisque spiralibus ornati; anfr. ultimus elongatus, infra medium parum contractus; apertura angusta, longit. totius* $\frac{5}{12}$ *adaquans; columella alba; labrum vix incrassatum, superne minime sinuatum.*

*Longit.* 6 *millim., diam. max.* $2\frac{1}{4}$.

This species is remarkable for the large size of the apex. The

[1] Pp. 247, 248.

general colour of the shell appears to be brown or reddish, but on close examination it will be seen that the spiral striæ are whitish, and the interstices or liræ only are coloured.

Pleurotoma (Mangilia) casta, Reeve.

The single shell collected by Capt. Turton agrees in many respects with the type of this species, which, unfortunately, is in rather bad condition, and only exhibits faint indications of spiral striæ. The specimen from the "Sea-horn" is beautifully striated, is rather shorter, and has one costa less than the type. Nevertheless, I have a strong belief that it belongs to the same species. The locality of *P. casta* was unknown to Reeve.

Murex (Ocinebra) purpuroides, Dunker.

*Hab.* Cape of Good Hope.

Columbella (Anachis) kraussii, Sowerby.

*Columbella kraussii*, Sowerby (1844), Thesaurus, Conch. vol. ii. p. 144, pl. xl. figs. 180, 181; Reeve, Conch. Icon. fig. 213.

*Buccinum cereale* (Menke, MS.), Krauss (1848), Südafr. Moll. p. 122, pl. vi. fig. 17; Reeve, Conch. Icon. (*Columbella*), pl. xxi. fig. 118.

*Columbella* (*Anachis*) *fulminea*, Gould, Proc. Bost. Soc. Nat. Hist. vol. vii. p. 334; Otia, p. 131.

This seems to be rather a common shell on the South-African coast. *C. fulminea* was described from Simon's Bay, Krauss cites the Cape Coast for it, and in the Museum there is a series labelled Natal. Two specimens only, of a rather dark tint, were obtained at St. Helena.

Columbella (Mitrella) proscripta. (Plate XXIV. fig. 12.)

*Testa minuta, angusta, tenuis, nitida, pallide fuscescens, infra suturam linea saturatiore cincta, versus apicem dilute rosacea; anfractus 5, primi duo magni, læves, convexi, cæteri convexiusculi, striis paucis spiralibus pallidis (in anfr. ultimo circiter 12) sculpti; apertura angusta, longit. totius ⅓ vix æquans; labrum leviter incrassatum, superne subsinuatum, ad marginem fusco tinctum; columella rectiuscula, callo tenui induta.*

*Longit.* 4 *millim.*, *diam.* 1½.

A small shining pinkish-brown shell, exhibiting a few spiral pale striæ. The penultimate and antepenultimate volutions show indications of longitudinal plication.

Purpura squamosa, Lamarck.

*Hab.* Cape of Good Hope and Natal coast (*Krauss* and others); St. Vincent, Cape Verde Islands (*Dunker*).

Only one young specimen of this common South-African species was sent by Capt. Turton. The locality given by Reeve (Con. Icon. sp. 48), "Tigre Bay, Abyssinia," requires confirmation. It may be correct, but the number of species common to South Africa and the Red Sea is not large.

MARGINELLA (VOLVARIA) ZONATA, Kiener.

The single specimen from St. Helena is small, about the same size as the form described by Krauss (Südafr. Moll. p. 126) under the name *M. dunkeri*, but the labrum at the upper extremity is united with the shell *at* the suture and *not below* it. The position of this point of juncture, judging from the series of specimens in the Museum, is variable, and consequently when it is high up at the suture the upper margin of the brownish-yellow band will fall further below than when the end of the labrum is attached further down or below the suture. I am therefore of opinion that *M. dunkeri* should be regarded as a variety of *M. zonata* and not as a distinct species, as the distinctive features referred to by Krauss are not constant.

Weinkauff (Monograph of *Marginella*, Conch.-Cab. ed. 2, p. 28) quotes this species as *M. dunkeri* from Ascension Island, his specimens being almost as large as typical examples of *M. zonata*, which appear to be common at the Cape of Good Hope.

MITRA SIMPLEX, Dunker.

*Hab.* Cape of Good Hope.

RISSOA PLATIA. (Plate XXIV. fig. 13.)

*Testa minuta, ovato-turrita, imperforata, albida; anfractus* 4½, *superne concave excavati, in medio subacute angulati, infra angulum contracti, spiraliter lirati; apex obtusus, involutus; apertura rotunde ovata, superne acuminata, longit. totius* ⅓ *subæquans; peristoma continuum, incrassatum, subeffusum, margine columellari inferne subproducta.*

*Longit.* 1⅔ *millim., diam.* ⅔.

The spiral sculpture is continued upon the apical whorl, which is involuted, thus producing a very blunt top to the shell. The liræ are four to six in number on the lower half of the penultimate whorl, and rather coarser than those above the angle.

RISSOA ATOMUS. (Plate XXIV. fig. 14.)

*Testa minuta, alba, pellucida, nitida, ovata, imperforata; anfractus* 4, *convexiusculi, læves, ultimus magnus; apertura subpyriformis, longit. totius* ⅔ *adæquans; peristoma continuum, margine externo leviter patulo et incrassato, columellari obliquo, superne valde calloso.*

*Longit.* 1 *millim., diam.* ½.

This minute species, of which there are three specimens, is certainly full-grown, and has no other sculpture except microscopic lines of growth.

RISSOA VAGA. (Plate XXIV. fig. 15.)

*Testa minuta, tenuis, subrimata, dilute fuscescens, spiraliter lirata; anfractus* 5, *convexi, liris filiformibus spiralibus (in anfr. penult.* 3, *ultimo* 10) *instructi; apertura ovato-rotundata, longit. totius*

$\frac{1}{3}$ *subæquans; peristoma tenue, margine columellari leviter reflexo, superne labro callo tenui juncto.*

*Longit.* 2 *millim., diam.* 1.

This species has more convex whorls than *R. varicifera*, to which it bears a general resemblance. Its spiral ridges also are finer, the aperture different, and the labrum has no external varix.

Rissoa simulans. (Plate XXIV. fig. 16.)

*Testa ovata, imperforata, alba vel pallide fuscescens; anfractus* 4, *convexi, primus et secundus spiraliter striati, sequentes liris transversis* (*in anfr. penultimo circiter* 3, *in ultimo* 8–9) *instructi; apertura rotunde ovata, longit. totius* $\frac{1}{2}$ *paulo minor; peristoma continuum, vix incrassatum, margine columellari anguste reflexo.*

*Longit.* $1\frac{3}{4}$ *millim., diam.* 1.

This is a shorter stumpier species than *R. varicifera* and has no postlabral thickening.

Rissoa ordinaria. (Plate XXIV. fig. 17.)

*Testa ovata, solidiuscula, alba, imperforata, nitida; anfractus* 4, *convexiusculi, sutura mediocriter profunda, paulo obliqua sejuncti, spiraliter substriati; apertura rotunde ovata, superne acuminata, longit. totius* $\frac{1}{3}$ *paulo superans; peristoma continuum, leviter incrassatum, margine columellari dilatato.*

*Longit.* $1\frac{1}{3}$ *millim., diam.* $\frac{2}{3}$.

This species, although so small, is certainly adult. The spiral striæ are not numerous, and only visible on well-preserved specimens by the aid of a microscope.

Rissoa æqua. (Plate XXIV. fig. 18.)

*Testa brevis, turrita, alba, vix rimata; anfractus* 5, *primi duo convexi, læves vel spiraliter tenuiter striati, cæteri superne tabulati, angulati, carinis fortibus* (*in anfr. superioribus duabus, in ultimo senis*) *instructi, lineis incrementi tenuissimis sculpti; apertura ovata, longit. totius* $\frac{1}{2}$ *haud æquans; peristoma continuum, margine externo vix incrassato, columellari dilatato, reflexo, rimam umbilicalem formante.*

*Longit.* $2\frac{1}{2}$ *millim., diam.* $1\frac{1}{4}$.

This species closely resembles *R. perfecta* in form. It is, however, a little larger, is not spotted, and has seven keels on the body-whorl instead of five; of these, the one nearest the suture is very fine and thread-like, the next two, which also pass up the spire, are strong and prominent, and the remaining four gradually lessen in thickness, the lowermost being very inconspicuous.

The nucleus of this species is also different from that of *R. perfecta*, and the outer lip is not thickened in the same manner.

Rissoa fenestrata, Krauss.

*Hab.* Cape of Good Hope.

Barleeia wallichi. (Plate XXIV. fig. 19.)

*Testa* B. congenitæ *similis, sed tenuior, pallidior, spiraliter tenuissime striata; anfractus* 5, *convexiusculi, ultimus rotundatus, haud obsolete angulatus; peristoma undique tenue, marginibus callo tenui junctis.*

*Longit.* 2 *millim., diam.* 1.

This species in form is very like *B. congenita*, from St. Helena. It is, however, rather smaller, thinner, paler, spirally striated, has no approach to an angle at the periphery, and has a thinner peristome.

Turritella carinifera, Lamarck.

*Hab.* Cape of Good Hope.

Triforis perversa (Linné).

*Hab.* South Africa (*G. B. Sowerby*).

This well-known species occurs in Great Britain, Mediterranean, at Madeira and the Canary Islands, also on the coast of California.

Turbo (Ocana) cidaris, Gmelin.

*Hab.* Cape of Good Hope.

Turbo (Collonia) incertus. (Plate XXIV. figs. 21, 21 *a*.)

*Testa minuta, imperforata, subglobosa, fusco-purpurea, lævis, incrementi lineis striata; anfractus tres, convexiusculi, celeriter crescentes, ultimus magnus, rotundatus; apertura magna, fere circularis, longit. totius $\frac{2}{3}$ fere æquans; peristoma interruptum, margine exteriori tenui, columellari albo, incrassato, reflexo.*

*Longit.* $1\frac{2}{3}$ *millim., diam. maj.* $1\frac{2}{3}$.

The generic position of this minute species, of which there are five specimens in the collection, would be somewhat uncertain, if the operculum had not been present in one of the examples. It is white, slightly convex, and consists of about three whorls.

Phasianella neritina, Dunker.

*Hab.* Cape of Good Hope.

Trochus (Cynisca) granulosus, Dunker.

*Hab.* Table Bay, Cape of Good Hope.

The type figured by Krauss (Südafr. Moll. pl. v. fig. 28) is of a pinkish tint. White varieties are also met with. A. Adams described this species (P. Z. S. 1853, p. 183) as *Cyclostrema granulata*. The locality he gave, Philippine Islands, can scarcely be relied on.

Trochus (Gibbula) musivus, Gould.

*Hab.* Simon's Bay, Cape of Good Hope (*Gould*).

Scissurella jucunda. (Plate XXIV. figs. 22, 22 *a*.)

*Testa minuta, umbilicata, depressa, alba; anfractus tres, convexi, liris spiralibus, tenuissimis, aliisque radiantibus, cancellati, ultimus*

*liris duobus elevatis fissuram contingentibus superne instructus; apertura irregulariter rotundata; peristoma tenue, continuum.*
*Diam. maj.* 1¼ *millim.*

There are two specimens of this very minute shell. The larger has the slit almost closed at the peristome, which is otherwise continuous, so that it is likely, if it had lived a short time longer, it would have been quite closed, and then would have become a form of *Schismope*.

In his report on the Gasteropoda of the 'Challenger' Expedition, p. 119, Mr. Watson has described as *Schismope carinata* the same species as that published by A. Adams (Ann. Mag. Nat. Hist. 1862, vol. x. p. 346) under the name of *Scissurella carinata*.

Fissurella mutabilis, Sowerby.

*Hab.* South Africa, at the Cape.

Patella umbella, Gmelin.

*Hab.* South Africa, Cape of Good Hope.

Patella rustica, Linn.

*Hab.* South Africa, Cape of Good Hope.

Patella oculus, Born.

*Hab.* Cape of Good Hope.

Patella compressa, Linné.

The two specimens from St. Helena are of an unusual bright red colour, and the interior, excepting the muscular scar and the part it encloses, is of the same bright colour. They are in an excellent state of preservation, exhibiting on and between the fine radiating lirae very pretty close-set concentric wavy striae.

Although found on the beach by Capt. Turton, these specimens have doubtless been transported from the Cape of Good Hope to St. Helena upon floating seaweed, upon the stems of which it is said to attach itself.

Cylichna remissa. (Plate XXIV. fig. 20.)

*Testa parva, tenuis, albida, superne anguste perforata, striis spiralibus et longitudinalibus minute decussata; anfr. ultimus lateribus rectiusculis, inferne paulo latior quam supra; apertura supra angusta, infra medium leviter dilatata; columella obliqua, subrecta, leviter reflexa.*
*Longit.* 2¼ *millim., diam.* 1¼.

This species has much resemblance to *Utriculus complanatus*, Watson, in form. It is, however, a little narrower at the upper part, and the aperture is produced higher above the spire. The reticulate sculpture can only be seen under a compound microscope.

## II. PELECYPODA.

SAXICAVA ARCTICA (Linn.).

*Hab.* Cosmopolitan.

KELLIA CRASSIUSCULA. (Plate XXIV. fig. 23.)

*Testa globosa, rotunde ovata, nitida, alba, apices versus subpellucida, concentrice subrugose striata, fere æquilateralis; latus anticum posteriore paulo angustius; pagina interna alba, incrassata, minute subrugosa; linea cardinalis crassiuscula, dente vel tuberculo cardinali et laterali posteriore tubercolari in utraque valva instructa; ligamentum internum pone umbones situm.*

*Longit.* 6½ *millim., alt.* 5, *diam.* 3¾.

For a shell of such small size it is rather thick. The umbones are only very slightly elevated, curved towards the anterior end, and capped at the tip with a minute embryonic shell.

KELLIA ATLANTICA. (Plate XXIV. fig. 24.)

*Testa minuta, oblongo-rotundata, inæquilateralis, sordide albida, concentrice tenuissime striata; margo dorsi anticus valde declivis, leviter convexus, posticus longior, subhorizontalis; latus anticum acute rotundatum, posticum latius excurvatum; margo inferior late arcuatus. Dens cardinalis valvæ sinistræ* Λ *formæ, valvæ dextræ unicus prominens, acutus; dens lateralis posticus in utraque valva elongatus, in dextra validus, margine dorsali sulco separatus.*

*Longit.* 2½ *millim., alt.* 2, *diam.* 1¼.

This species is about the size of *Lepton clarkiæ*, but not of the same form.

MONTACUTA SUBTRIANGULARIS. (Plate XXIV. fig. 25.)

*Testa fere æquilateralis, mediocriter convexa, sordide albida, haud nitida, rotunde subtriangularis, lineis incrementi striata, postice quam antice paulo angustior; margo dorsalis utrinque declivis, postice vix excurvatus, antice leviter concavus, ventralis rectus vel in medio levissime incurvatus; umbones prominuli, subacuti; pagina interna nitida, prope margine incrassata; cicatrices magnæ, subpyriformes; dentes duo valvæ sinistræ prominentes, divergentes.*

*Longit.* 4½ *millim., alt.* 3½, *diam.* 2½.

This species has the dorsal margin sloping on each side and the base almost straight, so that a somewhat triangular shape is produced, the two lower angles being well rounded.

LUCINA (CODAKIA) IMBRICATULA, C. B. Adams.

*Lucina imbricatula*, C. B. Adams, Proc. Boston Soc. Nat. Hist. 1845, vol. ii. p. 10; id. Contrib. Conch. p. 245.

*Lucina pecten*, Reeve (non Lamarck), Conch. Icon. pl. 7. figs. 34, 35 *a–b*.

*Lucina occidentalis*, Reeve, Conch. Icon. Index, Errata.

*Hab.* Various islands in the West Indies, also Cape Verde Islands (*P. Furse* in Brit. Mus.).

This species greatly resembles *L. fibula* Reeve, from the Philippines, Red Sea, &c., but the radiating ridges do not divaricate on the dorsal margins in the same manner. *L. munda*, A. Adams (Proc. Zool. Soc. 1855, p. 225), is the same species as *L. fibula*.

MYTILUS EDULIS, Linné?

Two or three small specimens collected by Mr. Melliss have been referred to this common species by Jeffreys. They were "found attached to long pieces of seaweed" which drift on shore at Sandy Bay beach on the south coast (Melliss), so probably had been carried northward from S. Africa. They might with equal propriety be referred to *M. compressus*, Phil., or *M. meridionalis*, Krauss.

MYTILUS MAGELLANICUS, Chemnitz.

Both Mr. Melliss and Capt. Turton obtained this form from seaweed. The specimens are all small, about an inch in length, and show considerable variation in the number and coarseness of the ribs. The colour varies from yellow to purplish.

MODIOLARIA MARMORATA (Forbes).

*Hab.* Gt. Britain, Mediterranean, Canary Islands.

According to Jeffreys this species also occurs in the Gulf of Suez, the Persian Gulf, and N. Pacific. The specimens from St. Helena collected by Capt. Turton are vividly mottled, but agree in form and sculpture with European specimens.

CRENELLA PURA. (Plate XXIV. fig. 26.)

*Testa minuta, æquilateralis, triangularis, inferne arcuata, alba; valvæ mediocriter convexæ, crassiusculæ, radiatim anguste sulcatæ, sulcis interstitiis angustioribus, lineis incrementi striatæ; margo dorsi utrinque valde declivis, subrectilinearis; umbones prominentes; linea cardinis valida, infra et pone umbones transversim striata, sulco angusto ligamentali postice obliquo sculpta; pagina interna nitida, alba, haud margaritacea, margine inferiori plus minus denticulato, dentibus 2–3 validis ad extremitatem posticam lineæ cardinalis instructa.*

*Longit.* 3 *millim.*, *alt.* 3½, *diam.* 2.

This little species for its size is rather solid, and peculiar on account of its hinge-plate, and the two or three denticles at the posterior end, just within the margin of the valves.

PECTEN PUSIO, Linn.

*Hab.* Mediterranean to Norway and Faroe Isles, Madeira, Canaries, Azores, S. Africa.

This species has been quoted from South Africa both by Jeffreys

and Sowerby. The latter has, correctly I think, cited *P. tinctus* and *P. albus* of Reeve as synonyms. In this category I should also place *P. sentis* and *P. textilis* of the same author.

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21. *Turbo (Collinia) incertus*, p. 311.
21 *a*. —— (——) ——; upper view.
22. *Scissurella jucunda*, p. 311.
22 *a*. —— ——; upper surface.
23. *Kellia crassiuscula*, p. 313.
24. —— *atlantica*, p. 313.
25. *Montacuta subtriangularis*, p. 313.
26. *Crenella pura*, p. 314.

## 4. On the Marine Mollusca of Ascension Island.

By Edgar A. Smith.

[Received March 14, 1890.]

In the following list of forty-two species of Mollusca from Ascension Island, nine, obtained by the 'Challenger' Expedition, ought not perhaps to be included in the fauna; for, although dredged close to the island off the west coast, they were from a depth of 420 fathoms.

The poverty of this list is doubtless due to the fact that no experienced collector has ever explored the shores.

Fourteen of these species occur at St. Helena, eleven are West-African, twelve are found at the Cape Verde, Canary Islands, and the Azores, nine are Mediterranean, and seventeen, or about 40 per cent., are West-Indian forms. These figures, on comparison with those referring to the species found at St. Helena, and given in the previous report, show that the relationship of the two faunas to other regions is the same. Both resemble that of the West Indies more than any other locality, both have a considerable percentage of species common to West Africa, to the Atlantic Islands, including the Cape Verdes, Canaries, Madeira, and the Azores, and also to the Mediterranean, the causes which have effected this distribution doubtless being the same in both cases.

The three species of *Marginella* are well-known Cape forms, and therefore the question arises, whether these shells may not have drifted to Ascension on floating tangles as in the case of numerous species at St. Helena.

A few species are eastern forms, for example *Ostrea cucullata* and *Malleus regula*. Both of these, I believe, are established at Ascension. The former was quoted by Chemnitz more than a hundred years ago, and although he remarks that ships returning from China and the East Indies used to call at Ascension for water, I do not think it likely that the shells were carried there from the east. The single valve received from Dr. Conry is in very fresh condition and has not the appearance of having been rolled on the beach.

In the 'Universal Conchologist' Martyn has figured a small specimen of the well-known *Fusus proboscidiferus* of Lamarck, under the name of *Buccinum incisum*, and gives as the locality "Ascension Island, new Guinea."

I have been unable to discover the existence of any island of that name near New Guinea, although that region would be a correct habitat for this species. Perhaps "new" should read *near*, which would then clear up the doubt with regard to Ascension Island, but I very much question the occurrence of this shell in the Atlantic.

All the species enumerated hereafter, with the exception of the three species of *Marginella* and *Ianthina globosa*, are represented in the British Museum by specimens from Ascension Island. The greater part were received from Staff-Surgeon T. Conry a few years ago, and partly recorded in the Ann. & Mag. Nat. Hist. for 1881, vol. viii. pp. 430, 431.

## I. GASTROPODA.

PISANIA PUSIO (Linné).

Two specimens of this common species were obtained by Dr. Conry, which agree in all respects with typical examples from the West Indies. It has not, I believe, been noticed before from the eastern side of the Atlantic.

COLUMBELLA (MITRELLA) CRIBRARIA, Lamarck.

*Hab.* Ascension (*Quoy & Gaimard, Kiener*).

The four specimens of this species are of a very dark or black-brown colour, and pale-spotted in the usual way. It is common at the West Indies.

PURPURA ASCENSIONIS, Quoy & Gaimard.

*Hab.* Ascension Island (*Q. & G., Kiener, Küster*, &c.).

This species has not, I believe, ever been recorded from any other locality than Ascension Island. Two specimens sent by Capt. Turton from St. Helena are in a very worn state, and were obtained by him near the harbour at Jamestown, so, as he observes in his notes, "perhaps they are not true natives."

PURPURA HELENA, Quoy & Gaimard.

The specimens obtained by Dr. Conry are not quite like Reeve's type of *fasciata* (a synonym of this species), having the tubercles rather more distant, the brown colour of a darker tint, and the blotches within the outer lip much more pronounced; but this may be due to the fact that none of the specimens appear to be adult.

HARPA ROSEA, Lamarck.

Ascension Island appears to be a new locality for this shell, which, as far as is at present known, has a limited range on the West Coast of Africa. Kiener cites "les mers du Japon" as the habitat, but this is certainly incorrect.

RANELLA CŒLATA, Broderip.

*Hab.* Ascension (*Conry*).

*R. pustulosa* is a variety of this species.

MARGINELLA CAPENSIS, Dunker.

*Hab.* Ascension (*Weinkauff*).

Other localities for this species are South Africa and Guinea.

MARGINELLA ZONATA, Kiener.

*Hab.* Ascension (*Weinkauff*); Cape of Good Hope.

MARGINELLA DUNKERI, Krauss.

*Hab.* Ascension (*Weinkauff*); Cape of Good Hope.

MITRA STRIATULA, Lamarck.

This well-known West-Indian species has not been previously recorded from the eastern side of the Atlantic. Of the two specimens obtained by Dr. Conry, one, which has lost the spiral striation through being beach-rolled, is very remarkable, and plentifully spotted with the opaque white which is so characteristic of this species. The other specimen is in fresh condition, and possesses all the features of typical examples from the West Indies. The shell figured by Sowerby (Thes. Conch. pl. 353. fig. 204) under the name of *M. barbadensis* is an immature specimen of this species.

EULIMA CHYTA, Watson.

*Eulima chyta*, Watson, Report 'Challenger' Gasteropoda, p. 516, pl. xxxvi. fig. 5.

*Hab.* Ascension Island, 420 fathoms.

IANTHINA GLOBOSA, Swainson.

*Hab.* Ascension Island (*Lesson*).

This species is quoted by Lesson (Voy. Coquille, Zool. vol. ii. p. 366) under the name of *I. prolongata*, Blainville.

CYPRÆA LURIDA, Linné.

*Hab.* Ascension (*Lister*).

CYPRÆA SPURCA, Linné.

Besides two specimens received from Dr. Conry, the British Museum possesses a third, presented by R. Trimen, Esq.

LITTORINA MILIARIS, Quoy & Gaimard.

*Hab.* Ascension Island (*Q. & G., Philippi, Conry, Craven*).

PLANAXIS LINEATUS (Da Costa).

*Hab.* Ascension (*Conry*).

RISSOINA BRYERIA (Montagu).

*Hab.* Ascension Island (*R. Trimen*).

RISSOA (SETIA) TENUISCULPTA, Watson.

*Rissoa (Setia) tenuisculpta*, Watson, Proc. Zool. Soc. 1873, p. 389, pl. xxxvi. fig. 28; Gasteropoda of the 'Challenger' Exp. p. 607.

*Hab.* Mediterranean, Madeira, Ascension Island, and West Indies (25–420 fathoms).

Rissoa (Setia) triangularis, Watson.

*Rissoa* (*Setia*) *triangularis*, Watson, 'Challenger' Gasteropoda, p. 611, pl. xlvi. fig. 2.

*Hab.* Ascension Island, 420 fathoms.

Alaba tervaricosa (C. B. Adams).

*Rissoa tervaricosa*, C. B. Adams, Proc. Bost. Soc. Nat. Hist. 1845, vol. ii. p. 6.

*Rissoa* (?) *melanura*, C. B. Adams, Contrib. Conch. p. 116.

*Hab.* Ascension Island (*Conry*); Jamaica (*Adams*).

The single well-preserved specimen from Ascension is a trifle more slender than any of the examples from Jamaica I have seen. It belongs, however, without doubt to this species, having the spiral striæ at the base of the whorls, and some opaque white spots in the same place as in Jamaican shells. This specimen has a single varix on the body-whorl, and its apex is not black, but this I do not regard as an essential feature.

After carefully studying the descriptions of *R. tervaricosa* and *R. melanura*, and examining a series of both, named by C. B. Adams himself, in Cuming's collection, I feel convinced that they constitute but one species. The number and position of varices is very variable, and their total absence occasionally occurs. The texture and striation are similar in all specimens, and all are white and mostly exhibit at the periphery of the body-whorl a series of opaque white dots, not mentioned by Adams, which are also visible around the lower part of the upper volutions. The apex is not constantly black, but is so occasionally, both in varicose and unvariced specimens.

Mitrularia dillwyni (Gray).

*Patella equestris*, Wood (*non* Linn.), Index Test. pl. xxxvii. fig. 1.

*Calyptræa dillwynii*, Gray, Ann. Philosoph. 1825, vol. ix. p. 407; Woodward, Man. Moll. pl. xi. fig. 11.

*Mitrularia dillwynii*, Fischer, Man. Conch. pl. xi. fig. 11.

*Calyptræa martiniana*, Reeve, Conch. Icon. vol. xi. pl. iv. figs. 13 *a–b*.

*Hab.* West Indies (*Woodward* and *Brit. Mus.*); Philippines (*Cuming*).

This species has the surface extremely uneven and wrinkled, and minutely radiately striated. The internal appendage is very large. I think it possible Reeve's locality may be an error. According to Hanley (Index Test. p. 183) this is *Patella undulata* of Bolten.

Hipponyx antiquatus (Linné).

This species occurs also at St. Helena.

Strombus bubonius, Lamarck.

*Hab.* West Indies, West Africa at Goree and Rufisque, also Cape Verde Islands.

The single specimen from Ascension Island is very like that

figured by Kiener (Coq. Viv. pl. 6), but the tubercles are rather larger and more obtuse.

NERITA ASCENSIONIS, Gmelin.

*Hab.* Ascension Island (*Quoy & Gaimard, Trimen, Conry, Chemnitz*, &c.); Island of Trinidad, off Brazil, and Fernando Noronha.

BASILISSA OXYTROPIS, Watson.

*Basilissa oxytropis*, Watson, Report 'Challenger' Gasteropoda, p. 104, pl. vii. fig. 9.

*Hab.* Ascension Island, 420 fathoms.

FISSURELLA NUBECULA (Linné).

*Hab.* Mediterranean, Morocco, Cape Verde Islands, Senegambia, Guinea.

With this species, besides *F. rosea*, Lamarck, should be united *F. ostrina*, Reeve, described without locality.

WILLIAMIA GUSSONII (Costa).

This species is also found at St. Helena, and has already been noticed and references given in the preceding report on the Mollusca of that Island.

UTRICULUS ORYCTUS, Watson.

*Utriculus oryctus*, Watson, Report 'Challenger' Gasteropoda, p. 653, pl. xlviii. fig. 12.

*Hab.* Ascension Island, 420 fathoms.

CYLICHNA CYLINDRACEA (Pennant).

*Hab.* Ascension Island ('*Challenger*' *Exped.*).

HAMINEA HYDATIS (Linné).

*Hab.* Ascension Island (*R. Trimen*).

The specimens from Ascension, like those referred to from St. Helena, are all small, none exceeding 10 millim. in length.

DENTALIUM ENTALIS, var. AGILE.

*Hab.* Ascension Island, 420 fathoms ('*Challenger*'); North Sea, Bay of Biscay, Mediterranean, Azores, Canaries, Gulf of Mexico.

## II. PELECYPODA.

SEMELE CORDIFORMIS (Chemnitz).

*Hab.* Ascension (*Conry*).

Remarks on the distribution and synonymy of this species are given in the St. Helena Report.

LUCINA (CODAKIA) IMBRICATULA, C. B. Adams.

*Hab.* Ascension (*Conry* and *R. Trimen*).

This species is scarcely distinguishable from *L. pecten*, Lamarck. The latter is rather more finely sculptured. Both forms occur at St. Vincent's, West Indies.

Cryptodon, sp.

*Hab.* Ascension Island, 420 fathoms (*'Challenger'*).

Cardium (Fragum) medium, Linné.

*Hab.* West Indies.

Two separate valves obtained by Dr. Conry possess all the features of this well-known form. It has not, I believe, been previously recorded from the eastern parts of the Atlantic.

Arca sanctæ-helenæ, Smith.

*Hab.* Ascension (*Meiklejohn*) and St. Helena.

Arca (Acar) domingensis, Lamarck.

*Hab.* Ascension (*Conry* and *Trimen*).

Arca (Acar) lactea, Linné.

*Hab.* Ascension (*Conry*).

This species occurs in the Mediterranean, British seas, West Africa at the Cape Verde and Canary Islands, and South Africa. Jeffreys has also quoted it as a Red-Sea form.

Nuculana jeffreysi (Hidalgo).

*Hab.* Ascension Island, 420 fathoms (*'Challenger'*), off the Azores in 1000 fathoms (*'Challenger'*). Off the west of Ireland, 165–1443 fath. (*'Porcupine' Exp.*, 1869); off Portugal, 740–1095 fath. (*'Porcupine' Exp.*, 1870).

Spondylus, sp.

A number of odd valves of a species of this genus were presented to the Museum by Dr. Meiklejohn, and a single valve was also received from Dr. Conry. The largest specimen is four and a half inches in diameter. All the valves are very much worn, so that it is impossible to identify them specifically. The colour is bright purple-red and the surface is covered with numerous radiating ridges, some of which, more or less far apart, are larger than the rest, and on the deeper valve appear to have been strongly nodose at distant intervals.

Malleus regula (Forskål).

*Hab.* Ascension (*Conry*); Red Sea and Philippines.

Two young specimens, which appear to belong to this species, is all the evidence we have of the occurrence of this species in the Atlantic.

Ostrea cucullata, Born.

*Hab.* Ascension (*Conry* and *Chemnitz*); Red Sea, Indian Ocean, Philippines.

Dr. Conry's specimen is in fresh condition and, although a little smaller, is very like Chemnitz's figure 679 *a* (Conch. Cab. vol. viii. pl. 74). He named this species *O. cornu-copiæ* and *O. forskålii*, the latter from Red-Sea examples.

1.

1a.

1b.

2a.

2.

3.

Peter Smit del. et lith. Mintern Bros. imp.

1. GENYOPHRYNE THOMSONI. 2. PALUDICOLA FISCHERI.
3. BUFO JERBOA.

Peter Smit. del. et lith. Mintern Bros. imp.

CERATOPHRYS CALCARATA

April 15, 1890.

G. A. Boulenger, Esq., F.Z.S., in the Chair.

The following papers were read :—

## 1. Second Report on Additions to the Batrachian Collection in the Natural-History Museum[1]. By G. A. Boulenger.

[Received March 18, 1890.]

(Plates XXV. & XXVI.)

Our knowledge of the species of Batrachians increases rapidly. After considering carefully every description that has been published since the beginning of 1882, I find that as many as 1119 apparently valid species are known at present, viz. 960 *Ecaudata*, 122 *Caudata*, and 37 *Apoda*.

The collection in the British Museum keeps pace with this increase, as testified by the following list of additions received during the last four years. In fact, the rate of increase has steadily risen since the collection of Frogs was first put in order by Dr. Günther in 1858[2]. The number of species then represented in the Museum was estimated at 214 (1691 specimens). In a report published ten years later by Dr. Günther[3] the number had risen to 313. In the second edition of the Catalogue, prepared by me and issued in 1882, the number of species was given as 522, and the number of specimens 4692. 63 species were added from 1882 to the middle of 1886, and 74 more are enumerated in the present report. So that the Museum possesses at present examples of about 660 species of Frogs, illustrated by over 6900 specimens. Thus we see that the increase in the number of species represented in the Museum has been at the rate of 10 per annum from 1858 to 1868, of 15 per ann. from 1868 to 1882, of 16 per ann. from 1882 to 1886, and of 18½ per ann. from 1886 to the present day.

The number of Tailed Batrachians in the Collection is now 85 species and about 1340 specimens; of Apodals, 29 species and 156 specimens.

### I. *List of the Species, new or previously unrepresented, added to the collection since June* 1886.

(An asterisk indicates type specimens.)

ECAUDATA.

*1. *Rana boulengeri*, Gthr. Ann. N. H. (6) iv. 1889, p. 222.—Ichang (*Pratt*).

*2. *Rana macroscelis*, Blgr. Ann. N. H. (6) i. 1888, p. 345.—New Guinea (*Forbes*).

[1] *Cf.* P. Z. S. 1886, p. 411.

[2] Catalogue of Batrachia Salientia.

[3] P. Z. S. 1868, p. 478.

*3. *Rana doriæ*, Blgr. Ann. Mus. Genova, (2) v. 1887, p. 482.—Tenasserim, Mergui (*Theobald, Beddome, Anderson*).
4. *Rana utricularia*, Harl.—Florida (*Bollman*).
5. *Rana amurensis*, Blgr. Bull. Soc. Zool. France, 1886, p. 598.—Lake Kanka and Corea (*Fischer*).
*6. *Rana leithii*, Blgr. Ann. N. H. (6) ii. 1888, p. 506.—Bombay (*Leith*).
7. *Rana galamensis*, D. & B.—Niger Benue.
*8. *Rana humeralis*, Blgr. Ann. Mus. Genova, (2) v. 1887, p. 420.—Upper Burma (*Fea*).
*9. *Rana labialis*, Blgr. Ann. N. H. (5) xix. 1887, p. 345.—Malacca (*Hervey*).
*10. *Rana flavicrus*, Blgr. Ann. N. H. (6) iv. 1889, p. 245.—Madagascar (*Majaster*).
*11. *Rana redimita*, Blgr. l. c.—Madagascar (*Majaster*).
*12. *Rana biporus*, Blgr. l. c. p. 246.—Madagascar (*Majaster*).
*13. *Rana himalayana*, Blgr. Ann. N. H. (6) ii. 1888, p. 507.—Darjeeling (*Jerdon, Blanford*).
14. *Rhacophorus leprosus*, Tsch.—Perak (*Wray*).
*15. *Rhacophorus opisthodon*, Blgr. Ann. N. H. (6) i. 1888, p. 105.—Madagascar.
16. *Rhacophorus viridis*, Hallow.—Loo Choo Islands (*Pryer*).
*17. *Rhacophorus albilabris*, Blgr. Ann. N. H. (6) i. 1888, p. 105.—Madagascar (*Baron*).
*18. *Ixalus vittatus*, Blgr. Ann. Mus. Genova, (2) v. 1887, p. 421.—Bhamo (*Fea*).
*19. *Cornufer johnstoni*, Blgr. P. Z. S. 1887, p. 564.—Rio del Rey, W. Africa (*Johnston*).
20. *Phrynobatrachus acridoides*, Cope.—Kiduwe, E. Africa (*Jackson*).
*21. *Batrachylodes vertebralis*, Blgr. P. Z. S. 1887, p. 337.—Solomon Islands (*Woodford*).
22. *Arthroleptis pœcilonotus*, Ptrs.—Gold Coast (*Burton & Cameron*).
23. *Rappia pusilla*, Cope.—Brass, Niger.
*24. *Rappia sordida*, Fischer, JB. Wiss. Anst. Hamb. v. 1888, p. 10.—Cameroon (*Fischer*).
25. *Hylambates anchietæ*, Bocage.—Angola (*Bocage*).
*26. *Hylambates angolensis*, Bocage.—Angola (*Bocage*).
27. *Phyllobates limbatus*, Cope.—Cuba.
*28. *Phyllobates trinitatis*, Garm. Bull. Essex Inst. xix. 1887, p. 13.—Trinidad (*Agassiz*).
*29. *Mantella baroni*, Blgr. Ann. N. H. (6) i. 1888, p. 106[1].—Madagascar (*Baron*).
30. *Phryniscus longirostris*, Cope[2].—Ecuador.
*31. *Engystoma leucostictum*, Blgr. Ann. N. H. (6) i. 1888, p. 416.—Sta. Catharina, Brazil (*Michaëlis*).

[1] = *Phrynomantis maculatus*, Thominot, 1889.
[2] = *Phryniscus bousingaulti*, Thominot, 1889.

*32. *Microhyla inornata*, Blgr. P. Z. S. 1890, p. 37,—Deli, Sumatra (*Moesch*).
*33. *Phrynella pulchra*, Blgr. Ann. N. H. (5) xix. 1887, p. 346.—Malacca (*Hervey*); Deli, Sumatra (*Moesch*).
*34. *Phrynella pollicaris*, Blgr. P. Z. S. 1890, p. 37.—Perak (*Wray*).
*35. *Cacosternum nanum*, Blgr. Ann. N. H. (5) xx. 1887, p. 51.—Caffraria (*Weale*).
*36. *Callulops doriæ*, Blgr. Ann. N. H. (6) i. 1888, p. 345.—New Guinea (*Forbes*).
*37. *Platyhyla grandis*, Blgr. Ann. N. H. (6) iv. 1889, p. 247.—Madagascar (*Majaster*).
*38. *Platypelis pollicaris*, Blgr. Ann. N. H. (6) i. 1888, p. 106.—Madagascar (*Baron*).
*39. *Genyophryne thomsoni*, Blgr., *infra*.—Sudest Island, New Guinea (*B. Thomson*).
*40. *Hylodes plicifera*, Blgr. Ann. N. H. (6) ii. 1888, p. 41.—Iguarasse, Pernambuco (*Ramage*).
*41. *Hylodes ramagii*, Blgr. l. c.—Iguarasse (*Ramage*).
*42. *Ceratophrys calcarata*, Blgr., *infra*.—Colombia (*Fischer*).
*43. *Paludicola fischeri*, Blgr., *infra*.—Venezuela (*Fischer*).
*44. *Paludicola bischoffii*, Blgr. Ann. N. H. (5) xx. 1887, p. 296.—Rio Grande do Sul (*Bischoff*).
*45. *Leptodactylus prognathus*, Blgr. Ann. N. H. (6) i. 1888, p. 187.—Rio Grande do Sul (*Iherinq*).
*46. *Limnodynastes fletcheri*, Blgr. Ann. N. H. (6) ii. 1888, p. 142.—Victoria (*Fletcher*).
*47. *Crinia victoriana*, Blgr. l. c.—Victoria (*Fletcher*).
*48. *Eupemphix nana*, Blgr. Ann. N. H. (6) i. 1888, p. 187.—Sta. Catharina, Brazil (*Michaëlis*).
*49. *Eupemphix trinitatis*, Blgr. Ann. N. H. (6) iii. 1889, p. 307.—Trinidad (*Hart*).
*50. *Bufo jerboa*, Blgr., *infra*.—S.E. Borneo (*Fischer*).
*51. *Bufo muelleri*, Blgr. Ann. N. H. (5) xx. 1887, p. 52.—Mindanao (*F. Müller*).
52. *Bufo debilis*, Gir.—Texas (*Taylor*).
*53. *Bufo superciliaris*, Blgr. P. Z. S. 1887, p. 565.—Rio del Rey, W. Africa (*Johnston*).
*54. *Bufo macrotis*, Blgr. Ann. Mus. Genova, (2) v. 1887, p. 422.—Kakhyen hills, Upper Burma (*Fea*).
*55. *Bufo parvus*, Blgr. Ann. N. H. (5) xix. 1887, p. 346.—Malacca (*Hervey*); Deli, Sumatra (*Moesch*).
*56. *Bufo quadriporcatus*, Blgr. l. c. p. 347.—Malacca (*Hervey*), Perak (*Wray*); Deli, Sumatra (*Moesch*).
*57. *Bufo philippinicus*, Blgr. l. c. p. 348.—Puerta Princesa (*Everett*).
58. *Cophophryne sikkimensis*, Blyth.—Sikkim (*Blanford*).
59. *Hyla langsdorffii*, D. & B.—Sta. Catharina, Brazil (*Ihering*).
*60. *Hyla copii*, Blgr. Ann. N. H. (5) xx. 1887, p. 53.—Texas (*Forrer*).

*61. *Hyla bischoffii*, Blgr. l. c. p. 298.—Rio Grande do Sul (*Bischoff*).
*62. *Hyla stepheni*, Blgr. P. Z. S. 1887, p. 579.—Port Hamilton, Corea (*Stephen*), Ussuri R. (*Fischer*).
*63. *Hyla phrynoderma*, Blgr. Ann. Mus. Genova, (2) vii. 1889, p. 248.—Colonia Resistencia, Argentine Republic (*Spegazzini*).
*64. *Hyla lutea*, Blgr. P. Z. S. 1887, p. 337.—Solomon Islands (*Woodford*).
*65. *Hyla nana*, Blgr. Ann. Mus. Genova, (2) vii. 1889, p. 249.—Colonia Resistencia (*Spegazzini*).
*66. *Hyla bivittata*, Blgr. Ann. N. H. (6) i. 1888, p. 188.—Sta. Catharina (*Michaëlis*).
*67. *Hyla marginata*, Blgr. Ann. N. H. (5) xx. 1887, p. 298.—Rio Grande do Sul (*Bischoff*).
68. *Hyla miotympanum*, Cope.—Mexico (*Copenhagen Mus.*).
*69. *Hyla catharinæ*, Blgr. Ann. N. H. (6) i. 1888, p. 417.—Sta. Catharina (*Michaëlis*).
*70. *Nototrema fissipes*, Blgr. Ann. N. H. (6) ii. 1888, p. 42.—Iguarasse, Pernambuco (*Ramage*).
71. *Leptobrachium fece*, Blgr. Ann. Mus. Genova, (2) iv. 1887, p. 512.—Kakhyen hills, Upper Burma (*Fea*).
72. *Bombinator igneus*, Laur.[1]—Germany, Denmark, Sweden, Austria.
*73. *Bombinator orientalis*, Blgr. Ann. N. H. (6) v. 1890, p. 143.—Chefoo (*Swinhoe*); Corea (*Carpenter*); Ussuri (*Fischer*).
74. *Alytes cisternasii*, Boscá.—Spain (*Boscá*).

CAUDATA.

1. *Molge meridionalis*, Cope, Bull. U. S. Nat. Mus. 17, 1880, p. 30.—Texas (*Taylor*).
*2. *Hynobius leechii*, Blgr. Ann. N. H. (5) xix. 1887, p. 87.—Corea (*Leech*).
*3. *Hynobius chinensis*, Gthr. Ann. N. H. (6) iv. 1889, p. 222.—Ichang (*Pratt*).

APODA.

1. *Cæcilia polyzona*, Fisch.—Panama (*Fischer*).
2. *Gymnopis oligozona*, Cope.—Guatemala (*F. Müller*).
*3. *Siphonops hardyi*, Blgr. Ann. N. H. (6) i. 1888, p. 189.—Porto Real, Rio Janeiro (*Hardy du Dréneuf*).

## II. *Descriptions of new Species.*

### GENYOPHRYNE, g. n.

Pupil horizontal. Tongue oblong, entire, free at the sides. Teeth on the palatine bones. Eight or nine small teeth on the anterior

[1] The European specimens referred to *B. igneus* in the Catalogue belong all to *B. pachypus*, Bp.

extremity of each ramus mandibuli. A denticulated transverse dermal ridge in front of the œsophagus. Ear hidden. Fingers free; toes webbed at the base, the tips slightly dilated; outer metatarsals bound together. No præcoracoid; sternum cartilaginous. Transverse processes of sacral vertebra moderately dilated.

*Genyophryne* may be regarded as the type of a new family of Firmisternia, *Genyophrynidæ*, characterized by absence of maxillary teeth and presence of mandibular teeth. In all but the latter character it agrees with the *Engystomatidæ*.

GENYOPHRYNE THOMSONI. (Plate XXV. fig. 1.)

Very similar in appearance to *Rhombophryne testudo*, Bttg. Head large and much depressed; eyes small and wide apart. First finger shortest, third much longer than second or fourth. Inner metatarsal tubercle indistinct. Heel with a triangular dermal process. Skin smooth. Pinkish brown above, variegated with blackish; temples whitish; a light line on each side from the eye along the back; hinder side of thighs and lower surface of tarsus black.

From snout to vent 32 millim.

A single specimen was obtained by Mr. Basil Thomson on Sudest Island, between New Guinea and the Louisiade Archipelago. It is unfortunately in very bad condition.

CERATOPHRYS CALCARATA. (Plate XXVI.)

Vomerine teeth in two very small, very indistinct groups between the choanæ. Head large, bony; a supratemporal bony ridge; nostril nearer the eye than the tip of the snout; tympanum perfectly distinct, a little smaller than the eye; interorbital space concave; upper eyelid prolonged into a small "horn." First finger longer than second; toes hardly half webbed; inner metatarsal tubercle very large, shovel-shaped, sharp-edged; a rather indistinct tarsal fold. The tarso-metatarsal articulation reaches the tympanum. Upper parts with small very prominent tubercles, the largest of which are ribbed. No dorsal shield. Dark olive above, with paler symmetrical markings; an arrow-headed green band on the back, widening and bifurcating between the eyes; lower parts with a few brown spots; metatarsal spur black.

From snout to vent 70 millim.

A single specimen, a female, obtained by Hr. Dämel in Colombia, was in the late Dr. J. G. Fischer's collection, recently acquired by the Trustees of the British Museum.

PALUDICOLA FISCHERI. (Plate XXV. fig. 2.)

Tongue elliptic, entire. Vomerine teeth none. Snout rounded, as long as the diameter of the orbit; interorbital space as broad as the upper eyelid; tympanum rather indistinct, about half the diameter of the eye. Fingers slender, first not extending quite as far as second; toes slender, fringed, with a slight rudiment of web; subarticular tubercles moderately large but very prominent; a small tarsal tubercle;

two oval, blunt metatarsal tubercles, inner more elongate and nearer its fellow than the tarsal tubercle. The tibio-tarsal articulation reaches the centre of the eye. Skin smooth; a large, flat, oval lumbar gland. Grey-brown above, with a blackish lateral band; lumbar gland with a black, light-edged ocellus; hind limbs with dark cross-bands; hinder side of thighs white-dotted; lower parts white, speckled with brown.

From snout to vent 33 millim.

A single female specimen from Venezuela, from Dr. Fischer's collection.

BUFO JERBOA. (Plate XXV. fig. 3.)

Allied to *Bufo leptopus*, Gthr., but with still longer hind limbs. The femoro-tibial articulation reaches the shoulder, the tibio-tarsal far beyond the tip of the snout, and the tibia measures two thirds the length of head and body. In *B. leptopus* the tibia measures half the length of head and body, and the tibio-tarsal articulation reaches the eye or between the eye and tip of the snout. Snout strongly projecting; loreal region vertical; interorbital space as broad as the upper eyelid; tympanum close to, and measuring half the diameter of the eye. First and second fingers equal; toes one-third webbed. Upper parts with small smooth warts; no distinct parotoids. Brown above, limbs with darker cross-bands; an X-shaped dark marking on the middle of the back; throat brown. Male with an internal subgular vocal sac and brown nuptial asperities on the inner finger.

From snout to vent 30 millim.

A single male specimen, collected by Hr. Grabowsky in S.E. Borneo, and mentioned in the list published by Fischer (Arch. f. Nat. 1885, p. 43) as *B. leptopus*. It is particularly curious to find in Borneo, which is the home of the most long-legged *Rana* (*R. jerboa*, Gthr.), a kind of Toad which by far exceeds all others in the length of the hind limbs.

## EXPLANATION OF THE PLATES.

### PLATE XXV.

Fig. 1. *Genyophryne thomsoni*.
1 *a*. Open mouth. ×2.
1 *b*. Right ramus of mandible. ×3.
2. *Paludicola fischeri*.
2 *a*. Open mouth. ×2.
3. *Bufo jerboa*.

### PLATE XXVI.

*Ceratophrys calcarata*, with side view of head.

## 2. On the Structure of *Psophia* and on its Relations to other Birds. By Frank E. Beddard, M.A., &c., Prosector to the Society.

[Received March 26, 1890.]

So far as I am aware there has been no paper especially devoted to the general anatomy of *Psophia* ever published, although many of the facts in its structure have been described incidentally in other papers. The following observations refer to the principal osteological and some other characters, of which a few are mentioned here for the first time.

The principal account of its skeleton is to be found in Burmeister's work upon *Cariama* [1], and in Parker's memoir of the osteology of *Rhinochetus* [2].

The skeleton and some of the separate bones (pelvis, sternum, &c.) are figured and described in Eyton's 'Osteologia Avium'; the skeleton of *Ps. crepitans* is also figured by Meyer in his 'Abbildungen Vögel-Skelet.' pl. lxxvi.

I have had the opportunity of studying both *Psophia crepitans* and *Psophia leucoptera*. It may not therefore be out of place to point out some of the differences which appear to distinguish these two species from each other. The difference in the proportions of the two lobes of the liver is remarkable; I have a MS. note in the handwriting of Prof. Garrod which shows that *Psophia viridis*, a species which I have not myself examined, agrees in this particular with *Ps. leucoptera*.

With regard to specific differences the following table shows all that I have been able to ascertain:—

| | Skull. | Liver-lobes. | Vertebral column. | Ribs. |
|---|---|---|---|---|
| *Psophia leucoptera*... | Palatine bones with longer inner lamina; space between postfrontal and zygomatic process wide. | L < R | Vertebræ Nos. 19–22 fused, followed by *three free* vertebræ. | 1 pair cerv. ribs; 8 attached to sternum (of these 2–6 with uncinate processes); 1 pair of lumbar ribs. |
| *Psophia crepitans* ... | Palatine bones with very short inner lamina; space between postfrontal and zygomatic process narrow. | L > R | Vertebræ Nos. 19–22 fused, followed by *two free* vertebræ. | 1 pair cerv. ribs; 8 attached to sternum (of these 2–7 with uncinate processes); a tiny rudiment of a 10th rib. |

[1] "Beiträge zur Naturgeschichte des Seriema," Abhandl. nat. Ges. Halle, Bd. i. p. 11 (1853).

[2] "On the Osteology of the Kagu (*Rhinochetus jubatus*)," Trans. Zool. Soc. vol. vi. p. 501 (1886).

I shall now proceed to direct attention to certain points in the skull, some of which I have not seen referred to elsewhere.

*Skull.*

As to the temporal fossæ, Prof. Parker contrasts the Kagu on the one hand with *Anthropoides*, *Balearica*, *Psophia*, *Eurypyga*, *Ocydromus*, and *Œdicnemus* on the other.

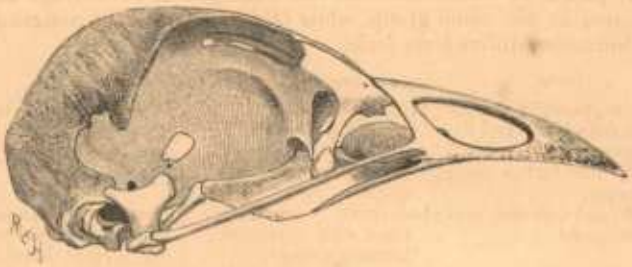
*Psophia* and *Rhinochetus* appear to me rather as the two extremes which are connected by various intermediate types as follows :—

*Psophia.*
*Œdicnemus.*
*Aramus.* }
*Grus.* }
*Fulica.* }
*Ocydromus.*
*Eurypyga.*
*Rhinochetus.*

In *Eurypyga* the temporal fossæ more nearly approach each other on the occipital face of the skull than in any other type except the Kagu.

In *Psophia*, as in most of its allies, the postorbital angle and the postfrontal process are one.

Fig. 1.



Side view of skull of *Psophia leucoptera*.

In the skull of *Rhinochetus* examined by myself, it seemed to me that this was not the case, and that the original (?) separateness of the two processes was just visible. This appears to be confirmed by the fact that the two are quite obviously distinct, though both are small, in *Eurypyga helias*, a bird unmistakably allied to *Rhinochetus*. Something of the same kind occurs in many *Limicolæ*.

The *maxillo-palatines* are comparatively large and swollen and are quite visible when the skull is regarded from below, as they

project inwards of the palatines. They differ from those of *Grus* and *Fulica* in being convex, and not concave, on the outer side. In these points, *Psophia* agrees with *Chunga* and *Ocydromus*.

In *Rhinochetus* and *Eurypyga* the maxillo-palatines are thin curved plates entirely invisible when the skulls are looked at from below.

In *Numenius*, *Metopidius*, and *Œdicnemus* their structure is much like that of the last-mentioned genera.

*Aramus* connects *Grus* with *Psophia*.

The *lachrymal* bone in *Psophia* is large and its descending process is club-shaped and swollen; it nearly comes into contact with the rather thick prefrontal process of the ethmoid. On the whole it appears to me that this bone is most similar to that of *Chunga* and *Œdicnemus*[1].

In *Fulica*, *Aramus*, *Ocydromus*, *Aramides*, and *Grus* the descending process of the lachrymal nowhere near touches the prefrontal process of the ethmoid. It becomes fused with it in *Parra*, *Hydrophasianus*, *Metopidius*, and *Numenius*.

The *palatines* of *Psophia*, as Parker has remarked[2], come nearest to those of the Cranes; I find that *Aramus* (which must be regarded as a Crane), *Œdicnemus*, and *Numenius* have palatines which are not unlike those of *Psophia* and the Cranes.

*Ocydromus*, *Fulica*, *Porphyrio*, *Parra* so far differ that the anterior half of each palatine is very much narrower than the posterior.

Before proceeding to discuss the affinities of *Psophia* as indicated by the skull, it will be convenient to clear the ground by contrasting several of the more typical Gralline forms, which have, it appears to me, been wrongly associated together. The Cranes do not show so many points of resemblance to the Limicolæ as to warrant their inclusion in the same group, while *Œdicnemus*, usually assigned to the Limicolæ, differs from both.

| *Grus*. | *Hæmatopus*. | *Œdicnemus*. |
|---|---|---|
| The supraorbital ridges are rounded off and the impressions for glands only just furrow their margin. | The supraorbital ridges are sharp and the depressions for supraorbital glands are conspicuous. | The supraorbital ridges are sharp. No depression for glands. |
| Lachrymal does not join ectethmoid. | Lachrymal completely fused with ectethmoid, forming a ring[3]. | Lachrymal articulates with ectethmoid, forming a ring; lachrymal also prolonged so as to nearly reach jugal. |
| Occipital foramina present. | present. | absent. |
| Basipterygoid processes absent[4]. | present. | absent. |

[1] In a specimen of *Œ. bistriatus* I found this bone ankylosed with the margin of the orbit.

[2] *Loc. cit.* p. 509.

[3] I find that Garrod ("On the Anatomy of *Aramus scolopaceus*," P. Z. S. 1876, p. 275) has laid stress upon this characteristic feature of the Limicoline skull.

[4] According to Huxley they are present in *Grus virgo*.

| *Grus.* | *Hæmatopus.* | *Œdicnemus.* |
|---|---|---|
| Maxillo-palatines of considerable size and visible from beneath. | Maxillo-palatines very small and fused with palatines. | Maxillo-palatines of considerable size and visible from beneath. |
| Vomer ends in a point. | Vomer truncated at extremity [1]. | Vomer ends in a blunt point. |
| Postorbital not distinct from postfrontal process. | Postorbital angle slight but distinct from postfontal process. | Postorbital angle not distinct from postfrontal process. |
| | Temporal fossæ commence below former and extend on to occipital surface. | |
| Foramen magnum at posterior end of skull. | Foramen magnum visible on under surface of skull. | Foramen magnum at posterior end of skull. |
| Schizorhinal. | Schizorhinal. | Holorhinal. |

Two prominent members of Huxley's Geranomorphæ show the following resemblances and differences:—

| *Grus.* | *Oxydromus.* |
|---|---|
| Occipital foramina present. | None. |
| Articulation of quadrate not concealed by squamosal. | Articulation of quadrate concealed by squamosal. |
| Interorbital septum less defective. | Interorbital septum hardly ossified [2]. |
| Maxillo-palatines with an outer concave border. | Maxillo-palatines with an outer convex border [3]. |
| Maxillary part of nasal bone facing forwards. | Maxillary part of nasal bone facing outwards. |
| Anterior process of quadrate does not end in a straight truncated extremity. | Anterior process of quadrate does end in a straight truncated surface. |
| Palatines of approximately equal breadth throughout; anteriorly they largely conceal the underlying maxillo-palatines. | There is a sharp distinction between the anterior narrow and the posterior broad portion of palatine. The maxillo-palatines are not much concealed by the palatines. |
| Schizorhinal. | Holorhinal. |

In the following pages some of the most prominent skull characters are given in which *Psophia* differs from various genera of "Alectorides." It does not appear to me to show any particular resemblances to the well-marked family of the Limicolæ. I have not therefore troubled to indicate its differences from that family which would be in all the points raised as well as in many others.

[1] Garrod ("Notes on the Anatomy and Systematic Position of the Genera *Thinocorus* and *Attagis*," P. Z. S. 1877, p. 417, fig. 2) figures the vomer of this and other "Limicolæ" as excavated at the top. It was certainly not so in my specimen. In *Numenius phæopus* there is an extraordinarily deep excavation at the point of the vomer; so much so that the vomer might be described as bifid with two slender branches.

[2] This is not so with *Fulica* and *Aramides*, which are nearer to the Cranes.

[3] This does not apply to *Fulica*.

*Psophia* shows the following points of difference from *Grus*:—

(1) The inner margin of the palatines is not greatly bent downwards to form the inner lamina.

(2) The vomer ends on a level with the anterior margin of the maxillo-palatines, it is anteriorly thin and compressed.

(3) There is no conspicuous foramen formed at the junction of the quadrato-jugal with the maxilla.

(4) There are no occipital foramina above the foramen magnum.

(5) The supraorbital margin is produced into a thin, strong, sharp-edged area.

(6) It is holorhinal.

(7) The interorbital plate is much less vacuolate.

(8) The palatines are wider behind than in front.

(9) The temporal fossæ are not so extensive.

(10) The surface of the maxillary process of the nasal bone is directed outwards.

*Psophia* shows the following points of difference from *Oedromus*:—

(1) The inner margin of the palatines is not greatly bent downwards.

(5) The supraorbital margin is produced into a sharp edge.

(7) The interorbital plate is not largely vacuolate.

(8) The contrast between the wider posterior and narrower anterior part of the palatines is not so marked.

(9) The temporal fossæ are not nearly so well marked.

(11) The lateral ethmoid processes come more nearly into contact with the descending process of the lachrymal, which very nearly reaches the jugal.

(12) The skull is relatively broad in the interorbital region.

(13) The articulation of the quadrate is not hidden by a downward growth of the squamosal.

In all these points *Psophia* also differs from *Fulica* and *Aramides*, *Crex* and *Porphyrio*; but, in the latter, characters Nos. 9 and 13 offer less-marked differences. The vomer in *Crex* and *Porphyrio* is a much broader bone, though ending in a point.

*Psophia* shows the following differences from *Œdicnemus*[1]:—

(2) The vomer does not extend beyond the anterior end of maxillo-palatines.

(3) There is no conspicuous foramen at the junction of the jugal with the maxilla.

(7) The interorbital plate is not so vacuolate, though the vacuolation is slight in *Œdicnemus*.

(9) The temporal fossæ are not so well marked.

[1] The sharp edge of the supraorbital region is largely due in *Psophia* to a chain of supraorbital bones, which were first made known by Parker ("On the Osteology of the Kagu," *loc. cit.* p. 503). It is possible that *Œdicnemus* and *Rhinochetus*, which agree in this particular with *Psophia*, will be found to have a similar series of ossicles which in the adult become completely fused with the frontals and parietals.

(11) The descending process of the lachrymal does not unite with the prefrontal process of the ethmoid.

*Psophia* shows the following points of difference from *Rhinochetus*:—

(1) The inner margin of the palatines is not so greatly bent downwards to form the inner lamina.

(6) It is holorhinal.

(8) The palatines are not of the same breadth throughout, but are wider behind than in front.

(9) The temporal fossæ are comparatively shallow, and there is no trace of them upon the occipital face of the skull.

(10) The surface of the maxillary part of the nasal bone is directed outwards and not forwards.

(11) The lateral ethmoid processes do not come into actual contact with descending process of lachrymal; lachrymals themselves are large and nearly join jugal.

*Psophia* differs in the following from *Eurypyga*:—

(3) There is no conspicuous foramen at junction of the quadrato-jugal with the maxillary.

(6) It is holorhinal.

(7) The interorbital plate is not largely vacuolate.

(8) The palatines are wider behind than in front.

(9) Temporal fossæ are comparatively deep but do not appear on occipital face of skull.

(10) The surface of the maxillary part of the nasal bone is directed outwards[1].

*Psophia* shows *no* perceptible differences from *Cariama* in the points enumerated above except in the comparative shallowness of temporal fossa, which indeed hardly extends on to the occipital region of the skull in *Psophia*.

The principal points in which it does differ are the absence of a special bone uniting the lachrymal with the quadrato-jugal[2], and of course the presence of the supraorbital chain: in the greater space which separates the two maxillo-palatines, which are all but fused in *Cariama*; in the fact that the jugals are attached to the maxilla above the point where the palatines articulate with the same bones. In this respect *Psophia* agrees with all Cranes and Rails that I have examined, while *Cariama strongly resembles Serpentarius*[3].

[1] This characteristic difference in the bone is *not* correlated with the schizorhinal or holorhinal nature of the skull; although it appears to be so from the types selected for comparison in these tables. For while *Numenius* agrees with *Eurypyga*, *Parra* agrees with *Psophia* and the Rails. *Larus*, which is, of course, schizorhinal, agrees with *Psophia*, and the holorhinal *Nycticorax* has the nasals directed forwards quite as in *Rhinochetus*.

[2] Mr. Forbes (Report on the Anatomy of Petrels [Tubinares], Zool. Chall. Exp. vol. iv. pl. xi. p. 44) remarks that a similar bone occurs in *Fregata* and in some Petrels. This may be so, but it must be remembered that in the latter birds, as Forbes correctly states, the bone is attached to the palatine, whereas in *Chunga*, as I have stated above, it is attached to the quadrato-jugal.

[3] Some other Desmognathous birds (not Accipitrine) also resemble *Cariama* in this point.

| | | | | |
|---|---|---|---|---|
| In (1) | *Psophia* | most | resembles | *Eurypyga, Cariama, Chunga.* |
| In (2) | ,, | ,, | ,, | *Cariama, Chunga, Rhinochetus.* |
| In (3) | ,, | ,, | ,, | *Cariama* and *Chunga.* |
| In (4) | ,, | ,, | ,, | Rallidæ, *Rhinochetus, Cariama, Chunga, Œdicnemus.* |
| In (5) | ,, | ,, | ,, | *Rhinochetus, Œdicnemus, Cariama, Chunga.* |
| In (6) | ,, | ,, | ,, | *Cariama, Chunga,* Rallidæ, *Œdicnemus.* |
| In (7) | ,, | ,, | ,, | *Œdicnemus.* |
| In (8) | ,, | ,, | ,, | *Cariama, Chunga.* |
| In (9) | ,, | ,, | ,, | *Cariama, Chunga.* |
| In (10) | ,, | ,, | ,, | *Œdicnemus, Cariama.* |
| In (11) | ,, | ,, | ,, | *Œdicnemus, Cariama, Chunga.* |
| In (12) | ,, | ,, | ,, | *Œdicnemus, Rhinochetus, Cariama, Chunga.* |
| In (13) | ,, | ,, | ,, | *Œdicnemus, Rhinochetus, Chunga, Cariama, Eurypyga.* |

In the greatest percentage of the above characters *Psophia* resembles the Cariamidæ, next come *Œdicnemus* and *Grus*, then *Rhinochetus*.

### *Pelvis.*

A comparison with the pelvis of a Crane (*Tetrapteryx paradisea*) may conveniently serve to indicate some of the peculiarities of the pelvis in *Psophia*, before comparing it with those of other types.

The pelvis in *Psophia* is narrower, and the anterior part formed by the prolongation of the ilia is not much longer than the posterior part; it covers only two ribs.

The inner borders of the postacetabular portion of the ilia are straight and lie close to the caudal vertebræ. The pubes come into close relations with the ischia. The process of the ilium overhanging the acetabulum is not very well developed.

In the Crane the contrary of all these conditions is found. The whole pelvis is broader and the anterior narrow region is longer than the posterior broader region. The inner borders of the postacetabular region of the ilia are concave and widely diverge from the vertebræ of the tail. The suprailiac crest is well developed.

*Cariama* and *Chunga*[1] come nearer to the Cranes in every one of the points enumerated except in the connection between the pubes and ischia.

*Aramides, Fulica*, and *Oeydromus* come nearest to *Psophia*; so also do *Parra* and perhaps *Œdicnemus*.

I do not lay any stress upon the preacetabular process (pubis of some writers), as it is absent or present in very closely allied forms; e. g. in *Tetrapteryx paradisea* (present) and *Grus australasiana* (absent).

[1] Prof. Parker says (Osteology of the Kagu, *loc. cit.* p. 516):—"Here let it be remarked that the pelvis of *Psophia* is more like that of *Oeydromus* than that of the typical Cranes."

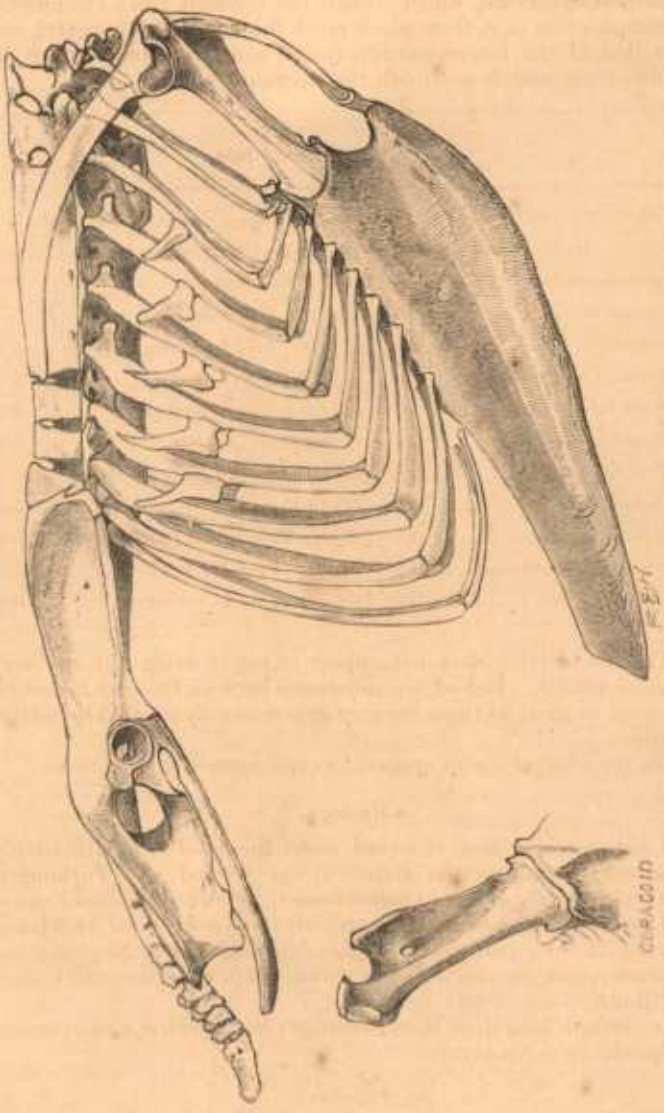



Fig. 2.

Vertebræ, ribs, and breast-bone of *Pezophaps binacpiera*.

The following table shows the number of cervical and dorsal vertebræ, of ribs, &c., in a series of birds more or less closely allied to *Psophia*. The letters *r*, *r'*, R represent rudimentary ribs, often spoken of as cervical, which precede the complete ribs; the number of complete ribs (*i. e.* those which reach the sternum) is indicated, and also that of the incomplete ribs (never more than two) which lie behind them and do not reach the sternum.

| | Cerv. vert. | Ribs. | Uncinate processes. |
|---|---|---|---|
| *Tetrapteryx paradisea* ..... | 17 | (10) $r+r'+6+2$ (lumbar) | On ribs 5–8 |
| *Balearica chrysopelargus* ... | 19 | (9) $r'+7+1$ (lumbar) | „ 4–6 |
| *Psophia leucoptera* ..... | 16 | (10) $r+8+1$ (lumbar) | „ 3–7 |
| *Eurypyga helias* ..... | 16 | (8) $r+r'+5+1$ (lumbar) | ? |
| *Parra jacana* ..... | 14 | (8) $r+r'+5+1$ (lumbar) | „ 3–6 |
| *Eupodotis senegalensis* ..... | 15 | (7) $r'+R+5$ (1 lumbar) | „ 5–8 |
| *Chunga burmeisteri* ..... | 13 | (8) $r+r'+5+r$ (lumbar) | „ 4–6 |
| *Cariama cristata* ..... | 13 | (7) $r+r'+5$ (2 lumbar) | „ 3–6 |
| *Œdicnemus grallarius* ..... | 13 | (9) $2r+r'+5+1$ (2 lumbar) | „ 3–8 |
| *Tribonyx mortieri* ..... | 13 | (11) $r+r'+5+4$ (1 lumbar) | „ 3–7 |
| *Otis tarda* ..... | 13 | (10) $r+r'+R+6+r$ (lumbar) | „ 5–8 |
| *Oxydromus australis* ..... | 13 | (10) $r+r'+6+2$ (1 lumbar) | ? |
| *Fulica ardesiaca* ..... | 13 | (10) $r+r'+7+1$ (lumbar) | „ 3–8 |

The above table does not appear to me to bring out any very valuable results. Indeed, the differences between *Otis* and *Eupodotis* are quite as great as those between genera usually referred to distinct families.

On the whole *Psophia* appears to come nearest to the Cranes.

### *Myology.*

I have nothing new to record under this head; I have simply been able to confirm the statements of Garrod and Fürbringer. In the leg the *ambiens*, *semitendinosus*, *accessory semitendinosus*, and *accessory femorocaudal* are present, the *femorocaudal* itself being absent; in these particulars *Psophia* agrees with *Otis*, *Serpentarius*, *Cariama*, *Aramus*, and *Phœnicopterus*, and differs from the Cranes and Rails.

In the fore limb there is, as Fürbringer has recorded, a conspicuous *biceps slip* to the patagium.

### *Trachea.*

The structure of the syrinx (woodcut fig. 3, p. 338) is nearest to that of *Cariama* among the possible allies of this bird, but no trenchant characters distinguish it from many Rails and the Cranes.

It has been stated by J. Hancock [1] that the windpipe in the male (but not in all males) is convoluted, passing down under the skin right to the anus and then back again. This is a remarkable point, as it shows an affinity with the Cranes, which are the only nearly allied birds, according to Mr. Forbes's careful list [2], with a similar modification. It is curious that *Psophia* is not included in that list; I have not found any such modification of the trachea myself, nor have I seen any MS. note to that effect of either Mr. Garrod or Mr. Forbes. It is evident that some particular species only shows this modification.

Fig. 3.

Trachea of *Psophia leucoptera*.

While upon this subject I may direct attention to a paper by Mr. T. S. Trail [3], in which it is said that the trachea communicates directly with the air-space surrounding it by slit-like apertures in the membrana tympani. In spite of the careful observations of Trail, it seems to me that we are dealing here with an accidental cut.

### *Viscera of Abdomen.*

The only point to which I direct attention, as being of some bearing upon the question of the affinities of *Psophia* is the attachment of the gizzard to the parietes and the development of the omentum. I have already pointed out the necessity of taking this structure into account in questions relating to the affinities of different birds. If the comparison which I [4] instituted, in part following Huxley [5], between this structure and a similar one in the Crocodile be just, it follows that those birds in which the omentum is extensive and continuous on each side with the oblique septum are relatively the most archaic forms; while the partial suppression or great reduction of this structure indicates a more modified type. Arguing thus, the Cranes will have to be relegated to a very low

[1] "Notes on the Trumpeter Bird or Warscoli of the Arowahs of Guiana, *Psophia crepitans* of Linnæus," Charlesworth's Mag. Nat. Hist. vol. ii. 1838, p. 490.

[2] "On the Convoluted Trachea of two Species of Manucode &c.," P. Z. S. 1882, p. 347.

[3] "Observations on the habits, appearance, and anatomical structure of the bird named the Trumpeter, *Psophia crepitans* of Linnæus, *Agami* of Cuvier," Mem. Wern. Soc. Ed. vol. v. (1825) p. 523.

[4] "Notes on the Visceral Anatomy of Birds.—No. 1. On the so-called Omentum," P. Z. S. 1885, p. 836.

[5] "On the Respiratory Organs of *Apteryx*," P. Z. S. 1882, p. 560.

position among Schizognathous birds; and I maintain that the structure of the skull is at least not opposed to such a conclusion.

In *Psophia* the omentum is very much reduced and the gizzard is attached to the parietes by an almost vertically running sheet of membrane; the elongated sternum completely covers the lobes of the liver, and the gizzard itself only just reaches beyond it. In these particulars *Psophia* especially resembles *Cariama* and *Chunga* and the Rallidæ, and differs in the most pronounced fashion from the Gruidæ. I have not yet dissected many Limicolæ from this point of view; but in *Hæmatopus ostralegus* the disposition of the omentum is more like that of the Cranes, though it is more reduced than in that group.

The above comparison of *Psophia* with other forms shows that it cannot be closely united with any other genus of those referred to. It appears to me to be most widely removed from the Limicolæ, though it is connected with this family by *Œdicnemus*, which should, in my opinion, be removed from the Limicolæ.

The Limicolæ may, from their skull-characters, be thus defined:—

Schizorhinal birds with the maxillary process of the nasal directed forwards. Supraorbital margin with a sharp edge marked above by considerable furrows for the nasal glands. Foramen magnum on the under surface of the skull; occipital foramina present. Vomer truncated or ending in a concave margin. Interorbital septum largely unossified. Lachrymal and prefrontal process of ethmoid fused to form a complete ring of bone. Maxillo-palatines very small and fused with palatines, invisibly or nearly so from beneath. Postorbital angle and postfrontal process distinct; temporal fossa commencing behind former process and visible on the occipital surface of skull. Basipterygoid processes usually present.

The family Rallidæ shows the following characters:—

Holorhinal birds with the maxillary process of the nasal facing outwards. Supraorbital margin rounded and without depressions for nasal glands. Foramen magnum on the posterior face of the skull; no occipital foramina. Vomer pointed in front. Palatines narrow in front, wide behind; maxillo-palatines large and swollen, quite conspicuous from below. Lachrymals quite free from prefrontal process of ethmoid. Interorbital septum incompletely ossified. Articulation of quadrate covered by a descending process of squamosal. No postorbital angle; temporal fossæ just reach the occipital face of skull. No basipterygoid processes.

If the members of these two families were the only "Gralline" birds known, it is obvious that there would be no difficulty in accepting Prof. Huxley's[1] arrangement of them into two sections—Charadriomorphæ and Geranomorphæ; but a consideration of other forms, including *Psophia*, appears to me to render this arrangement impossible.

The Cranes themselves are the first stumbling-block. They agree with the Limicolæ in many, perhaps most, characters, but in others they agree with the Rallidæ.

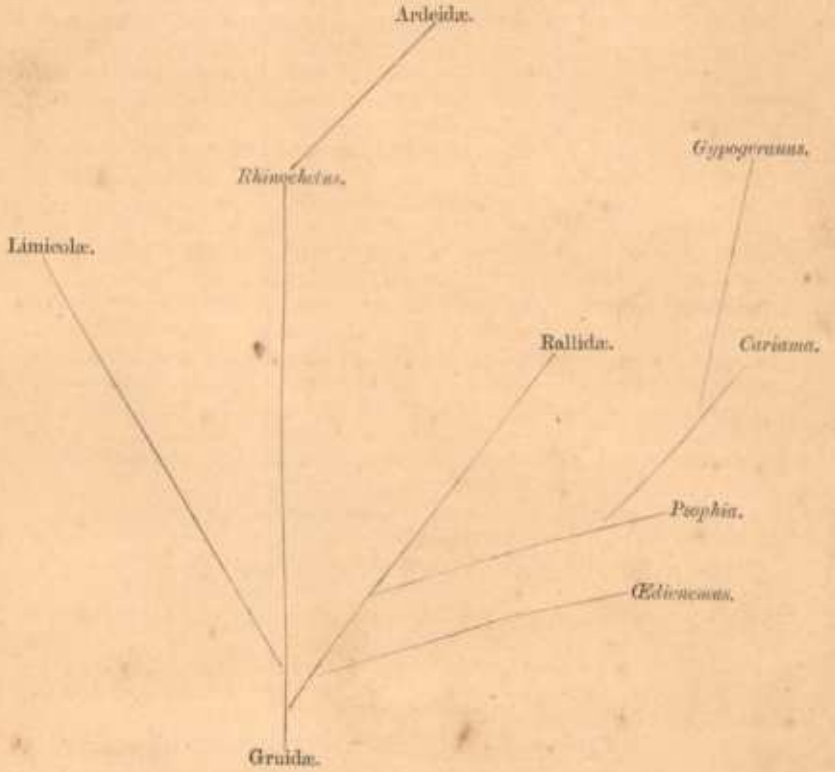
[1] "On the Classification of Birds, &c.," P. Z. S. 1867, p. 457.

They may be defined as follows :—

Schizorhinal birds with the nasals facing forwards. Supraorbital margin rounded, but with slight depressions for the nasal glands Lachrymal quite independent of the prefrontal process. Bony interorbital septum largely deficient. Maxillo-palatines large but hardly visible from below. Foramen magnum at posterior end of skull; occipital foramina present. No postfrontal process present.

The Cranes are placed by Mr. Sclater in his group Alectorides, and so far this is justified by the above definition, which shows that the Cranes are intermediate between the Rallidæ and Limicolæ and should be therefore placed apart; but when the other families included in the Alectorides are considered, such an arrangement does not appear to be feasible. *Psophia* is, in my opinion, sufficient to show that this association of birds will not hold, unless it be entirely restricted to *Psophia* and the Cariamidæ and perhaps the Bustards and *Œdicnemus*.

It appears to me, in fact, that the natural affinities of these different birds are not so difficult to make out, if we cease the attempt to combine together the various families of "Alectorides" and simply show the relationships of the several types in a graphic form.



J. Smit del. et lith.

Mintern Bros. imp.

1. HEMIZOS CANIPENNIS.
2. " CASTANONOTUS.

The most central form I believe to be *Grus*, *i. e.* the family Gruidæ (including *Aramus*). To unite this family with the Limicolæ in a group Pluviales, as Prof. Garrod[1] and Mr. Forbes[2] have done, seems to me to be an ignoring of some of the obvious cranial characters of the Gruidæ.

I do not propose to say much about *Rhinochetus* and *Eurypyga* now, as I am waiting an opportunity of completing my notes upon the anatomy of these two forms. In the meantime, however, I regard them as closely allied, and as having been given off from the Crane stock shortly after one branch of this had begun to develop in the direction of the Limicolæ.

In the Cranes the omentum is well developed, while it is less developed in the Limicolæ and is hardly recognizable in the Rallidæ, *Psophia*, and *Cariama*. If any stress may be laid upon this character, it would indicate the low position of the Gruidæ.

## 3. On new or little-known Birds from South-eastern China. By Henry Seebohm, F.Z.S.

[Received April 11, 1890.]

(Plate XXVII.)

Through the kindness of my old friend and travelling companion in Finnmark, Professor Collett, of the Zoological Museum of Christiania University, I have had an opportunity of examining a large collection of birds, comprising examples of 182 species, from North Fokien in South-eastern China. Most of the examples were procured by Herr Baun at Puching, up amongst the hills, but some of them were obtained at Foo-chow on the coast.

When it is remembered what large numbers of birds were collected by Swinhoe in South Fokien, it is surprising that amongst the birds of North Fokien examples of so many interesting species as are enumerated in the following list have been procured.

### Xanthopygia cyanomelæna.

Herr Baun has sent a female collected at Puching on the 28th of April, which agrees exactly with females of this species from China in the Swinhoe collection, and from Japan in the Pryer collection. It also agrees with the plate in the 'Fauna Japonica' of *Muscicapa gularis*.

### Xanthopygia narcissina.

Herr Baun has sent examples of this species collected at Puching

[1] "On certain Muscles of Birds.—Pt. II.," P. Z. S. 1874, p. 117. The wide separation of the Rallidæ &c. from the Cranes appears to me to be one of the most striking signs of artificiality in Garrod's scheme.

[2] "Notes on the Anatomy and Systematic Position of the Jaçanâs (*Parridæ*)," P. Z. S. 1881, p. 639; "Forbes's Final Idea as to the Classification of Birds," Ibis, 1884, p. 119. In associating together all the birds treated of in the present paper as a group Charadriomithes, Fürbringer exactly expresses my own opinion. This also is the position taken up by Mr. Seebohm (Ibis, 1889, p. 415).

on the 27th of April and the 1st of May, and there is a fine series in the Pryer collection from Japan. The females agree with the plate in the 'Fauna Japonica' of *Muscicapa hylocharis*, which appears to me to have been erroneously identified with *Xanthopygia tricolor* (Sharpe, Cat. Birds Brit. Mus. iv. p. 250). The latter species is not represented in the Pryer collection from Japan, nor is it included in the 'Fauna Japonica;' consequently the adult male (stuffed) in the British Museum, labelled "Japan, Leyden Museum," must be regarded with suspicion, and is probably a Chinese example. There is no satisfactory evidence that *X. tricolor* has ever occurred in Japan, whilst *X. narcissina* is a common bird there.

HEMIXUS CANIPENNIS, sp. n. (Plate XXVII.)

Hemixus *dorso castaneo, alis cinereo marginatis.*

In the sixth voulme of the Catalogue of Birds in the British Museum seven Bulbuls are placed in the genus *Hemixus*. A Bulbul collected by Herr Baun near Foo-chow appears to be perfectly distinct from all of them, having the ashy-grey margins to the outer webs of the quills, which are characteristic of *Hemixus cinereus* from Sumatra and Malacca, combined with the chestnut-brown back, which has hitherto been regarded as diagnostic of *Hemixus castanonotus* from Hainan.

The Foo-chow species further differs from its Hainan ally in being slightly larger (total length 8¼ inches, culmen ·85, wing 4·1, tail 3·8, tarsus ·75); in having the axillaries and under wing-coverts white, with no stains of yellow; and the breast and flanks grey, with no brown on the former, and no olive on the latter; and in having the wings and tail-feathers dark grey instead of brown.

There can be little doubt that this is the species which was met with by Mons. de la Touche near Foo-chow (Styan, Ibis, 1887, p. 224).

IOLE HOLTI (Swinhoe), Sharpe, Cat. Birds Brit. Mus. vi. p. 61.

Iole *dorso brunneo, gulâ cinereâ albo striatâ.*

Swinhoe's Bulbul has hitherto only been known from the type specimen in the Swinhoe collection from the Pih-ling hills near Foo-chow, and from an example in the Leyden Museum from Hing-yang (Swinhoe, Ibis, 1861, p. 409). The occurrence of a third example collected by Herr Baun at Puching on the 10th of May is consequently very interesting. It appears to be a good species.

It was originally described as *Hypsipetes holtii* (Swinhoe, Ibis, 1871, p. 256), but was afterwards wrongly identified by its discoverer with *Hypsipetes maclellandi* (Swinhoe, Proc. Zool. Soc. 1871, p. 369).

POMATORHINUS SWINHOEI, David, Ann. Sc. Nat. xix. Art. 9 (1874).

Pomatorhinus *pectore nigro striato, tibiis cinereis, superciliis minime albis.*

Herr Baun obtained an example of this fine species of Scimitar

Babbler at Ching-fung, in North Fokien, on the 13th of October. It is most nearly allied to *Pomatorhinus erythrocnemis*, from Formosa, which it resembles in its dimensions, but from which it differs in the following particulars:—the crown is brown rather than grey; the back is chestnut-red rather than chestnut-brown; the breast and belly are pale slate-grey in the centre, and dark slate-grey on the sides, instead of dull white in the centre, and chestnut-brown on the sides; whilst the thighs are almost entirely slate-grey, instead of chestnut and brown.

ALCIPPE HUETI, David, Ann. Sc. Nat. xix. Art. 9 (1874).

Alcippe *annulo ophthalmico albo; hypochondriis brunneis; pileo cinereo.*

Two examples collected by Herr Baun, one on the 14th of November at Puching, and the other on the 28th of October at Kien-ning, appear to be distinct from *Alcippe morrisoni* from Formosa, and still more so from *Alcippe nipalensis* from the Eastern Himalayas. The Fokien species agrees with them in having a conspicuous ring of white feathers round the eye, but differs from both in the colour of the crown and nape, which is slate-grey without any tinge of brown. The lores also differ in having no white bases to the feathers. On the underparts it agrees with the Formosan species in having the throat suffused with grey instead of buff, and with the Himalayan species in having the flanks and under tail-coverts suffused with olive-brown instead of sandy buff.

The male measures 2·55 inches in length of wing, and 2·4 in length of tail; but the female is smaller, measuring only 2·45 inches in length of wing, and 2·15 in length of tail. In both sexes the culmen measures ·5 and the tarsus ·9.

The Abbé David appears to have been fully justified in describing the Fokien bird as a distinct species; though he was subsequently induced to identify it with *Alcippe nipalensis* (David et Oustalet, Ois. Chine, p. 218), and still more recently other ornithologists have identified it with *Alcippe morrisoni* (Styan, Ibis, 1887, p. 222).

LIOTHRIX LUTEA.

Liothrix *pileo olivaceo, caudâ valde furcatâ.*

Two examples of the Red-billed Hill-Tit procured by Herr Baun at Puching, one in May and the other in November, differ from Himalayan examples in various particulars, and cannot be regarded as of the same species. The specific term *lutea* must be retained for the Chinese species, having been originally applied to examples from Nankin (Scopoli, Del. Flor. et Faun. Insubr. ii. p. 96), whilst that of *calipyga* (Hodgson, Indian Review, 1838, p. 88) will probably be recognized as the name of the Indian species. The Chinese species has a much more forked tail, the outer feathers being ·35 inch longer than the central feathers, instead of only ·15 inch. The red patch on the wing is almost as rich, whilst the red on the outer webs of the two innermost primaries is almost as pale as in *Liothrix argentauris*. The tertials of the Chinese species are

slaty green, like those of *Liothrix argentauris*, instead of being rufous green, and the general colour of the upper parts is of a bluer green than in *Liothrix calipyga*.

PARADOXORNIS GUTTATICOLLIS, David, Nouv. Archives, 1871, Bull. p. 14.

Paradoxornis *pileo rufo, gulâ albâ nigro sagittatâ*.

Herr Baun obtained an example of this curious bird at Chingfung on the 13th of October. It measures 3·6 inches in length of wing, and 4·7 inches in length of tail. The type of *Paradoxornis austeni* (Gould, Birds of Asia, iii. pl. 73) is a smaller bird, measuring only 3·1 inches in length of wing, and 3·2 in length of tail, and has all the appearance of being in immature plumage. There is a fine series in the Hume collection which agree in dimensions with the Chinese examples, so that there can be little doubt of the absolute identity of the Himalayan and Chinese birds.

SUTHORA BULOMACHUS, Swinhoe, Ibis, 1863, p. 300.

This species has hitherto been supposed to be peculiar to the island of Formosa, but Herr Baun has sent two examples collected at Puching (one in February and the other in May), which are very conspicuously streaked on the throat, and in the richness of the chestnut on the crown are intermediate between the types of *Suthora bulomachus* and *Suthora suffusa*, both of which are in the Swinhoe collection.

LANIUS BUCEPHALUS.

Herr Baun has sent two examples of this Shrike collected at Puching, one in September and the other in December.

PARUS VENUSTULUS, Swinhoe, Proc. Zool. Soc. 1870, p. 133.

Herr Baun has sent two examples of this rare Tit from Puching, collected on the 15th and 16th of November. One of them agrees with the type in the Swinhoe collection, but the other is very different. The blue-black on the head, neck, back, wing-coverts, and tertials is replaced by olive-green, and the white on the nape is suffused with yellow. It is probably a bird of the year.

SITTA CÆSIA SINENSIS.

Two Nuthatches collected by Herr Baun at Puching, one in March and the other in April, only differ in size, and that very slightly, from examples from South Europe. They measure 2·95 inches in length of wing from carpal joint.

The variations of colour in the races of the Common Nuthatch appear to be climatic, and correspond to a remarkable degree with the July isothermal lines of mean temperature. Nuthatches moult only once in the year, and July is probably the month when most of the new feathers are formed. The Kamtschatkan race is the palest, as it is of the various climatic races of *Parus palustris*, *Pyrrhula vulgaris*, *Pica caudata*, &c. It moults in a mean temperature of 54° to 58°;

## 4. On some new Fishes from the English Wealden and Purbeck Beds, referable to the Genera *Oligopleurus*, *Strobilodus*, and *Mesodon*. By A. Smith Woodward, F.Z.S., of the British Museum (Natural History).

[Received March 18, 1890.]

(Plates XXVIII. & XXIX.)

The list of genera and species of Upper Mesozoic fishes met with in the English Purbeck and Wealden beds is already somewhat extensive, many contributions to the subject having been made by Agassiz and Egerton. There still remain, however, several undescribed species well represented in collections; and a few of these in the British Museum, referable to the three genera enumerated above, form the subject of the following notes. Researches already published have indicated a close connection between the fish-fauna of the English Purbeck beds and that of the Upper Jurassic Lithographic Stones of France, Bavaria, and Würtemberg; and the new forms now described tend to demonstrate that alliance even more clearly. The British fossil remains of *Oligopleurus* are also worthy of special note, apart from questions of distribution; for their comparatively satisfactory state of preservation adds much to our knowledge of the osteology of this genus, which has hitherto been only imperfectly elucidated.

### Genus Oligopleurus.

[V. Thiollière, Poissons Fossiles du Bugey, pt. ii. 1873, p. 21.]

Oligopleurus vectensis, sp. nov. (Plate XXVIII. figs. 1–4, Plate XXIX. figs. 1, 2.)

The specimen to be regarded as the type of this species is a large laterally compressed skull and mandible from the Wealden of the Isle of Wight (Brit. Mus. no. 42013), shown, of one half the natural size, in Plate XXVIII. fig. 1. A group of scattered head- and opercular bones, with a series of vertebral centra of an equally large individual, from the same formation and locality (B.M., no. 42014), exhibit some further osteological details. Moreover, the characters of the mandibular symphysis, gill-rakers, and a single vertebral centrum in the first-mentioned fossil show that an imperfect specimen from the Purbeck beds, erroneously determined by Agassiz as *Lepidotus minor*[1], must be assigned to the same form; and this discovery leads to the identification of other Purbeckian fragments of the axial skeleton, which elucidate additional features of some interest and taxonomic importance.

*Skull, Mandible, and Opercular Apparatus.*—The type specimen is much crushed and broken, but, as shown by the figure (Plate XXVIII. fig. 1), several of the elements are distinguishable and well preserved.

[1] Foss. Poiss. Foss. vol. ii. pt. i. (1844), p. 269, pl. xxix. *c*, fig. 12.

the Central Siberian race enjoys a mean temperature at that season of 58° to 62°. The Western race in the Baltic Provinces, and the Eastern race in the valley of the Amoor, which are scarcely distinguishable, moult in a mean temperature of 65° to 70°, whilst the dark race in South Europe and its prototype in China enjoy a mean temperature of 75° to 80° during the moulting-season.

COCCOTHRAUSTES PERSONATUS.

Herr Baun obtained this species at Puching in April.

SCOPS GLABRIPES.

Herr Baun obtained an example at Puching in December. This is doubtless the species obtained by Mons. de la Touche near Foo-chow (Styan, Ibis, 1887, p. 230) and regarded as *Scops elegans*. I only know of the existence of five examples of the latter species. The type is in the Philadelphia Museum; the second example is in the British Museum (and was erroneously described in the Catalogue, vol. ii. p. 56, as *Scops japonicus*); the third is in the Educational Museum of Tokio; the fourth is the Pryer collection; and the fifth in the Smithsonian Institution at Washington.

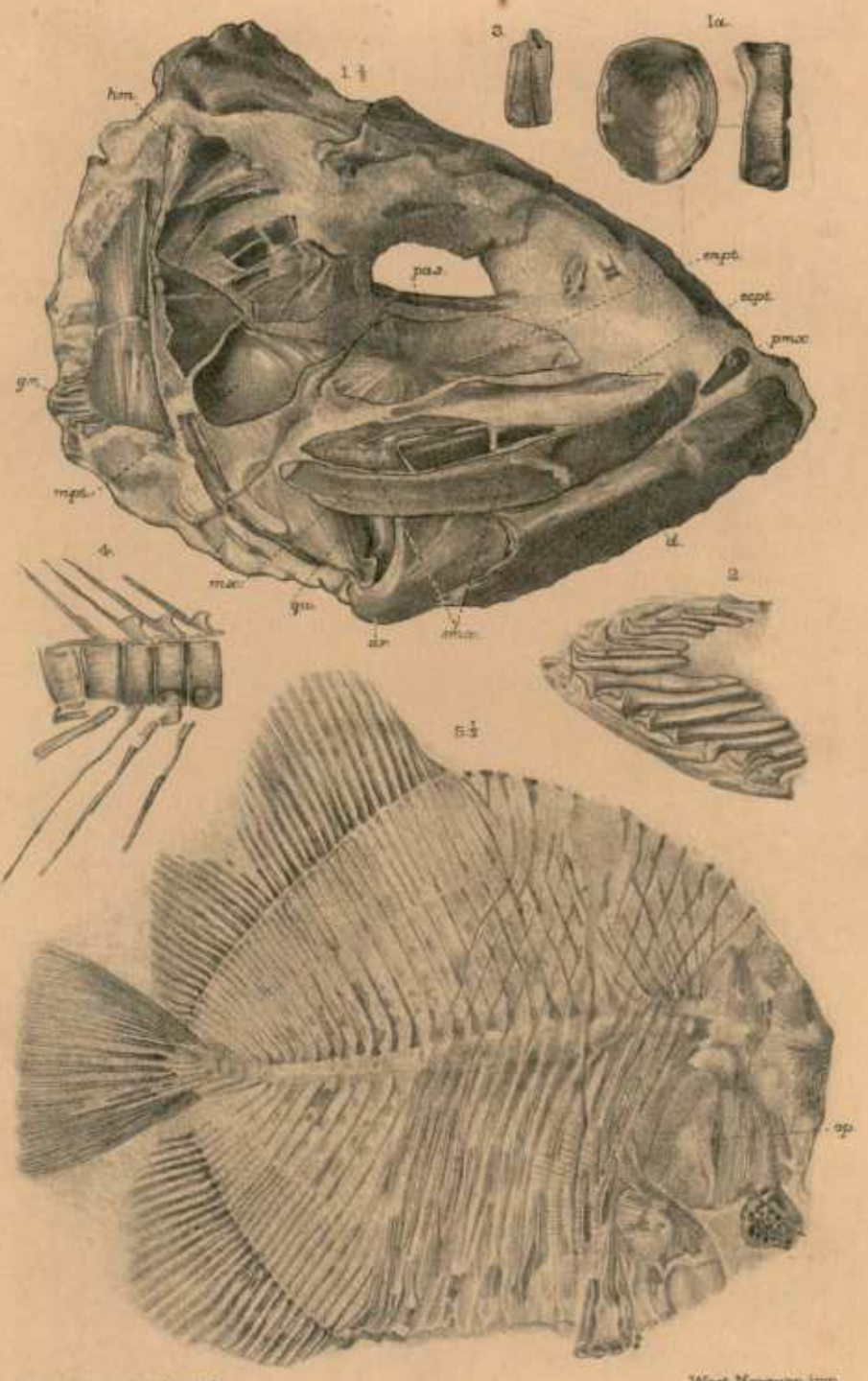
MICROHIERAX MELANOLEUCUS, Blyth, Journ. As. Soc. Beng. xii. pt. i. p. 179.

An example of this beautiful little Hawk was collected by Herr Baun at Shinkow in North Fokien on the 9th of October. It resembles four examples in the British Museum from Eastern Assam. Two other examples in the National collection differ in having more or less white at the back of the neck. Three examples collected by Abbé David in the province of Kiang-si and one obtained by Monsieur Heude near Nankin are described as "avec une tache blanche au haut du dos," and on the faith of this character have been regarded as a distinct species under the name of *Microheriax chinensis* (David, Bull. Soc. Philom. sér. 6, xii. p. 18). The validity of this species must be regarded as very doubtful.

CHARADRIUS PLACIDUS.

This species winters at Puching.

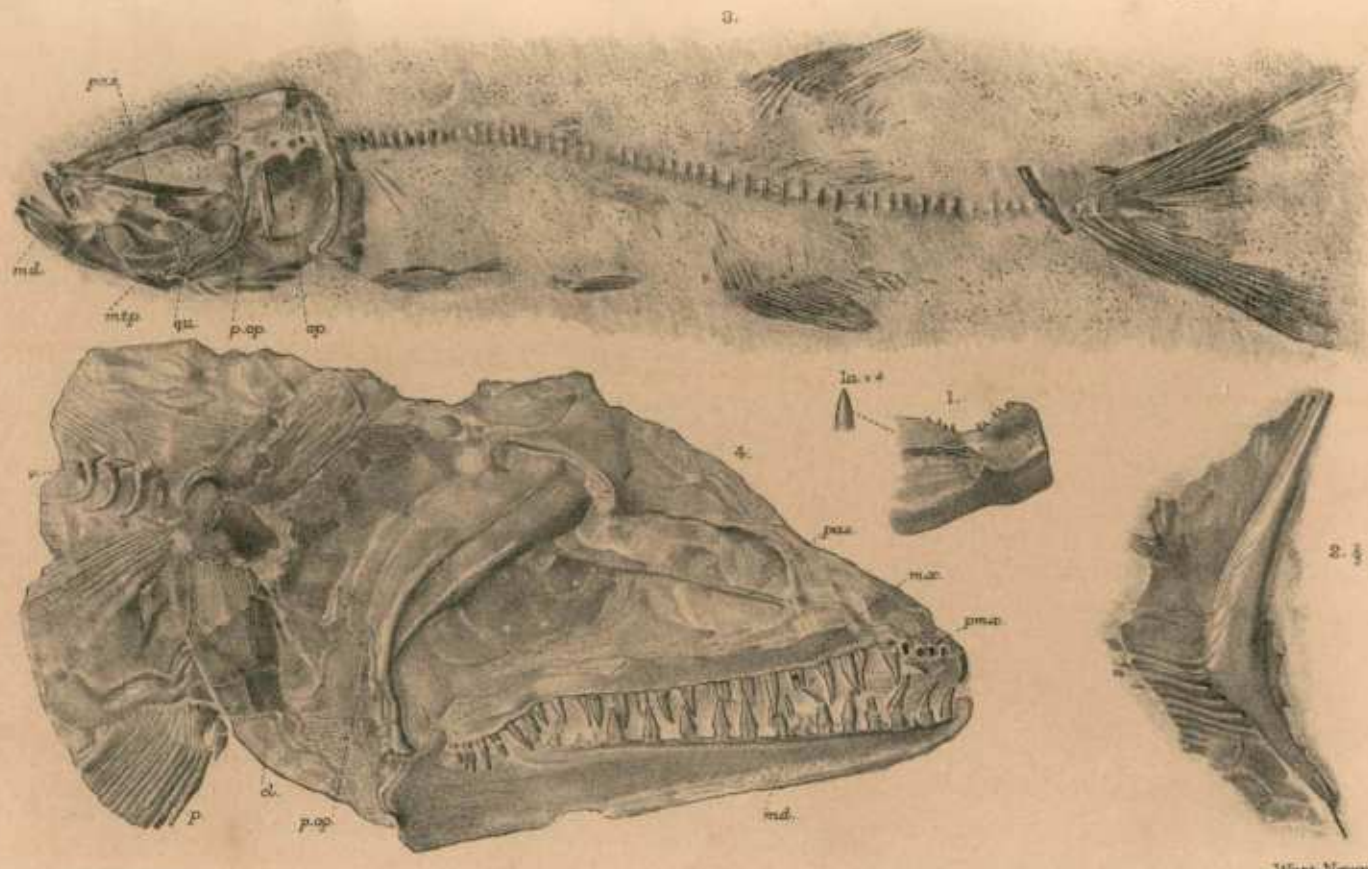
On examining a large collection of birds from a definite locality like the province of Fokien, and comparing them with an equally important collection of birds from Japan, it is impossible not to be surprised at the difference in their general character. In both collections there are many Palæarctic species which are winter visitors, but when these are eliminated it is found that the species breeding in South China and Formosa are for the most part Oriental, whilst those breeding in North China and Japan are mostly Palæarctic. Possibly the best boundary between the two Regions in China, so far as birds are concerned, may be the watershed between the valley of the Hoang-Ho and the valley of the Yang-tze-Kiang.




G.M. Woodward, del. et lith.

West, Newman imp.

1-4. Oligopleurus vectensis.
5. Mesodon daviesi.




G.M. Woodward del. et lith.

West, Newman, imp.

1, 2. Oligopleurus vectensis. 3. Oligopleurus (?vectensis).
4. Strobilodus purbeckensis.

The head is of triangular shape, much laterally compressed, and measures about 0·18 in length by 0·16 in maximum depth at the occiput. The cranial roof is broadest at the occipital border, gently arched from side to side, and produced sufficiently downwards behind the eye to form a considerable portion of the posterior border of the orbital space; there is a longitudinal median depression attaining its maximum depth and greatest breadth immediately behind the interorbital region and gradually becoming shallower in front and behind; while none of the bones appear to have been ornamented, the only superficial markings being radiating rugæ and ridges, evidently due to the ordinary processes of growth. No details of the cranial osteology can be deciphered; but it is clear that there was originally no ossified interorbital septum, and there is a fragment of the *parasphenoid* (*pas.*) in position, which shows that this bone was narrow in the middle region of the skull. In the mandibular suspensorium, the *hyomandibular* (*hm.*) is conspicuous, but its inferior portion and connections are unfortunately destroyed; the upper part of the bone is triangular in form, much expanded and laterally compressed, and at the median constriction the direction of compression becomes antero-posterior. Of the means of connection between this element and the quadrate, nothing can be discerned; but the latter bone is well shown, in position, with its condyle adjoining the socket of the articular element of the mandible. The *quadrate* (*qu.*) is triangular in shape, thinning out at its notched superior border,—the hinder margin being thickened, gently arched, turned outwards, and continued upwards as a long slender process; while the articular condyle is somewhat constricted from the main part of the bone, and has a robust, inwardly-directed process arising from its base. The last-named process is only distinguishable on the left side of the fossil, but is there prominent and not readily explained. Of the pterygo-palatine arcade, three elements are seen from their outer lateral aspect. The *metapterygoid* (*mpt.*) is nearly as deep as long, triangular, with a thickened superior border and attenuated postero-lateral and antero-lateral margins; it is gently bent, being outwardly concave behind and outwardly convex in front. The *entopterygoid* (*enpt.*) is broadest posteriorly, much elongated, with a nearly straight outer inferior border and an irregularly curved inner superior border, these gradually converging to a rounded apex in front; the bony lamina is placed more nearly in a horizontal than in a vertical position, is sharply curved downwards at its postero-lateral angle, and appears concave when viewed from the outer aspect above. The *ectopterygoid* (*ecpt.*) is a long, narrow, lamelliform bone, apposed to the outer border of the entopterygoid, and apparently extending somewhat in advance of this; but its exact form and proportions cannot be discerned. The *premaxilla* (*pmx.*) was evidently small, but only an imperfect fragment remains. The *maxilla* (*mx.*) is a long, narrow, laterally compressed, and gently arched bone, of almost uniform depth, except in its anterior third, which gradually contracts and ends in a stout, inwardly directed process; the oral border is convex, and the hinder two-thirds of the

superior border exhibit a deep, narrow depression overlapped by two *supra-maxillary* bones (*smx.*). Of the latter the hindermost is irregularly triangular, pointed behind, deepest in front, with a sharp re-entering angle on the anterior border, and a long antero-superior process; the second element is also triangular, but much elongated, its narrow base fitting into the re-entering angle just mentioned, and its tapering apex directed forwards. In the mandible, the *articular* bone (*ar.*) is laterally compressed, abruptly truncated behind, narrow beneath the socket for the condyle, and much expanded forwards in the form of an elevated triangular plate. The *dentary* (*d.*) is long, thin and deep, abruptly truncated at the symphysis, but too much crushed to exhibit all the details of form. The mandibular suspensorium is somewhat inclined forwards, and the dentary symphysis evidently projects in advance of the premaxillæ. Of cheek-plates and circumorbitals almost all traces are lost, but fragments of a thin lamina of bone, above and exterior to the metapterygoid, may probably be assigned to this category; they are marked by somewhat radiating ridges. Of the hyoid arch and its appendages, the right *ceratohyal*, with the distal end of the *epihyal* in position, is exhibited in the small Purbeck fossil described by Agassiz, and there seems to be evidence of small, slender, widely spaced *branchiostegal rays*. The operculum and suboperculum are not distinctly recognizable in any specimen; but the *preoperculum* (Plate XXIX. fig. 2) is a characteristic element. This bone is of considerable size, narrow and deep, with a broad, much thickened anterior border; its lower limb is relatively large, meeting the upper limb in a sharp angulation; and the hinder expansion of the upper limb is almost smooth, while that of the lower limb is separated from this by a transverse ridge and is itself marked by three or four rounded, parallel, or somewhat divergent ridges.

*Dentition.*—The oral margin of the maxilla is thickened, rounded, and regularly reticulated in such a manner as to suggest the original presence of a uniform cluster of very small teeth. None of these are preserved; and the teeth of the mandible are also not shown, its dentigerous border being obscured by pyritous matrix and the overlap of the maxillæ. In the small Purbeck fossil, however, the symphysial end of the right dentary is well exhibited (Plate XXIX. fig. 1). Here are preserved a few small, stout, conical teeth, which seem to have formed part of an irregular spaced series, around and between which were still more minute teeth.

*Branchial Arches.*—In the postero-inferior region of the type specimen, a short vertical series of small, horizontally directed, thick rods is conspicuous (*g.r.*), though very imperfectly preserved; and the appearance of these fragments is at first suggestive of the base of a powerful pectoral fin. The supposed *Lepidotus minor* of Agassiz, however, explains that the structures in question are referable to the branchial apparatus; and in the last-mentioned fossil one of the arches is tolerably well displayed from the outer aspect (Plate XXVIII. fig. 2). A most singular feature is thus made known, the arch being provided with a close series of enormous bony gill-

rakers (the fragmentary rods of the type specimen), each of these being smooth and elongated, with a slight constriction immediately above its base, and tapering to a point distally.

*Vertebral Column.*—A single centrum attached to the occipital portion of the type specimen (Plate XXVIII. fig. 1 *a*) shows that the vertebræ were completely ossified, while the second Wealden fossil and some of the Purbeckian specimens reveal the principal characters of the anterior part of the vertebral column. The centra are narrow and distinctly amphicœlous, much deeper than broad, and marked on the sides by fine transverse striations extending between a thickened rim anteriorly and posteriorly; a pair of deep pits on the upper aspect accommodates the neural arch, and there is a similar pair of pits on the ventral aspect for the insertion of a hæmal arch. The only traces of attached peripheral elements on the sides of the centra consist in a small, faint, rounded pit or rugosity on four or five of the anterior vertebræ in the so-called *Lepidotus*, which may have supported an intermuscular bone. The first vertebral centrum, articulating with the basioccipital, is composed of two thin discs fused together (Plate XXVIII. fig. 3), but the others are all simple, each bearing its own arch. The neural spines (Plate XXVIII. fig. 4) are long and slender, fixed to delicate, low arches, with prominent zygapophyses; and if the fossil that best displays these structures gives equally reliable indications of the hæmal elements, the latter have the form of very feebly developed ribs. Two long curved bones in the second of the large Wealden specimens are also at first sight suggestive of ribs, and seem to indicate a greater development of these structures than is here shown; but the elements in question are not certainly determinable and may be branchiostegal rays.

*Generic and Specific Determination.*—That the fossils now described pertain to the genus *Oligopleurus* seems evident from the form and proportions of the jaws and dentition, the characters of the vertebral centra, and the slight development of the neural and hæmal arches. The absence of scales is explained by their extreme tenuity in the fish of the Lithographic Stone, and the coarse nature of the matrix in which the new Wealden and Purbeck specimens occur.

These fossils, however, scarcely suffice for a specific determination, and unless the small immature individual from the Purbeck beds, shown, of slightly reduced size, in Plate XXIX. fig. 3, be the young of the form under consideration, no precise diagnosis can as yet be attempted. That the larger fossils now described represent a distinct species from the typical *O. esocinus*, seems to be indicated by the narrowness and greater relative depth of the anterior vertebræ in the English specimens; and they may thus be provisionally named *O. vectensis*, from the discovery of the first and best-preserved fossil in the Isle of Wight. If, however, the small fish just referred to prove to be truly referable to the same species, it will readily be distinguished by its much more slender proportions—the depth of the trunk at the position of the pectoral arch being comprised nearly seven times in the total length, whereas in *O. esocinus* the same

measurement is contained scarcely six times in the total length. The caudal pedicle is also much less robust in this immature Purbeckian fish than in the typical species from the French Lithographic Stone.

## Genus Strobilodus.

[A. Wagner, Abh. k.-bay. Akad. Wiss., Cl. ii. Bd. vi. 1851, p. 75.]

Strobilodus purbeckensis, sp. nov. (Plate XXIX. fig. 4.)

A single example of the head and pectoral arch, with a portion of the abdominal region, exposed from the right lateral aspect, indicates the occurrence of a small species of *Strobilodus* in the Purbeck beds of Swanage. The specimen is shown of the natural size in Plate XXIX. fig. 4, and is unfortunately too much crushed to exhibit many details of its osteology. It adds, however, a few new points to previous observations on the genus.

*Head and Opercular Apparatus.*—The head must have been originally somewhat compressed from side to side, longer than deep, and with a pointed snout. The cranium is narrow and elongated, with a well-developed *parasphenoid* (*pas.*); and the cranial roof exhibits no ornamentation, being only sparsely pitted. The *premaxilla* (*pmx.*) is evidently short, though much broken, and the *maxilla* (*mx.*) is relatively long and narrow. This element is robust and has a somewhat wavy denticerous border, its anterior two thirds forming a gentle convexity, this passing backwards into a short concavity, and becoming convex again at the hinder end. The *mandible* (*md.*) is also long and narrow, deepest at its articulation, and gradually tapering to its pointed extremity. The mandibular suspensorium is very oblique, but its elements are obscured by thin postorbital membrane bones, which seem to have attained considerable proportions and are externally unornamented. The branchial arches and pectoral arch are also covered by the crushed remains of the opercular bones, which likewise exhibit a smooth outer surface. The *preoperculum* (*p.op.*) is long, narrow, and gently curved, without a distinct inferior limb.

*Dentition.*—A single series of teeth, of large size and well spaced, occupies the whole of the margin of the mouth above and below. Each tooth is fused with the supporting bone, has a large pulp-cavity, is somewhat tumid at its base, and ends upwards in a long, slender, tapering apex; there is also a characteristic median longitudinal depression on the outer aspect of the tumid base of all the principal teeth. The teeth vary somewhat in size, those of the maxilla being largest in the middle of the great convexity, smallest in the concavity, and relatively long, slender, and closely arranged on the hinder convexity. In the mandible, the largest examples are in the middle of the ramus. There are not less than twenty-eight teeth in the upper jaw and twenty in the lower.

*Vertebral Column.*—The remains of the vertebræ (*v.*) are seen in the form of narrow, though robust rings, either complete or nearly so, somewhat angulated, and apparently with slight tuberosities for

the support of the hæmal arches. There are also long slender ribs and neural spines.

*Appendicular Skeleton.*—The basal portion of the pectoral fin (*p.*) consists of stout unarticulated rays, not less than fifteen in number; but the distal part of the appendage is unfortunately wanting.

*Scales.*—There is distinct evidence of a well-developed squamation. The scales are thin, ganoid, and smooth externally, and appear as if deeply overlapping.

*Generic and Specific Determination.*—The principal characters of the fossil thus described show that it pertains either to *Caturus* or *Strobilodus*; and, as remarked by von Zittel, the known differences between these two types are so slight that it is probable the latter must only be regarded as a subgenus of the former. Since, however, the obliquity of the mandibular suspensorium is greater and the ossification of the vertebræ apparently more advanced than in the typical species of *Caturus*, while the teeth exhibit bases as tumid and as much indented externally as those of the typical *Strobilodus*, it seems advisable to adopt the latter name for the Purbeckian fossil, whatever its value may eventually prove to be.

Of this genus, *S. gigas*, from the Lithographic Stone of Bavaria [1], and *S. suchoides*, from the Kimmeridge Clay of Norfolk [2], are the only two recognized species; and the new fossil is distinguished from both by attaining scarcely half the size, by the relative narrowness of the maxilla and mandible, the slenderness of the apical portion of the principal teeth, and the extreme elongation of the hindermost maxillary teeth. It may thus be regarded as indicating a hitherto unrecognized species, to be named *S. purbeckensis*, from its occurrence in the Purbeck beds, which constitute the highest horizon as yet known to yield remains of the genus in question.

## Genus Mesodon.

[A. Wagner, Abh. k.-bay. Akad. Wiss., Cl. ii. Bd. vi. 1851, p. 56.]

Mesodon daviesi, sp. nov. (Plate XXVIII. fig. 5.)

A typical member of the Pycnodont genus *Mesodon*, from the Purbeck beds of Swanage, is indicated not only by the well-preserved fish shown in Plate XXVIII. fig. 5, but also by the head and anterior abdominal region of another individual, which may possibly pertain to a distinct species. The total length of the complete specimen is 0·225, the figure being thus one half of the natural size. The fish is round and short, the maximum depth of the trunk immediately in advance of the dorsal fin being somewhat less than the length of the head and trunk to the base of the caudal fin; while the head and opercular apparatus are contained nearly five times in the total length (including the caudal fin).

*Head and Opercular Apparatus.*—The bones of the head are much crushed and obscurely defined, the majority being partly broken away, and some only displaying the fibrous inner aspect. The skull

[1] A. Wagner, *loc. cit.* p. 75, pl. ii.

[2] *Thlattodus suchoides*, R. Owen, Geol. Mag. vol. iii. (1866), p. 55, pl. iii.

and mandible together are more than twice as deep as broad, and, as usual in the genus, the facial profile below the frontal angulation is vertical. The *operculum* (*op.*) is small, having a coarse, radiating, fibrous appearance, possibly not merely superficial, but textural; it is irregularly triangular in shape, its depth being at least twice as great as its maximum breadth, and the postero-inferior angle apparently well-rounded.

*Dentition.*—The jaws and teeth are so much crushed as not to be readily determinable; but the principal teeth are not more than twice as broad as long, while the others are of considerable relative size and round. Appearances are also suggestive of there being only two outer series of teeth in the mandible [1].

*Vertebral Axis.*—There is the ordinary vacant space denoting a persistent notochord, and the small expansions of the bases of the neural and hæmal arches are partly seen. There are not less than 13 segments in the abdominal region, and 20 in the caudal, these exhibiting the usual form and proportions.

*Appendicular Skeleton.*—To the remains of the pectoral arch behind is fixed a large expanded fin, situated well upon the side of the fish. It consists of numerous broad delicate rays, doubtless closely articulated, and very divergent distally. The ventral margin that would support the pelvic fins is broken away; but the median fins are well preserved, except the distal portion of the anal. Their rays, like those of the pectoral, are broad, closely articulated from a point near the base, somewhat spaced, and branching distally. The dorsal fin arises at the middle point of the trunk, and comprises 39 rays, of which the fifth or sixth is probably the longest, its length being nearly half that of the base-line of the fin. The anal fin comprises about 30 rays, is somewhat more than three-quarters as long as the dorsal, arising behind the latter, but terminating at the same point quite at the end of the caudal pedicle. The caudal fin has a narrow base, and its rays are most slender and clustered at the dorsal and ventral borders; the median rays are sparser and more robust, but scarcely extend further back than the lateral rays, thus imparting to the fin a truncated, rather than a rounded form.

*Scales.*—The thickened ribs of about fifteen vertical series of scales are observed in the abdominal region, the hindermost proceeding from a point slightly in advance of the dorsal fin and meeting the origin of the anal. There are also traces of the serrated dorsal and ventral ridge-scales, but these seem to have been small.

*Generic and Specific Determination.*—The form and proportions of the head, caudal pedicle, and caudal fin demonstrate that the fish now described is truly referable to *Mesodon*; and it is one of the most complete examples of the genus hitherto made known. The circumstance that so few details are forthcoming as to the

[1] In the imperfect specimen mentioned above (p. 351) there are distinctly only two series of teeth external to the principal row in the mandible; but the present writer is inclined to doubt the specific identity of this fossil with the fine specimen now described, its principal lower teeth being broader in proportion to their length and the outer teeth relatively smaller.

characters of the teeth is somewhat unfortunate, and this important information must be supplied before the species can be regarded as completely defined. The characters enumerated above, however, are at once sufficient to exclude from comparison all known species except the typical *M. macropterus*, from the Lithographic Stone; and, as shown by a nearly complete specimen of the last-named form in the British Museum (no. P. 5546), it is distinguished from the Purbeck fossil by the maximum depth of the trunk being equal to the combined length of the head and trunk, while the head and opercular apparatus together occupy not less than one quarter of the total length of the fish. It is thus evident that we are concerned with a new species; and, the generic relationships of the fossil having been first recognized by Mr. William Davies (in the Brit. Mus. Register), the name of *Mesodon daviesi* seems appropriate.

## EXPLANATION OF THE PLATES.

### Plate XXVIII.

Fig. 1. *Oligopleurus vectensis*, sp. nov.; head, lateral aspect, one half natural size. Wealden; Isle of Wight. [B.M., no. 42013.]
*ar.*, articular. *d.*, dentary. *ecpt.*, ectopterygoid. *enpt.*, entopterygoid. *g.r.*, gill-rakers. *hm.*, hyomandibular. *mpt.*, metapterygoid. *mx.*, maxilla. *pas.*, parasphenoid. *pmx.*, premaxilla. *qu.*, quadrate. *smx.*, supramaxillaries.
1 *a*. Vertebral centrum, posterior and lateral aspects.
2. Ditto; branchial arch and gill-rakers, outer aspect. Middle Purbeck beds, Swanage. [B.M., no. P. 4219.]
3. Ditto; first vertebral centrum of same specimen, right lateral aspect.
4. Ditto; vertebræ, lateral aspect. *Ibid.* [B.M., no. P. 1121.]
5. *Mesodon daviesi*, sp. nov.; lateral aspect of fish, one half natural size. *Ibid.* [B.M., no. 41387.]
*op.*, operculum.

### Plate XXIX.

Fig. 1. *Oligopleurus vectensis*, sp. nov.; anterior portion of dentary bone, lateral aspect. Middle Purbeck beds, Swanage. [B.M., no. P. 4219.]
1 *a*. Tooth, enlarged four times.
2. Ditto; preoperculum, two thirds natural size. *Ibid.* [University College, Bristol.]
3. *Oligopleurus* (? immature *vectensis*); lateral aspect of fish, nearly natural size. *Ibid.* [B.M., no. 40423.]
*md.*, mandible. *mtp.*, metapterygoid. *op.*, operculum. *p.op.*, preoperculum. *pas.*, parasphenoid. *qu.*, quadrate.
4. *Strobilodus purbeckensis*, sp. nov.; head, &c., lateral aspect. *Ibid.* [B.M., no. 46911.]
*cl.*, clavicle. *mx.*, maxilla. *pmx.*, premaxilla. *p.*, pectoral fin. *v.*, vertebræ. Other letters as before.

B.M. = British Museum. Unless otherwise stated the figs. are of the natural size.

May 6, 1890.

Prof. Flower, C.B., 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 April 1890 :—

The total number of registered additions to the Society's Menagerie during the month of April was 104, of which 36 were by presentation, 3 by birth, 46 by purchase, 1 was received in exchange, and 18 on deposit. The total number of departures during the same period, by death and removals, was 71.

Amongst the additions special attention may be called to:—

Two specimens of Simony's Lizard (*Lacerta simonyi*) from the lonely rock of Zalmo, near the island of Ferro, Canaries. This is a rare Lizard lately described by Dr. Steindachner (Anz. k. Ak. Wiss. Wien, 1889, p. 260), and only known from this spot, where it is said to subsist on crabs. These specimens were obtained by Canon Tristram, F.R.S., during his recent visit to the Canaries, and were presented to the Society by Lord Lilford.

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Mr. Sclater exhibited and made remarks upon the stuffed head of an Antelope, sent to him for identification by Mrs. Montgomerie, of Hunston House, Ware, Herts.

The specimen had been shot by Commander R. A. J. Montgomerie, R.N., of H.M.S. 'Boadicea,' on or about the 16th June, 1889, when on a shooting-excursion about four days inland from Malimdi, on the East-African coast, north of Zanzibar. It was observed, along with several others like it, amongst a herd of Zebras.

Mr. Sclater referred this head to what is commonly called the Korrigum Antelope (*Damalis senegalensis*), and made the following remarks:—

The Korrigum is a fine and conspicuous Antelope, well figured in the 'Knowsley Menagerie' (tab. xxi.) from specimens formerly living at Knowsley; but it is still rare and little known in Europe. I have never seen living specimens during my long experience among Zoological Gardens, and there is no example of its skin in the British Museum, where it is only represented by a series of skulls and horns[1].

The Korrigum appears to have a wide distribution across Central Africa from Senegal through the interior to Sennaar and Somali-Land. Whether it is really the "Koba" of Buffon, upon which the term *senegalensis* was originally founded by Desmarest, seems to be uncertain, but it is certainly the *Damalis senegalensis* of Gray; and there is no doubt that it occurs in Senegal, whence living

[1] There are two stuffed specimens in the Derby Museum, Liverpool, as Mr. T. Moore kindly informs me, no doubt the animals formerly living in the Knowsley Menagerie.

specimens were transmitted to Lord Derby by Mr. Whitfield. Dr. Percy Rendall has also recently sent a skull of this Antelope from the Upper Gambia to the British Museum.

In Central Africa the Korrigum was obtained by Messrs. Denham and Clapperton during their journey to Lake Tchad. Proceeding further eastwards, we find this Antelope recorded by Sundevall as

Fig. 1.

Head of *Damalis senegalensis*.

met with in Sennâar, under the name *Bubalis koba* (Exp. Pec. Syst. p. 159). It is probably also the *Damalis tiang* of Heuglin, so far as we can tell from his figure and description (Antlopen u. Büffel Nordost-Afr. p. 23). Heuglin tells us this is one of the commonest

Antelopes on the Sobat and Bahr-el-Ghasal. Two skulls obtained by Petherick on the Bahr-el-Ghasal are in the British Museum.

Examples of the Korrigum have recently been obtained by several of our naturalists and hunters in Eastern Africa, where this

Fig. 2.

Skull of *Damalis senegalensis*.

species appears to be distributed over Southern Somali-Land as far south as the river Tana. Lord Walsingham has a skull obtained by Mr. F. J. Jackson, F.Z.S., in the vicinity of Lamu (see fig. 2),

and there is a head in the British Museum obtained by Sir John Kirk on the river Juba[1]. We have also the present head now before us, obtained in the Tana valley; and the "Senegal Antelope" is enumerated among those "seen up the Tana" by Sir Robert Harvey and his party in Sir John Willoughby's 'East Africa and its Big Game' (p. 283).

I append a list of the principal references to this Antelope:—

*Le Koba*, Buffon, Hist. Nat. xii. p. 267 (1764) (Senegal) (?).

*Senegal Antelope*, Pennant, Synops. Quadrupeds, p. 38 (1771); id. Hist. Quadrupeds, p. 91 (1781) (?).

*Antilope senegalensis*, Cuv. Dict. Sc. Nat. ii. p. 235 (1816).

*Antilope koba*, Desm. N. D. d'H. N. ii. p. 167 (1816).

*Antilope senegalensis*, Desm. Mammalogie, p. 457 (1820) (?).

*Antilope senegalensis*, Children in Denham and Clapperton, Narrative of Travels in N. and Central Africa, p. 192 (1826).

*Damalis senegalensis*, Ham. Smith, in Griff. An. K. v. p. 363 (1827).

*Antilope korrigum*, Ogilby, P. Z. S. 1836, p. 103.

*Bubalis lunatus*, Sund. Act. Stock. 1842, pp. 201, 243 (Sennaar).

*Bubalis koba*, Sund. Exp. Pec. Syst. p. 159 (Sennaar) (1844).

*Damalis korrigum*, Gray, List of Mamm. in B. M. p. 158 (1843).

*Damalis senegalensis*, Gray in Knowsl. Men. p. 21, t. xxi. (1850).

*Damalis senegalensis*, Gray, Cat. of Mamm. in B. M. iii. Ungulata Fure. p. 126 (1852).

*Damalis tiang*, Heuglin, Ant. u. Büff. Nordost-Afrika's, p. 22 (1863).

*Damalis senegalensis*, Gray, Cat. Rum. in B. M. p. 45 (1872).

*Damalis senegalensis*, Gray, Hand-list of Edentates &c. p. 115 (1873).

*Damalis senegalensis*, Noack, Zool. Jahrb. ii. p. 208 (1887).

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Prof. G. B. Howes, F.Z.S., exhibited some specimens of *Hatteria* showing the "pro-atlas" and vomerine teeth, and made the following remarks thereon:—

"*Pro-atlas*."—His attention had been recently called, in conversation with Mr. Boulenger, to a specimen of *Hatteria* in which the "pro-atlas" was present only on the left side. The specimen in question was dissected by Mr. Ridewood, and was now among the exhibits in the index collection of the Natural History Museum. As the "pro-atlas" was present only on the left side in Albrecht's

[1] Sir John Kirk writes to me, in reply to inquiries about this specimen, as follows:—

"The Senegal Antelope, so far as I know, is first found on the east coast, to the north of the river Sabaki at Malimdi. It is common at Mererei in Formosa Bay, where it might be seen every day when I was shooting there. It was also common between Lamu and the river Juba, where I first shot it. So far as I am aware it does not exist anywhere on the coast south of the Sabaki, but may be found further inland. In the Kilimanjaro district it is replaced by *Alcelaphus cokii*, and in the country opposite Zanzibar by the (so-called) *A. lichtensteini*, which, however, I suspect is not the same as *A. lichtensteini*, Peters, of the Zambesi region."—P. L. S.

original specimen (Bullet. Mus. Belg. t. ii. p. 185), and as doubts had recently been thrown upon its existence by Cornet and Smets (*cf.* Dollo, Zoolog. Jahrb. Jena, t. iii. Anat. p. 433), he deemed it advisable to examine the material at his disposal. Six spirit-specimens were accordingly examined; five of them showed that, as with the examples of Baur (Zoolog. Anz. 1886, p. 1) and Dollo, the "pro-atlas" was present and bilaterally symmetrical, while in the sixth (viii.) it was present on the right side only, having been apparently removed on the left. He fully acquiesced in Dollo's criticisms of the statements made by Cornet and Smets and of the views of these and other observers, and agreed with them in regarding the "pro-atlas" as (*l. c.* p. 437) "without doubt constant in *Hatteria*"; he, moreover, believed that it was invariably present on both sides, and that in those examples in which it had been detected on one side only, it had been either lost (as suggested by Albrecht, *l. c.* p. 192) in maceration, or incautiously removed. Referring to the general relationships and morphology of the "pro-atlas," he pointed out that the former are most nearly in harmony with the supposition that it represents the arches of a vestigial vertebra. It articulates upon the skull; and in its relations to the episkeletal muscles it repeats the conditions of the atlas; its arches are preformed in cartilage (*cf.* Baur, Amer. Nat. 1886, p. 288); they lie, like those of a normal vertebra, buried in the dorso-lateral (occipito-atlantal) ligaments (fig. 3) of the vertebral column, and their separation in the dorsal middle line is but an exaggeration of that so characteristic of the atlas in *Hatteria*, Crocodilia, and many other Sauropsida. He stated that he was inclined to accept Dollo's declaration of homology between those various structures, which have been described in leading classes of Vertebrata, to which he collectively applies the term "pro-atlas" (for genera and species see Dollo, Bull. Mus. Belg. t. iii. p. 127, and Zoolog. Jahrb. *l. c.*); and that the views of that author appeared to him to be in complete harmony with Froriep's important discovery (Archiv f. Anat. u. Phys., Anat. Abth. 1882, p. 279) of the vertebral nature of the occipital segment of the skull, and with those of Sagemahl (Morpholg. Jahrb. Bd. ix. p. 177), Jungersen, and others which bear upon it.

*Vomerine Teeth.*—These were originally described by Baur (Zool. Anz. 1888, p. 85) in a young individual of 210 millim. total length, the skeleton of which was still largely cartilaginous. Prof. Howes's interest in the question had been heightened by a statement of Mr. Boulenger's to the effect that he had not been able to find vomerine teeth in any of the skulls of *Hatteria* in the Natural History Museum. He had examined the palates, in all, of nine specimens, details of which were given as follows:—

*Specimens examined.*

Prepared skeletons.

| | *"Pro-atlas"* | *Vomerine teeth* |
|---|---|---|
| i. 200 mm..... | ..... | absent. |
| ii. 220 mm..... | ..... | present, the right the larger. |

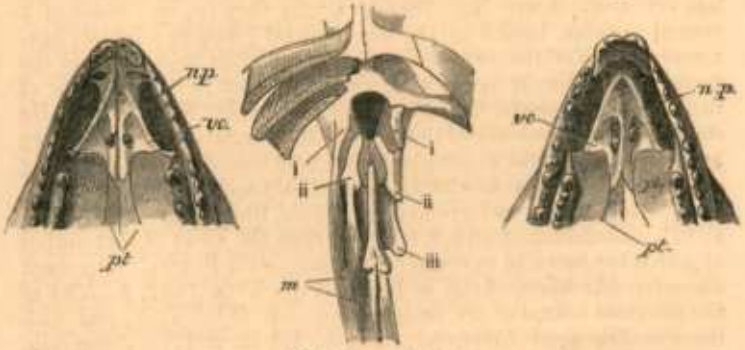
Carcases.

| | "*Pro-atlas*" | *Vomerine teeth* |
|---|---|---|
| iii. ♂, 240 mm. ..... | present on both sides. | last traces. |
| iv. 240 mm. ..... | present on both sides. | absent. |
| v. Senile ♂, 225 mm. | present on both sides. | present on right side only. |
| vi. ♀, 220 mm. ..... | present on both sides. | absent. |
| vii. ♂, 210 mm. ..... | present on both sides. | present, bilaterally symmetrical. |
| viii. ♀, 182 mm. ..... | damaged. | absent. |
| ix. ♀, 158 mm. ..... | present on both sides. | absent. |

Five of the above-named specimens are in the teaching collection of the Normal School of Science and Royal School of Mines, S. Kensington; for the opportunity of examining three others Prof. Howes was indebted to his former pupil Mr. A. Vaughan Jennings, who had just returned from New Zealand, and for the remaining one he had to thank his Demonstrator, Mr. M. F. Woodward.

The occasional absence, mutilation, or reproduced condition of the tail render measurements expressive of the total length of the body of a Lizard of little value. Those given above express the length of the body along the mid-ventral line, from the posterior edge of the symphysis ischii (which can be readily felt through the skin) to the anterior one of the symphysis mandibuli.

Fig. 1. Fig. 3. Fig. 2.




*Hatteria punctata.*

Fig. 1. Anterior palatal region of skull, showing bilaterally symmetrical vomerine teeth. (Young [sexually mature] ♂.)

Fig. 2. Similar view of a second specimen, showing asymmetrical condition of the teeth together with their mode of suppression, and apparent duplication on the right side.

Fig. 3. Dorsal aspect of the occipito-atlantal region to show the "pro-atlas" in relation (right side) to the occipito-atlantal ligament and skull, and (left side) to the dorsal episkeletal muscles.

*Reference letters.*—*m.*, dorsal episkeletal muscles; *n.p.*, posterior nares; *pl.*, palatines; *pt.*, pterygoids; *vo.*, vomers; i, "pro-atlas"; ii, atlas; iii, axis vertebra.

Four of these showed the teeth in an unmistakable form; and in all which had not been macerated he found, whether teeth were present or not, a couple of thickenings of the mucous membrane, in the region which they occupied, beneath which there lay corresponding ridges of the vomers. He had noted the presence of these

ridges in all the skulls which he had examined. Alluding to the teeth themselves, he said he had been able to examine them in relation to the mucous membrane of the roof of the mouth in two specimens. In one of these, it so happened that the teeth were unequally developed, that of the right side being the larger. The individual tooth alluded to was the largest he had observed; its apex was exposed, but it could not in any sense be said to project into the cavity of the mouth. The tooth of the opposite side, which had more nearly the proportions observed in other specimens, was wholly buried beneath the mucous membrane, in the manner of a vestigial structure. In the other specimen the insignificant vestiges of the teeth which were present lay wholly beneath the mucous membrane, which completely covered their apices.

In one specimen there was present on the right side (fig. 2, p. 359) a small tooth-like tubercle in continuity with the base of the vomerine tooth. He was unable to say definitely whether the former represented a distinct tooth or a dismembered portion of the larger one.

Commenting upon the aforementioned facts, he pointed out that in the recently discovered *Palæohatteria* of the Permian (Credner, Zeitschr. deutsch. geolog. Gesellsch. 1888, p. 490), which animal unmistakably connects the living *Hatteria* with the *Stegocephalia*, the vomers were markedly dentigerous. It becomes therefore a question whether, in *Hatteria*, we are dealing with a vestigial or a reversional condition of the same. Baur's observation alluded to would seem to indicate that vomerine teeth appear in the young individual and disappear with advancing age. On the other hand, the most marked development of the individual tooth which Prof. Howes had observed was realized in a senile old male (v.), while Mr. Boulenger had failed to find teeth in a specimen much younger than that of Baur[1]. The presence of a minute tooth on one side (ii.), where that of the other was well defined, was suggestive of a peculiar mode of disappearance of paired vestigial structures known elsewhere (which he illustrated by the exhibition of a Pigeon's intestine in which but one of the two familiar cæca was present), and therefore indicative of the vestigial nature of the vomerine teeth. The observations of Boulenger and Baur did not appear to him to be contradictory, as vestigial structures are well known to frequently appear late.

So far as the evidence afforded by his tooth-bearing specimens went, the tooth of the left side was the more variable, that being either small or absent, while the tooth of the right side was well-developed or even duplicated (?). It would therefore appear that the teeth in question are not only vestigial but that they are, at the present time, undergoing suppression from left to right.

Prof. Howes finally directed attention to the fact that those individuals possessed of teeth, in which he had been able to determine the sex, were males, and alluded to the desirability of information concerning the vomer of Colenso's supposed new species of *Hatteria* (*Sphenodon diversum*, Trans. New Zealand Instit. vol. xviii. p. 118, 1886).

[1] In the possession of Sir W. Buller, approximate total length about 120 mm.

Two letters were read addressed to the Secretary by Dr. Emin Pasha, C.M.Z.S., dated Bagamoyo, March 1890, announcing that he had forwarded certain zoological specimens for the Society's acceptance. Amongst them was an example of *Anomalurus orientalis*, Peters, from Monda, in the Nguru Mountains, and one of *Rhynchocyon petersi* from Mandera.

Mr. Henry Seebohm exhibited a specimen of the Eastern Turtle-Dove (*Turtur orientalis*), which had been sent to him by Mr. James Backhouse, jr., of York, with a letter stating that it had been shot on the 23rd of October last at a place commonly known as Nab Gutter, a small stream running from Oliver's Mount near Scarborough down to the sea. It flew very swiftly and was pursued by a number of small birds. A Red-breasted Flycatcher (*Muscicapa parva*) was shot in the same locality on the same day. This example of the Eastern Turtle-Dove is in the plumage of the first autumn, without the pied patch on each side of the neck. The Oriental Turtle-Dove, in its typical form, with the axillaries, under tail-coverts, and the tips of most of the tail-feathers bluish grey, bred in South-east Siberia, China, and Japan, as well as in the hilly part of India. It was not known to have previously occurred in the British Islands, but it had twice been recorded, both times in immature plumage, in the north of Scandinavia.

Prof. F. Jeffrey Bell, F.Z.S., read the first of a series of papers entitled "Contributions to our Knowledge of the Antipatharian Corals." The present communication contained the description of a particularly fine example of the Black Coral of the Mediterranean (*Gerardia lamarcki*), and an account of a very remarkable Antipathid from the neighbourhood of the island of Mauritius, which it was proposed to call *Antipathes robillardi*.

This Memoir will be published in the Society's 'Transactions.'

The following papers were read:—

## 1. Notes on the Wild Sheep and Mountain-Antelope of Algeria. By E. N. Buxton[1].

[Received March 31, 1890.]

During a shooting-excursion into the Algerian Atlas in 1890, I obtained specimens of the Wild Sheep and the Mountain-Gazelle, of which the mounted heads are now exhibited.

My expedition was undertaken in January and February of the present year. The Djebel Metlili overlooking El Kantera, a station on the Biskra railway, was the first range I tried for Wild Sheep. I was advised by naturalists at home that the extension of the railway to this point would certainly have driven them further afield. It so

[1] Communicated by P. L. Sclater, M.A., Ph.D., F.R.S.

happened, however, that, though we were singularly unlucky in our hunting here, we saw them on several occasions within sight of the Station and within hearing of the railway-whistle. This was no doubt owing to the fact that there is a very lofty and broken cliff at that end of the mountain. On one occasion I saw with the telescope, from the neighbourhood of the Station itself, a small herd about 4 miles off, near the top of the mountain.

Other ranges which we explored, and where we found the Sheep, were the curiously honeycombed Salt Mountain (literally of solid salt) to the east of El Outaja, a few miles south of El Kantera; Bou Arif, 12 miles to the west of that place; and the Ahmar Khadou, 40 miles to the east of Biskra, and forming part of the Aurès Range. In fact, we found more or less of them in every precipitous range where we sought for them.

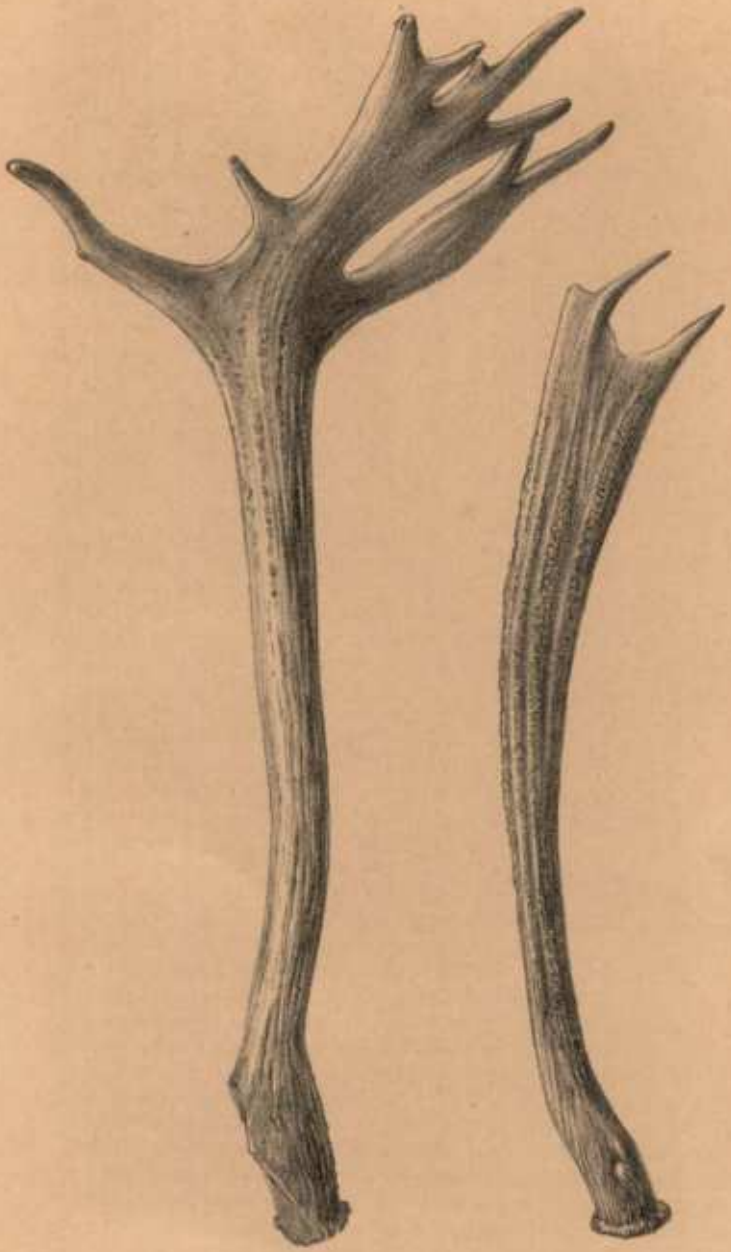
The Sheep (*Ovis tragelaphus*) rejoices in a confusing number of vernacular names. In the Gardens of this Society it is known as the "Aoudad." The name is not recognized in Algiers, where it is called "Moufflon à Manchettes" by the French, and "Aroui" by Arabs, or, in the case of the old males, "Feshtal."

The Aroui are thinly scattered all over the above-named ranges, wherever they are rough and precipitous, and are doubtless to be found in similar spots on all the arid southern slopes of the Atlas from the Atlantic to Tunis. They are unknown further into the mountains, *i. e.* nearer to the coast, and I do not think are ever found out of sight of the desert[1].

After numerous inquiries I cannot hear authoritatively of any Englishman who has successfully stalked these animals until we did so, though I heard of two who have tried and failed. This is not surprising, for they are more difficult to find than any animal I have ever hunted. My own experience will illustrate this. I hunted for twenty-three days, being nearly always out from before sunrise till after sunset, and I got shots at only four during that time. The reason for this is the extraordinary capacity for hiding itself shown by the "Aroui," in which it is assisted by its own nearly invisible colour, which is a pale rufous-yellow, and by the extremely broken character of the rocks, which, being for the most part of a soft limestone, readily decompose and are cut into numerous fantastic hollows and fissures, and are covered in many places with a rather extensive growth of scrubby *Thuya* bushes.

The habits of the Arabs, continued for countless generations, have helped to form the habits of the Aroui. The nomad tribes pitch their tents necessarily within reach of one of the scanty springs of water, and daily lead their flocks of goats up the mountains, and no cliff or corrie is safe from their intrusion. The Aroui have thus no means of escaping from them, as every mountain within reach of water is similarly infested. They are constantly within sight and

[1] The Arabs say that these Sheep never drink more frequently than once in five days; but though this, no doubt, enables them to traverse long distances in these thirsty slopes, I do not think they are often found at a great distance from water.—E. N. B.



1 2

F.C.Woodward, lith. West, Newman, imp.

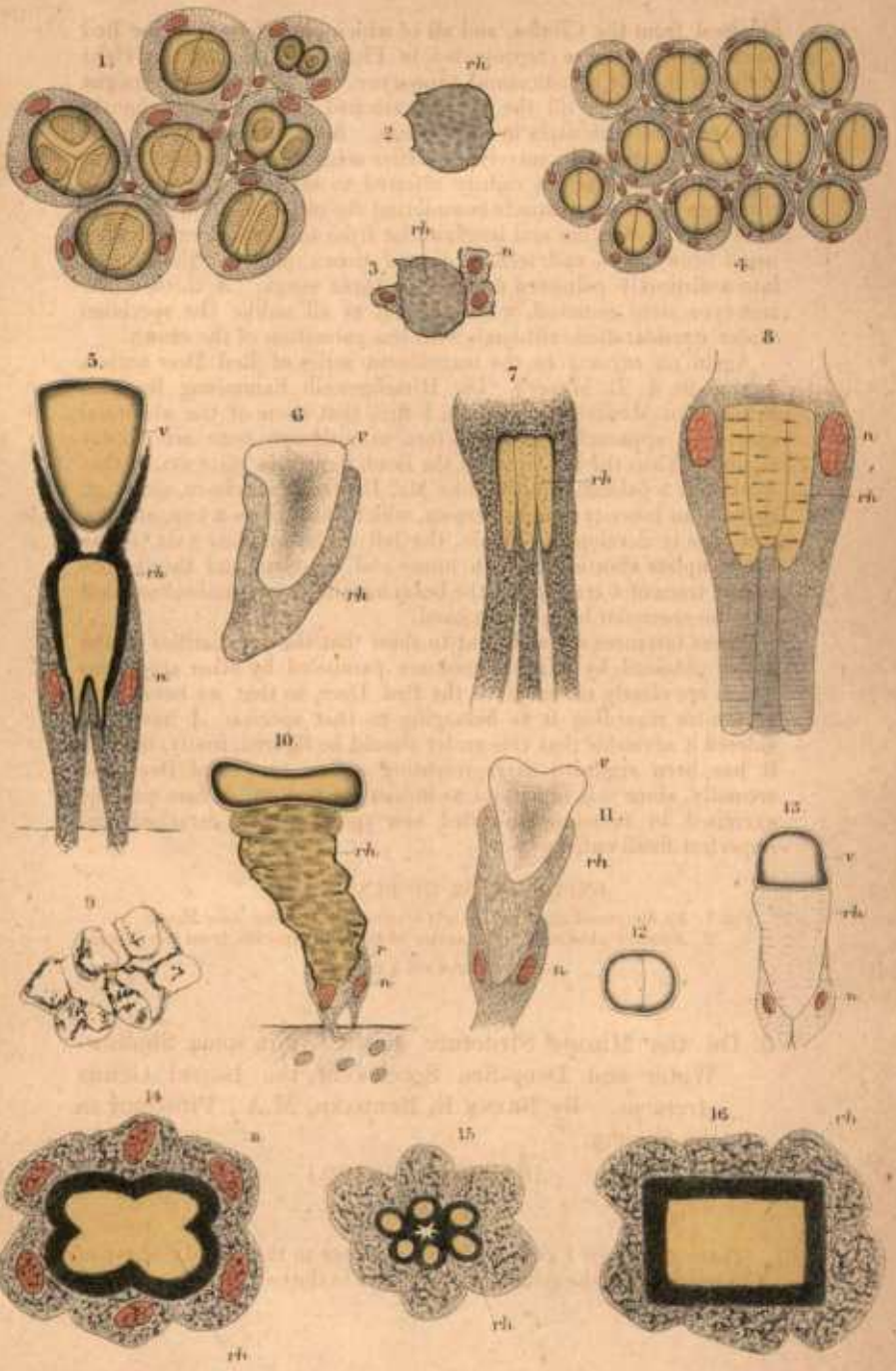
Abnormal Antlers of Cervus elaphus.

the same specimen is alluded to in the following words:—"At the village of Jarpuz, at the foot of the Bimboghas Mountains near Albistan, Danford obtained from a peasant a very remarkable Deer's antler, in either a subfossil or a greatly weathered condition: and he saw another similar specimen in the same locality. When he exhibited this antler at a meeting of the Society last year there was some difference of opinion as to whether it was or was not an abnormal specimen of *Cervus elaphus*; but as we are ourselves strongly of opinion that it cannot be referred to any known recent Deer, we reserve its description for another opportunity."

Recently Mr. Danford has presented this interesting specimen to the British Museum, and, at the request of Mr. O. Thomas, I have undertaken an examination, the results of which are now laid before the Society. I may say, first of all, that my conclusions differ from those arrived at by Messrs. Danford and Alston, and that the specimen, in my judgment, is nothing more than a very abnormal antler of a Red Deer. There is nothing in the condition of the specimen to suggest fossilization, although it has evidently been exposed for a considerable period to the action of the atmosphere.

This antler (Plate XXX. fig. 1) belongs to the right side, and is perfect, with the exception of the base, which has been longitudinally split, so as to carry away the brow- and bez-tynes. It is that of an animal nearly or quite as large as the Maral, the beam being very stout and as much as two and a half feet in length. Unfortunately the imperfect condition of the base renders it impossible to be certain that both a brow- and a bez-tyne were present, but from the presence of a prominence some distance above the burr corresponding to the point of origin of a bez-tyne, I am inclined to consider that both these tynes may have been present, although, as is not uncommonly the case, they must have originated very close together. Above the point of origin of the presumed bez-tyne there is an almost cylindrical and nearly straight beam extending, without any trace of a trez-tyne, for a distance of two feet. Beyond this point the beam suddenly expands into a crown, which is imperfectly palmated, consisting of a stout cylindrical anterior tyne, of a median palmation with five snags, and of a somewhat flattened posterior tyne terminating in two snags. The whole of the crown forms, so to speak, one side of a cup, so that no true cup occurs.

At first sight this antler looks utterly unlike that of a Red Deer, but further comparison shows that it may be readily derived from the more normal type. Thus, if I am right in considering that both a brow- and bez-tyne were developed, we have one very strong point in favour of this view. Next, if the crown be compared with antlers like the specimens in the Geological Department of the British Museum (No. M. 392) from an Irish lake, figured in Owen's 'British Fossil Mammals and Birds,' p. 472, fig. 196, it will be found that the palmation of the crown is very similar in the two, if we remove the tyne forming the external portion of the cup in the Irish specimen. A much more striking resemblance is, however, presented by three recent detached antlers in the Museum, some at least of which were




F.E.B. del.

Mintern Bros. lith.

STRUCTURE OF EYES OF ARCTURUS.

obtained from the Crimea, and all of which are referred to the Red Deer. One of these (represented in Plate XXX. fig. 2) is a right antler, with only a rudimental brow-tyne, and above this a straight beam with no tyne till the crown is reached. The latter is slightly palmated and terminates in three snags. Such an antler, it appears to me, is likely to be merely an earlier stage of one of the present type; and if the one is rightly referred to the Red Deer, I think there can be no hesitation in considering the other as referable to the same form. Another and larger antler from the Crimea exhibits the usual brow-, bez-, and trez-tynes, and then expands at the summit into a distinctly palmated crown with three snags. A third, if the trez-tyne were removed, would be not at all unlike the specimen under consideration, although with less palmation of the crown.

Again, on turning to the magnificent series of Red Deer antlers figured in A. B. Meyer's 'Die Hirschgeweih Sammlung im kön. Schlosse zu Moritzburg' (1883), I find that some of the abnormal specimens approach the one before us, although none are exactly similar. Thus the left antler of the head, figured in plate xvi. of that work, has a palmation not unlike Mr. Danford's specimen, although there is an inner tyne to the crown, which thus forms a cup, and the trez-tyne is developed. Again, the left antler in plate xxix. shows the complete abortion of both brow- and bez-tyne, and the absence of any trace of a trez-tyne; the beam forming a long unbroken shaft like the specimen before mentioned.

These instances are sufficient to show that the peculiarities of the antler obtained by Mr. Danford are paralleled by other specimens which are clearly referable to the Red Deer, so that we have every reason for regarding it as belonging to that species. I have considered it advisable that this antler should be figured, firstly, because it has been regarded as representing a new species of Deer, and secondly, since it is important as indicating how much care must be exercised in founding so-called new species upon detached and imperfect fossil antlers.

EXPLANATION OF PLATE XXX.

Fig. 1. An abnormal right antler of *Cervus elaphus*, from Asia Minor.
2. Another abnormal right antler of the same species, from the Crimea.

Both figures are ⅓ nat. size.

## 3. On the Minute Structure of the Eye in some Shallow-Water and Deep-Sea Species of the Isopod Genus *Arcturus*. By Frank E. Beddard, M.A., Prosector to the Society.

[Received April 15, 1890.]

(Plate XXXI.)

Three years ago I communicated a paper to the Royal Society of Edinburgh upon the structure of the Eye in the two Isopodan families

of the Serolidæ and the Cymothoidæ, which was published in the 'Transactions.' The present paper is a continuation of the same subject, but deals with the genus *Arcturus*. The material, like that of my former paper, consists of teased preparations and of sections of the eyes of species obtained during the voyage of H.M.S. 'Challenger,' all of which species have been described by me in my Report (3).

In my paper on the structure of the eye in the Cymothoidæ, I mentioned the principal papers dealing with the Isopodan eye, which are not many in number. Since the appearance of that paper but little has been published upon the Isopodan eye. I am, indeed, only acquainted with a single memoir upon the subject, one by Mr. S. Watase (11); this paper deals largely with *Serolis*, but it contains also some very weighty observations upon the morphology and pedigree of the Arthropod eye in general.

It is gratifying to me personally to find that Mr. Watase has "verified all the chief results" of my own research. This fact also gives me greater confidence in laying the present paper before the Society. If the state of preservation of the specimens of *Serolis* was so good as to enable me to state accurately the principal facts in the anatomy of the eye, it seems likely that the *Arcturi*, which were preserved in an identical fashion, will also furnish reliable data. In any case our knowledge of this particular genus is at present, so far as I am aware, absolutely *nil*; and it is almost unnecessary to state that the deep-sea forms are as little known as those which inhabit the shallower waters. Mr. Watase, in his description of the eye of *Serolis*, which occupies the first five pages of the special part, refers to the presence of a "corneagen"[1] (a term introduced by Patten, 13) below the cornea and above the cells of the vitrella; he also figures a row of pigmented cells surrounding the vitrella[2]. These structures were not figured or described by myself, but I am not prepared to dispute the probable justice of Mr. Watase's addition to my own account.

It seems to me to be very probable that this corneagen layer is, as Patten has particularly insisted, always present in eyes of these types; and Watase has shown a very strong *raison d'être* for its presence.

The present paper, however, only professes to be a very small contribution to the morphology of the Isopodan eye; the main object is to compare the minute structue of the eye of species living in shallow water with that of their deep-sea allies.

The questions involved are interesting and lead to some rather important conclusions about the life of these deep-sea forms.

In the first part of my 'Challenger' Report, dealing only with the very remarkable genus *Serolis* (2), I gave some figures and a brief description of the structure of the eyes in two deep-sea species, viz. *Serolis bromleyana* and *Serolis neœra*. Without recapitulating all the results here, I may point out that the eyes in those forms showed very considerable traces of degeneration; this degeneration was

[1] Pl. xxix. fig. 1 *cg*, fig. 1[a] *a*.

[2] This term was introduced by Lankester and Bourne.

shown to have affected all the component parts of the eye. The cornea was little (*S. neœra*) or hardly at all (*S. bromleyana*) convex below; the lens was granular, and could hardly have been transparent during life; the rhabdom and retinules were not recognizable—at least in the form which they present in other (shallow-water) species. The amount of pigment present was comparatively small, or, as in *S. bromleyana* and *S. gracilis*, completely absent. I hope to show in the present paper a somewhat similar though less marked series of changes in the eyes of the deep-water *Arcturi*.

Before the appearance of my preliminary account of the genus *Serolis* (1), which contained a summary of observations upon the structure of the eye, but little had been done in investigating the histology of that organ in deep-sea Crustacea. Dr. P. P. C. Hoek, in his Report on the 'Challenger' Pycnogonida (6), mentioned that pigment is often absent from the eyes of deep-sea forms, and that the retina may be replaced by a mass of connective tissue, though the lens be present. The details given by Hoek are not very numerous. Since the publication of my Report several other groups of deep-sea animals have been reported on. Mr. S. I. Smith (12) found that in the majority of species of Atlantic deep-sea Decapods the eyes have undergone certain structural changes; these changes are partly in the alteration of the pigment, which becomes lighter coloured in the abyssal species, and partly in the reduction of the number of the visual elements.

A considerable number of deep-sea Mollusca according to Pelseneer (8) have rudimentary eyes; some are totally blind.

Henderson found (7) with regard to the Anomura that degeneration was common in the eyes of abyssal forms; this degeneration was largely shown by the absence or reduction in quantity of the pigment. Here, however, there is no elaboration of detail and the points raised are not illustrated by figures.

Animals that dwell in caves are, so far as absence of sunlight is concerned, subjected to the same conditions as are deep-sea animals. Packard (10), in investigating animals from the Kentucky caves, found various conditions of degeneration in the eyes, culminating in the total blindness of some species.

The result, then, of all these investigations has been to show that *the deep-sea fauna is chiefly made up of animals which are either blind or—if they have eyes—show evident traces of degeneration in these eyes.*

I attempted to show, in considering the deep-sea Isopods, that the blind deep-sea genera were, at any rate for the most part, peculiar genera, and that those deep-sea Isopods with apparently well-developed eyes were closely allied to, if not identical with, forms living in shallow water. Thus it appeared reasonable to assume that the *eyed forms were comparatively recent immigrants into deep water.* This view has already, I find, been considered by Prof. Semper [1] to

[1] 'Animal Life,' Int. Scient. Series, p. 84. "We have become acquainted .... with a wonderful deep-sea fauna, showing the same striking mixture of blind and seeing animals as the fauna of the caves. This case is all the more

account for the presence of animals with eyes in dark caves and the deep-sea, but rejected. It is accepted, however, by Henderson. This being the case it is unnecessary to make any further use of the ingenious "theory of abyssal light," and it is impossible to build up any theories with regard to the brilliant coloration of deep-sea animals. These colours must be absolutely without any secondary meaning, as must also the frequent phosphorescence of Alcyonarians and other animals living in great depths.

If there were no intermediate stages between Crustacea and other animals of the deep sea with well-developed eyes and those without any trace of eyes at all, such theories might be put forward with some plausibility. It might be urged that the eyeless forms were simply peculiar in this respect; that is to say, that just as among shallow-water genera, and even surface forms, eyes may be absent and characterize a particular genus or species by their absence, such might also be the case with genera inhabiting the deeper waters of the oceans. The numerous stages of degeneration appear to me to render this view untenable.

I shall now proceed to describe, in as much detail as my preparations allow of, the minute structure of the eye in a number of species of *Arcturus*.

### (1) Arcturus furcatus, Studer.

The eye of this species is quite a typical Isopodan eye, though differing in certain details from any type that has been hitherto studied.

The *vitreous body* is rounded conical in form and is distinctly made up of two halves. As is illustrated (Plate XXXI. fig. 4), there appear to be four nuclei corresponding to each vitreous body and lying above it. These are, I imagine, the nuclei of Semper and the nuclei of the corneagen cells.

The *retinula* of each eyelet is made up of six cells, which is not a number that has been hitherto met with among the Isopods. In insects this number appears to be common according to Grenacher's figures (5).

The *rhabdom* secreted by these retinula-cells is in certain respects rather remarkable.

It is conspicuous on account of its size; it has the clear amber-yellow colour of the vitreous body; peripherally (see Plate XXXI. figs. 5, 14–16) the rhabdom is markedly a very densely pigmented band. Towards its upper extremity the rhabdom is, as shown by

puzzling, because the chief part of such deep-sea animals as can see are extraordinarily unlike their nearest congeners living at the surface and in the light, so that we are forbidden to suppose that they may be species that have only lately migrated from the surface to great depths." It is unnecessary to point out that this statement does not allow for such cases as I refer to, where the eyes, although *apparently* like those of others, are really in various stages of degeneration. There are no doubt plenty of species in which, as in *Serolis scara*, the facetted cornea is the last part of the eye to disappear. Hence totally blind animals may *seem* to have well-developed eyes.

transverse sections (figs. 14–16), of an oblong shape, the corners are sharply marked and the sides are perfectly parallel with, or at right angles to each other. Lower down, at about the level of the nuclei of the retinula-cells (fig. 14), the rhabdom becomes indented, and shows obvious traces of its orgin from six rhabdomeres. Lower down still (fig. 15) the six rhabdomeres diverge from each other.

Each rhabdomere becomes surrounded by a dense pigmented sheath.

When the eyes are teased in glycerine after depigmentation by nitric acid, the rhabdom shows a tendency to break up into squarish blocks (fig. 8), as has frequently been noticed in other Arthropods.

### (2) Arcturus spinosus, F. E. Beddard.

The eye of this species, which is from deep water, contrasts in many points with that of *Arcturus furcatus*—a typically shallow-water form.

The lens has the peculiar form shown in the drawing (Plate XXXI. fig. 10), which represents a semidiagrammatic longitudinal section through an eye-element. It is somewhat muffin-shaped, being depressed on both sides in the middle. In some other slides which are labelled "*Arcturus spinosus*," and which I have no reason for doubting are really preparations from this species, the lens has the form shown in another drawing (figs. 6, 11); it is pear-shaped, and in the middle it is decidedly more opaque than peripherally, where it is quite transparent. This central opacity may be due to a precipitated and coagulated fluid occupying the interior of the lens, such as Watase (11) has described and figured in *Serolis*[1]. I have not, however, observed anything similar in the shallow-water species of *Serolis* which I myself investigated. Perhaps it will turn out to be a commencing degeneration in the eyes of the species described which is carried out more fully in *Serolis neæra*.

The *rhabdom* of *Arcturus spinosus* is very large, and in longitudinal sections of the undepigmented eye shows the characters exhibited in the drawing (fig. 10); it is of roughly conical form, the apex of the cone lying towards the ommateal membrane. In some examples of this species which I referred to above in connection with the peculiar difference in the structure of their lenses, the rhabdom also shows a departure from the ordinary condition. As indicated in fig. 6, its upper extremity embraces the lens, which is sunk into a depression of what is really the broad end of the conical rhabdom; although in such preparations as those illustrated in figs. 6, 11, the vitreous body and the rhabdom appear to be very nearly if not quite in actual contact, there is not the least difficulty in distinguishing between them.

The rhabdom in both forms of eye is by no means so clear and transparent as in *Arcturus furcatus*, and it is proportionately very much larger than in that species. Its form varies much, but is usually more or less bent.

[1] *Loc. cit.* p. 290, pl. xxix. fig. 1 *a*.

The retinula-cells are, on the other hand, very much smaller proportionally, and are only well developed and conspicuous at the end of the rhabdom, which, by the way, shows no traces of division into six rhabdomeres.

As may be seen by longitudinal sections (fig. 10), a coating of dense pigment covers the rhabdom, and occasionally pierces into its interior for a short distance; this I presume to be the upper portion of the retinula-cells. The nuclei of these cells are placed on a level with the posterior end of the rhabdom instead of near the upper extremity of this structure, as they are in *Arcturus furcatus*. The pigment, although deep black in colour, is very much less in amount than it is in *A. furcatus*. It is clear, therefore, that the eye of *Arcturus furcatus* differs from that of *A. spinosus* in many points.

I do not possess so many preparations of other species of *Arcturus* as of the two which I have just described. The following notes therefore show many lacunæ which I see no chance of being able to fill up. They are largely but not entirely based upon sketches which were made some five years ago, when I commenced to work at this subject. These sketches, unfortunately, do not show all the points which I have since ascertained to be important.

### (3) Arcturus anna, F. E. Beddard.

In this species the lens has an ellipsoidal form, the long axis coinciding with that of the ommatidium when the lens is in position.

The lens agrees, however, with that of *Arcturus spinosus*—at least with some individuals of that species—in being composed of a clearer peripheral portion and a granular-looking opaque middle.

The rhabdom is large and solid, it is not prolonged into six separate rhabdomeres at the posterior extremity as in *A. furcatus*; after treatment with nitric acid, however, it shows distinct traces of longitudinal division into a number of pieces which no doubt correspond with the cells of the retinula.

The retinula-cells themselves, as in *A. spinosus*, are only clearly distinguishable as such behind the rhabdom where their nuclei are situated; a coating of pigment which covers the rhabdom up to very nearly the lens is doubtless deposited in a forward prolongation of the retinula-cells.

### (4) Arcturus cornutus, F. E. Beddard.

In most respects the eye of this species agrees with that of *Arcturus anna*; so close is this agreement, that I need not enter into any description of the ommatidium. All that I shall do is to call attention to one rather important point of difference between this species and *Arcturus anna*.

This point of difference concerns the vitreous body, which appears to be even less fitted as a refracting medium in this species than in the last.

The opacity, which is quite a noticeable feature of the lens in *A. anna*, is exaggerated in *A. cornutus*, until there is not even a

narrow peripheral band left which is clear. The whole vitreous body appears to be more or less granular and opaque.

### (5) Arcturus brunneus, F. E. Beddard.

In this species the vitreous bodies or lenses of the ommatidia have the form which is illustrated in the drawing exhibited (Plate XXXI. fig. 13); their shape is usually that of a buffet with the convex outer surface and a straightish margin where the lens comes into actual or at any rate very near contact with the rhabdom. As a rule the lens is decidedly smaller.

The rhabdom, on the other hand, is particularly large.

### (6) Arcturus glacialis, F. E. Beddard.

The eye of this species calls for no lengthy description, the vitreous bodies have the same curious muffin-shape that they have in *A. spinosus*; the rhabdom is large, and the nuclei of the retinula-cells are placed below it.

### (7) Arcturus studeri, F. E. Beddard.

This is the only shallow-water species besides *A. furcatus* and *A. americanus* that I have studied; unfortunately in this case, as in that of *A. americanus*, I am dependent upon a single sketch which I made some years ago; the preparations themselves are missing. This is particularly to be regretted, as *A. studeri* resembles in some particulars species that only occur in deep water. The vitreous bodies, however, are quite like those of *A. furcatus* in their perfect transparency and in their general shape. I am unable to give any details about the rhabdom; it does not, however, seem to be particularly large; the retinula-cells are unlike those of *A. furcatus*, and like those of *A. spinosus* and all the deep-sea species described in the present paper in that their nuclei are placed below the posterior extremity of the rhabdom. Whether there is much or little pigment I cannot say.

The following table indicates the depths at which the various species described in the present paper were met with:—

1. *Arcturus furcatus*. 7–127 fathoms (one specimen in 1675 fathoms).
2. *Arcturus americanus*. 55 fathoms.
3. *Arcturus studeri*. 25–127 fathoms.
4. *Arcturus glacialis*. 1675 fathoms.
5. *Arcturus brunneus*. 1600 fathoms.
6. *Arcturus anna*. 600 fathoms.
7. *Arcturus cornutus*. 500 fathoms.
8. *Arcturus spinosus*. 1375 fathoms.

The first three species are therefore to be looked upon as shallow-water forms; the remainder as true deep-sea species.

It is noteworthy that all the shallow-water species, viz. *Arcturus furcatus*, *A. americanus*, *A. studeri*, have lenses which are perfectly clear and transparent, and are characteristically pear-shaped.

On the other hand, all those species which have an apparently partly opaque lens are deep-water forms[1]; these are *Arcturus spinosus*, *A. anna*, *A. cornutus*. This list is not exhaustive of the deep-sea forms which I have been able to examine; but there are no others in which the lens appears to be getting opaque. It is remarkable, however, that in the other deep-sea species which I have examined, viz. *Arcturus brunneus* and *A. glacialis*, and some specimens of *A. spinosus*, the lens should show a reduction is size and an alteration in shape which must impair its perfection as an organ for the passage of rays of light, if the form best suited for that purpose be that exhibited by *A. furcatus*.

The retinula-cells appear to be best developed in *A. furcatus*, where, as shown in my drawing (fig. 8), the nucleus is placed high up, not far from the commencement of the rhabdom. This may also be the case with *A. americanus*, but my sketches are unfortunately not conclusive as to this point and the preparations have been since spoiled.

In all the other species of *Arcturus* examined by me, the retinula-cells are relatively small, and the nuclei are situated (*e. g.* fig. 13, *n*) *below* the extremity of the rhabdom. It is possible that this reduction of the retinula-cells (which I believe with Grenacher and others to be the essential visual cells) is correlated with a commencing degeneration of the eye. If it were not for the single exception offered by *A. studeri* (*a shallow-water* species from Kerguelen), I should be disposed to lay considerable weight upon this series of facts. As it is, it does not appear to me to be safe to make any such assertion in at all a positive way.

The rhabdom does seem in several of the deep-sea species, particularly in *A. spinosus*, to be undergoing degeneration. This is shown by its less perfect transparency and by its irregular form, and perhaps also by its very large size. It may not perhaps seem very reasonable to adduce increase of bulk in an organ as indication of degeneration. If we are to regard the rhabdom as formed by the retinula-cells, the large size of the former may be connected with the diminished size of the latter; it may therefore be a sort of degeneration. On the Lamarckian view of evolution, the increase in size of the media for concentrating the light might seem to be an attempt to keep up with the diminishing supply of light. I myself should be disposed to regard this phenomenon as a kind of "running to seed" of the non-essential part of the eye.

Another point of very considerable importance in relation to the supposed degeneration of the eye is the smaller amount of pigment which occurs in the eyes of most of the deep-sea species examined by me. In teased preparations the rhabdom was always perfectly distinct, the yellowish-brown colour being quite visible; and in sections of *A. spinosus* the amount of pigment covering the rhabdom is seen to be not great (*cf.* Plate XXXI. figs. 10 and 5). On the other

[1] *I. e.* occurring at depths greater than 500 fathoms.

hand, in teased preparations of *A. furcatus* the rhabdom always appeared as a densely black mass in the centre of the retinula-cells, its outline only being recognizable; although in these deep-sea forms the *amount* of the pigment is very decidedly less than that which is found in the shallow-water species *A. furcatus*, its colour is the same; in all forms it had a dense black appearance. These facts are similar to those which I stated with reference to *Serolis neæra*; in that species (a deep-sea form) the pigment is just as densely black as in the shallow-water *Serolis cornuta*, but less in amount[1]. On the other hand, it has been several times observed that in other deep-sea Crustacea the pigment is of an orange colour. This I suppose only means that the pigment-granules are less dense in those forms; for in the species of *Arcturus* which I describe in the present paper the pigment when dissolved by means of nitric acid showed an orange-brown colour. Unfortunately I am not able to state what is the amount of pigment, as compared with other forms, present in the ommatidia of *Arcturus studeri*. It agrees, as I have pointed out, with other deep-water forms in the small size of the retinula-cells and in the position of their nuclei below the level of the extremity of the rhabdom, but it has a large clear vitreous body like that which is found in each ommatidium of the eye of *A. furcatus* and *A. americanus*.

In any case I have been able to describe in this paper for the first time certain interesting differences of structure in the eyes of a number of species of *Arcturus*.

These differences fall into two main categories:—

(1) In *A. furcatus* and *A. americanus* (?) the rhabdom is comparatively small (though large compared with other Crustacea), and the retinula-cells are very large, the nuclei being situated at the level of the anterior end of the rhabdom.

(2) In *A. spinosus*, *A. anna*, *A. cornutus*, *A. brunneus*, *A. glacialis*, and *A. studeri* the rhabdom is very large and the retinula-cells are comparatively small, their nuclei[2] being situated below the extremity of the rhabdom, near to the basement membrane of the ommateum. Besides these morphological differences in the retinula-cells, which perhaps have no reference to the conditions under which the animals live, the second division shows various peculiarities in most species which seem to be correlated with a deep-sea habit. Thus in some forms the lens is reduced in size and altered in form or has become partially opaque and the pigment is small in amount; these statements apply to all the species in the second list except *Arcturus studeri*.

*List of Memoirs referred to.*

1. Beddard, F. E.—Preliminary Notice of Isopoda collected

[1] It will be remembered that in the case of this deep-sea *Serolis* the small amount of pigment is also correlated with degeneration of the retinula.

[2] This position of the nuclei, though unusual, is not unparallelled. They occur in that position in *Talorchestia*, even below the ommateal membrane (Watase), and in other Amphipods.

during the Voyage of H.M.S. 'Challenger.'—Part I. *Serolis*. P. Z. S. 1884, p. 330.

2. Beddard, F. E.—Report on the Isopoda collected by H.M.S. 'Challenger' during the years 1873-76.—Part I. The genus *Serolis*. Zool. Chall. Exp. pt. xxxiii.
3. Beddard, F. E.—Report on the Isopoda collected by H.M.S. 'Challenger' during the years 1873-76.—Part II. Zool. Chall. Exp. pt. xlviii.
4. Beddard, F. E.—On the Minute Structure of the Eye in the Cymothoidæ. Trans. Roy. Soc. Edinb. vol. xxxiii. p. 443.
5. Grenacher, H.—Untersuchungen über das Sehorgan der Arthropoden. Göttingen, 1879.
6. Hoek, P. P. C.—Report on the Pycnogonida collected by H.M.S. 'Challenger' during the years 1873–76. Zool. Chall. Exp. pt. x.
7. Henderson, J. R.—Report on the Anomura collected by H.M.S. 'Challenger' during the years 1873–76. Zool. Chall. Exp. pt. lxix.
8. Pelseneer, P.—Report on the Anatomy of the Deep-sea Mollusca collected by H.M.S. 'Challenger' in the years 1873–76. Zool. Chall. Exp. pt. lxxiv.
9. Lankester, E. R., and Bourne, A. G.—On the Minute Structure of the Lateral and Central Eyes of *Limulus* and *Scorpio*. Q. J. Micr. Sci. vol. xxiii. p. 177.
10. Packard, A. S.—The Cave Fauna of North America, with Remarks on the Anatomy of the Brain and Origin of the Blind Species. Mem. Nat. Acad. Sci. vol. iv.
11. Watase, S.—On the Morphology of the Compound Eyes of Arthropods. Stud. Biol. Lab. Johns Hopkins Univ. vol. iv. no. 6, p. 287 *et seq.*
12. Smith, S. I.—Abyssal Decapod Crustacea of the 'Albatross' Dredgings in the North Atlantic. Ann. & Mag. Nat. Hist. (5) xvii. p. 187 *et seq.*
13. Patten, W.—Studies on the Eyes of Arthropods.—I. Development of the Eyes of *Vespa*, &c. Journ. Morph. vol. i. no. 1.

## EXPLANATION OF PLATE XXXI.

The following letters have the same significance in all the figures:—*v.*, vitreous body; *rh.*, rhabdom; *r.*, retinula; *n.*, nuclei of retinula-cells. The chitinous parts of the eye (vitreous body and rhabdom) are for the most part coloured yellow.

Fig. 1. A number of ommatidia of *Arcturus spinosus*, from above.
2, 3. Cross sections at different levels through rhabdom of *A. spinosus*.
4. A number of ommatidia of *A. furcatus*, from above.
5. Longitudinal section through ommatidium of *A. furcatus*.
6. Vitreous body and rhabdom of *A. spinosus*, from a teased and depigmented preparation.
7. Partially depigmented retinula of *A. furcatus*.
8. Depigmented retinula of *A. furcatus*.
9. Transverse section of ommatidium of *A. furcatus* below extremity of rhabdom; one rhabdomere is seen.
10. Longitudinal section through ommatidium of *A. spinosus*.

Fig. 11. Ommatidium of *A. spinosus*, from a teased and depigmented preparation.
12. Vitreous body of *A. brunneus*, from above.
13. Ommatidium of *A. brunneus*, from a teased and depigmented preparation.
14, 15, 16. Transverse sections through ommatidium of *A. furcatus* at different levels.

## 4. Note on the Bones of small Birds obtained by Professor Nation from below the Nitrate-beds of Peru. By E. T. Newton, F.G.S., F.Z.S.

[Received April 17, 1890.]

At the meeting of the Zoological Society held on the 14th January, 1890, Dr. Sclater exhibited some bones of small birds sent to him by Prof. Nation in a small quantity of guano-like earth obtained from "beneath the nitrate-beds of Peru." At present we have no information as to the precise locality where these specimens were found, and although the nitrate is now being extensively worked, little seems to be known as to the age of the deposits; some account of them, however, has been published by Mr. Ralph Abercrombie in 'Nature' (June 20 and July 25, 1889), and he alludes to the fact that there is "in some deposits a layer of guano under the caliche (nitrate);" but this is not always the case.

The specimens were handed to me by Dr. Sclater for further examination, and by sifting the guano several other bones were found, so that there are now for examination portions, more or less complete, of the following:—3 femora, 4 tibio-tarsi, 7 metatarsi, 2 or 3 fragments of pelvis, 8 humeri, 4 ulnæ, 3 metacarpals, and 2 coracoids. The only portions of the head found are the curved extremities of 3 upper bony beaks, a fragment of a horny beak, the hinder ends of two mandibular rami, and a quadrate bone. There are also portions of 3 vertebræ.

With regard to the lengths of the long bones, it is only the femora and metacarpals which are quite entire, but by comparing the different examples of each of the other bones, a tolerably accurate idea of their length may be obtained, and the following measurements were made before I had seen those of the *Cymochorea leucorrhoa* given by W. A. Forbes (Memorial Volume, p. 426, 1885), which are here reproduced for comparison.

| | Bones from below nitrate-bed. millim. | *Cymochorea leucorrhoa*, after Forbes. millim. |
|---|---|---|
| Femur | 16 | 16 |
| Tibio-tarsus | 37? | 37 |
| Tarso-metatarsus | 25–30 | 24 |
| Humerus | 37–42 | 35 |
| Ulna | 35–40 | 35 |
| Metacarpal | 20 | manus 42 |
| Coracoid | 13–15 | |

The agreement in size and structure of the different examples of each of the bones leads to the conclusion that most of them belong to one species of bird, and it was thought at first they might be parts of a small Tern; but the curved beak, as well as the longer and more slender tarso-metatarse, seems to indicate a closer affinity with the Petrels. Possibly these remains will be found to belong to some species now living on the western coasts of South America, although the nitrate districts are said to be, at the present time, almost devoid of animal life and the birds from which these fossils are derived must have existed in the district in considerable numbers.

Mr. H. Seebohm kindly suggested a reference to Mr. H. A. Forbes's memoir on the 'Challenger' Petrels as likely to help in the comparison of these remains; and in that memoir (Memorial Volume, p. 426) measurements are given of the limb-bones of several forms, including those of *Cymochorea leucorrhoa*, the latter agreeing so closely with the measurements of the fossils as to render it highly probable that they are generically allied. At present, however, I have been unable to get a skeleton of any species of this genus for close comparison. The 'Challenger' specimen of *Cymochorea leucorrhoa* seems not to be in the British Museum collection.

Mr. O. Salvin, who is so well acquainted with the Petrels, tells me that *C. leucorrhoa* is not known on the west coast of S. America; but is there replaced by a closely allied species which he has described (Proc. Zool. Soc. 1883, p. 430) and named *C. markhami*.

Two skins of Mr. Salvin's species are in the British Museum, and by the kindness of Mr. Bowdler Sharpe I have been able to examine them; but the only parts which can be compared are the beak and the length of the tarso-metatarse, and in so far as one can judge of parts which are still enclosed in their horny coverings, they seem to agree with the Peruvian fossils.

The peculiarities of structure presented by these fossil bones agree so nearly with those of forms closely allied to *Cymochorea*, and their proportions and absolute lengths agree so well with the measurements of *C. leucorrhoa*, that it is highly probable they will prove to belong to the genus *Cymochorea* and to be closely allied to *C. leucorrhoa* and *C. markhami*, but the want of skeletons for detailed comparison prevents a more definite determination.

## 5. Note on Canine Dental Abnormalities.

By Dr. St. G. Mivart, F.R.S.

[Received April 25, 1890.]

It appears to me that it may be useful to record some dental abnormalites amongst the Canidæ which I have myself observed or have found noticed by others. In his recent paper[1] Dr. Windle has enumerated, with respect to Domestic Dogs, 7 cases of an additional

[1] P. Z. S. 1890, p. 29.

upper molar on one side and 5 cases of an additional upper molar on both sides.

I have found the following abnormalities in skulls at the British Museum:—

*C. magellanicus*, No. 46. 11. 3. 9: an extra lower molar on both sides.

*C. lateralis*, No. 71. 5. 27. 8: five premolars on the right side. One of these is an extra tooth introduced between P. 1 and P. 2, as is shown by the presence of a corresponding diastema on the left side.

*C. cancrivorus*, No. 1033*b*: a small extra lower molar on both sides.

In No. 46. 6. 15. 3, on the right side of the mandible there is, instead of the third lower molar, a bunch of five small denticles, as shown in the accompanying figure.

Hindmost teeth of right side of mandible of a specimen of *Canis cancrivorus*. Twice the size of nature.

In skull No. 84. 2. 21. 1 there is a very small extra lower molar on one side.

In *Cyon javanicus*, No. 58. 5. 4. 99, the second upper molar is wanting on both sides.

Professor Huxley has noted[1] the abnormalities above given as regards *C. magellanicus* and *C. cancrivorus*, including the five small denticles. He has also called attention to a South-American canine skull described by Van der Hoeven as having an extra upper molar

[1] In his papers on the *Canidæ*, P. Z. S. 1880, p. 268.

on each side, and to the fact that in *Otocyon* there is sometimes a fourth upper molar.

Professor Flower has recorded [1] the presence of a second, small, upper molar in *Ictictyon*.

Donitz [2] has described the presence of an extra lower premolar between the normal first and second premolars in one specimen of *C. mesomelas*, and of a small third upper molar with two tubercles on the left side of another specimen of the same species.

Finally, Nehring [3] has called attention to the cases of a Dingo with five premolars above and below, and of two domestic dogs, one with an extra molar both above and below, the other (a terrier) with only two inferior molars.

The abnormal defects of dentition in Pug dogs, as is well known, may be such that but one tooth exists on either side of either jaw behind the canines [4].

## 6. On some new Moths from India. By H. J. Elwes, F.Z.S.

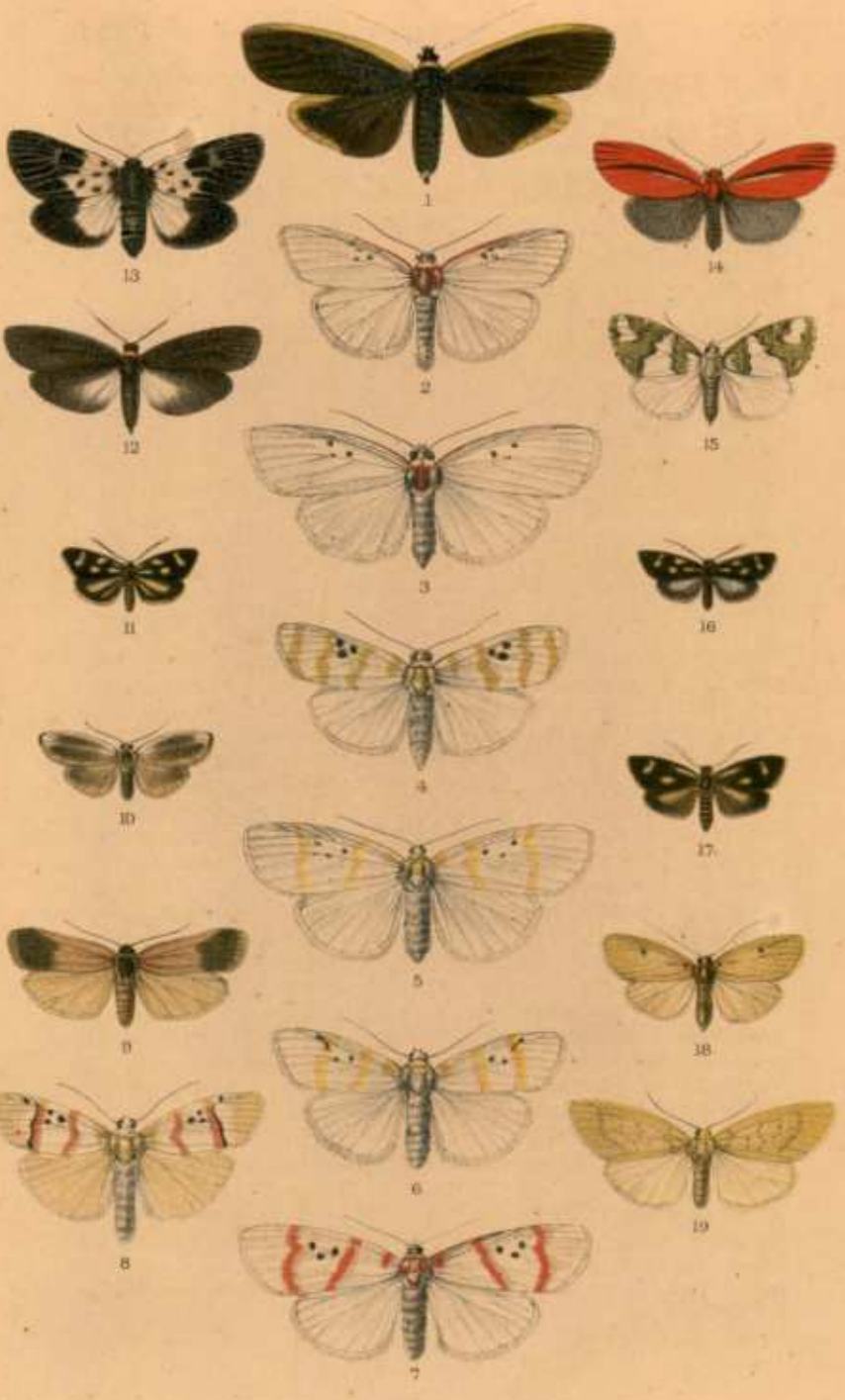
[Received May 6, 1890.]

(Plates XXXII.–XXXIV.)

Since I returned from India in 1886 I have been gradually getting into order the very large collection of Moths which I made in Sikkim; and as this has been yearly increased by numerous additions sent me by my lamented friend Otto Möller and by Messrs. Gammie and Knyvett, I have hitherto refrained from describing any of the novelties, which I believe to amount to something like 200 species out of about 2000 found in Sikkim. The difficulty of naming these is very great, as since Guenée's time no one has attempted a general revision of the genera of Heterocera, and though the nomenclature of Eastern species has been almost a monopoly of Messrs. Walker, Butler, and Moore, yet the genera they have described are rarely based on characters which can be easily examined or compared with those of their allies. Notwithstanding the assistance I have received from Mr. F. Moore, whose knowledge of Indian moths is unequalled, and from Messrs. Druce and Leech, and Col. Swinhoe, to all of whom my best thanks are due, I have in some instances been unable to find genera to suit my new species, for which in the existing state of classification I think it unwise to propose new generic names.

I have lately received from the Naga Hills a fine series of Moths collected by Mr. Doherty, of which a few are included in this paper, and which will, when worked out, throw much light on the distribution of species in that most interesting and prolific part of the Himalo-Chinese subregion.

[1] P. Z. S. 1880, p. 71.
[2] Sitzungsb. d. Gesell. naturf. Freunde, Berlin, 1869, p. 41, and 1872, p. 54.
[3] *Op. cit.* 1882, p. 65.
[4] See Dr. Gray, P. Z. S. 1867, p. 46, and also Cope, Proc. Acad. N. S. Philad. 1879, pp. 188 & 189, and the 'American Naturalist,' vol. xiii. (1879), p. 655.




New Indian Moths.

1.

2.

3.

4.

5.

West, Newman, Chromo. Lith.

New Indian Moths.

1

4

4a

2

5

3

6

West, Newman, lith.

New Indian Moths.

Genus ARTONA, Wk.,
Butler, Journ. Linn. Soc. xii. p. 356 (1876).

ARTONA SIKKIMENSIS, n. sp. (Plate XXXII. fig. 17, ♂.)

♂. Brown, with a pale yellow streak at base of costa; an ovate spot of the same colour at the middle of the hind margin, and a short transverse band near apex of fore wing; hind wing with a long yellowish-brown streak in centre. Beneath, the same markings, but the streak of the hind wing is broader, connected with the costal margin near the middle; fringes of both wings pale yellow. Thorax and head brown, with yellowish tegulæ and spots on sides of neck. Abdomen banded with yellow above, beneath yellowish; front of head and palpi yellow. Antennæ pectinate, black.

Expanse 21 mm.

Described from a single specimen, taken by myself on the Singalelah range, dividing Sikkim and Nepal, at about 12,000 feet elevation, in July 1886.

This species is most nearly allied to *A. zebraica*, which I have from Sikkim and Kulu.

ARTONA ZEBRA, n. sp. (Plate XXXII. fig. 11, ♂.)

♂. Brown, with a faint yellow costal streak; 4 conspicuous yellow spots on fore wing, of which one at the base is elongate, the next two in the centre ovate, and the last near the apex geminate. Hind wing with a broad central longitudinal yellow patch. Fringes broad, yellow, abruptly changing to brown close to the apex of the fore and hind wings, by which character it can readily be separated from the allied species. Beneath, the two central spots coalesce and touch the basal streaks; on the hind wing the yellow patch extends towards the abdominal margin. Tegulæ and sides of neck, front of head, and base of coxæ yellow. Abdomen brown, faintly banded with whitish; end of abdomen below yellowish. Antennæ black.

Expanse 18 mm.

Described from two males taken at the same time and place as the last, but lower down the mountain, at about 11,000 feet elevation.

ARTONA POSTALBA, n. sp. (Plate XXXII. fig. 16, ♂.)

With *A. sikkimensis* I took still another, which might be thought to be a variety of it, but which differs so conspicuously in the colour of the hind wings and fringes that, as I know of no similar variation in the species of this family, I must conclude to be a distinct species. It may be described shortly as like *A. zebra*, but with the central patch of the hind wing white instead of yellow, the fringes of the hind wings blackish instead of yellow, the costal streak at base of fore wing wanting. The tegulæ show no yellow; the abdomen no whitish bands above, but narrow yellow bands below. Antennæ black.

Expanse 18 mm.

Besides the species of this genus described above I have from Sikkim the following:—

*A. zebraica*, Butl. J. L. S. xii. p. 356 (1876); Ill. Het. v. p. 27, t. 84. fig. 9, which is most like *A. zebra*, but has 8 yellow patches on the fore wing and the fringes all yellow. It occurs also in the N.W. Himalayas.

*A. posteitta*, Moore, which is entirely without yellow markings, having only a white patch on the hind wing, white fringes to the hind wings, and some white on the legs and underside of body.

A sixth species, described by Mr. Moore as from Darjeeling, but of which all the specimens in the Atkinson Collection are labelled Calcutta, is *A. fuliginosa*, which is entirely brown without spots, and I think belongs to another genus.

I have also compared my three new species with the collections of the British Museum and those of Messrs. Moore and Druce, and found that they agree with none of the species described from other parts of India.

Genus Clelea, Wk. Cat. ii. p. 465.

Clelea nigroviridis, n. sp.

Black, with iridescent green markings on fore wings and thorax. Base of fore wings, neck, and head showing golden and purple reflexions in some lights. Hind wing black, with a green stripe from base to margin, near anal angle. Beneath, fore wing black, paler towards the hind margin, with narrow green stripes from base halfway up the wing; hind wings black, with costal green stripe, another below it forking outwardly, and a broad green stripe extending to margin. Antennæ shining purple. Legs and underside of abdomen tinged with shining purple and green.

This differs from *Clelea chola*, Moore, and *C. sapphirina*, Wk., so much in the colour of its iridescent markings that I am obliged to suppose it distinct. I have specimens from Sikkim which agree fairly with both of these species, which may be identical, and one other came with *C. nigroviridis* from the Naga Hills, which also agrees with the Javan *Clelea*. There is, however, a specimen from Formosa in the British Museum, which, though in bad condition, may be the same as *C. nigroviridis*[1].

Described from a single male taken by Mr. Doherty in the Naga Hills.

Genus Atossa, Moore, P. Z. S. 1874, p. 577.

Atossa nelcinna, Moore, *l. c.* t. 67. fig. 7, ♂.

This was till recently the only species of the genus, and the type in Mr. Moore's collection was unique. As figured, the venation is not very clear, but Mr. Moore has kindly sent me an accurate drawing which agrees with the figure here given of Mr. Leech's specimen (Plate XXXIV. fig. 1). It will be seen that the subcostal vein has four branches, of which the first arises from about half the length of

[1] I have since seen better male specimens from Formosa in Coll. Moore which he calls *C. sapphirina*, and which differ from mine in having the markings blue, and a blue band on outer margin of fore wing.

the cell, the second and third from a point considerably beyond it. The vein dividing the cell, as shown in the Plate, differs from Mr. Moore's drawing, which does not, as in the specimen figured and in *A. moorei*, fork near the end of the cell.

It will be seen that in both my new species the venation differs in the fore wing, showing that in this as in other genera of Chalcosiidæ venation cannot be considered as a good generic character.

This species was taken by Col. Laug in Gurhwal, North-west Himalayas, where it is found in July flying heavily by day among high trees of *Pavia indica*.

In 1887 Dr. Staudinger described *A. nelcymna* (sic) in Romanoff's Memoires, vol. iii. p. 192, figuring the only specimen received under the name of *Chalcosia palæarctica* (Stgr. *l. c.* t. x. fig. 3, ♀); taken on the Ussuri river, N.E. Asia, by Dorries.

I have examined this specimen, which is a much paler insect than *A. nelcinna*, and has the prothorax and tegulæ black, with a yellow collar, which is not visible in *A. nelcinna*, the breast also is yellow; the abdomen has a black dorsal stripe marked with narrow yellow bands and four rows of spots, two of them lateral and two ventral. The venation also differs in the branches of the subcostal being all emitted beyond the cell. This species must therefore stand as *Atossa palæarctica*, Stgr.

Mr. Leech in 'Entomologist,' vol. xxiii. March 1890, describes *A. nelcymna* (sic), var. *chinensis*, as follows:—

"♀. In this form the neuration is broadly bordered with blackish; the outer third of all the wings is much suffused with the same colour and sprinkled with greenish-grey scales.

"Expanse ·79 mm.

"I received one female taken at Changyang (Central China) in June by Mr. Pratt."

Mr. Leech having kindly lent me this specimen to examine, I have compared it with Mr. Moore's figure, and should say that it as well as a male, obtained in 1889 also by Mr. Pratt at Washan, in the province of Szechuen, and now figured (Plate XXXIV. fig. 1), is apparently not separable from *A. nelcinna* even as a variety, Mr. Leech's comparison having evidently been made with *A. palæarctica*, which I have shown to be distinct. They agree in their venation, size, and colour, except that they have not so much of the yellow tint as Moore's figure shows. The female has the hind wing rounder than the male, but not so round as in *A. palæarctica*.

A third specimen, ♂, also taken by Mr. Pratt at Huang Machung near Ta-tsien-lo in West Szechuen, has a decided yellow tint on both wings and surfaces, and much less of the dark marking below. It agrees in venation with the other two.

In neither of these males is the abdomen banded above; in the female it is inconspicuously so. The thorax in all is black, but in the last-mentioned specimen is a yellow spot on each side of the prothorax. If this is found to be constant and not present in any specimens of *A. nelcinna*, as I suspect to be the case, it may belong to a distinct species, for which I would suggest the name *A. leechii*.

Lastly, I received four specimens of this genus, two males and two females, from the Naga Hills, which I describe as follows:—

ATOSSA MOOREI, n. sp. (Plate XXXIV. fig. 2.)

♂ ♀. Resemble *A. nelcinna* in general outline, but larger, male 77 mm., female 82–90 mm.

Antennæ, ♂ 13 mm., ♀ 16–17 mm.

Body from head to end of abdomen, ♂ 27, ♀ 31 mm.

Head and thorax black, with prothorax yellow and tegulæ with a broad yellow margin. Abdomen thick, yellow, with seven black bands above and five broader ones below; a single line of black spots on the sides. Breast yellow; antennæ black, pectinate in male, minutely serrate in female.

Colours greyish white, with a broad dark bar on fore wing crossing end of cell, and broad marginal band with paler markings down its centre. Hind wings greyish white, with black edges and a series of blackish streaks or spots between the veins, coalescing into an irregular band across the outer half of the wing. Beneath as above, but the dark markings less distinct.

Differs from *A. nelcinna* in the second branch of the subcostal being forked beyond its separation from the main branch (*cf.* Plate XXXIV. figs. 1, 2).

Along with these specimens I received a single male, which differs very considerably in markings, and though on account of the apparently variable character of the markings in this genus, I should not have been inclined to consider it as more than a variety, yet the neuration is also so different that I am forced to believe it is of a distinct species. The differences will best be appreciated by a comparison of the accompanying figures, which show that there are only 3 instead of 4 branches to the subcostal, whilst the shape of the cell in the fore wing is also different.

If the same species can vary to this extent in venation as well as in markings, I can only say that hitherto accepted generic characters will have to be entirely revised, because the difference in these two specimens would by many be considered generic rather than specific.

I propose to call this form

ATOSSA NAGAENSIS, n. sp. (Plate XXXIV. fig. 3.)

♂. Differs from *A. moorei* in the venation (*cf.* fig.), in having a black central stripe dividing the yellow collar, and in having the whole of the fore wing pale grey, excepting a band of whitish marks between the veins near the outer margin.

*Hab.* Naga Hills (*W. Doherty*).

Genus HERPA, Walk. Cat. Het. ii. p. 442 (1854).

HERPA SUBHYALINA, var. PRIMULINA, n. var.

♂ ♀. Nearly allied to *Herpa subhyalina*, Moore, Descr. Coll. Atk. i. p. 18 (1879), but smaller and of a much brighter yellow. The costal border of the hind wings not fuliginous as in that species, though the underside of the costa in the fore wing only towards the base is in the male sex darker than the upperside. The antennæ

of the female are very narrowly pectinated compared with those of the male, but there is no other difference.

This species was taken at 6000–7000 feet in the Naga Hills, by Mr. Doherty, and seems to be the local representative of the genus, of which only two others are known—*H. venosa*, Walker, a shorter-winged species from the Khasia Hills, with the veins much blacker and black fringes; and *H. subhyalina*, which is only known by a male from the Lachung valley, Sikkim, 8000–10,000 ft., which is one of the insects I took myself in 1870, and gave to the late Mr. Atkinson. I have compared my specimens with this, which is now in Dr. Staudinger's collection.

### Genus Campylotes, Westwood.

Campylotes histrionicus, Westw., Royle, Ill. Him. p. liii, t. 10. fig. 1 (1837).

*Chalcosia histrionica*, Koll. Hügel's Kashm. p. 463 (1848).

The type of this species came from the North-west Himalaya, where it is not uncommon at moderate elevations, and extends with some variation throughout the Himalayas to the Khasia and Naga Hills, and, as I learn from M. Oberthür, into the Chinese provinces of Yunnan, Kouytcheou, and Szechuen. The Sikkim form might almost be separated as a local variety, as in the male the red or reddish-yellow stripes which run parallel to the inner margin do not, in Khasia specimens, usually extend more than halfway to the anal angle, whereas in Sikkim specimens they come almost to the margin. The colour of the markings on the hind wing also is less tinged with crimson than in Sikkim specimens. So far as I have seen, North-western and Nepalese specimens are nearer to the Khasia than to the Sikkim ones. I found this species common on open grassy downs at 5000 feet near Shillong, in September, flying heavily by day, but have not taken it myself in Sikkim.

There is a dwarf form of this species found in Sikkim, the Naga Hills, and the North-west Himalayas, which, though not differing appreciably in markings, is constantly smaller in size [1].

The measurements of five specimens in my collection are as follows:—

| | mm. |
|---|---|
| ♀. Sikkim, 10,000 feet, July (*Elwes*) ..... | 51 |
| ♀. Sikkim, March 17 (*Möller*) ..... | 54 |
| ♀. Sikkim, 10,000 feet (*D. Roy*) ..... | 52 |
| ♂. Naga Hills, 5000 feet, Aug. (*W. Doherty*) .... | 49 |
| ♀. " " " " .... | 56 |

*Measurements of* C. histrionicus.

| | |
|---|---|
| Khasia male in my collection ..... | 69 |
| Khasia female ..... | 74 |
| Sikkim males vary from ..... | 70–84 |
| Sikkim females vary from..... | 76–84 |

[1] A photograph sent me by M. C. Oberthür of *Campylotes* in his collection shows a specimen from Ta-tsien-lo which seems to belong to this form.

The only difference of colour in this form that I see is that the three lower ovate apical glassy spots on the fore wing are in the Naga specimen yellow, not white; in the Sikkim specimens this colour is paler, and does not extend to the outermost of the three spots. This difference holds good in a very small specimen of *histrionicus* type from Mandi in the N.W. Himalaya, which from its size I at first thought to be *altissima*. In this respect the variety shows some resemblance to *C. sikkimensis*, but I can distinguish all specimens of the latter with certainty. As this form appears in Sikkim at least to be confined to high elevations, I propose to call it *C. histrionicus*, var. *altissima* (Plate XXXIII. fig. 1).

CAMPYLOTES SIKKIMENSIS, n. sp. (Plate XXXIII. fig. 2[2].)

This species I have long hesitated to separate from the last, which it resembles closely in size, but as I have now four specimens and have seen others in Messrs. Druce and Moore's collections which agree pretty closely, I am obliged to give it a name.

♂ ♀. Differ from *C. histrionicus* in their much smaller size (♂ 46–51 mm., ♀ 51–61 mm. in expanse); in having all the marks on the fore wing pale yellow, which are vitreous white in *C. histrionicus*; in the hind wing the red stripes are divided near the margin by a black line, outside of which the markings are yellow as in *C. desgodinsi*, Ob. In one specimen only this character fails, making it intermediate between *C. sikkimensis* and *C. histrionicus* var. *altissima*, but on the underside the apex of the hind wing clearly distinguishes it from the latter.

At the apex of the fore wing are two additional spots not seen in any specimens of *histrionicus*, though in two of the var. *altissima* there are small white specks in the same position.

On the underside the markings are also different, and leave no doubt in my mind that this is a different species. It occurs rarely on Tonglo at 10,000 feet with the last, where I took a male in August 1886, and received three others in the same collection, made by natives in the Chumbi Valley, which contained the new butterflies I described in P. Z. S. 1882, p. 398.

Among the numerous beautiful Heterocera sent me by Mr. Doherty were 7 specimens of a *Campylotes*, which though it agrees in pattern and colour pretty fairly with *Campylotes desgodinsi*[1], is so much larger and brighter in colour, that I can hardly place it under that species. As, however, intermediate forms may occur, I propose to call it

CAMPYLOTES DESGODINSI, var. SPLENDIDA, n. var. (Plate XXXIII. fig. 3.)

The subjoined comparison is made with a specimen from Ta-tsien-lo in East Tibet, and with a photograph of three others, for which I am indebted to the kindness of M. Charles Oberthür.

Much larger, expands 80 mm. as compared with 58 mm.; very

[1] *Epyrgis desgodinsi*, Oberth. Et. Ent. livr. ix. p. 18, t. xi. fig. 10.

[2] The difference shown in the Plate between the abdomen of this species and that of fig. 1 does not really exist, and is caused by the yellow bands of the sides showing above in its more distended state.

much brighter in colour, being bright cherry-red instead of dull reddish pink, the yellow spots, even in worn specimens, much brighter and larger. The body is black as in *C. desgodinsi*, with a row of 6 large yellow spots on the sides and under surface of the abdomen separated by black bands.

The underside of the tibiæ in all the legs is bright yellow, the tarsi and feet black. This seems to be the case also in *C. desgodinsi*, though my specimen is not so fresh. M. Oberthür informs me that a similar form occurs in Yunnan.

Besides the species of *Campylotes* above referred to, the following only are known to me:—

Campylotes atkinsoni, Moore, Descr. Atk. Coll. i. p. 17 (1879).

A rare species, from high elevations in Sikkim, without any yellow markings.

Campylotes prattii, Leech, Ent. 1890, p. 109.

From Central China. A species allied to *C. desgodinsi*, but easily distinguished from it and from all other described species by the transverse black band near the base of the fore wings.

Cyclosia? ochrea, n. sp. (Plate XXXIII. fig. 4, ♀.)

This very curious little insect agrees well with no genus known to me nor with any in the British Museum, if its size, colour, and aspect are regarded; but its antennæ and the ovipositor-like projection from the abdomen in the ♀, as well as the neuration, show that it belongs to the Chalcosiidæ, where it would come between *Herpa* and *Cyclosia panthona*, Cr. It is probably nearly allied to *Arbudas bicolor*, Moore, Atk. i. p. 20, t. 2. 19, which, though placed by Mr. Moore in the Nyctemeridæ, is also, I think, a Chalcosid Moth.

♂ ♀. Fore wings ochreous yellow without markings; hind wings the same, but paler and brighter, with darker abdominal border. Beneath, plain dull yellow-ochre. Head and body brown; antennæ black; legs and underside of body yellowish.

Expanse 24 to 26 mm.

Described from a single male and three females taken by Mr. Doherty in the Naga Hills at about 5000 to 7000 feet elevation.

Soritia? mölleri, n. sp. (Plate XXXII. fig. 13.)

I know of no insect in the family at all resembling this, and believe it will form the type of a new genus; but I have only seen two specimens, of the sex of which I cannot be certain with the help of a strong lens, and as I do not wish to destroy them, I must leave it uncertain for the present, though they seem to agree in venation and general appearance with *Soritia* (*Heterusia*) *circumdata*, Walk. Cat. xxxi. p. 121.

Colour black, with the inner half of both wings white except at the base, the veins of fore wing and a bar at the end of the cell vitreous; four black spots in the white part of the fore wing. Beneath, the white is tinged slightly with bluish. Head, thorax,

and abdomen tinged with steel-blue, which also extends to the base of the fore wings. Hinder part of abdomen clothed with some scattered white hairs. The haustellum bright red, looking, when rolled up, like a red spot below the neck.

Of this curious and distinct species I received two specimens only, from the late Otto Möller in 1887. As they have neither date nor locality, I presume they were taken in the interior of Sikkim by his native collectors.

RETINA? FUSCESCENS. (Plate XXXII. fig. 12, ♀.)

Of this very distinct species I have a single specimen only, of which the antennæ are not perfect and the wings somewhat worn; but though I cannot be certain of the genus, yet the insect can be confounded with no other known to Mr. Moore or myself from the Indian region [1].

The venation seems near that of *Retina rubrivitta*, though in this family I do not attach so much importance to that character. The antennæ are somewhat less pectinated though similar in structure. The projecting organ which resembles an ovipositor, and the red neck and the character of the wing-scales, all tend to prove that it belongs to the Chalcosiidæ, though its superficial appearance might lead one to place it among the Lithosiidæ.

Colour dull black, with a large whitish patch from the base to beyond the middle of hind wing. Tip of fore wing and costa of hind wing below also whitish. Collar and shoulders beneath red. Head, legs, and body black.

Expanse 33 mm.

Described from a single specimen taken in the interior of Sikkim by one of Möller's collectors.

RETINA? FLAVICOSTA, n. sp. (Plate XXXII. fig. 1, ♀.)

Of this insect I had a single female in the same collection as the last. It seems to be most nearly allied to *R. rubrivitta*, Wk. Cat. Het. ii. p. 439 (1854); Butl. Ill. Het. v. p. 25, t. 84. fig. 4.

Fore and hind wings dull black, with the costa of both wings and outer margin of hind wing dull yellow; collar and sides of neck below crimson. Thorax and body apparently tinged with green, but the specimen is too much rubbed to be certain; antennæ wanting.

Genus ELCYSMA, Butl. Trans. Ent. Soc. 1881, p. 4.

ELCYSMA DOHERTYI, n. sp. (Plate XXXIV. fig. 4, ♂.)

This remarkable species is very nearly allied to *E. westwoodi*, Voll., from Japan, which is figured in the Tijdschrift for 1863, t. ix. fig. 3, ♂, and described at page 136, of which *E. translucida*, Butl.,

[1] After describing this species I saw it in Dr. Staudinger's collection, and found that it was the same as *Soritia fuscescens*, Moore, Atk. p. 16 (1879). The male differs in having the hind wing without white, only a paler brown in the centre, and in being smaller. The antennæ are very long, measuring ·40 of an inch, which is the same as the length of the hind wings. Both sexes are in the Atkinson collection.

is a synonym (Plate XXXIV. fig. 5). It is also closely allied to *Chalcosia caudata*, Brem.[1] (Plate XXXIV. fig. 6), which I have from the island of Askold; but though there is nothing very marked in the coloration to separate it from either of them, yet the difference in venation affords a sufficient character. It may be described as resembling *E. westwoodi* in size, shape, and colour, but the fore wings more smoky, and the second discocellular vein of the hind wing forked close to, instead of some distance from, the end of the cell.

From *E. caudata* it differs in its larger size, much darker colour of both fore and hind wings, and in the recurrent vein in the cell of the fore wing being simple as it is in *E. westwoodi*, and not forked. From both the other species it differs in having the costal vein of the hind wing forked near the base, the two branches being connected by a short transverse vein near the middle of the cell (*cf.* fig. 4, *a*).

All three species have a yellow patch edged with a dark line at the base of the fore wing. The antennæ, head, legs, and abdomen are black. In *E. caudata* and *E. westwoodi* the abdomen is much paler. The antennæ of the female in *E. caudata*, and probably in the other species, are much more finely pectinate than in the male. The claspers of the male and the ovipositor of the female are of the same character as those of *Cadphises*, *Chelura*, and *Aglaope*, to which genera *Elcysma* seems to me to be most nearly allied. The only specimen I have seen was taken by Mr. W. Doherty in the Naga Hills, at an elevation of about 5000 feet, in August 1889.

Expanse of fore wing 66 mm.; length of hind wing 41 mm.; length of antennæ 12 mm.

CHIONOMERA PULCHELLA, n. sp. (Plate XXXII. fig. 15.)

This species is a near ally of *Tyana superba*, Moore, and belongs to the genus *Chionomera*, Butl. Trans. Ent. Soc. 1881, p. 18, in which he placed *C. superba* and *C. argentea* from Japan. It belongs to the Nycteolidæ and would come near *Earias*, but has no other near allies in Asia as far as I know. It is easily distinguished from *C. superba* by the green instead of yellow bands of the fore wing and by the much greater breadth of these bands, and these characters do not vary in the five specimens I have seen. It is rare in Sikkim; one specimen in Möller's collection was taken at about 5000 feet in April. I have received others taken near Tonglo at about 7000 feet. Of *C. superba* I have only two—one from Bhutan taken in September, the other by myself at Darjeeling in July[2].

Fore wings silvery above, with rich olive-green markings as shown in the Plate; below, only an indistinct olive-green patch on the middle of the costa; hind wings pure silvery white on both sides. Legs olive-green, with white joints and tarsi; two pairs of strong spurs on the hind legs. Palpi long, extending beyond the head. The sexes do not appear to differ.

Expanse 23–27 mm.

[1] *Chalcosia caudata*, Brem. Lep. Ost.-Sib. p. 97, t. viii. fig. 8.

[2] There are several specimens of *C. pulchella*, from Sikkim, unnamed, in the Atkinson collection which agree with mine.

LITHOSIA? ANOMALA, n. sp. (Plate XXXII. fig. 14, ♀.)

I am unable to say with certainty to what genus or even to what family this species belongs. Mr. Moore has a specimen unnamed in his collection which he has placed next to *Propachys*, but the palpi and legs are utterly different from this genus. Superficially it resembles a *Tyspanodes*, but has short legs like those of a Lithosid moth; its habit and general aspect make me think it must belong to the Lithosiidæ, in which also Dr. Staudinger concurs; and as I am unable to make out the venation clearly without injuring the specimen, I have placed it here for the present. I have two pairs, which I took at light on July 7th, 1886, at the old bungalow at Rangyroon near Darjeeling, at about 5000 feet; also a male from Bhutan and another which agrees perfectly, from the Naga Hills, taken in September.

♂ ♀. Fore wings above pale red, with a black line from the base to the outer margin, and two faint short ones above this at the apex; hind wings sooty black. Below, the fore wing is sooty black with the costal margin and fringes red, and a red tinge at the base and hind margin. Thorax, tegulæ, base of the antennæ, and front of head red. Palpi, legs, and abdomen black. The hind legs have a strong double spur on the last joint; there is a conspicuous haustellum. Antennæ rather short and filiform, with fine setæ at the joints.

Expanse, ♂ 23–25 mm., ♀ 28–31 mm.

KATHA? SEMIFUSCA, n. sp. (Plate XXXII. fig. 9.)

According to Mr. Moore this belongs to the genus *Katha* (P. Z. S. 1878, p. 16), but I am unable to follow his minute subdivision of the Lithosiidæ, and have no other species with which to compare it, except *K. nigrifrons*, which it resembles in size and shape. It comes, however, nearer to the figure of *K. terminalis* (P. Z. S. 1878, pl. i. fig. 14) in colour, but differs in the band of the fore wing being more than twice as broad. Fore wing fawn-colour, with a broad fuscous band not extending to the costa except at the apex, or to the outer margin. Hind wing pale straw-colour. Below as above, but the band paler and less defined. Head and thorax brown; neck, legs, and abdomen pale straw-colour.

Expanse 32 mm.

Described from a single specimen, which seems to be a male, taken by one of Möller's men in the interior of Sikkim.

NUDARIA? DUDGEONI, n. sp. (Plate XXXII. fig. 10.)

This species seems to come nearest to *Nudaria margaritacea*, Wk., but I am not at all sure that it is congeneric with the European *Nudaria*, the venation being obscure. Mr. Moore thinks it should form the type of a new genus, but there are too many ill-defined genera in the family already, as it seems to me.

The species is very distinct from anything known to me or to Mr. Moore, and the figure is so good that I need hardly describe the colour. The fringes at apex of both fore and hind wings are much darker brown than the remainder, and all the markings of the underside are darker than above. The hind legs have a double spur on

the last joint. The antennæ are filiform, with minute setæ at the joints.

Expanse 23 mm.

Described from a single specimen (? female) taken by Mr. Dudgeon at about 5000 feet, near Darjeeling, May 15, 1887.

SETINA? PUNCTATA, n. sp. (Plate XXXII. fig. 18, ♀.)

This species is nearly allied to *S. dasara*, Moore, which I have from the Naga Hills and Sikkim, and which also occurs in the North-west Himalaya. It is also less nearly allied to *S. nebulosa*, Moore, of which I have both sexes from Sikkim, but distinguished from both these by having no bands across the wings.

From *S. dharma*, Moore, and *S. punctilinea*, Moore, it is also distinct, as I have compared these species in Mr. Moore's collection. It comes nearest to *S. discisigna*, Moore, from the Khasi Hills, but differs from it in having no purplish brown on the hind wing, no black spots on the head or thorax, abdomen and legs yellowish instead of purplish brown.

Described from two females, one from Sikkim, and one from the Naga Hills. I doubt whether the Indian species are congeneric with *Setina* of Schrank, in *S. nebulosa* at least the male antennæ are pectinate; but I leave them so at present as my series is not sufficiently good to rearrange them.

LYCLENE SIMPLIFASCIA, n. sp. (Plate XXXII. fig. 19, ♀.)

This species is nearly allied to *L. nubifascia*, Walk., of which I have numerous specimens of both sexes, but differs in the following particulars:—The double row of spots across the fore wing is not bent outwards at the hind margin, and except in very fresh specimens is hardly visible. The fore wings are much deeper in colour. The dark bands across the fore wings are very faint, often quite invisible on the upper surface, and always narrower, especially in the female.

If I had not several fresh specimens of both sexes I should not have ventured to separate it, but finding that both Mr. Moore, Col. Swinhoe, and Mr. Butler have separated it in their collections without naming it, I have decided to do so. I took this species as well as *L. nubifascia* commonly at light at Darjeeling, on Tonglo, also on the top of the Rishilah in West Bhotan, from June to August. The antennæ of the male are pectinate as in *L. nubifascia*.

Genus BIZONE, Walk. Cat. Het. ii. p. 548 (1854); Moore, Lep. Ceyl. ii. p. 60.

*Chionæma*, H.-S. Aus. Schmett. p. 21 (1858).

In order to identify the numerous species of *Bizone* I have from India, and before describing any new species, I was obliged to revise the whole genus, and have carefully gone through the specimens in the British and Oxford Museums and in the collections of Messrs. Druce, Moore, Leech, Col. Swinhoe, and Dr. Staudinger, all of whom

I have to thank for allowing me to borrow for comparison specimens about which I was doubtful. As the species are numerous, little known, and closely allied, I have thought it best to give a list of those known to me. I think that the species for the most part do not vary much, and that the characters by which I have separated them seem constant in all those species of which I have seen many specimens. The form of the costal fold and the lobe beneath the fore wing, which is found in the males of most of the species, and the number, position, and colour of the bands on the fore wing, as well as the discal spots, which are usually different in number and position in the two sexes, afford good specific characters.

The distribution of the genus is rather peculiar. It seems to reach its maximum of development in the Eastern Himalayas, where no less than fifteen species are found, six only of which are as yet known to occur west of Nepal. In Southern India and Ceylon only three occur. In China there are seven, of which several seem to belong to a different group, in which the costal fold is absent or only slightly developed. In Java, Sumatra, Borneo, and the Malay peninsula we know of six or seven, and these too little to separate them in a satisfactory way. Celebes and Amboina have each one peculiar species. Madagascar has two; and one is found at Sierra Leone.

SECT. I.

A. *Costal fold present, with 4 red bands on fore wing.*
♀ *with one spot between 2nd and 3rd bands.*

*a*. ♂ with 3 black spots between 2nd and 3rd band.

*a'*. 3rd band concave, 2nd comma-shaped.

1. BIZONE PUELLA, Drury, Exot. Ins. ii. p. 3, t. 2, ♀ (1773).

*B. peregrina*, Walk. Cat. ii. p. 551, in part.

The type was a ♀ from South India. I have a ♀ from Bangalore which agrees with the plate, and both sexes from Kulu, which agree in the bands and spots. The male has a black or pinkish dash beyond the third band, which is sometimes edged with black.

Var.? PALLENS, Butl. Trans. Ent. Soc. 1877, p. 338, ♀.

This may be distinct, but the bands are usually much straighter and more parallel, and the insect smaller. I have a single ♂ from Sikkim which is rather intermediate. Others from the Naga Hills seem more distinct from the type. Mr. Butler has placed specimens from Moulmein, Sylhet, and Kangra under this name in the British Museum.

*a''*. 3rd band connected with 4th by a red line on costa; a deep cavity in the underside of fore wing.

2. BIZONE PEREGRINA, Walk. Cat. ii. p. 351, in part.

Walker confused two or three species under this name, which I restrict to the Ceylon species, which I have seen only in Mr. Moore's collection. It can certainly be distinguished from the last in the ♂, though possibly not in the ♀ sex.

I have seen no males from S. India, but if they should be found to agree with the Ceylon species, then the name of *puella* must be applied to this form, and the Himalayan insect, which I have called *puella*, would take the name of *peregrina*.

Moore has figured in Cat. E. I. C. p. 351, t. 13, the larva and pupa of a Javan species under the name of *puella*; but I have seen none from that island, though there are three females from Sumatra in Dr. Staudinger's collection which may be a form of it. These, however, have the marginal band very faint, and the 3rd band convex instead of concave.

*b*. ♂ with 2 black or pinkish-brown spots and a red dash between 2nd and 3rd bands, which are bent inwards and towards each other.

3. Bizone hamata, Wk. Cat. ii. p. 549 (1854); Leech, P. Z. S. 1888, p. 604.

? *B. puella*, Fixsen (*nec* Drury), Rom. Mem. iii. p. 332.

The type from Shanghai agrees with Japanese specimens.

It occurs also in Central China, and has been recorded from Hong Kong, though this may be another species.

4. Bizone fasciola, Leech, MS.

This species is separated from *B. hamata* by the 2nd and 3rd bands being straighter, and the lower black spot in the male being placed outside the upper one, not straight below it as in *B. hamata*. It has been taken at Ichang and Changyang, in Central China by Mr. Pratt.

5. Bizone inconclusa, Walk. Journ. Linn. Soc., Zool. vi. p. 120, ♂ (1862).

This species, which I have seen from Borneo and Sumatra, seems intermediate between *B. hamata* and the next species; but I have not seen a sufficient number of both sexes to be able to form an opinion. Walker describes it as distinct from the next by the difference in the discal dots, shorter costal fringe, and narrower bands. The lobe below the costa is single, not double as in *conclusa*.

6. Bizone conclusa, Walk. Journ. Linn. Soc., Zool. vi. p. 120, ♂ (1862).

? Var. *javanica*, Butl. Trans. Ent. Soc. 1877, p. 337.

This species occurs in Java, Sumatra, Borneo, and the island of Nias, and is distinguished from the last by the larger costal fold, broader red bands, of which the 2nd is edged inwardly, the 3rd outwardly, with black. The hind wing of *B. conclusa* is fawn-colour; Walker says tinged with pale yellow, perhaps this is faded. That of *B. javanica* is pink. If this is constant, the species might very well be separated, but I have seen but few specimens of either.

7. Bizone plateni, n. sp. (?).

Allied to *B. conclusa*, Wk., var. *javanica*, Butl., but has not the

dash running outward from the 2nd band, and has the lower of the two spots in the male obliquely inside instead of outside the upper spot. The shape, colour, and position of the fringe and lobe are very similar to *B. javanica*, and the hind wing also is pink. The red bands are broader, as in *B. conclusa*.

This species I describe with some hesitation, as I have seen only a single male, which is in Dr. Staudinger's collection, and was collected by Dr. Platen in the Minahasa district of North Celebes.

*c*. 1 spot only and a red dash between 2nd and 3rd bands. ♂ with a large brush of hairs on underside of the fore wing.

8. Bizone unipunctata, Leech, MS.

This very distinct species seems to be very rare in Japan, but Mr. Leech has a pair from Satsuma and a female from the Liukiu Islands, all taken by Mr. H. Pryer.

*d*. Very small red spots between 2nd and 3rd bands, which are straight.

9. Bizone amabilis, Moore, P. Z. S. 1877, p. 597, t. 59. f. 2, ♂.

From the description and figure I supposed this to be a form of *puella*, but on examining the type I find it is a good species. A female in Moore's collection is from Car Nicobar island.

10. Bizone pudens, Walk. Journ. Linn. Soc., Zool. vi. p. 120 (1862).

*B. perversa*, Butl. Trans. Ent. Soc. 1877, p. 338, ♀.

A small species from Borneo, which seems to come very near to the last. I have only seen it in the British and Oxford Museums.

B. *Costal fold well marked.*

*a*. ♂ with 3 spots between 2nd and 3rd bands.

*a'*. ♀ with 2 spots between 2nd and 3rd bands.

*a''*. Hind wings red.

11. Bizone bianca, Walk. Cat. vii. p. 1684, ♂ (1850).

A distinct species, which occurs in Sikkim, Burmah, and Penang.

*B. determinata*, Wk. Journ. Linn. Soc., Zool. vi. p. 120, ♀ (1862), from Sarawak, seems nearest *B. bianca*, and may be its female; but the male is unknown, and what is put as the female of *bianca* in the Oxford Museum by Walker has three spots, whilst all I have from Sikkim and Burmah have two only.

*a'''*. With hind wings fawn-colour.

12. Bizone puer, n. sp. (Plate XXXII. fig. 8, ♂.)

♂. Fore wings white, with two red bars, the outer one edged outwardly with black, the inner one angled; a short orange-buff band at base of wing; the whole apex and entire hind wing pale buff.

♀. Like the male but larger, with two larger spots between the bands.

Between the red bars on fore wing are three black spots in a triangle, and a fourth outside the bar near the costa close to the fold which is little marked above; below there is a single lobe as in *B. sikkimensis*. Beneath buff, with the costa of hind wing and hind margin of fore wing white. Head and body white. Thorax buff with white stripes. Legs white with black bands.

Of this distinct species I took a male at light near Darjeeling on July 20, 1886, and have seen a female in Atkinson's collection from the Khasia Hills, taken October 1867. I have also a pair from Mao on the Manipur side of the Naga Hills, taken by W. Doherty in August 1889. There is a female without name, from Assam, in the Oxford Museum.

*b*. ♀ with 3 spots between 2nd and 3rd bands.

*b'*. All white, with no marginal band.

13. BIZONE SIGNA. (Plate XXXII. fig. 7, ♀, ? var.)

*B. signa*, Walk. Cat. Het. ii. p. 550, ♂ (1854). Silhet.

? *B. fasciculata*, Walk. l. c. vii. p. 1684, ♂ (1855). Himalaya, Kulu to Sikkim.

*B. adita*, Moore, Cat. E. I. C. ii. p. 306, t. 7 *a*. fig. 11, ♀ (1859).

I cannot be certain whether *B. signa* and *B. fasciculata* are the same, as the type of the latter is in the Oxford Museum, and the type of *B. signa* in the British Museum. In this and in one of my Sikkim specimens the two outer spots coalesce and form a short black bar, but it does not seem to be otherwise different. The female which I have figured as *B. signa*, var. (fig. 7), has no corresponding male. I have four specimens of it from Sikkim, which differ from the female of *B. fasciculata*, Wk., which is common in Sikkim, by the larger size of the spots, the shape of the outer bar, and the red band on the hinder part of the thorax. I also notice that the basal band in *fasciculata* is reduced to a line on the costa which runs along it from the 2nd band, whereas in what I figure as *signa* there is no pink edge to the costa, and the basal band extends nearly to the hind margin. If *B. signa* and *B. fasciculata* (= *B. adita*) prove distinct, which I doubt, this might be the female of *B. signa*. If not it may be a new species, which I would call *B. walkeri*.

14. BIZONE ADELINA.

*Bizone adelina*, Stgr. Rom. Mem. iii. p. 191, t. x. fig. 14, ♀ (1887).

This is most nearly allied to *B. fasciculata*, Wk., and has the same spots, but differs in the pink bands being more angular and in the pink colour of the hind wings. It seems to be a good species. It was found near Vladivostock in July and August by Christoph.

*b''*. With marginal bands present. White hind wings.

15. Bizone ariadne, Leech, MS.

This is a good species, distinguished from *signa* by marginal band and shape of the second and third bands; in the male there is a pink spot on the costa above the black spot, which is separated by the fold from the pink band.

It has been found in Central China, at Changyang, by Mr. Pratt.

*b'''*. Red hind wings.

16. Bizone pratti, n. sp.

This was sent to me by Mr. Leech under the name of *B. sanguinea*, Brem., but it is quite distinct from what I take to be that species, which is described further on.

It is like *B. ariadne*, but differs in having the hind wings and abdomen bright pink as in *B. bianca*. There are three black spots in both sexes, but in the male the outer one is placed on the third bar instead of within it. As this species will doubtless be figured by Mr. Leech, I will not describe it more particularly. It was taken by Mr. and Mrs. Pratt at Changyang and Ichang in June 1888.

Next we have a group of five species with four fawn-coloured bands (except in *B. sikkimensis*, which has only three), all, so far as I know, confined to the Himalayan region. They are all nearly allied but, as I believe, quite distinct.

I have been obliged to name no less than three of them, which I should not have ventured to do if I had not examples of both sexes in good condition of every species.

*c*. 4 yellow bands.

*c'*. Pink body and pale pink hind wings.

17. Bizone arama, Moore, Cat. E. I. C. ii. p. 306, t. 7 *a*. fig. 10, ♀.

A distinct species, which seems rare wherever found. The male, which is undescribed, I have only seen in Dr. Staudinger's collection.

The middle spot in the male takes the form of a short bar, as though two spots were united. The outer spot is placed, as in *B. pratti*, rather outside the third band, which is broken by the fold, and appears as a spot on the costa. I have females from Kulu and Sikkim in my collection, and there are others from Khasia in the British Museum.

*c''*. White body and hind wings; hind wings with a dark lunule.

18. Bizone dohertyi, n. sp. (Plate XXXII. fig. 4, ♀.)

♂ ♀. White, with pale yellow bands on the thorax and tegulæ. Four pale yellow bands across the wings, of which the first does not extend to the hind margin, the second and third irregular. In

addition to the triangle of black spots between these bands, the male has a fourth close to the costa outside or partly in the third band. The fringe of the fold is very narrow, and the lappet beneath the wing small. Underside and hind wings pure white, the black dots showing through, and on the hind wing a small blackish lunule at the end of the cell, which is not visible in the Plate, but which distinguishes this species from any other. Described from two males and a female taken by Mr. Doherty at Mao, on the Manipur side of the Naga Hills, in August 1889. I have a single female agreeing perfectly with them from Möller's collection, taken in 1888, in Sikkim.

$c^3$. 2 spots only within the bands in ♂.

19. Bizone mölleri, n. sp.

Very near the last species, but distinguished by the absence of the dark lunule on the hind wing, by the male having two only instead of three spots in the disk, by the somewhat smaller size, and differently shaped lappet below the wing. I think it is a perfectly good species, as I have 1 ♂ and 2 ♀ from Sikkim, and have compared a male from Cherra Pungi in the Khasia Hills, in the Atkinson collection, which perfectly agrees.

This species may be distinguished from *B. guttifera* by the much larger black spots, the pure white hind wing, and larger costal fringe.

$c^4$. With pale yellow hind wings.

20. Bizone guttifera, Walk. Cat. vii. p. 1779.

Smaller than the last, with smaller black spots, and the hind wings in fresh specimens bright yellowish fawn-colour, which in worn or old specimens fades towards the base. Agrees with type in the British Museum, which came from the North-west Himalaya. Seems common in the interior of Sikkim, and brought from Chumbi by native collectors, but not found, so far as I know, near Darjeeling. A pair from the Naga Hills agree perfectly.

In the British Museum and Moore's collection some specimens which may belong to *B. sikkimensis* are mixed with it, but fourteen specimens in Möller's and my collection, of which four are males, are constant in the colour of the hind wing and other characters.

$c^5$. Pure white, with 3 yellow bands, the terminal one wanting.

21. Bizone sikkimensis, n. sp. (Plate XXXII. fig. 6 ♂, 5 ♀.)

♂ ♀. White, with orange-buff bands on the thorax and tegulæ, and three orange-buff bands across the fore wing as in the figure. The male has two round black spots between second and third bands, and a black streak on the third band, the outer angle of which is partly concealed by the costal fold.

The fold appears to be much shorter and differently shaped to those of *B. signa* or *B. mölleri* and seems more like that of *B. guttifera*, whilst the lobe below is shorter and single.

In the female the three black spots are smaller, and more widely separated than in *B. arama* or *B. mölleri*, resembling those of *B. signa* ♂.

I took this species on Tonglo, at 10,000 feet elevation, in July, where it was rare; there was also a male in Möller's collection.

*d.* Pure white, without bands.

22. Bizone candida. (Plate XXXII. fig. 2 ♂, 3 ♀.)

*Chionæma candida*, Feld. Reise Nov. t. 10 *b*. fig. 17.

I had described this species already under the name of *candida*, when Mr. Butler called my attention to Felder's figure, which appears to be the same insect and has the same name. As, however, it has not been described, I annex a short diagnosis.

♂ ♀. Pure white, with crimson band across the thorax; a crimson spot in its centre and on the tegulæ (these are absent in a specimen taken at Rala). A crimson line along both sides of the costa as far as the sexual fold above and the large lobe below; the base of the costa is also pale crimson. The male has, in addition to the three black spots in a triangle, a fourth partially concealed by the fold as in *B. signa*. Tarsi white banded with black. Palpi white below, black above.

*Hab.* Sikkim, 8000–10,000 feet elevation; Kulu, in Indian Museum (*fide* Swinhoe); Rala, N.W. Himalaya, 6000 ft. (*McArthur*).

I have received several males and one female of this species from native collectors on Tonglo, and have no doubt it is a good species.

Species of doubtful position.

23. ? Bizone triguttata, Walk. Char. Undescr. Lep. p. 89, ♀ (1869).

I cannot identify this species with certainty, as the description of the female only might do for *B. mölleri*.

The type is in the Devon and Exeter Museum, where, on application to the curator, I have not been able to see it. It was said to have come from Benares. There is in Mr. Moore's collection a male labelled N.W. Himalaya, which may be of this species, and which differs from *B. guttifera* only in the pure white hind wings, and from *B. dohertyi* only in the absence of the lunule on the hind wing. For the present this species must remain obscure.

24. Bizone subornata, Walk. Cat. ii. p. 550, ♀ (1854); Moore, Lep. Ceyl. ii. p. 60, t. 103. 4.

The type of this is a single female in bad condition from Ceylon; the male is unknown. Mr. Moore has one from Ceylon, another female from the Andamans, and a third from Borneo. Col. Swinhoe has a female from Khandalla, near Bombay. All these appear to belong to one species, which may be described as like *B. puella*, but with the bands straighter, as in *B. pallens*, Butl., and with three spots instead of one.

Aberrant species, of which the male only is known.

25. Bizone costifimbria, Walk. Journ. Linn. Soc., Zool. vi. p. 121, ♂ (1862).

This species is described from Sarawak, and the type is in the Saunders collection at Oxford. The description agrees with a male from Sumatra collected by Paul Staudinger and with one taken at Perak by Doherty, except that the third band of this species is not black-bordered outwardly as Walker says. I find this character, however, is not constant in other species. Without seeing the female, I cannot tell where to place this species.

26. Barsine effracta, Walk. Cat. ii. p. 546.

*Bizone effracta*, Butl. Trans. Ent. Soc. 1877, p. 339.

A distinct species, which probably belongs to this genus, as the costal fold and lobe are well marked. It differs from all others in having five pink bands on the fore wing, and pink spots between each of them, except the two inner ones. It has also a dark spot on the hind wing.

It occurs very rarely in Sikkim, and is recorded from Nepal.

Sect. II.

A. *Costal fold absent or inconspicuous.*

*a*. Hind wings red.

*a'*. Fore wings red, with 2 black bands and 3 black spots.

27. Bizone coccinea, Moore, P. Z. S. 1878, p. 28, t. iii. 14, ♂.

A very distinct species, of which the male only is known.

It appears to be very rare in Sikkim.

*a''*. Fore wings white, with 3 red bands and an apical yellow patch.

28. Bizone bellissima, Moore, P. Z. S. 1878, p. 27, t. iii. 13, ♂.

Of this species also the female is unknown. The type was from Masuri, and I have a male from Sikkim, where it is very rare, and there are two more in the Atkinson collection.

*a'''*. Fore wings white with 3 pink bands.

29. Bizone pitana, Moore, Cat. E. I. C. ii. p. 305, ♀ (1858–9).

This resembles *B. subornata*, except that it has no apical band. The type is in the British Museum from Java. There is also a single male from Sindaglaia, Java, in Dr. Staudinger's collection, which, though in bad condition, appears to have no costal fold or lobe beneath.

*a''''*. Fore wings red, with white markings and 3 black spots.

30. Bizone phædra, Leech, Trans. Ent. Soc. 1889, p. 126, t. ix. fig. 6, ♀.

This is a very distinct species, which might be put in another

genus with the next two, as the bands are replaced by much broader irregular markings. Mr. Leech says that the sexes are alike, but the position of the three spots is different in two specimens which he has lent me to examine.

It occurs at Kiukiang and Changyang, in Central China, also at Ningpo and at Ta-tsien-lo, whence I have two specimens from M. Oberthür which fairly agree with Mr. Leech's, though the white on the fore wing is much more extended and the red much paler. These specimens, however, are not fresh enough to enable me to judge correctly.

31. BIZONE SANGUINEA.

*Calligenia sanguinea*, Brem. Schmett. N. China, p. 14 (1853).

? *Bizone sanguinea*, Leech (nec Brem.), Trans. Ent. Soc. 1889, p. 126.

? *Bizone cruenta*, Leech, Entomologist, Feb. 1890, p. 49, ♂ ♀.

I cannot be certain what Bremer's species is, as the plate to which Mr. Leech refers is not in any copy of Bremer's work which I have seen, and it is doubtful whether it was ever published. Bremer's Latin diagnosis, however, together with his German description, seem to me to answer exactly to the species described by Leech as *B. cruenta*, except that the Latin says "punctis *duobus* nigris in media ala," whilst the German says "wo derselbe vor *einem* schwarzen Punkte endigt."

In six specimens of *B. cruenta* which are before me, including the types, there are two black spots; but in worn specimens one of them is faint, and Bremer may have had such before him when he wrote the description. Bremer's type came from near Pekin, Leech's from Changyang in Central China, where it seems common.

32. BIZONE HARTERTI, n. sp.

This species seems quite distinct, and may be described as like a small *B. guttifera*, but differs in having no costal fold, white hind wings, smaller spots, and narrower yellow bands; on the underside of the fore wing is a dark patch corresponding in position to the spots above, but no lappet. The underside is white, with the costal and outer margins of the fore wing broadly tinged yellow. The types are two specimens, of which one is certainly, and the other probably, a male, in Dr. Staudinger's collection. They were taken in Upper Assam in 1888 by Lieut. Hartert, after whom I name the species.

33. BIZONE IMPUNCTATA, Feld. Sitzungsb. Ak. Wissen. Wien, xliii. Abth. 1, p. 37 (1861).

A very distinct species, which I have seen in Dr. Pagenstecher's and Staudinger's collections from Amboina. It has four red bands, but no spots at all, and in the specimen before me, which appears to be a male, there is no costal fold or lappet.

34. Bizone divakara.

*Barsine divakara*, Moore, P. Z. S. 1865, p. 798, t. 43. fig. 9.

This is a large species which is common at Darjeeling, and is distinct from all others. The fold in this case is short and less conspicuous, but appears to be formed somewhat in the same way as that of *B. puella*.

35. Bizone rubrifasciata, Druce, Waterh. Aid, t. 172. fig. 1.

*Bizone rubrifasciata* is a splendid and very distinct species from Celebes, with dark slaty hind wings. The type is in Mr. Druce's collection, and there are two females from North Celebes in Dr. Staudinger's.

36. Bizone saalmülleri, Butl. Cist. Ent. iii. p. 3.

From Madagascar. Type in British Museum.

37. Bizone delicata, Walk. Cat. ii. p. 550.

From Sierra Leone. Type in British Museum.

38. Bizone amatura, Walk. P. Z. S. 1863, p. 16.

From Madagascar. Type in British Museum.

*Doubtful Species.*

Lithosia alborosea, Walk. Cat. xxxi. p. 230.

*Bizone alborosea*, Butl. Trans. Ent. Soc. 1877, p. 339.

The type is a female, and so much worn that it cannot be recognized. Butler gave no reason for putting it into this genus.

Bizone gazella, Moore, P. Z. S. 1872, p. 572, t. 33. fig. 4, ♂.

A distinct species, but it cannot be included in the genus on account of the antennæ of the male being distinctly pectinate, as shown in the plate. I have not seen this sex however, but only a female from Sikkim in Atkinson's collection. It must be very rare there. The types were from Masuri.

Bizone quadrinotata, Walk. Char. Undescr. Het. p. 90, ♂ (1869).

Described from Benares. The type is in the Devon and Exeter Museum, and for the present must remain obscure, though from the description I expect it will prove to be either *B. pallens* or *B. puella*.

Bizone alba, Moore, P. Z. S. 1878, p. 28.

A single specimen in Mr. Moore's collection from N. China (? Shanghai), in bad condition and of uncertain sex, is all I know of this species. It is white, without bands, and with a single discal spot.

Notodonta (?) gigantea.

I am quite unable to say with any certainty what this remarkable insect is, having seen nothing like it in any collection, except

another of the same species in Mr. Druce's, which I received some years ago from Capt. Graham Young, and which was taken in the Mandi or Kulu district of the N.W. Himalaya. The sex cannot be determined with certainty, but both specimens seem, on account of the simple frenulum, to be males.

I took my specimen at Darjeeling in August. It may be described as follows:—

Form and venation of *Notodonta trepida*, but twice as large. Fore wings brown, mottled with grey and reddish brown; a dark line inside the outer margin and a broad grey patch along the middle part of the costa. A distinct fringed lobe in the centre of the hind margin, resembling that found in the genera *Notodonta* and *Lophopteryx*, but not found in *Phalera*. Hind wings fawn-colour, with dark veins and long dense brown hairs at the base. Beneath, fore wings brown, with dense hairs clothing the basal part of the wing; hind wing paler, the costa reddish brown. Head and thorax grey-brown. Abdomen dark brown, with yellow projecting tufts along the sides and yellow bands below. Extremity of abdomen yellowish brown. Fore legs densely covered, as in *Notodonta trepida*, with reddish-brown hair. Palpi short. A dense tuft of hair between the eyes and at base of the antennæ, which are very minutely ciliated. Expanse 125 mm., length of body from eyes 41, length of hind wing 38, antennæ 21 mm.

### Genus Sinna, Wlk.

*Sinna*, Walk. Cat. Het. xxxii. p. 641 (1865).
*Teinopyga*, Feld. Reis. Nov., Atl. p. 9 (sine descr.) (1868).

Sinna dohertyi, sp. nov. (Plate XXXIII. fig. 5.)

This genus contains four or five species, which are all represented in the British Museum, and from all of which my species differs. It most resembles *S. calospila*, Wk., from Java, but differs in having the ground-colour of the fore and the whole of the hind wing pure shining silvery white instead of pale buff.

From *S. extrema*, Wk., from Shanghai (probably identical with *Teinopyga reticularis*, Feld.), and *S. fentoni*, Butler, from Japan, which is also very nearly allied, it differs in having the markings of the fore wing red instead of yellow. *T. clara*, Butler, from Japan has no black at the tips of the wings.

The markings of the fore wing above are too intricate for a description that would be intelligible; but the colour in fresh specimens is brighter than shown in the Plate. Beneath it is silvery white, with smoky black instead of red and yellow markings. The thorax is white with yellow bands; the abdomen white with two black spots on each side of its end. Legs white, with some black spots.

Described from two specimens taken in the Naga Hills by Mr. Doherty. I should have been disposed to place this genus near *Chasmina* among the Noctuæ, but it is arranged in the British Museum with the Lithosiidæ between *Setina* and *Camptoloma*, and Felder suggests its affinity to the genus *Hulias*.

## EXPLANATION OF THE PLATES.

### Plate XXXII.

Fig. 1. *Retina flavicosta*, ♀, n. sp., p. 386.
2. *Bizone candida*, ♂, p. 396.
3. —— ——, ♀.
4. —— *dohertyi*, ♀, n. sp., p. 394.
5. —— *sikkimensis*, ♀, n. sp., p. 395.
6. —— ——, ♂.
7. —— *signa*, ♀, var., p. 393.
8. —— *puer*, ♂, n. sp., p. 392.
9. *Katha semifusca*, n. sp., p. 388.
10. *Nudaria dudgeoni*, n. sp., p. 388.
11. *Artona zebra*, ♂, n. sp., p. 379.
12. *Retina? fuscescens*, ♀, p. 386.
13. *Scritia mölleri*, n. sp., p. 385.
14. *Lithosia anomala*, ♀, n. sp., p. 388.
15. *Chionomera pulchella*, n. sp., p. 387.
16. *Artona postalba*, ♂, n. sp., p. 379.
17. —— *sikkimensis*, ♂, n. sp., p. 379.
18. *Setina? punctata*, ♀, n. sp., p. 389.
19. *Lycleue simplifascia*, ♀, n. sp., p. 389.

### Plate XXXIII.

Fig. 1. *Campylotes histrionicus*, var. *altissima*, p. 384.
2. —— *sikkimensis*, n. sp., p. 384.
3. —— *desgodini*, var. *splendida*, p. 384.
4. *Cyclosia ochrea*, ♀, n. sp., p. 685.
5. *Sinna dohertyi*, n. sp., p. 400.

### Plate XXXIV.

Fig. 1. *Atossa nelcinna*, Moore, p. 381.
2. —— *moorei*, ♂, n. sp., p. 382.
3. —— *nagaensis*, ♂, n. sp., p. 382.
4. *Elcysma dohertyi*, ♂, n. sp., p. 386.
5. —— *westwoodi*, Voll., p. 386.
6. —— *caudata*, Brem., p. 387.

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## May 20, 1890.

Prof. Flower, C.B., LL.D., F.R.S., President, in the Chair.

Mr. Gambier Bolton, F.Z.S., exhibited a series of photographs, principally taken from animals living in the Society's Gardens and in the Menagerie of Mr. Walter Rothschild, F.Z.S.

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Prof. Flower exhibited and made remarks on a photograph of a nest of a Hornbill (*Toccus melanoleucus*), taken from a specimen in the Albany Museum, Grahamstown, in which the female was shown "walled in."

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The Rev. Canon Tristram, F.R.S., F.Z.S., gave an account of his recent visit to the rock of Zalmo in the Canaries, where he obtained specimens of Simony's Lizard (*Lacerta simonyi*)[1].

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The following papers were read:—

1. On the reported Discovery of Dodo's Bones in a Cavern in Mauritius. By Sir Edward Newton, K.C.M.G., F.L.S., C.M.Z.S.

[Received April 30, 1890.]

At a meeting of the Society, November 3rd, 1885 (P. Z. S. 1885, p. 719), an extract from a letter addressed to the Secretary by Mr. J. Caldwell, C.M.Z.S., of Mauritius, was read announcing the finding by one of his collectors of a hitherto unknown deposit of bones of the Dodo (*Didus ineptus*) in a small cavern in the island. Nothing further has been heard, I believe, of the supposed discovery, and Mr. Caldwell died a few months after he had made his communication to the Society. I have, however, just received a letter from Mr. Evenor Dupont, a well-known shell-collector of Mauritius, with an endorsement by Mr. C. E. Bewsher, C.M.Z.S., which I think leaves no doubt that the late Mr. Caldwell had been imposed upon, and that the bones in question were not those of the Dodo.

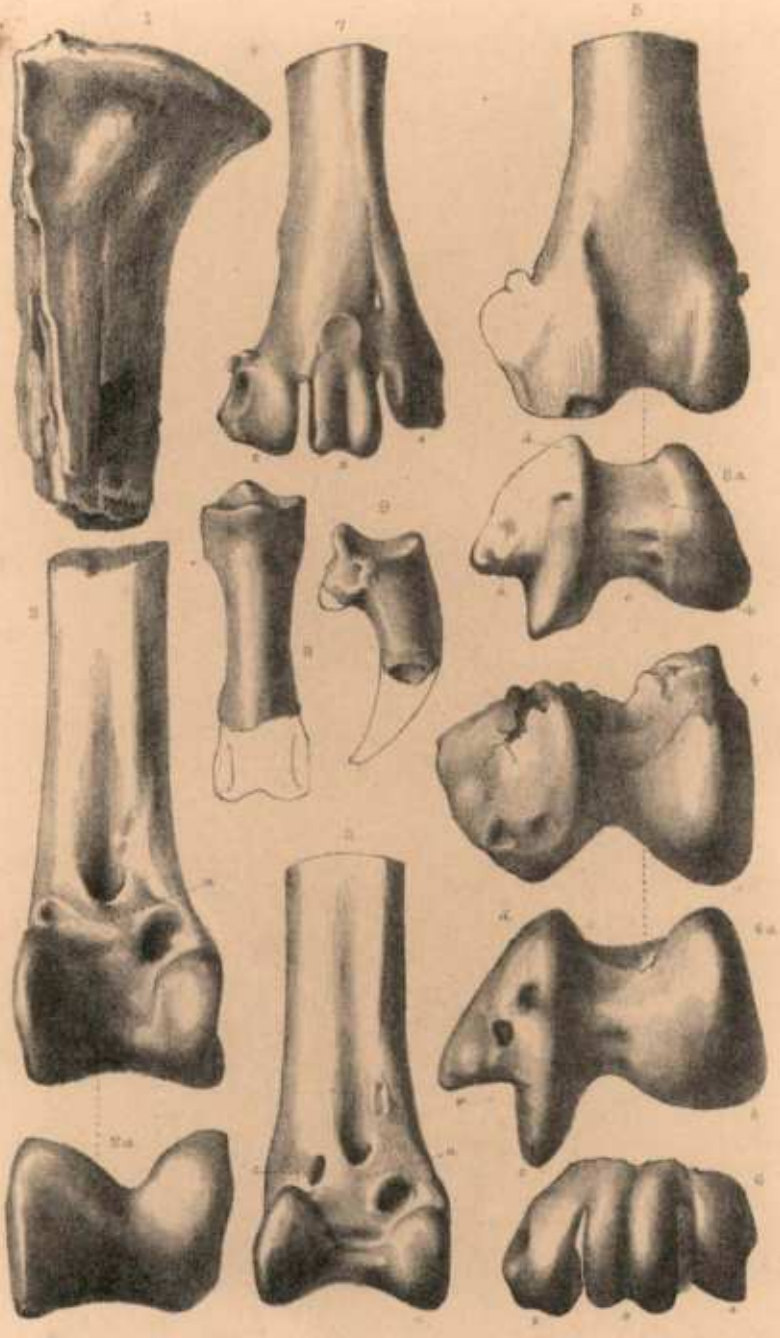
Mr. Dupont writes:—

"Port Louis, Mauritius,
March 20, 1890.

"....I write to correct a statement made by the late Mr. Caldwell, and published in Proceedings of the Zoological Society, to the effect that Dodo bones have been found in a cavern in Mauritius. Mr. Caldwell, I believe, was induced to make this statement on the faith of a story told him by one of our native collectors (a Creole) here who brought him the bones. The whole thing was a fraud, and I am afraid the bones were not those of the Dodo, but Turkey's. I searched for them without success in Mr. Caldwell's collections when they were sold after his death. I have never heard of any Dodo bones being found except in a marsh at Flacq (by Mr. Ange Réguard, one bone, doubtful) and in the Mare aux Songes at Grand Port. I am the more inclined to discredit the story of the Cave bones, as these men, who for years have made a business of hunting for specimens of Natural History (one of whom brought the bones to Mr. Caldwell), have more than once tried to pass off doctored shells as new species and not always without success."

Mr. Bewsher endorses this by writing:—"On my return to Mauritius two years ago, I went very carefuly into this question of the Cave bones, and the result of my enquires led me to the same conclusion as my friend Dupont. I fully endorse all he has said, and would add that Mr. Caldwell was in very failing health both bodily and mentally lately, and so the cunning Creole imposed on him more easily."

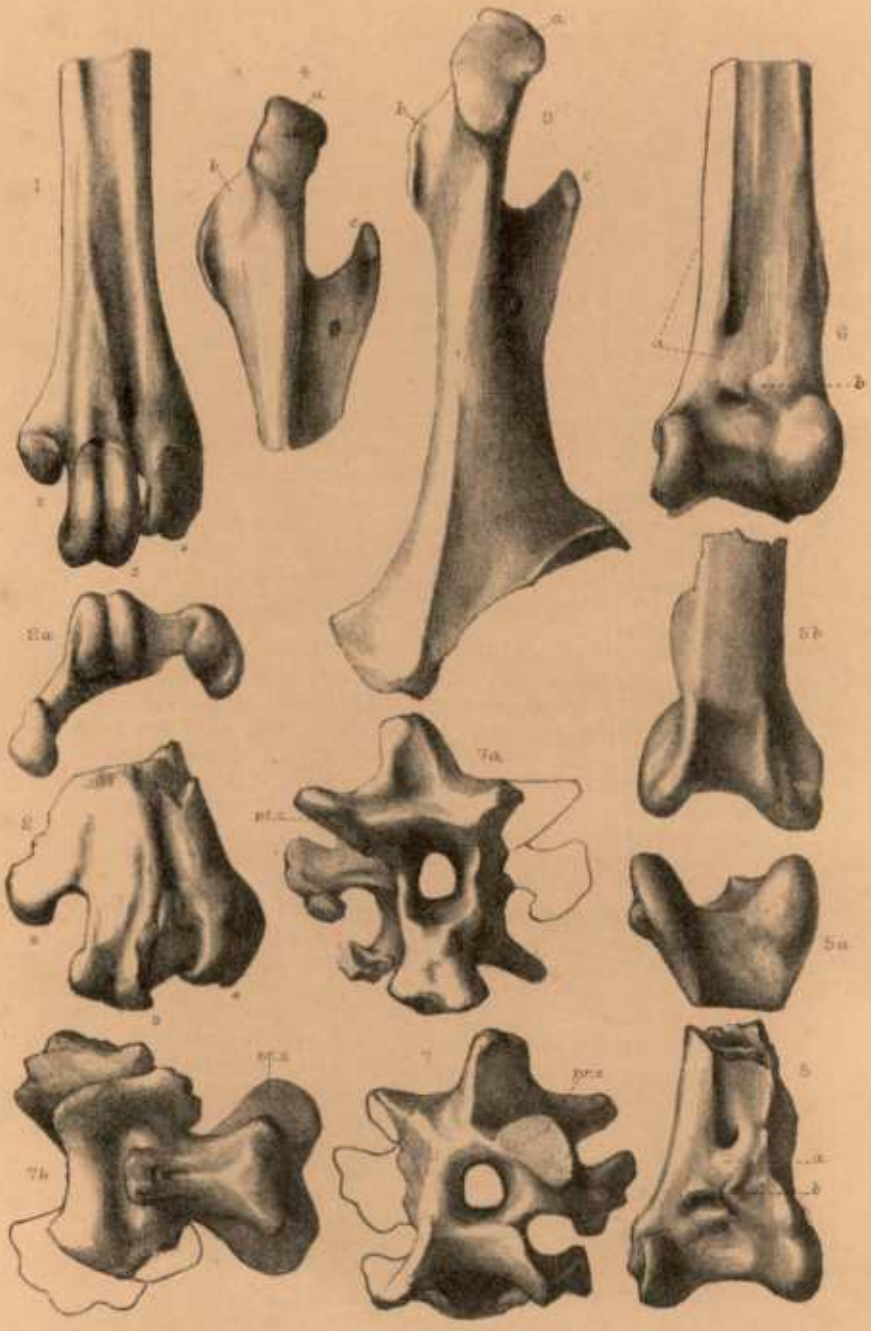
[1] See above, p. 354.



H.C.Woodward lith.

West,Newman imp.

Fossil Bird-bones from Malta.



Fossil Bird-bones from Malta.

caverns which had been collected by the late Admiral Spratt. These were subsequently figured in vol. vi. pl. xxx. of the 'Transactions'; but what has now become of them I am unable to state. Several of them are, however, almost or quite perfect, and therefore better suited to the exact determination of the affinities of their owners than those I have now to describe.

The greater number of these specimens were regarded as belonging to a species of Swan, for which the name *Cygnus falconeri* was proposed. This species was described as being about one third larger than *C. musicus*, from which it was distinguished by the relatively shorter femur, the shorter tarso-metatarsus, and the much shorter phalangeals.

In recently examining the small series of bird-bones from the Maltese caverns presented to the British Museum by Admiral Spratt, all of which have hitherto been labelled *Cygnus falconeri*, I found that only a few of them, viz. two specimens of the imperfect distal extremity of the tarso-metatarsus and some phalangeals, really belonged to that form. These specimens agree with the types in being decidedly larger than the corresponding bones of *C. musicus*, and the phalangeals confirm the conclusion that the species is widely different from any existing form. Most of the other bones, however, are referable to a Vulture and a Crane, and these I now proceed to describe.

### Gyps melitensis, n. sp.

The bones of the Accipitres are so easily recognized and so widely different from those of other birds that there is no difficulty whatever in deciding whether given fossil specimens belong to members of this group. A considerable number of specimens in the series already mentioned indicate the existence in Malta during the Pleistocene period of a Vulture exceeding the existing *Vultur monachus* by about one fifth of its dimensions, and therefore the largest member of the Accipitres yet known, with the exception of the still more gigantic extinct New-Zealand bird described by the late Sir J. von Haast under the name of *Harpagornis*. For this species, which may be sufficiently diagnosed by its large dimensions, I propose the name of *Gyps melitensis*, my reasons for the generic reference being given below.

It will be unnecessary on this occasion to give an account of the distinctive osteological features of the Accipitres, since those who are desirous of making themselves acquainted with this subject will find full details in Professor A. Milne-Edwards's 'Oiseaux Fossiles de la France'; and I accordingly at once proceed to notice the various bones, commencing with the tibio-tarsus as one of the most characteristic parts of the skeleton.

In my drawings (see Plate XXXV. figs. 2, 2*a*) there are given two views of the distal portion of the right tibio-tarsus, an anterior view of the corresponding part of the homologous bone of *Vultur monachus* being given in fig. 3. A comparison of the figures will at once show

the complete structural identity of the bones, so that detailed description is unnecessary. The characteristic Accipitrine features of this part of the tibio-tarsus are the fore and aft compression of the shaft, the shallow anterior groove, the wide separation of the two condyles on the anterior surface, the extreme obliquity of the bony bridge over the groove for the extensor tendons, and the absence of any tubercle on the bridge itself[1]. On the posterior aspect of the bone, which has not been figured, the shallowness and great relative width of the trochlear surface are equally characteristic. The rough surface for the articulation of the distal extremity of the long fibula is distinctly seen on the postaxial border of the fossil. The specimen represented in the next figure (Plate XXXV. fig. 1) is the imperfect proximal extremity of a right tibio-tarsus, doubtless forming a part of the same bone as the preceding specimen. The cnemial crest and external surface of this fragment are somewhat imperfect, but the contour of the portion which remains perfect agrees in all respects with that of the smaller tibia of *V. monachus*. The greatest transverse diameter of the fossil tibia is 0,030, the corresponding dimension in that of the existing species being 0,025. The total length of the tibia of *V. monachus* is 0,222; and if the same proportion of breadth to length obtained in the extinct species the total length of its tibia would be 0,266. The fossil tibia may be distinguished from the recent one by the somewhat greater prominence of the bridge (*a*) over the groove for the extensor tendons, and the absence of the lateral perforation (*c*) which communicates with the same groove. The great size of this tibia indicates the probability of its owner having belonged to *Vultur* (or an allied genus) rather than to *Aquila*, this inference being rendered certain by the following specimens.

The tarso-metatarsus of the Accipitres is fully as characteristic as the tibio-tarsus, even when, as in the present instance, we have only the distal trochleæ to work with. Thus these trochleæ approximate more or less closely to the same transverse line, and form a slight but regular curve from side to side. The distal extremity of a left tarso-metatarsus (represented in Plate XXXV. fig. 6) accords so exactly in contour with the smaller bone of *Vultur monachus* (shown in fig. 7 of the same Plate) that their close affinity is manifest at the first glance. Moreover, in the relative length of the trochleæ, and the elevated position of the trochlea for the fourth digit, coupled with the slight lateral expansion of the one for the second digit, the fossil specimen resembles *Vultur* and differs from *Aquila*. The much shorter tarso-metatarsus of *Gypaëtus*, while approximating to *Vultur* in the general form of the trochleæ, resembles *Aquila* in the lateral expansion of the trochlea for the second digit. This specimen is therefore decisive that the fossil form should be referred to *Vultur* or *Gyps*. The transverse diameter of the trochlea for the third digit is 0,012, against 0,010 in *V. monachus*. The Museum also possesses portions

[1] By an unfortunate error it is stated in Nicholson and Lydekker's 'Manual of Palæontology,' 3rd. ed. vol. ii. p. 1239, that the bridge itself, instead of its tubercle, is absent in the Accipitres.

of two other specimens of the tarso-metatarsus, as well as another of the distal extremity of the tibio-tarsus.

Of the femur we have a specimen of the distal extremity (represented in Plate XXXV. figs. 4, 4*a*). This bone belongs to the right side, and it is practically certain that the detached head of a right femur in the Museum (No. 49355) originally formed a portion of the same bone. The detached head agrees with the femur of *Vultur* and *Gyps*, as distinguished from that of *Aquila*, by the large size of the depression for the attachment of the ligamentum teres. It has a diameter of 0,018, against 0,015 in *V. monachus*. The distal extremity agrees in all respects with the corresponding portion of the femur of the existing species (represented in figs. 5, 5 *a* of the Plate cited) even down to the position of the fossa (marked *d*) for the attachment of a muscle or ligament. The transverse diameter of the fossil is 0,044 and that of the recent bone 0,037 ; the former being, as in the case of the metatarsus, about one fifth larger than the latter. The length of the femur of *V. monachus* being 0,133, the calculated length of that of the fossil species would be 0,159.

The imperfect proximal phalangeal of the third digit of the pes (represented in Plate XXXV. fig. 8) as well as the imperfect terminal phalangeal (shown in fig. 9 of the same Plate) resemble the corresponding bones of *Vultur monachus*, with the same excess in size as holds good with the other portions of the skeleton.

So far as I am aware there are no very well-marked characters by which the bones of the hind limb of *Vultur* can be generically distinguished from those of *Gyps*. A marked osteological distinction between the two genera is afforded, however, by the cervical vertebræ, more especially those from the hinder part of that region. To exhibit this difference a late cervical vertebra of each genus is figured in the two accompanying drawings (figs. 1, 2, p. 407). It will be seen from these figures that in *Gyps* the lateral borders of the inferior surface of the centrum are much more emarginate than in *Vultur*, while the posterior extremity of this surface is more expanded. The same surface of the centrum is also convex and has a sharp descent to the very deep pit immediately behind the anterior articular surface ; whereas in *Vultur* this surface is almost flat, and nearly in the same plane as the lower border of the anterior articular surface. In consequence of this difference a front view of the cervical of *Gyps* shows an abrupt vertical surface some distance behind and below the anterior articular face of the centrum, which is totally wanting in that of *Vultur*. Moreover, the anterior face of the centrum of *Gyps* is relatively larger than in *Vultur*, with much sharper and more oblique lateral borders. Again, in the figured vertebræ of *Gyps* the inferior surface of the centrum has a median pneumatic foramen totally absent in that of *Vultur* ; while in the succeeding posterior vertebræ of the former there is a foramen situated below the root of each lower transverse process, which are unrepresented in the corresponding vertebræ of the latter genus.

The above description will at once show that the imperfect late cervical vertebra from the Maltese deposits (represented in Plate XXXVI.

figs. 7, 7 *a*, 7 *b*), which agrees fairly well in relative size with the fossil limb-bones, indicates a Vulture referable to *Gyps* rather than to *Vultur*. The whole of the characters of this vertebra are indeed so essentially the same as those of the existing *G. fulvus*, even down to the presence of the median pneumatic foramen, that it would be waste of words to recapitulate them. Indeed the only distinctive mark of the fossil, in addition to its superior dimensions, is the somewhat greater prominence of the tubercle on the inferior surface of the centrum immediately behind the anterior pit. This slight difference could not, however, be regarded as more than an individual or specific one. The length of the fossil centrum in the median line is 0,029, and the greatest transverse diameter 0,023. The first

Fig. 1.

Anterior and inferior aspects of a late cervical vertebra of *Vultur monachus*.

Fig. 2.

Anterior and inferior aspects of the corresponding vertebra of a small individual of *Gyps fulvus*.

Letters as in Plate XXXVI. fig. 7.

of two later cervicals in the Museum (No. 49354, *a*), apparently coming next behind the preceding specimen, agrees exactly with the corresponding vertebra of *G. fulvus*, having the same pair of pneumatic foramina at the roots of the lower transverse processes. An imperfect anterior cervical (No. 49354*) resembles the seventh cervical of *G. fulvus* in the narrowness of the inferior surface of the centrum, which appears to be the most characteristic feature of the vertebræ of the anterior cervical region.

Taking it for granted that these cervical vertebræ are referable to the same species as the limb-bones described above, they afford conclusive evidence that the large Accipitrine bird of the Maltese caves belonged to the genus *Gyps* and not to *Vultur*.

The specimens described above afford therefore conclusive evidence of the former existence in Malta of a Vulture considerably larger than any existing species, but apparently very closely allied in osteological characters to the large Griffon Vulture of Southern Europe. The existence of such a large raptorial bird in company with the "Pigmy Elephant," of which the height is estimated at three feet, is certainly suggestive that the old fable of the "Roc" carrying off the Elephant may possibly have had a foundation in fact.

I observe that remains of a species of *Gyps* have been recently described from volcanic deposits in Italy[1], but these have not received a distinct name.

GRUS MELITENSIS, n. sp.

The evidence showing the existence during the Pleistocene period of a large species of Crane in the Maltese Islands is afforded by certain specimens (represented in Plate XXXVI, figs. 2, 4 and 5) all of which are portions of very characteristic bones.

The specimen first represented (Plate XXXVI. fig. 4) is the proximal half of the right coracoid, the entire right coracoid of *Grus cinerea* being drawn for comparison (in fig. 3). The coracoid of a Crane is a bone which cannot be mistaken for that of any other bird; the chief features of the proximal portion being the strongly-marked crest extending on the ventral surface from the head (*a*) to join the intermuscular ridge of the lower part of the bone, and the deep channel, with a large pneumatic foramen, separating the body of the bone from the subclavicular process (*c*). The elongated form of the glenoidal surface, of which the lateral border is seen at *b*, is also characteristic. Now in all these respects the fossil coracoid agrees with the recent one, to which it also approximates very closely in size. The head of the fossil coracoid is, however, smaller and relatively narrower than in *G. antigone*, a character which affords a well-marked distinction from that species.

Equally characteristic is the distal extremity of the left tibio-tarsus (represented in figs. 5, 5 *a*, 5 *b*, of Plate XXXVI.). This bone in the Cranes (as is shown by that of *G. antigone* drawn in fig. 6) is characterized by the wide anterior intercondylar interval, and by the bony bridge (*a*) over the groove for the extensor tendons being sunk below the level of the lateral borders of the bone and carrying a low tubercle (*b*). A comparison of the figures will show such a close resemblance between the recent and fossil bones as to leave no doubt of the generic identity of their owners. The fossil is, however, readily distinguished by the bridge over the extensor groove being much shorter than in *G. antigone*; a feature in which it resembles

[1] R. Meli, Bull. Soc. Geol. Ital. vol. viii. p. 490 (1890).

*G. australiaca*[1]. The transverse diameter of the fossil bone is 0,025, against 0,0255 in *G. antigone*.

The imperfect distal extremity of a left tarso-metatarsus (represented in Plate XXXVI. figs. 2, 2*a*, as being considerably larger than the corresponding bone of *G. antigone*, fig. 1) indicates a Crane larger than the individuals to which the preceding specimens belonged, although not necessarily specifically distinct. It exhibits the relative shortness and backward position of the trochlea for the second digit characteristic of the Cranes. Its greatest transverse diameter is 0,032, compared with 0,026 in *G. antigone*.

Taking the coracoid and tibia alone into consideration these bones indicate the specific distinctness of the Maltese Crane from *G. antigone*, and therefore from the smaller *G. communis*; and its distinction from *G. australiaca* (the coracoid of which I have not had an opportunity of examining) may be regarded as pretty certain. Several species of fossil Cranes have been described. Of these the so-called *G. primigenia*, from the caverns of the Dordogne, agrees with *G. antigone* in the length of the bridge over the extensor groove of the tibia[2], and I believe that both this form and the Italian *G. turfa*, Portis, are indistinguishable from *G. antigone*. The geological horizon of *G. excelsa*, from the Lower Miocene of Allier, in which the tibial bridge is short[3], is alone sufficient to indicate that the present form is in all probability distinct from that species. With *G. pentelici*, of the Lower Pliocene of Greece, the present specimens do not admit of comparison.

Under these circumstances I propose to regard the Maltese Crane as belonging to a new species, for which the name *G. melitensis* may be adopted. It may be defined as agreeing typically in size with *G. antigone*, but distinguished by the smaller and narrower head of the coracoid, and the shorter bridge over the extensor groove of the tibio-tarsus. If the above-mentioned tarso-metatarsus also belonged to it, some individuals of *G. melitensis* will have considerably exceeded the dimensions attained by *G. antigone*.

### Cygnus falconeri.

The specimens of this species to which I desire to draw attention are the phalangeals to which allusion has been already made, and one of which has been figured by Prof. Parker in the 'Trans. Zool. Soc.' vol. vi. pl. xxx. figs. 20–23. Of these bones the Museum possesses ten examples. In their stoutness and shortness these bones are so utterly different from the phalangeals of existing Swans that it is at first sight difficult to believe that they belonged to a kindred bird. Closer examination shows, however, that the first phalangeals of the third digit (fig. 3, A, p. 410) agree in the form of their proximal articular surface with the corresponding bone of *C. olor* (fig. 3, B, p. 410); while the distal articulation of this bone has the peculiar obliquity and the prominent ridge formed on the posterior

[1] See Milne-Edwards, 'Oiseaux Fossiles de la France,' pl. lxxiii. fig. 5.
[2] See Milne-Edwards, *op. cit.* pl. lxxvi. fig. 8. [3] *Ibid.* pl. lxxv. fig. 5.

aspect by the outer trochlea which are features absolutely characteristic of the family to which the genus *Cygnus* belongs. The figured phalangeal of the extinct species has a length of 0,046, with an antero-posterior diameter of the proximal articular surface of 0,017; the corresponding dimensions in the homologous bone of *C. olor* being 0,060 and 0,014. The lateral phalangeals of the proximal row have similar proportions. Thus in the second digit the proximal phalangeal has a length of 0,037 against 0,048 in *C. olor*; while in the fourth digit the lengths are respectively 0,045 and 0,061.

Fig. 3.

Anterior and distal aspects of the first phalangeal of the third digit of the right pes of *Cygnus falconeri* (A) and *C. olor* (B). ½.

A second phalangeal of the third digit exhibits the peculiar oblique proximal articular surface characteristic of the *Anatidæ*, so that its reference to the present form is undoubted. It has a length of 0,025 against 0,043 in the corresponding bone of *C. olor*.

This remarkable shortness and stoutness of the phalangeals of the pes in *Cygnus falconeri* leaves no doubt as to its distinctness from all other species. The difference is indeed sufficiently great to afford grounds for generic separation; but since the multiplication of generic terms is to be avoided as much as possible I prefer to let the species remain in the genus to which it was referred by its original describer, who remarks that in the shortness of its toes and the length of its legs this species seems to connect the modern Swans with the Geese.

## EXPLANATION OF THE PLATES.

(All the figures are drawn of the natural size.)

### Plate XXXV.

Fig. 1. Anterior aspect of the proximal portion of the right tibio-tarsus of *Gyps melitensis*.

2, 2 *a*. Anterior and distal aspects of the distal portion of the right tibio-tarsus of *Gyps melitensis*. *a*, extensor bridge.

3. Anterior aspect of the distal portion of the right tibio-tarsus of *Vultur monachus*. *a*, extensor bridge; *c*, lateral foramen.

4, 4 *a*. Anterior and distal aspects of the distal extremity of the right femur of *Gyps melitensis*. *a*, ectocondyle; *b*, entocondyle; *c*, fibular ridge; *d*, fossa for muscular or ligamental attachment.

5, 5 *a*. Anterior and distal aspects of the distal extremity of the right femur of *Vultur monachus*. Letters as in figs. 4, 4 *a*.

6. Distal extremity of the left tarso-metatarsus of *Gyps melitensis*.

7. Distal extremity of the left tarso-metatarsus of *Vultur monachus*.

8. Proximal phalangeal of the third digit of the pes of *Gyps melitensis*.

9. Terminal phalangeal of the pes of *Gyps melitensis*.

### Plate XXXVI.

Fig. 1. Distal portion of the left tarso-metatarsus of *Grus antigone*.

2, 2 *a*. Anterior and distal aspects of the distal extremity of the left tarso-metatarsus of *Grus melitensis*.

3. Ventral aspect of the right coracoid of *Grus antigone*. *a*, head; *b*, border of glenoid surface; *c*, subclavicular process.

4. Ventral aspect of the proximal portion of the right coracoid of *Grus melitensis*. Letters as in fig. 3.

5, 5 *a*, 5 *b*. Anterior, distal, and posterior aspects of the distal extremity of the left tibio-tarsus of *Grus melitensis*. *a*, extensor bridge; *b*, tubercle on same.

6. Anterior aspect of the distal portion of the left tibio-tarsus of *Grus antigone*. Letters as in fig. 5.

7, 7 *a*, 7 *b*. Imperfect cervical vertebra of *Gyps melitensis*. *prz*, prezygapophysis; *ptz*, postzygapophysis.

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June 3, 1890.

Prof. Flower, C.B., 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 May 1890:—

The total number of registered additions to the Society's Menagerie during the month of May was 152, of which 96 were by presentation, 19 by birth, 24 by purchase, 2 were received in exchange, and 11 on deposit. The total number of departures during the same period, by death and removals, was 86.

Amongst these special attention may be called to the following:—

1. A pair of the Hartebeest Antelope (*Alcelaphus caama*), obtained by purchase May 5. Like most of the South-African Antelopes, this species is now becoming very scarce and is seldom imported. We have had no specimens of it in the Society's Gardens for the past ten years.

2. A pair of Beatrix Antelopes (*Oryx beatrix*), presented by Col. E. C. Ross, C.S.I., H.B.M.'s Consul-General at Bushire. This Arabian representative of the Antelopes of the genus *Oryx* is a

scarce and little-known animal, and we are much indebted to Col. Ross for the present pair, which appear to be about three-parts grown.

3. Two Swainson's Long-tailed Jays (*Calocitta formosa*), purchased May 24. In 1877 we had a single specimen of this fine Corvine bird in the Society's Aviaries. The present examples have been acquired from the Jardin d'Acclimatation in Paris, where a small consignment of them has lately been received.

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Mr. Sclater laid on the table two young specimens of Darwin's Rhea (*Rhea darwini*), obtained by Mr. A. A. Lane at Cancoa, in the Province of Tarapacá, during his recent visit to that district, while employed by Mr. H. Berkeley James, F.Z.S., to collect birds in various parts of Chili. Mr. Sclater made the following remarks:—

"It was long ago stated by Dr. Philippi (see his Catalogue of Chilian Birds, An. Univers. de Chile, xxxi. p. 270, 1868) that Darwin's Rhea is found in the vicinity of Mendoza; and the same author (Ornis, iv. p. 159) has mentioned this species as of common occurrence in the desert of Atacama, on the eastern side of the Andes, and ascending to the high plateau. Mr. H. Berkeley James has likewise assured me that a Rhea occurs in this district, though he was not certain as to the species[1].

"The specimens I now exhibit, along with the larger adult, but imperfect specimen, received from the same collector, have set this question finally at rest. It is now certain that *Rhea darwini*, so far from being confined to the portion of Patagonia south of the Rio Negro, as has been generally supposed, extends, like many other species of birds, along the eastern base of the Andes into the north of the Argentine Republic, and thence crosses the chain into the province of Tarapacá (20° N. lat.), which now belongs to Chili."

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Mr. Sclater exhibited the flat skin of a Zebra, received from Berbera, Northern Somali-Land, by Herr Menges, and kindly for-

[1] Mr. James writes as follows:—

"In a sporting excursion to the Cordillera of Tarapacá some fifteen years ago, I came across some Rheas which were very wild, and it was impossible to distinguish the species; it was at an altitude of about 12,000 feet, on a sandy plain utterly destitute of vegetation, and what the birds fed upon I cannot imagine.

"Mr. Lane, when sending the skin shown at the meeting, makes no remark as to how he procured it; he mentions, however, that he had bought two young birds from the Indians, which he kept alive for some time; when they succumbed he preserved the skins and sent them to me.

"Rhea-skins make up into very pretty rugs, and large numbers are brought from the neighbourhood of Mendoza in the Argentine Republic, across the Cordillera, into Central Chili. The Patagonian Indians also, in the Straits of Magellan, trade in them; but I have never known skins brought to the coast from the interior of Tarapacá."—*June* 1, 1890.

warded to Mr. Sclater by Mr. Carl Hagenbeck, and made the following remarks:—

"In 1882 (see P. Z. S. 1882, p. 721) I called the attention of the Society to the discovery of the new Zebra of Shoa, named *Equus grevyi* by M. Milne-Edwards, and to its differences from the southern *E. zebra*. I have recently again examined the typical example of this species, now mounted in the new gallery of the Jardin des Plantes, and am still more confident of its distinctness, as shown by the narrowness of the black stripes, the difference of the markings,

Fig. 1. Fig. 2.

Fig. 1.—Flat skin of *Equus grevyi*, from Somali-Land.
Fig. 2.—Flat skin of *E. burchelli*, from Masai-Land.

and the white spaces on the forehead and on each side of the dorsal stripe in the northern species.

"Dr. Gestro, of the Museo Civico, Genoa, informs me that that museum received, in June 1888, two specimens of this Zebra (an adult female, skin and cranium, and the skin of a young animal) from Dr. V. Ragazzi, Chief of the Italian Station Let-Marefix in Shoa.

"Being anxious to know whether the 'Berg-Zebra' of Somali-Land, spoken of by Herr Menges (Zool. Gart. 1887, p. 263) as found

in the mountains of that country as far north as 8° N. lat., belongs to *E. grevyi*, I requested Mr. Hagenbeck to endeavour to obtain for me a skin of this animal. This he has most kindly done through the intervention of Herr Menges.

"It will be seen, I think, that the Mountain Zebra of Somali-Land is *Equus grevyi* (*cf.* fig. 1, p. 413), while the Zebra of Masai-Land, as I judge from the flat skin now exhibited (fig. 2, p. 413), obtained in that country by Mr. Joseph Thomson, and kindly sent for exhibition by Col. Grant, would seem to be *Equus burchelli*, or rather its northern subspecies *E. b. chapmani*."

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The following papers were read:—

## 1. On a Collection of Acarina formed in Algeria. By A. D. Michael, F.L.S., F.Z.S., F.R.M.S., &c.

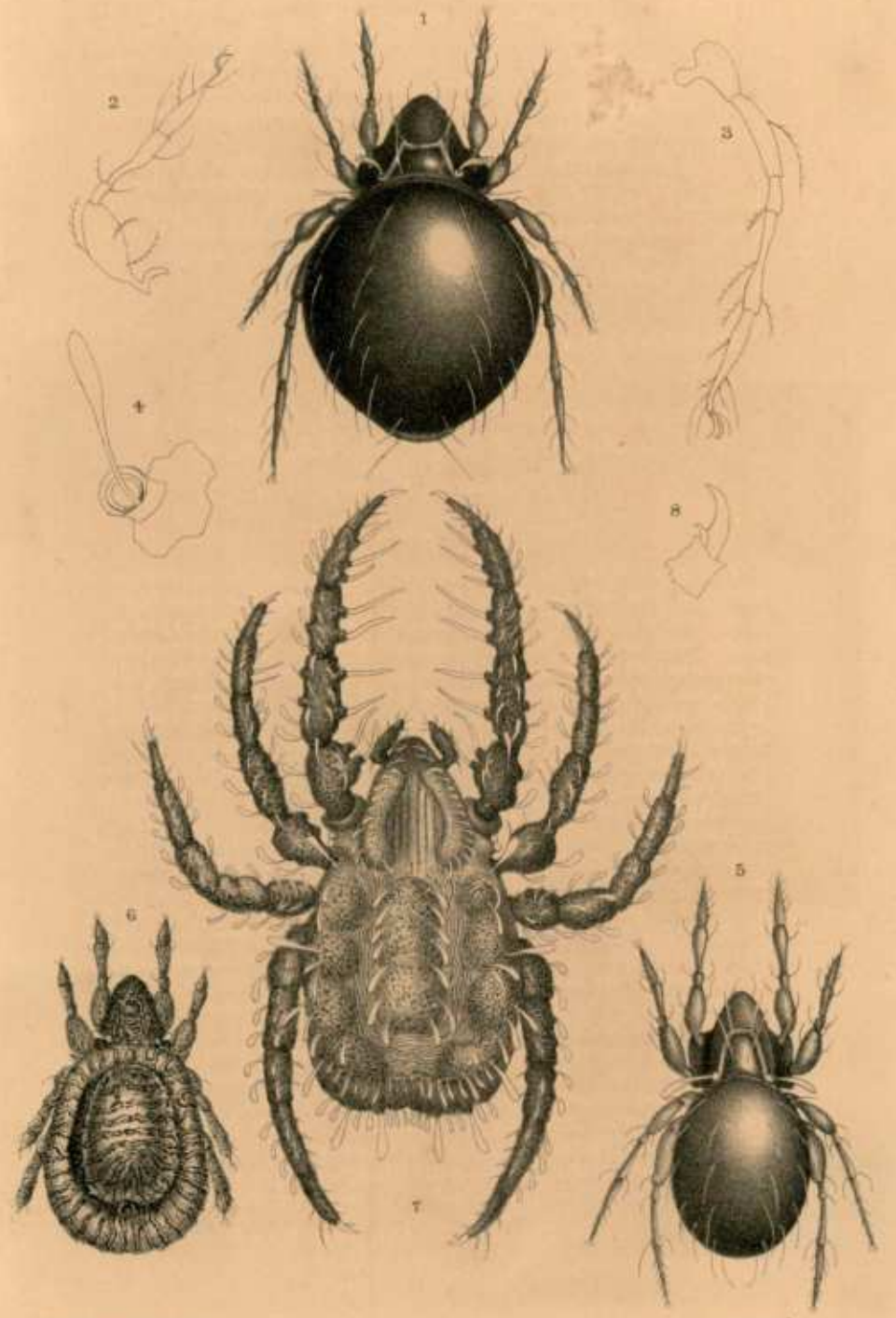
[Received May 13, 1890.]

(Plates XXXVII. & XXXVIII.)

This paper shows the results of my endeavours to obtain *Acarina* during a tour of about two months in Algeria, the time being March and April 1889. The principal fauna of that country is of course well known; but, as is usually the case in non-European countries, that belonging to the above-named order is practically unknown. Two or three species of Acarina have been recorded by Lucas[1], and there have been one or two other notices of the capture of a single species in Algeria or Tunisia; but this is all, except with regard to the *Analgesinæ*, or bird-parasitic Mites, many of which have been recorded by M. Trouessart from dried specimens found on the bird-skins in the French Museums.

The journey was not undertaken for collecting-purposes, but I took with me a Stephenson binocular microscope and an ordinary dissecting microscope, both arranged to pack in as small a space as could be conveniently arranged, and I made regular use of these instruments, and searched pretty constantly for creatures belonging to my own specialty during all parts of the tour. The route embraced almost the whole length and a good deal of the breadth of the country, and most of the varying conditions of level and climate which it affords. It commenced on the sea-coast at Philippeville, almost at the extreme east, or Tunisian frontier; thence south to Constantine, which is a more high-lying situation, and again southward to the low-level oasis of Biskra in the Sahara, returning to near Constantine, and along the ordinary railway to Setif, whence the coast was again reached at Bougie through the magnificent gorge of the Chabet-el-Akhira; from Bougie I went to Algiers by land. While at Algiers, in addition to exploring that neighbour-

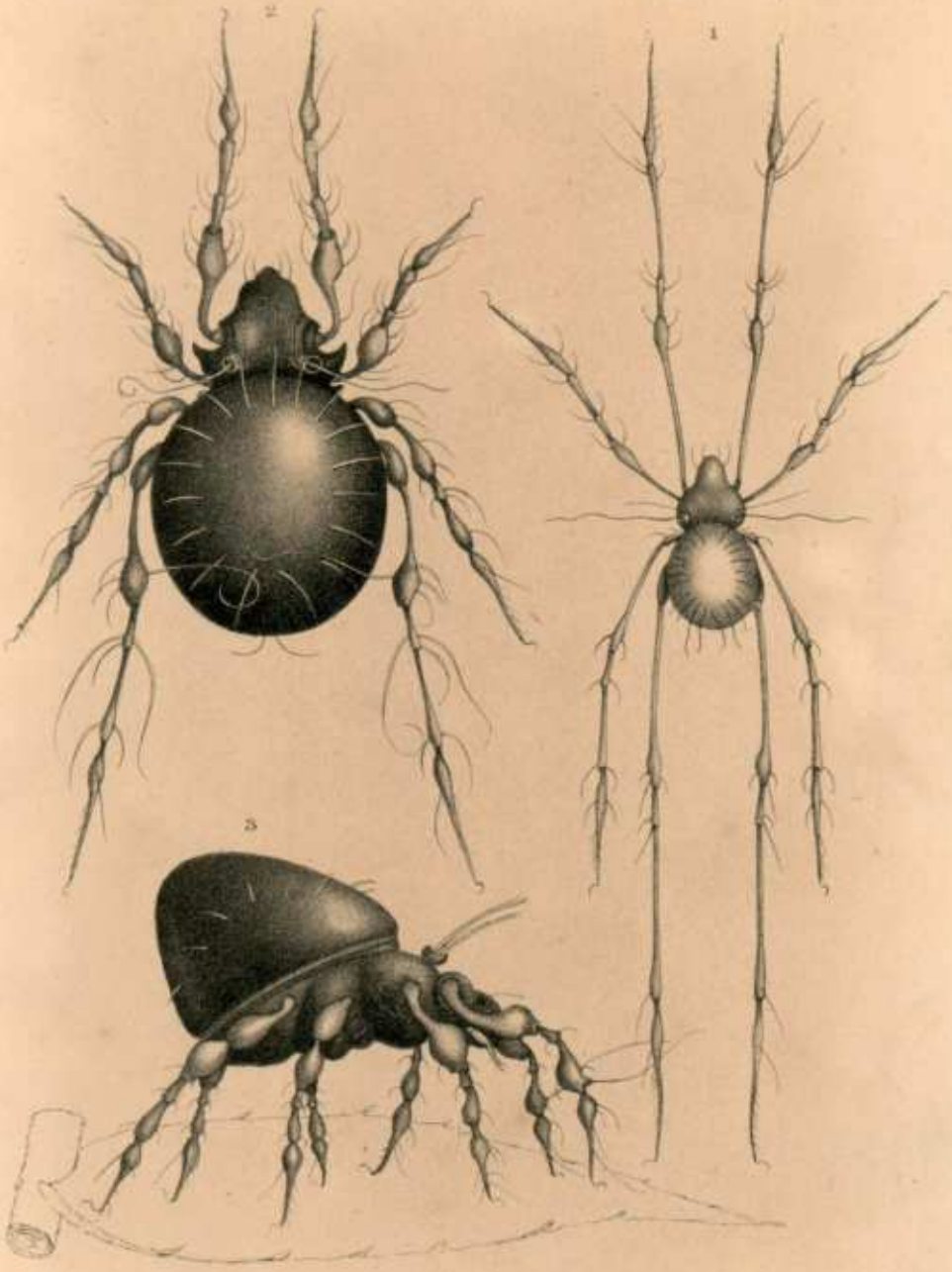
[1] Exploration Scientifique de l'Algérie, &c. Paris, 1849.




A.D.Michael ad nat. del.

West, Newman & Horace Knight } lith.

New Acarinæ from Algeria.




A.D.Michael ad nat. del.

West, Newman & Harrace Knight } lith.

New Acarinæ from Algeria.

Europe. There are only 102 known British species of Oribatidæ, and it is perhaps rather remarkable that I should have found a quarter of them in a two-months' tour in Algeria.

Of the new species probably the most remarkable is the curious new *Caculus* before referred to; not only because there was only one species of this very exceptional genus known previously, but also on account of its size and the singular arrangement of the hairs on the cephalothorax. There are, however, other creatures of considerable interest. One of these I propose calling *Notaspis burrowsii*; it is rather a handsome Acarid, but is quite typical of the genus, and is just such a species as one might expect to find in England: it has not, however, been captured anywhere in Europe so far as I know. What really makes it noticeable is the example it affords of the very wide distribution of these minute creatures, a fact which I have called attention to more than once. The species is, I believe, unrecorded, but just before I left for Algeria the Rev. C. R. N. Burrows sent me a small collection of Oribatidæ which he had lately formed in the neighbourhood of Lake Winnipeg in Canada. He remarked that the species seemed mostly identical with the British, which proved to be the case, but amongst them were a few unrecorded, the most conspicuous of which was the present species, which I at once recognized when I found it in Algeria, where it is not uncommon. I cannot detect any difference between the African and the Canadian specimens. Another very curious creature is that which I propose to call *Damæus phalangioides*. The various species of this genus have mostly long and slender legs, as compared with other Oribatidæ, but in the present species this character is exaggerated to such an extent that it would hardly have been supposed that they could remain unbroken when the extreme brittleness of the chitin in this family of Acarina is remembered. Another new species of the same genus is exceptional, viz., that called *D. patelloides*. Almost all the members of the genus have a more or less globular abdomen, or else one which is discoidal, the latter being considered a separate genus by some Acarologists. In the present species the abdomen is pyramidal, a form which I do not think is found again in any known member of the family; in order to appreciate this shape the creature must be seen sideways, I have therefore drawn it in that position.

An Acarid which is not, I think, new, is nevertheless interesting on account of a difference between the Algerian specimens and those hitherto recorded in Europe. With the single exception about to be mentioned, all known Oribatidæ have either monodactyle or tridactyle claws. Among the tridactyle claws some are homodactyle, *i. e.* have the three claws similar; others are heterodactyle, *i. e.* have the central claw different from the lateral pair; usually the central is much the stronger, the lateral claws being thin and weak. It was formerly thought that Oribatidæ could be classified chiefly by these differences of the claws, but wider knowledge has shown that any such classification would be extremely artificial. There is an English and European species called *Nothrus sylvestris*, which is

monodactyle; a species very similar to it, and erroneously supposed by some to be identical with it, has been found in Italy by Prof. Canestrini, and called by him *N. anauniensis*. This creature has the strong central claw and an extremely weak and small lateral claw on one side only, so that it becomes didactyle with very unequal claws. In Algeria I find a creature which I have, with some doubt, considered to be a variety of *N. anauniensis*, and which does not differ from Prof. Canestrini's species in any respect that I can see, except that it has the weak lateral claw on each side of the central, thus becoming tridactyle and completing the series.

### *List of Species found in Algeria.*

(Those known to be also British are marked B.)

| Name. | | Places of capture, &c. |
|---|---|---|
| **ORIBATIDÆ.** | | |
| *Pelops acromios*, Hermann. | B. | Algiers and Blidah. |
| *Oribata lapidaria*, Lucas. | B. | Algiers. |
| „ *globula*, Nicolet. | B. | Algiers, common. |
| „ *quadricornuta*, Michael. | B. | Algiers. |
| „ *cuspidata*, Michael. | B. | Algiers. |
| „ *lucasii*, Nicolet. | B. | Algiers. |
| „ *alata*, Hermann. | B. | Algiers, &c., common. |
| „ *avenifera*, Michael. | B. | Algiers. |
| „ *longipes*, Berlese. | | Algiers and Blidah. |
| *Serrarius fusifer*, Berlese. | | Algiers and Blidah, common. |
| *Leiosoma simile*, Nicolet. | B. | Algiers. |
| *Cepheus tegeocranus*, Hermann. | B. | Blidah. The hairs are finer and the abdomen less spotted than in the British specimens. Query, whether identical. |
| *Scutovertex sculptus*, Michael. | B. | Hammam R'hira. |
| *Tegeocranus latus*, Koch. | B. | Hammam R'hira. |
| „ *coriaceus*, Koch. | B. | Blidah. |
| „ *marginatus*, Michael. | B. | Algiers and Blidah. |
| „ *elongatus*, Michael. | B. | Algiers. |
| *Notaspis burrowsii*, n. sp. | | Hammam R'hira. |
| „ *æqualis*, n. sp. | | Algiers. |
| „ *glabra*, n. sp. | | Blidah. |
| „ *bipilis*, Hermann. | B. | Common everywhere. |
| „ *oblonga*, Koch. | B. | Algiers. |
| „ *longilamellata*, Michael. | B. | Gorge de la Chiffa. The specimens are rather larger than the British, and have the pseudo-stigmatic organs not quite so clubbed. |
| „ *splendens*, Koch. | B. | Blidah. |
| *Damæus phalangioides*, n. sp. | | Gorge de la Chiffa. One specimen only. |
| „ *patelloides*, n. sp. | | Forest of Ain Beida, near Algiers. |
| „ *flagellifer*, n. sp. | | Cedar-forest of Teniet-el-Ahd. |
| „ *clavipes*, Hermann. | B. | Algiers. |
| „ *bicostatus*, Koch. | | Algiers, Blidah, Hammam R'hira, common. |
| „ *globipes*, Canestrini. | | Algiers. |
| „ *femoratus*, Koch; *dugesii*, Canestrini. | | Algiers, Blidah, &c., common. |
| „ *troisii*, Berlese. | | Gorge de la Chiffa. |

*List of Species* (continued).

| Name. | | Places of capture, &c. |
|---|---|---|
| *Hermannia arrecta*, Nicolet. | B. | Forest of Ain Beida. |
| *Eremæus fimbriatus*, n. sp. | | Algiers. |
| *Nothrus sylvestris*, Nicolet. | B. | Cedar-forest of Teniet-el-Abd. The specimens are rather smaller than the British, and have the hairs on the hind margin shorter and more spatulate. |
| „ *anauniensis*, Canestrini. | | Hammam R'hira. Is tridactyle, not didactyle. Query, if identical. |
| „ *doderleinii*, Berlese. | | Algiers, Blidah, &c., common. |
| „ *scaliger*, Koch; *thelyproctus*, Berlese. | | Blidah. |
| „ *spiniger*, Koch. | B. | Algiers. |
| „ *horridus*, Hermann. | B. | Cedar-forest of Teniet-el-Abd. |
| *Hoplophora dasypus*, Dugès. | B. | Algiers. |
| „ *carinata*, Koch. | | Algiers, Blidah, Hammam R'hira; common. |
| *Zetorchestes micronychus*, Berlese. | | Forest of Ain Beida, common. |
| HOPLOPIDÆ. | | |
| *Caculus spatulifer*, n. sp. | | Forest of Ain Beida. One specimen. |

NOTASPIS BURROWSII, n. sp. (Plate XXXVII. figs. 1–4.)

Average length about ·75 millim.
Average extreme breadth about ·50 millim.
Average length of legs, first three pairs about ·35 millim.
„ „ fourth pair about ·58 millim.
A somewhat large and handsome species.
*Colour* darkish yellow-brown.
*Texture* smooth.

*Cephalothorax*.—Anterior half conical, posterior half suddenly widening, and its lateral parts forming conspicuous platforms for the support of the two anterior pairs of legs. Without markings. Rostrum round-pointed; rostral hairs long; palpi visible from the dorsal aspect. Pseudostigmata nearly at the base of the cephalothorax, but not at all hidden by the abdomen or lamellæ; pseudostigmatic organs shortish, with thin peduncles and small, almost globular, heads. *Lamellæ very short*, not much above a third of the length of the cephalothorax, of about even width throughout; *much nearer together anteriorly than posteriorly*; provided with small cusps and joined by a translamella which is little more than a mere line. Interlamellar hairs large and stiff, very near the lamellæ. Lamellar hairs long, stiff, and near together. Apodemata not joined to the sternum. Tectopedia large for the genus.

*Legs* of the type usual in the genus, with stout hairs on almost all the joints, the first three pairs of about equal lengths. Claws tridactyle, heterodactyle.

*Abdomen* almost, but not quite, round; it has a few small, circular, clear spots near the hind margin, only seen in preparations. There are four longitudinal rows of thick hairs, and three pairs of

similar hairs on the hind margin at the dorsal level, besides two pairs at the ventral level. There is a very thick, almost fusiform hair projecting on each side from the shoulder, and a long stiff hair on the edge of the abdomen a little further back. All these hairs, and indeed almost all those on the creature, are slightly rough or imbricated if seen by a high amplification; but, excepting perhaps those on the legs, they cannot be called serrated. Genital plates roundish; anal plates almost square, far from the genital.

I found several specimens of this species at Hammam R'hira, Algeria; but just before leaving England for my Algerian journey I received a collection of Oribatidæ from the Rev. C. R. N. Burrows, which he had collected in the district of Lake Winnipeg, Canada, and that collection contains an example of the present, hitherto unrecorded, species. I have named it after Mr. Burrows.

Notaspis æqualis, n. sp. (Plate XXXVII. fig. 5.)

Average length about ·42 millim.
Average extreme breadth about ·24 millim.
Average length of legs, 1st pair about ·25 millim.
" " 2nd " ·21 millim.
" " 3rd " ·25 millim.
" " 4th " ·30 millim.

*Colour* yellowish brown, of medium depth.

*Texture* polished.

*Cephalothorax* almost conical, sides slightly curved, without special markings. Rostrum blunt-pointed; rostral hairs fine and long. Pseudostigmata at the base of the cephalothorax; pseudostigmatic organs rather long, with very fine peduncles, and gradually thickening, somewhat clavate heads. *Lamellæ and translamella forming a continuous band of equal breadth throughout, and without any demarcation between them.* No cusps to the lamellæ. Interlamellar hairs straight, rather thick, upright. Lamellar hairs very long, fine. Apodemata not joined to the sternum.

*Legs* of the ordinary type in this genus; a few fine hairs on each joint. Claws tridactyle, very heterodactyle.

*Abdomen* elliptical, without markings. Four longitudinal rows of curved hairs nearly as long as half the width of the abdomen; one or two extra pairs of shorter hairs on the hind margin, and a straight spine on each side standing out from the shoulder. Genital and anal plates almost round, far apart.

Algiers; not uncommon.

Notaspis glabra, n. sp.

Length about ·34 millim.
Extreme breadth about ·21 millim.
Length of legs, 1st pair about ·17 millim.
" " 2nd " ·15 millim.
" " 3rd " ·16 millim.
" " 4th " ·18 millim.

*Colour* light yellow-brown.

*Texture* polished.

*Cephalothorax* almost conical, without special markings. Rostrum pointed; rostral hairs fine and long. Pseudostigmata at the base of the cephalothorax; pseudo-stigmatic organs medium length, with short peduncles and rough pyriform heads. Lamellar blades on edge *gradually increasing in width from the posterior to the anterior ends*, provided with very short cusps. Lamellæ joined by a *translamella not so wide as the lamellæ*. Interlamellar hairs upright, rather short. Lamellar hairs long and fine. Apodemata not joined to the sternum.

*Legs* of the type usual in the genus, with fine hairs. Claws tridactyle, heterodactyle.

*Abdomen* slightly pyriform, but very broad and short; with four longitudinal rows of extremely minute white hairs, and a few similar hairs on the hind margin, and a short hair on each side of the shoulder. Genital and anal plates rather square, with rounded corners; far apart.

Algiers.

DAMÆUS PATELLOIDES, n. sp. (Plate XXXVIII. fig. 3.)

Average length about ·66 millim.

Average breadth about ·42 millim.

Average length of legs, 1st and 3rd pairs about ·57 millim.

" " 2nd pair about ·46 millim.

" " 4th pair about ·68 millim.

A species remarkable for the exceptional shape of the abdomen.

*Colour* very dark brown.

*Texture* smooth but not polished.

*Cephalothorax* nearly as wide as the abdomen; without true sculpturings; but there is a vague ridge running transversely between the two pseudostigmata, this is not straight, but advances in the middle and curves backward to each pseudostigma. Rostrum rather small, pyramidal, almost sharp-pointed; there are two pairs of rostral hairs, of which the hinder are the thicker. The cephalothorax widens greatly and suddenly behind the rostrum, the first pair of legs being attached at the side of the projection thus formed; then there is a slight indentation, and then a rounded lobe between the first and second pairs of legs. Pseudostigmata far apart, raised, cup-shaped, but with the outer side of the cup produced to a point. Pseudostigmatic organs long, rod-like, but slightly tapering. Interlamellar hairs short, rod-like, and placed quite close to the inner sides of the pseudostigmata.

*Legs* not long for the genus, joints strongly clavate; peduncles of the femora not long and gradually thickening. One to four thick, somewhat curved hairs on each joint, mostly arranged in whorls; tarsi with one thick straight hair on the outside, and numerous fine hairs. Claws monodactyle.

*Abdomen almost conical*, with curved sides and a curved apex, it leans somewhat back; the dorsum has a great resemblance to the

form of the shells of some of the limpets (whence the name I have given to the species). There are two longitudinal curved rows of short, thick, almost straight hairs on the notogaster, so arranged as to appear to form a ring round the abdomen when seen from the side (see Plate XXXVIII. fig. 3). Genital and anal plates of nearly equal size, almost square, close together, and occupying nearly the whole length of the ventral plate.

Almost all the thick hairs on the creatures are slightly rough or serrated if seen by a high amplification.

When the creature is alive the true form of the abdomen is scarcely seen, as mud is plastered on the hinder portion of that region, concealing the shape, and this mud is not irregularly placed, but is generally so affixed as to make the abdomen appear a thick flat oblong.

I have three or four specimens from the neighbourhood of Algiers, and from Blidah, Algeria.

DAMÆUS PHALANGIOIDES, n. sp. (Plate XXXVIII. fig. 1.)

Length about ·52 millim.
Breadth about ·22 millim.
Length of legs, 1st pair about 1·30 millim.
" " 2nd " ·80 "
" " 3rd " 1·05 "
" " 4th " 1·50 "

This species is remarkable for its extremely long and slender legs.

*Colour* yellow-brown, of medium depth.

*Texture* smooth, but not polished.

*Cephalothorax* distinctly divided into two parts—the rostrum, which is somewhat conical, and the larger hind portion, which is more globular. Rostrum rather blunt-pointed, with two pairs of long fine rostral hairs; the second pair almost at the posterior limit of the rostrum. Pseudostigmata small cups, considerably raised, and almost transparent. *Pseudostigmatic organs* setiform, flexible, extremely long and fine, about the same length as the body without the rostrum. Interlamellar hairs placed close to the inner sides of the pseudostigmata, and similar to the pseudostigmatic organs, but even finer and not quite so long.

*Legs extraordinarily long and fine.* Femora with very long thin peduncles of almost equal thickness throughout, and elongated clubs. Genuals and tibiæ scarcely clavate. Tarsi of the first and second legs considerably, those of the third and fourth slightly, enlarged near the proximal ends; toward the distal ends they are all remarkably thin, and are singularly curved or undulated, particularly the fourth pair. Claws monodactyle, very fine. There are a few setiform hairs on the various joints, mostly black, those on the fourth legs being the largest.

*Abdomen* a short ellipse without markings, but with two longitudinal rows of hairs, of which those constituting the anterior and central parts of each row are black, short, and curved; those forming the posterior portion longer, more flexible, and lighter in colour.

There are a few hairs similar to the last-named round the hind margin. Genital and anal plates small, projecting, close together.

I have only one specimen, which came from the Gorge de la Chiffa, Blidah.

DAMÆUS FLAGELLIFER, n. sp. (Plate XXXVIII. fig. 2.)

Length about ·65 millim.
Breadth about ·40 millim.
Length of legs, 1st and 3rd pairs, about ·60 millim.
" " 2nd pair about ·45 millim.
" " 4th " " ·85 "

*Colour* very dark brown.

*Texture* smooth, not polished, very finely punctured; this, however, is difficult to see in unprepared specimens.

*Cephalothorax* somewhat spotted but without true markings, considerably less wide than the abdomen. Rostrum rather small, almost pointed. Two pairs of rostral hairs, of which the hinder is the thicker. The cephalothorax widens suddenly behind the rostrum, forming a large, almost triangular projection, to the outer and hinder face of which the first pair of legs are articulated. There is another large projection between the first and second legs; it has a rounded lobe posteriorly, to the hinder edge of which the second leg is articulated, and a large tooth anteriorly curving forward and outward. Pseudostigmata far apart, dorsal, slightly raised. Pseudostigmatic organs long, setiform, flexible; generally undulated or curled toward the distal extremity. Interlamellar hairs short, curved, almost close to the pseudostigmata.

*Legs* of moderate length for the genus, joints clavate, the femora suddenly so, not gradually thickened. There are three or four moderately curved hairs arranged in a whorl on almost every joint; the upper hair of the whorl in the femora and genuals of the fourth legs is markedly larger than any of the others, and indeed these hairs, which are whip-like with flexible curled or undulated ends, are much the largest hairs on the creature, except the pseudostigmatic organs, and form a conspicuous feature of the species. Claws monodactyle.

*Abdomen* elliptical, without markings. There are two longitudinal rows of curved hairs of moderate length on the notogaster; these hairs diminish slightly in length from the anterior to the posterior margin. There is also a pair of similar hairs on the anterior edge, close to the median line, directed forward over the cephalothorax, and a pair on the hind margin sharply hooked outward. Genital and anal plates close together, the latter much longer in form than the former.

Two specimens from the cedar-forest of Teniet-el-Ahd.

EREMÆUS FIMBRIATUS, n. sp. (Plate XXXVII. fig. 6.)

Length about ·38 millim.
Breadth about ·24 millim.

Length of legs, 1st and 4th pairs, about ·16 millim.
" " 2nd pair about ·14 millim.
" " 3rd " " ·13 "

*Colour* red-brown, of moderate depth.

*Texture* rough and dull.

*Cephalothorax* almost conical, considerably arched, bearing numerous irregular, raised, rough dots and short ridges. Rostrum somewhat rounded, rather trifid; one pair of very short curved rostral hairs. Pseudostigmata close to the abdomen, slightly raised. Pseudostigmatic organs very short, with almost globular heads upon peduncles so short as scarcely to be seen.

*Legs* short, the fourth pair not nearly reaching the hind margin; somewhat flattened, rough. The tibiæ long, the tarsi short; most joints have a pair of very short curved hairs near the distal end; claws tridactyle, heterodactyle.

*Abdomen* large in proportion to the cephalothorax, compressed dorso-ventrally. The anterior margin is somewhat truncated, but not straight, the hind margin strongly rounded. The central part of the notogaster is an elliptical arched lobe or elevation, the exterior margin of which, after attaining its lowest level, turns gently up again and forms a rough irregular edge, from which there is a projection in the centre of the posterior margin. Some very short, rather clavate, hairs project from this margin at regular intervals. Outside the above-named edge is a deep irregular trench which extends all round, except the anterior edge. Outside this, forming the margin of the abdomen, is a broad, slightly arched band or border, which is widest at the posterior margin, and is there fringed with short clavate hairs at regular intervals. Both the central portion of the abdomen inside the trench and the raised border bear conspicuous, rough, raised, irregular ridges; those on the anterior part of the central ellipse are almost transverse, those on the posterior portion strongly bent forward in the middle. The ridges on the border are not continuous with those on the central part, they are much more numerous and are arranged almost radially.

I only found a single specimen of this minute creature, which I obtained at Algiers; its nearest ally is probably *Eremæus brevipes*, a British species.

Cæculus spatulifer, n. sp. (Plate XXXVII. fig. 7.)

*Size* of the single specimen found:—
Length 1 millim.
Breadth ·60 millim.
Length of legs, 1st pair 1 millim.
" " 2nd and 3rd pairs ·70 millim.
" " 4th pair ·80 millim.

*Colour*.—Legs and chitinous plates of the body very dark brown, almost black; parts where the skin shows between the plates or in articulations lighter yellowish brown.

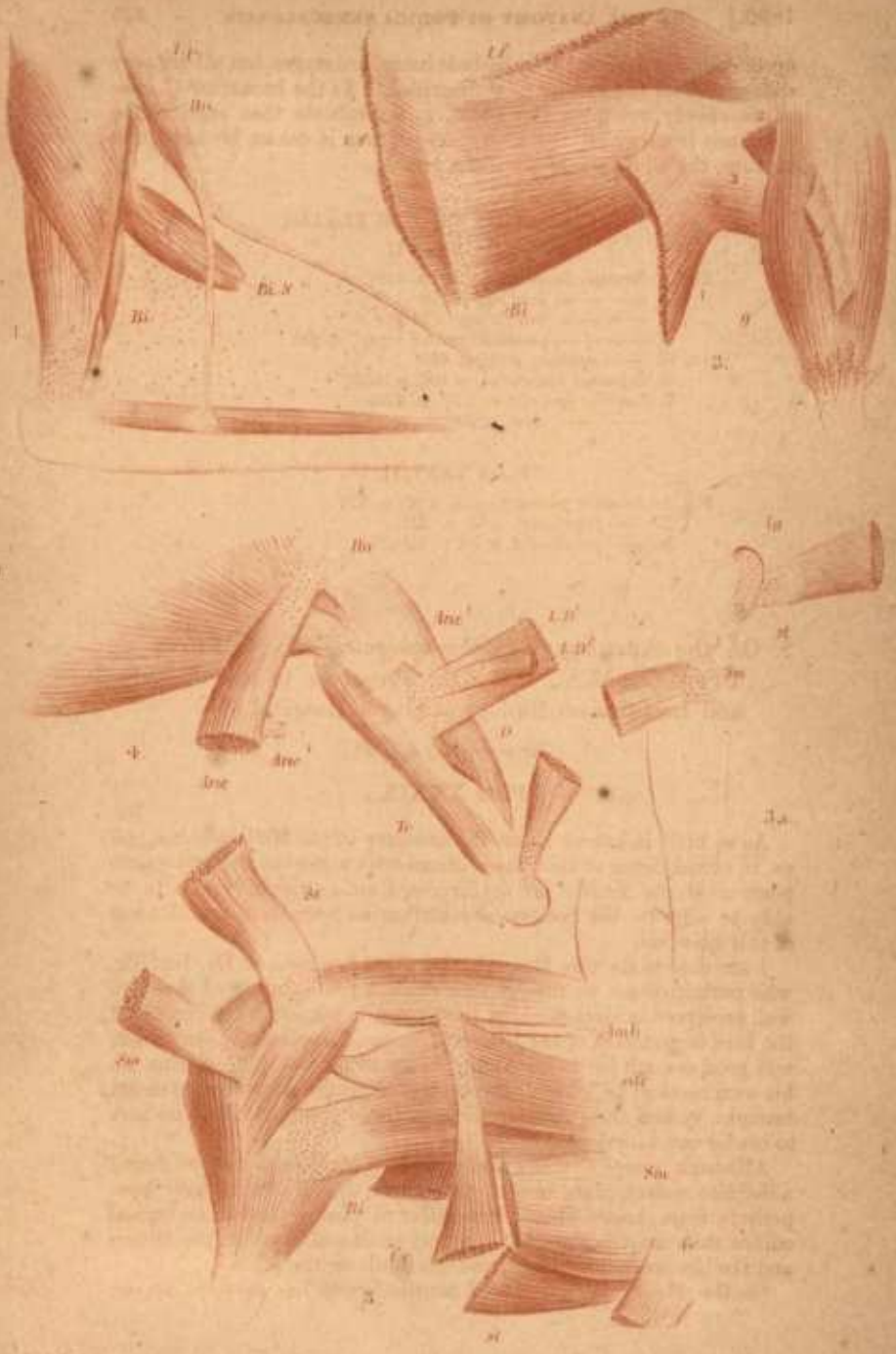
*Texture* of chitin very rough and dull, of skin finely striated with irregular wavy striæ like that of most *Sarcoptidæ*.

*Cephalothorax*.—The plate on the dorsum of the rostrum is not carried nearly so far forward as in *C. echinipes*; it allows almost the whole of the palpus to be seen from the dorsal aspect projecting beyond the rostrum. The palpi are very large and are dark and chitinized, the penultimate joint very large, the ultimate provided with a strong claw or spine, the palpus also bears several large spatulate hairs; the median portion of the rostral plate is depressed and marked with several parallel, straight, longitudinal lines. This central portion is bordered by a large raised ridge or roll on each side; the ridges are narrow anteriorly, where they nearly meet, and gradually thicken and become more separated towards their posterior ends, which are suddenly thickened and turned inward. These ridges are thickly set with stout, very curved, opaque white hairs which are extremely conspicuous. The chitinizing of the rest of the body hardly assumes the form of distinct plates. The median portion of the cephalothorax behind the rostrum is raised, forming three large rough lobes. There are two long spatulate hairs on each side of each lobe, thus forming two longitudinal lines; they are much longer and less spatulate than those on *C. echinipes*. All round these lobes is a deep depressed trench, showing the striated skin but little chitinized; outside this laterally is a raised chitinized margin composed of three lobes on each side, and a fourth lobe continues on to the posterior margin of the cephalothorax; these lobes all bear spatulate hairs similar in character to those on the central lobes. The posterior margin is bordered with hairs corresponding to those described below as bordering the abdomen. The eyes are two on each side, placed as in *C. echinipes*, but rather more projecting.

*Legs* very similar to those of *C. echinipes*, but the spines on the femora of the first pair are more curved. The claws are didactyle, but the two claws of each pair are very unequal, one claw being strong, thick at the base, and slightly brown; the other very small and short, on some of the legs quite rudimentary.

*Abdomen* (if this be really the division of the body) only projecting a comparatively short distance behind the cephalothorax, and decidedly lower in level, so that the hairs on the hind margin of the cephalothorax stand free above it. The hind margin is divided into two flat lobes, being thus indented at the median line; it is bordered by a close line of large spatulate hairs, of which some are markedly larger than others. The arrangement of the sizes is definite: starting from the median line we find, on each side, first three small hairs, then a large one, then two small, then one large, and then two more small. All these hairs, and indeed all the spatulate hairs, both on the body and legs, are opaque white, giving the creature a very singular and conspicuous appearance.

I was only able to obtain one specimen of this species, which was found in moss in the forest of Ain Beida, near Algiers. I doubt if it be quite mature. I therefore thought at first that it might possibly be some young form of *C. echinipes*; but Professor Berlese, of Florence, has been kind enough to lend me all his specimens of that



MYOLOGY OF PODICA SENEGALENSIS.

species for comparison; they include immature stages, but all are very different from the species now described. As the immature *C. echinipes* closely resemble the adult, it is probable that even if the specimen from which the above description is taken be not quite mature, the adult would not differ greatly.

## EXPLANATION OF THE PLATES.

### Plate XXXVII.

Fig. 1. *Notaspis burrowsii*, ×50, p. 418.
2. —— ——, first leg, ×110.
3. —— ——, fourth leg, ×110.
4. —— ——, pseudostigmatic organ, ×300.
5. —— *æqualis*, ×80, p. 419.
6. *Eremæus fimbriatus*, ×100, p. 422.
7. *Caeculus spatulifer*, ×50, p. 423.
—— ——, claw, ×200.

### Plate XXXVIII.

Fig. 1. *Damæus phalangioides*, ×50, p. 421.
2. —— *flagellifer*, ×65, p. 422.
3. —— *patelloides*, ×70, p. 420.

## 2. On the Anatomy of *Podica senegalensis*. By Frank E. Beddard, M.A., F.R.S.E., Prosector to the Society, and Lecturer on Biology at Guy's Hospital.

[Received May 6, 1890.]

(Plate XXXIX.)

As so little is known about the anatomy of the *Heliornithidæ* and as, in consequence of this, the opinions with regard to the systematic position of the family are so diverse, I am particularly glad to be able to offer to the Society a contribution towards the settlement of this question.

I am able to do this through the great kindness of Dr. Jentink, who permitted me to dissect and study a fine example of the bird well preserved in alcohol. Dr. Büttikofer, to whom, as the curator of the Bird department of the Leiden Museum, I applied for assistance, was good enough to mention my wants to Dr. Jentink, offering on his own account to let me have the use of a rather imperfect skeleton brought by him from Africa. To both these gentleman I desire here to tender my hearty thanks.

Although many families and genera of birds have not yet found a definite resting-place in the system, the *Heliornithidæ* have been perhaps more tossed about from pillar to post of the ornithological edifice than most. They have mainly oscillated between the Divers and Grebes on the one hand, and the Rails on the other.

On the whole, the opinion of ornithologists has been in favour

of uniting them with some of the Rails; and all those writers who have themselves studied the structure of the bird take this view. Thus Nitzsch [13] places the *Heliornithidæ* with *Aramus* and *Parra* in the "Fulicariæ"; Brandt [7] unites them with *Fulica*, but removes the group thus formed to the "Natatores." Giebel [6] unites the *Heliornithidæ* with the Fulicariæ. This view is accepted by Fürbringer [4], who, however, is only able to base his opinion upon the investigations of others, particularly of those who have just been mentioned; but the reasons for this belief are stated in the tables which conclude his review of the different groups of birds. Schlegel [8] places *Heliornis* with *Spheniscus*, *Alca*, *Podiceps*, and *Colymbus* in his Urinatores. One of the most recent writers, who believes that the *Heliornithidæ* are not closely allied to Coots or Rails, is the late Mr. W. A. Forbes [12]; he associates the family with the *Colymbidæ* and *Podicipedidæ* to form an order Eretopodes. I believe, however, that Mr. Forbes's knowledge of the bird was only derived from the writings of others.

The *Heliornithidæ* appear to consist of only two genera, viz. *Heliornis* or *Podoa*, which is Neotropical, and *Podica*, which is Ethiopian and Oriental. The former genus is at present the only one which has been investigated anatomically [1]. It is clear that, as Fürbringer points out, the Old-World forms require a close investigation before the position of the family can be fairly considered. The following description will be found, I trust, to contain some materials for a more detailed consideration of the affinities of the family.

## § 1. *Pterylosis.*

Dr. Büttikofer has recently published some notes upon the African species *Podica senegalensis* and *P. petersi*; being desirous of studying further the skin of the present specimen, he requested me to have the skin prepared. I have been able to comply with his request and to study the pterylosis, partly by ascertaining the distribution of the apteria before the skin was removed and partly by examining the feather-tracts from the inside.

Nitzsch, in describing [13] the pterylosis of *Podoa surinamensis*, distinguishes it from other Rails on account of the broad and undivided ventral tracts and the absence of continuity between the anterior and posterior regions of the dorsal tracts. In the latter character it resembles *Psophia* and the Limicolæ, but the two dorsal tracts only unite just in front of the oil-gland, whereas in the Limicolæ they unite at a point considerably anterior to this.

I find, however, that in *Podica senegalensis* the two halves of the dorsal tract unite about $2\frac{1}{2}$ inches in front of the oil-gland, showing that the above character is not one of family value.

I find also that the ventral pterylosis is less peculiar than might be inferred from Nitzsch's description. In *Podica senegalensis*

[1] With the exception of some observations upon the Intestinal Coils by Dr. Gadow [5] of *Podica*.

there is a distinct division of the pectoral tract such as occurs in the Rails. The inner branch is much broader than the outer, and ends abruptly, as figured by Nitzsch in *Rallus aquaticus*, a short way below the wing; the inner branch of the pectoral tract is if anything rather broader nearer to its free extremity than at its origin; it is $1\frac{1}{2}$ inches long; the outer branch of the pectoral tract is wider at first, though not so wide as the inner branch. The humeral tracts are very strong, and certainly more than two feathers wide (2–6). In almost every point, therefore, the pterylosis of *Podica senegalensis* differs from that of its American ally.

As regards other external characters, I find that there is a close agreement between the Neotropical and African forms.

The *oil-gland* is distinctly tufted.

The *contour-feathers* have *no* aftershaft.

There are 18 *rectrices*.

I count 21 *remiges*.

It is important to notice that the *5th cubital remex* is *not* wanting [see Wray, **10**; Sclater, **9**].

The pterylosis of *Podica* is so different from that of *Heliornis*, that we must assume one of two things: either that Nitzsch's description is wrong, or that the pterylosis—at least in this group—has not the significance that is frequently attached to it.

As a mere question of probability, it does not appear to me to be necessary to pin our faith too firmly to the data of pterylography. And I should be disposed to regard Nitzsch's description of *Heliornis* as likely to be right.

## § 2. *Myology*[1].

The *pectoralis primus* muscle is separable into two layers, which are even to be distinguished by a slight difference of colour; the separation is effected by a tendinous sheet. The muscle arises from the keel of the sternum and from its outer margin behind the third pectoral and alongside of the second pectoral, and from the hinder part of the sternum which is not reached by the second pectoral; it has also an origin along a line running parallel to but of course below the uncinate processes from the ribs[2].

*Pectoralis secundus*: this muscle is large and extends nearly to the end of the sternum; it has the usual bipinnate form.

The *scapulo-humeralis* is a broadish band of muscle underlying the tendon of the biceps.

In the accompanying sketch (Plate XXXIX. fig. 1) is illustrated the patagial muscles of the bird.

[1] I have in this section principally confined myself to those muscles which are known to be of use for systematic purposes.

[2] Fürbringer [4, p. 417 and note] denies that this extrasternal portion of the pectoral muscle springs from the ribs; it takes its origin, according to him, from the "parasternal fascia" which covers the sterno-costal muscles. Nevertheless I cannot but think that in *Podica senegalensis* the origin is actually in part from the ribs themselves.

There is only a single *patagial muscle*, which divides into two tendons, the *longus* and *brevis*.

The latter, as shown in the drawing (Plate XXXIX. fig. 1), is a single strongish tendon which passes straight to its attachment near to the elbow; it gives off no recurrent slip to join the *longus* tendon.

As in so many other birds, a muscular slip arises from the biceps and passes into the patagium; *it is*, however, *not attached to the longus tendon*, as is so generally the case, but is inserted on to the patagial membrane. I have carefully examined both sides of the body of the single specimen at my disposal, and have found that the conditions are absolutely identical; it may be therefore reasonably inferred that this peculiar termination of the biceps slip is characteristic of the bird.

So far as my own experience goes, this peculiar arrangement of the muscle is not to be met with in any other Rail-like bird; nor do I find any mention of such by Fürbringer [4]. In the *Colymbidæ*, however, in the genera *Colymbus*, *Alca*, and *Podiceps* Fürbringer figures (4, Taf. xix. figs. 2, 3, 4) and describes a similar ending of this muscle which he terms "*Biceps propatagialis*." This is obviously a rather important fact, though perhaps it may be thought that its significance is somewhat reduced by the occurrence of an identical arrangement in the Cormorant; many ornithologists, however, have indicated points of affinity between the Steganopodes (particularly *Phalacrocorax*, *Plotus*, and *Phaethon*, see Garrod 3) and the *Colymbidæ*.

*Expansor secundariorum*.—This is a muscle upon the presence or absence of which Garrod [1] laid very considerable stress as a classificatory mark. I find that it is distinctly present in *Podica senegalensis*, having an attachment to the *teres* which is frequently found in other birds. In the *Rallidæ* this peculiar muscle is present, and has the form which Garrod termed Ciconine [1]. In the *Colymbidæ* and *Podicipedidæ* this muscle was "not seen;" however, Fürbringer found [4] in the latter group undoubted vestiges of the tendon, of which he was unable to trace very definitely the origin or insertion.

Merely from the point of view of its presence, then, this muscle does not permit of any conclusions with respect to the relationship of *Podica*. With regard to the course of the tendon, I have already referred to the fact that it joins the *teres* at a point where that muscle begins to become converted into its tendon of attachment, passing through a fibrous pulley; the tendon of the expansor secundariorum is here comparatively broad and tough and not easily missed; it then passes beyond the *teres* and enters the thoracic cavity, ending apparently in the usual way.

*Anconæus longus*.—This muscle (*Anc*, Plate XXXIX. fig. 4) arises from the scapula by an origin which is fleshy internally, but tendinous externally; it is also attached to humerus close to its scapular origin; further down the humerus, a little above the insertion of the *latissimus dorsi*, is a flat but somewhat narrow tendon (*Anc'*) which attaches the *anconæus* to that bone. There appear to be no special

differences between the condition of this muscle in the *Rallidæ* and that in the *Colymbidæ* and *Podicipedidæ*.

The two *latissimi dorsi* muscles are shown as regards their insertion in the accompanying figure (Plate XXXIX. fig. 4); as is generally the case among birds, the posterior of the two muscles (which are hardly distinguishable in the middle of their course[1]) ends in a long thin tendon below the fleshy insertion of the other. It seems, from Prof. Fürbringer's account [4] of the posterior *latissimus dorsi*, that its origin from the front border of the ilium is very inconspicuous among the Fulicariæ; indeed it was not observed at all in many cases. In the *Colymbidæ*, on the other hand, this muscle has an extensive origin from the anterior border of the ilium; *Podica* is in this particular Colymbine and *not* Ralline.

The two *rhomboidei* have an extensively aponeurotic origin. This appears to be so far evidence in favour of the Colymbine affinities of the genus, since these muscles seem to have less tendon among the Rails; this is certainly the case with *Gallinula chloropus*, which I dissected for the purposes of comparison along with *Podica*.

The *serratus posterior* has a very large tendinous insertion on the end of the scapula; in *Gallinula chloropus* this muscle is fleshy up to its insertion.

The *ambiens* is present and has the usual relations.

The *semitendinosus* is a powerful muscle ending in a muscular insertion covered by an aponeurosis.

There is no *accessory semitendinosus*.

The origin of the *tensor fasciæ* extends behind the acetabulum.

The *biceps* is very large and important, with a somewhat unusual mode of insertion; it is of course covered by the tensor fascia; when that muscle is cut across and turned back the *biceps* is seen to arise from the whole of the postacetabular region of the ilium. It has no less than three insertions:—(1) By a broad flat muscular insertion on to the fascia covering the outside of the leg; this strip of muscle springs from the outer side of the *biceps* just behind its division into the second and third insertions. (2) By a thickish long tendon which corresponds to the tendon of insertion in most birds; this passes in the ordinary way through a loop and is inserted some way down the leg. (3) The muscle divides just after the branch to the fascia of the leg into two branches, of which one has the insertion through the *biceps* loop that has just been described; the other branch forms a long thin muscle which becomes tendinous just before its insertion on to the leg some way below the second insertion.

This singular modification of the *biceps cruris* (which is illustrated in Plate XXXIX. fig. 2) appears to be, so far as our present knowledge enables us to speak, quite unique among birds; it recalls in many respects the *biceps* in the Mammalia, though I have not the faintest desire to make any comparison with other groups: nothing seems to me to be more unreasonable than to compare muscles from one large group of animals to another; although I am

[1] Their origins are closely side by side, and there is no space between, as there is, for example, in *Gallinula chloropus*.

convinced that myology is a most valuable aid in determining the affinities of different *genera*, and even groups, of birds, its use in my opinion is restricted to this; no wider inferences can be drawn with any degree of safety.

The *semimembranosus* arises deep of the *semitendinosus*, from the ischium; it is a tolerably strong muscle, though slighter than the *semitendinosus*; it is inserted by a broad flat tendon considerably below the insertion of the *semitendinosus* on to the tibia.

The relative positions of the insertions of this muscle and of the *semitendinosus* are shown in the drawing (Plate XXXIX. fig. 3; and more in detail in fig. 3*a*). As Garrod [2] has pointed out, this muscle is usually very thin in the Grebes and may even [1], as stated by Sundevall, occasionally disappear.

I find, however, in some notes left by Prof. Garrod that *Colymbus glacialis* has a large *semimembranosus* "twice the size of *semitendinosus*." Its origin appears to be a little peculiar; it arises from the ilium and ischium near to the posterior end of the pelvis.

The *femoro-caudal* is a strong and well-developed muscle which has the usual origin and ends by a narrow thin tendon of insertion.

The *accessory femoro-caudal* is a short fleshy muscle which is inserted in common with the *femoro-caudal* (as shown in Plate XXXIX. fig. 3); it appears as if inserted on to the tendon of the latter.

The *adductor* muscles appeared to me to be comparatively small in size; the lower of the two was largely tendinous.

The *gastrocnemius* arises by three heads: the outer head is a large fleshy muscle arising by a thin and strong tendon from the femur, and also by a few muscular fibres from the fascia covering the leg, which has already been spoken of in connection with the *biceps*; the inner head is of equal size and arises from the cnemial crest of tibia, from fasciæ covering the leg, from septum between itself and the *peroneus longus*; its tendon joins that of the outer head at the *tendo Achillis*. The middle head is a very tiny muscle with a very long tendon of insertion; it unites with that of the inner head before the latter joins the tendon of the outer head of the *gastrocnemius*.

There are *two peronei* muscles which have the usual relations; the tendon of the *longus* fuses with the tendon of the superficial flexor of the third digit.

The *peroneus brevis* is a large muscle which forms a kind of sheath round the *tibialis anticus* and the other muscles which spring from the front of the leg; its flat, rather broad tendon, appears to be inserted on to the heel in the usual fashion.

The *tibialis anticus* has the usual two heads, one femoral, the other tibial; its tendon just before its insertion into metatarsus gives off a small branch to the fascia which covers over the tendon of *extensor communis*.

According to Giebel's [6] notes upon the myology of *Heliornis surinamensis*, the *pectoralis primus* and *secundus* agree with the same muscles in *Podica*; he mentions also the large "musculus gracilis" (=*ambiens*). The *peroneus longus* has evidently the same relations, and is, as in *Podica*, a large muscle. The description of

[1] Garrod, MS. (in *Podiceps minor*).

the myology, however, is a very short one, and occupies hardly one page of Giebel's paper.

§ 3. *Alimentary Viscera.*

The remarks that I am able to make under this head are not many, as the organs were not in a very first-rate condition, being much softened and compacted together.

The right lobe of the *liver* is larger than the left, and there appears to be no *gall-bladder*; the *intestines* measure twenty-one inches.

*Cæca* are present and arise from the gut at a distance of about two inches from the cloaca; each cæcum measures as nearly as possible one and a half inches in length.

These facts do not point in any particular direction; the absence of a gall-bladder is certainly peculiar, but I should not like to be very positive upon this point, considering the somewhat softened condition of the viscera [1].

One of the most important aspects of the alimentary tract, viz. the disposition of the convolutions of the intestine, has been already investigated by Gadow, and a description appears in the most recent fasciculus of his work on the Anatomy of Birds [5, p. 709 *et seq.*].

Dr. Gadow makes the following remarks:—"The birds of the first circle group themselves round the Grallæ as the middle point. Limicolæ and Rallidæ can readily be derived from each other; they have, however, sufficient differences in the general alimentary system to allow them to be regarded as equivalent divisions of the Grallæ. To the Rallidæ belong the Alectorides or Crane-like forms, such as *Grus*, *Psophia*, *Dicholophus*, *Otis*. *Rhinochetus* unites in its alimentary system, particularly in the disposition of the intestine, characters of the Rail, Limicoline and Ibis-like birds; the relationship with these is, however, remote, and only the Ethiopian genus *Podica* shows striking resemblances to the New-Caledonian *Rhinochetus*. It is not improbable that both, with the American genera *Heliornis* and *Eurypyga*, diverged early from the common Rail-like stock, and are now isolated forms." The Pygopodes (incl. Podicipedidæ and Colymbidæ) appear to be altogether different as regards their intestinal convolutions.

§ 4. *Syrinx.*

This organ is illustrated in the accompanying drawing (p. 432, fig. 1); there is nothing particularly remarkable about it. The intrinsic muscles are attached to the first bronchial semirings; these are very different from the tracheal rings in appearance; they are much bent (into a bow-shape, the convexity being anterior), thin, and not ossified; the last tracheal rings on the contrary are stout and stiff, though apparently not ossified, and closely applied to each other. There are 17 (16 on one side) bronchial semirings, between which are membranous intervals decreasing posteriorly. The bronchidesmus is complete. The syrinx of *Podica* is in fact in every way thoroughly typical.

[1] Moreover Giebel distinctly states that a gall-bladder is present in *Podoa*.

The relationships of the bird from the point of view of the structure of the syrinx are somewhat doubtful.

It is, in any case, very different from that of *Podiceps*, of which I propose to give a more detailed description in another paper.

As to the Colymbidæ, I have in my possession a syrinx of *Colymbus septentrionalis* which agrees in all essentials with that of

Fig. 1.

Syrinx of *Podica senegalensis*, front view ; nat. size.

*Podica*; the only difference is that the bronchial semirings are rather more numerous, and are hardly divided anteriorly by membranous interspaces; I do not mean to imply that they are fused, but they are so close together as to leave only the merest chink between adjacent rings.

The resemblance then of *Podica senegalensis* to *Colymbus septentrionalis* in respect of the syrinx is very close, but there are many Rails which show an equally close resemblance to both, so that the syrinx is unfortunately not very useful as a diagnostic character.

### § 5. *Osteology.*

Brandt [7, p. 199] remarks that *Podoa* and *Podiceps* agree closely in the form of the skull, but that it is broader and more vaulted posteriorly in *Heliornis*: it is clear from his figures (pl. xii. figs. 1, 2, 3) that *Heliornis* offers no marked points of difference from *Podica*. In another section of the same paper (p. 155), Brandt comments upon certain points of resemblance between *Podoa* and the Steganopodes; there is, however, no detailed comparison of the skeleton in any of these types.

In spite of these alleged resemblances, *Heliornis* is placed with *Fulica* into a separate Family (*Podiceps* being placed with Penguins and Auks in another) of the six into which the Natatores are divided.

Giebel [6] has described, without figures, but in a more thorough fashion, the osteology (and to a certain extent the soft parts also) of *Heliornis surinamensis*, comparing it with the Grebes on the one hand, and with various genera of Rails (*Fulica*, *Gallinula*, *Porzana*) on the other.

He does not, however, direct attention in the skull to all the points which I refer to in the following brief enumeration of the characters which distinguish the Grebe from the Rails.

In the Rails the *maxillo-palatines* are large, and are not concealed by the underlying palatines when the skull is viewed from below[1].

In the Grebe, the *maxillo-palatines* are very slight curved plates of bone, which are almost entirely concealed by the underlying palatines, only projecting very slightly on the inner side of these bones.

In the Rails the *cranial axis* extends as far forward as (at least) the middle of the maxillo-palatines. In the Grebes it does not reach the posterior margin of these bones.

Fig. 2.

Skull of *Podica senegalensis*, lateral view; nat. size.

In the Rails the *temporal fossa* is not bounded by very sharply marked ridges[2]; in the Grebes it is so marked, particularly in *Podiceps cornutus* and *P. cristatus*; in *P. minor* this character is less obvious.

The *temporal fossæ* themselves are much more extensive in the Grebes than in the Rails.

The *occipital condyle* in the Rails is round; in the Grebes it is decidedly kidney-shaped with the "hilum" above.

The forward process of the quadrate[3] is more slender in the Grebes than in the Rails.

The general outline of the skull from above appears also to be very characteristic in these two groups. The hinder part of the skull is rhomboidal in the Grebes, and squarish in the Rails; this is due to the peculiar development of the temporal fossæ, which are quite visible from above, while the jutting-out region of the skull

[1] In the *shape* of its maxillo-palatines, *Fulica* comes nearer to *Podiceps* than do either *Ocydromus* or *Crex*; they are curved and comparatively thin in *Fulica*, instead of being inflated bullæ as in the two latter genera.

[2] In *Ocydromus australis* this ridge is rather more marked than in *Fulica*, *Crex*, and *Aramides*; it is curious to note there is not any approximation here to the Grebes through *P. minor*. In the Rail it is the commencement of the ridge which is best marked, in the Grebe the middle portion. Giebel has remarked that *Podiceps minor* is less of a typical Grebe than is, for example, *Podiceps cristatus*; but he does not refer to this particular point.

[3] Special attention has been lately directed to the quadrate as furnishing evidence of particular affinities in an interesting paper by Miss Walker (Studies from the Mus. of Zool. Univ. Coll. Dundee, vol. i. no. 1).

which forms the lower boundary of the fossæ presents the appearance of independence, and the eye hardly takes it in in noting the shape of the skull.

In all these points the skull of *Podica* resembles that of the Rails.

Fig. 3.

Skull of *Podica senegalensis*, ventral view; nat. size.

The general appearance of the skull of *Podica* is more like that of *Aramides* than of any other Rail with which I have been able to compare it. But it differs from *Aramides*, and agrees with *Fulica* and *Ocydromus*, in the comparatively short, outwardly and backwards directed part of the lachrymal, and also in the slender ventrally-directed process which does not (as far as the ossified part at any rate is concerned) reach the jugal.

There is rather a less marked contrast in diameter between the anterior and posterior parts of the palatines than exists in the Rails; but this character by no means offers a link with the Grebes.

There is no advantage to be gained by comparing *Podica* with *Colymbus*, for that bird shows the characters of *Podiceps* even exaggerated, and has also a well-marked supraoccipital foramen and grooves for nasal glands, which are wanting in the Rails and also in *Podiceps*[1].

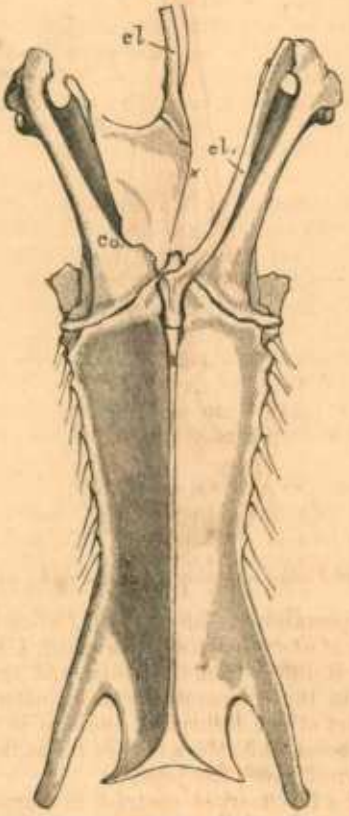
[1] The outline of the foramen magnum shows where this supraoccipital foramen has coalesced with the foramen magnum.

Judging from the figures given by Brandt and from Giebel's description, there are no noteworthy points of difference between *Podica* and *Heliornis* in the skull.

The *sternum* of *Podica* (fig. 4, p. 435), as far as Grebes, Rails, and Divers are concerned, is decidedly peculiar. Giebel has also noted this with regard to *Podoa*.

In general shape it is perhaps as much like that of *Eurypyga*

Fig. 4.




Sternum of *Podica senegalensis*, ventral view; nat. size.

*Co.*, Coracoid; *cl.*, clavicle (only shown on left side); ×*cl.*, articulation of clavicle, shown from the side.

*helias* as of any other bird with which it can be reasonably supposed to be related, but its two lateral margins are more concave and the lateral processes extend for a short distance beyond the median part of the sternum. The keel also is less developed in proportion. In this character it is Rail-like, but in *Colymbus*, as in other birds,

the keel is not deep as in many purely flying birds. *Eurypyga* has a very deep keel to the sternum.

The *clavicles* have a large interclavicular piece which is prolonged in front as well as behind.

Here, again, *Podica* appears to be peculiar, or rather to resemble *Ardea*, which has also an anterior and posterior interclavicular process.

Among the supposed near allies of *Podica*, *Colymbus* and *Podiceps* have both a posterior interclavicular process only, which is present, though extremely small, in Rails.

The pelvis of *Podica* is in some respects like that of many Rails; but in other particulars again it is Grebe- or Diver-like. The ilia in front (see fig. 5, p. 437, and fig. 6, p. 438) do not reach up to the top of the spines of the dorsal vertebræ; each ilium also is deflected away from the vertebral column and overlaps several ribs. In most Rails that I have examined, the ilia completely cover the vertebræ, being fused with the summit of their neural spines; this is the case at any rate with *Ocydromus* and *Aramides*. In *Tribonyx* and *Fulica* the ilia do not completely cover up the dorsal vertebræ which they overlap; but in both these forms the ilia approach each other at their anterior extremity, and are not deflected away from each other as they are in *Podica*. In this particular the pelvis of *Podica* is decidedly Colymbine.

The general outline of the pelvis is as decidedly that of a Rail, being wider behind than in front; but in all the Rails which I have examined the pelvic bones are perfectly free from the ischia, though they do not extend very far behind the termination of the latter.

In *Podica* there is in places a close union between the pubis and ischium of each side, amounting to a synostosis, while the pubic bones themselves extend for about an inch in length beyond the ischia, and are curved inwards towards each other.

As regards the non-fusion of the pubis and ischia, the Divers are at one extreme and *Podica* at the other—the Rails occupying an intermediate position; so that, although *Podica* is in some respects peculiar, it must be considered as coming nearer to the Rails than the Grebes. The backward extension of the pubes is, however, a Grebe-like character, though it is after all rather slight. The ilia of *Podica* end posteriorly in a strong blunt point on each side, about as long as the first two vertebræ, and there is no strong ridge, such as we meet with in the Rails; the hinder part of the pelvis is smoothed and rounded. Although there are differences here from the Rails, it cannot be said that there are any marked resemblances to the peculiar pelvis of the Diver and of the Grebe.

The anterior parts of the ilia together with the intervening vertebræ are narrower than the postacetabular portion of the pelvis; but the disproportion is certainly not so great as in most of the Rails: the long and narrow pelvis of *Fulica ardesiaca*, though it does not approach in shape that of *Podica*, does so in the proportion of the anterior and posterior regions; so also that of *Aramides*, with which

the genus *Podica* has been already especially compared on account of the skull characters. Three ribs are covered at their origin by the ilia, which just fall short of the posterior margin of the next rib in front.

In *Fulica* only one rib is thus covered, the pelvis being placed

Fig. 5.

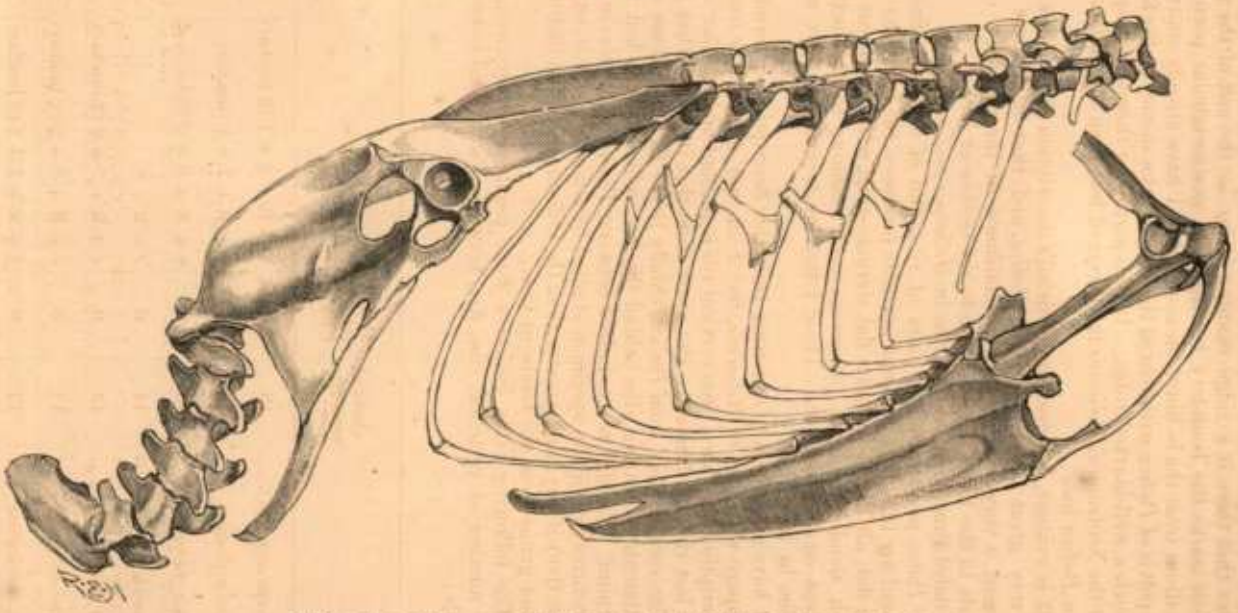
Pelvis of *Podica senegalensis*, dorsal view; nat. size.

further back. In the Divers and Grebes there are two ribs thus covered over by the ilia.

In *Oeydromus australis* the ilia completely cover the origin of one pair of ribs and nearly reach over another, so that there is no great use to be made of this point.

The pelvis of *Heliornis* shows the same peculiarities as that of *Podica*; the pubes are in the same way united with the ischia and prolonged beyond them; the fused neural spines of the lumbar vertebræ

Fig. 6.



Pelvis, ribs, and sternum of *Podica senegalensis*, lateral view; nat. size.

project freely as a vertical plate of bone between the two ilia. Giebel states that there is a ridge running as far as the end of the pelvis which marks the boundary between the postacetabular portion of the ilium from the ischium on each side; I have already contrasted the pelvis of *Podica* with that of the Rails by the absence in the former of such a well-marked ridge. In this particular therefore it appears that the Neotropical *Heliornis* has diverged less from the Rail-pattern than *Podica* has.

It is evident, however, from Giebel's description that *Podoa* offers no very great differences from *Podica*, and that both these birds present a very much closer resemblance in the characters of the pelvis to the Rails than they do to the Grebes or Divers.

Giebel thus describes the ribs in *Heliornis*:—

"*Podoa* possesses eight pairs of ribs, and of these the first and second are false ribs, without uncinate processes, the following broad and flat, all bound by quite flat sternocostalia with the breast-bone, with slender uncinate processes, each reaching to the next rib, except on the two last. These latter are covered at their articulation by the pelvis."

I have attempted to construct from this description a formula to compare with that of *Heliornis*, but I am not quite clear from the description whether a free cervical rib is present and whether any of the last ribs are lumbar. But apart from this it is clear that *Podoa* differs considerably from *Podica*, chiefly in the fact that there are no rudimentary floating ribs behind the last, which is attached to the sternum. The differences indeed between *Podica* and *Podoa* in these structures are (if the specimen studied by Giebel was not in any way defective) if anything greater than the differences which distinguish either genus from the Grebe or Coot.

The following table indicates some points of comparison, as to the number of vertebræ, ribs, &c., between *Podica* and some other birds:—

| | Cervical vertebræ. | Dorsal vertebræ fused. | Ribs. | Uncinate processes. |
|---|---|---|---|---|
| *Podiceps cornutus* ..... | 19 | 2–5 | r + R + 6 + 1 (2 lumbar) | 2–7 |
| *Fulica ardeniaca* ..... | 13 | 0 | r + R + 7 + 1 (lumbar) | 3–8 |
| *Podica senegalensis* ... | 15 | 0 | r + R + 6 + 2 (3 lumbar) | 3–7 |
| *Heliornis surinamensis* | 14 | 0 | r + R + 8 | 3–6 |
| *Uria troile* ..... | 13 | 0 | r + R + 7 + 2 (2 lumbar) | 2–9 |
| *Fratercula arctica* ..... | 13 | 0 | r + R + 7 + 2 (2 lumbar) | 2–8 |
| *Frat. corniculata* ..... | 13 | 0 | r + R + 7 + 2 (3 lumbar) | 2–8 |

Not much, as it appears to me, can be gathered from the above facts as to the relationship of *Podica*: it is not distinctively Ralline nor is it, on the other hand, distinctively Colymbine. In *Porzana* and *Gallinula* (Giebel) there is a fusion between a number of the dorsal vertebræ.

The *coracoid* is a stout bone; the mesocoracoid process (Parker, **11**) is continued into a long thin ridge, which extends along nearly the whole of the inner edge of the bone, gradually decreasing in depth.

This process is much larger than in any Rail which I have examined, but not so large as in *Psophia* (*cf.* P. Z. S. 1890, p. 336). In the Grebes the process in question is obsolete or rudimentary.

The *clavicle* has been already partly described in connection with the sternum; it is attached above to the mesocoracoid process and to the acromion. In *Heliornis* the furcula is also firmly attached to the carina sterni, but Giebel has omitted to mention anything about the anterior and posterior interclavicular processes. The articulation of the clavicle is a point upon which Fürbringer lays some importance; it allies *Podica* with the Rails and not with the Divers, in which birds the clavicle extends beyond the acromion.

The *Heliornithidæ* thus agree with the Rails in the following characters:—

(1) In the general structure of the skull.

(2) In the general form of the pelvis.

(3) In the pterylosis.

(4) In the presence of an *expansor secundariorum* and in the relation of the tendons of this muscle.

They agree with the *Colymbidæ* in the following:—

(1) The insertion of the *biceps slip* on to the patagium instead of on to the tendon of the *patagialis longus*.

(2) In the characters of the *latissimi dorsi*.

(3) In the muscle-formula of the leg, which is ABX+ (with *Colymbus*, not with *Podiceps*).

The *Heliornithidæ* appear to be peculiar in the following characters:—

(1) The absence of an aftershaft.

(2) The form of the sternum.

(3) The shape and relations of the interclavicular [1].

(4) In the fusion of the pubes with the ischia and the absence of lateral postacetabular ridges.

(5) In the arrangement of the intestinal coils.

(6) In the form of the *biceps cruris*.

It will be evident therefore, from a glance at the above statement, that the *Heliornithidæ* have more characters peculiar to themselves than characters which ally them with either the Ralline or Colymbine birds; and these characters appear to me to be not merely numerous but also for the most part important ones; nor are they confined

[1] I do not emphasize the resemblances which they show in this or other particulars to other groups of birds.

to one organ or system, but are manifested in the entire structure—bones, muscles, and viscera.

It appears to me, therefore, to be necessary to strongly emphasize the justice of regarding the *Heliornithidæ* as a distinct and well-marked family. The following is a brief definition of that family :—

*Characters of the Family* Heliornithidæ.

Schizognathous holorhinal birds with 18 rectrices, moderately long cæca, a tufted oil-gland, no aftershaft ; with an elongated one-notched sternum and low carina ; clavicles with an anterior and posterior interclavicular process, the latter firmly attached to the carina sterni ; the skull without basipterygoid processes, occipital foramina and supraorbital furrows, and without greatly developed temporal fossæ. Biceps slip ending freely on patagial membrane ; expansor secundariorum well developed ; in the hind limb ambiens, femoro-caudal, accessory femoro-caudal, semitendinosus present, accessory semitendinosus absent ; relations of biceps cruris peculiar. Muscular formula of leg ABX+.

*Affinities of the* Heliornithidæ.

It is curious to notice that the osteological characters and those shown by the muscles are almost in antagonism.

Judged entirely by its myology, *Podica* would be referred to the Pygopodes, though it would doubtless be regarded as an aberrant member of that group [1].

If only osteology were taken into consideration, then *Podica* would be as unhesitatingly assigned to the Rails, though the characters afforded by the sternum would necessitate its separation as a very distinct genus from the other Rail-like birds.

Which set of characters are we to be guided by in attempting to settle the systematic position of the *Heliornithidæ* ?

It is hardly necessary to emphasize the fact that in deducing affinities one character is *not* as good as another ; adaptive characters must clearly be set aside when they are not in harmony with structural characters showing no evident relation to the mode of life of the bird.

I should be inclined therefore, in the first place, to discount very liberally the skull characters, as least some of them.

The strongly developed temporal fossæ with the ridges on either side of them distinguish the Grebes from the *Rallidæ*. But we find exactly the same extraordinarily developed fossæ in the *Ardeidæ* and in *Plotus* and *Phalacrocoracæ*. These birds, like the Grebes, use their neck and heads greatly and have powerful muscles which are inserted

[1] This makes me think that Mr. Forbes must have dissected *Podica* or *Podoa* ; otherwise, if he had only published accounts to go upon, or had only examined the osteological structure, he would hardly have definitely placed it in the same group with the Divers and Grebes, as he did at the close of his career [13].

into these fossæ. Perhaps also the comparatively great length of the basis cranii is associated with this muscular development. If you smooth down the skull of a Grebe and pare away the strongly developed ridges, the result is not very unlike the skull of a Rail. There are not any other really marked differences between the skulls. Fürbringer [4, p. 1029 *et seq.*] lays no weight upon the systematic value of these characters; he does not refer to them in his digest of the important cranial characters.

With regard to the other characters which the skeleton exhibits, it is true that no resemblance is shown to the Divers and Grebes. On the other hand, its resemblance to the Rails which has been so insisted upon by Giebel is in my opinion less striking than its differences from the same group of birds.

Turning to the muscular anatomy, we have a mixture of Colymbine and Ralline characters with a decided element that is peculiar to the *Heliornithidæ*. On the whole, if it were necessary to associate *Podica* definitely with either of the two groups to which it shows affinity, I should feel obliged to regard it as belonging to the Colymbidæ.

Taking everything into consideration, it seems that the *Heliornithidæ* form a distinct family which has traversed for a certain distance the branch leading from the Rails to the Colymbidæ and has then diverged rather widely in a direction of its own.

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2. Garrod, A. H.—On Certain Muscles of the Thigh of Birds, and on their Value in Classification.—Part II. Proc. Zool. Soc. 1874, p. 111 *et seq.*
3. Garrod, A. H.—Notes on the Anatomy of *Plotus anhinga*. Proc. Zool. Soc. 1876, p. 335 *et seq.*
4. Fürbringer.—Untersuchungen zur Morphologie und Systematik der Vögel. Amsterdam, 1888.
5. Gadow, H.—Aves, in Bronn's 'Thierreichs.'
6. Giebel, C.—Zur Naturgeschichte des surinamischen Wasserhuhns, *Podoa surinamensis*. Zeitschr. ges. Naturw. Bd. xviii. (1861) pp. 424–437.
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9. Sclater, P. L.—Remarks on the Fifth Cubital Remex of the Wing in the Carinatæ. Ibis, 1890, p. 77.
10. Wray, R. S.—On some Points in the Morphology of the Wings of Birds. P. Z. S. 1887, p. 343.
11. Parker, W. K.—A Monograph on the Structure and Development of the Shoulder-girdle and Sternum in the Vertebrata. Ray Society, 1868.

J. Smit del. et lith. Hanhart Print. imp.

SCIURUS PYRRHOPUS ANERYTHRUS

12. Forbes, W. A.—Forbes's Final Idea as to the Classification of Birds. Ibis, 1884, p. 119.
13. Nitzsch's Pterylography. Ed. Sclater. Ray Society, 1867.

## EXPLANATION OF PLATE XXXIX.

Myology of *Podica senegalensis*.

Fig. 1. Patagial muscles. *T.p*, tensor patagii; *Bi.s*, biceps slip; *Bi*, biceps; *Hu*, tendon attaching tensor patagii to humerus.
2. Muscles of thigh, outer view. *Bi*, Biceps; 1, 2, 3, its three insertions; *g*, gastrocnemius; *t.f*, tensor fascia, cut and reflected.
3. Muscles of thigh, inner aspect. *Amb*, ambiens; *afc*, accessory femoro-caudal; *st*, semitendinosus; *f.c*, femoro-caudal; *sm*, semimembranosus.
3 *a*. Insertion of semitendinosus (*st*.) and semimembranosus (*sm*.).
4. Some of the muscles of the shoulder-girdle. *Anc*, Anconæus longus; *Anc'*, its tendinous slip to humerus; *Sc*, scapula; $LD^1$, $LD^2$, two latissimi dorsi; *D*, deltoid; *Tr*, triceps; *Hu*, humeral head of anconæus.

# 3. On a Collection of Mammals obtained by Dr. Emin Pasha in Central and Eastern Africa. By Oldfield Thomas, F.Z.S.

[Received June 3, 1890.]

(Plate XL.)

The Mammals now described were collected partly on Dr. Emin's return march from his Equatorial Province, and partly by himself or by friends of his during his stay at Bagamoyo. The former, like the magnificent collection sent over in 1887 [1], were presented by him direct to the Natural History Museum, and the latter were given to the Zoological Society, whose Council have in their turn passed them on to the Museum for comparison and preservation.

After the collections described in the previous papers were dispatched in 1887, Dr. Emin continued to investigate the fauna of the region of the great lakes, and it speaks volumes for his energy and enthusiasm that after all the collections then made had most unfortunately been lost, he should, nevertheless, have perseveringly continued to collect all the way down during the painful march from Equatoria to Bagamoyo, and should, under such difficulties, have been able to obtain so many valuable specimens as are here described. Later, while at Bagamoyo, he exercised his influence among his friends, and the specimens recorded as from Monda, in the Nguru Mountains, and from Mandera, a place equidistant from Saadani and Bagamoyo, about 25 miles from the coast, were obtained for him in this way. Those from the latter locality were collected by Lieut. Langheld, to whose friendly exertions we owe some of the most interesting specimens obtained.

Every skin collected during the march has been most carefully labelled by Emin himself, many of the particulars so recorded being

[1] See P. Z. S. 1888, p. 3.

of the utmost value, and increasing very considerably the interest of the specimens.

1. Anthropopithecus troglodytes, Gm.

*a*. ♂. "Skull of a full-grown Chimpanzee shot by me in Mssougua, shores of Albert Lake, the first specimen ever obtained in these regions."—E.

*b*. ♀. Skull without mandible. No exact locality.

Specimen *a* is an unusually fine male skull, measuring 198 millim. from occiput to gnathion, and 138 in its greatest bi-zygomatic breadth.

There appears to be no essential difference between it and ordinary West-African Chimpanzee's skulls; and in regard to "*Troglodytes schweinfurthi*" and "*T. niger* var *marungensis*," I can only repeat my opinion of 1888[1], namely, that the evidence is as yet too meagre for their proper distinction.

2. Herpestes galera, Erxl.

♂. Monda, Nguru Mountains.

A remarkably handsome specimen, strongly influenced by erythrism, many of the hairs, especially those on the belly, being wholly or partly of a brilliant rufous colour.

3. Helogale parvula undulata, Peters.

*a*. ♀. Usambiro, S. Victoria Nyanza. 1/9/89.

*b*. ♂. Usagara. 22/11/89.

"Iride fusca. Native names (*a*) "Ndjóroro" and (*b*) "Viguiri." Common in little flocks of from 6 to 10 individuals, running about the fields."—E.

Although, on the whole, I am disposed to agree with Dr. Jentink[2] as to the specific identity of *H. parvula*, Sund., and *H. undulata*, Peters, yet the difference in the colour of typical examples of each is such as to render it advisable to consider the two as representing different geographical races—a southern semi-tropical, and a northern tropical one respectively.

Dr. Emin's observation as to the gregarious habits of the species is of remarkable interest, and is, I believe, the first observation of the sort made about any member of the family.

4. Rhynchocyon petersi, Bocage.

*a*. Mandera. 3/90. Coll. Langheld.

The present is the third specimen of this rare species that has been received by the Museum. The first was obtained on the island of Zanzibar by Sir John Kirk in 1884; and a second one, a fine male in spirit, in the Rabai Hills, Mombasa, by the Rev. W. E. Taylor in 1886. All the three agree precisely with the original description given by Prof. du Bocage[3], of which an abstract was published by Dr. Günther in his monograph of the genus[4].

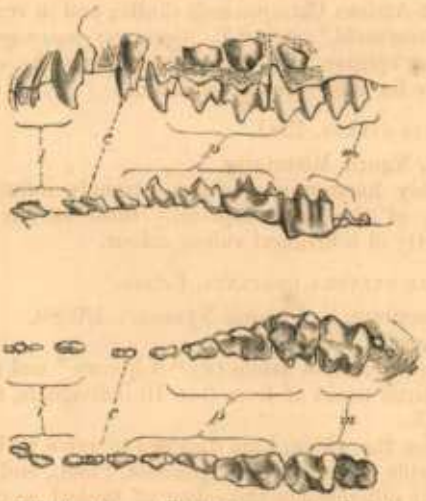
[1] P. Z. S. 1888, p. 5.
[2] Notes Leyd. Mus. xi. p. 31 (1888).
[3] J. Sci. Lisb. vii. p. 159 (1880).
[4] P. Z. S. 1881, p. 164.

5. PETRODROMUS TETRADACTYLUS, Peters.

*a–c*. Mandera. 3/90. Coll. by Lieut. Langheld.

In this species it is worthy of note that there is a very considerable difference in size between the sexes, a difference so great as at first, with only unsexed specimens for examination, to make one suspect specific distinctness. Thus a male skull in the Museum collection measures 50 millim. in basal length, whilst that of a fully adult female is only 45.

Specimen *c* has its milk-dentition still in place, and a figure of it may be of use. Its interest, however, lies, not in the mere form of the milk-teeth, but in their proving that all the usually received dental



Milk-dentition of *Petrodromus tetradactylus*.
Side and top view of upper and lower teeth.

formulæ of the members of the family are wrong in one important essential. So far as I know, without exception, every author has considered that the *Macroscelididæ* have three premolars, and three molars above and below, except *Macroscelides brachyrhynchus* and *M. fuscus*, which have four molars below. This last fact might have aroused a suspicion of what is really the case, as proved by the milk-dentition, namely, that in all the members of the family there are four premolars, the last three changing, as is usual, and only two molars in the ordinary forms, the above-mentioned two species having three below.

This is rather a remarkable example of the many mistakes which occur owing to naturalists homologizing teeth from their form alone, for in this case, what is now proved to be $P.^4$ is in its shape absolutely molariform, so that it has hitherto always been taken to be $M.^1$.

In *Rhynchocyon* and *Macroscelides* other specimens in the Museum show the same fact equally clearly and decisively.

The revised formulæ for the three genera will therefore be:—

*Rhynchocyon*: I. $\frac{0,0,1 \text{ or } 0}{1.2.3}$, C. $\frac{1}{1}$, P. $\frac{1.2.3.4}{1.2.3.4}$, M. $\frac{1.2.0}{1.2.0} \times 2 = 34$ or 36.

*Petrodromus*: I. $\frac{1.2.3}{1.2.3}$, C. $\frac{1}{1}$, P. $\frac{1.2.3.4}{1.2.3.4}$, M. $\frac{1.2.0}{1.2.0} \times 2 = 40$.

*Macroscelides*: I. $\frac{1.2.3}{1.2.3}$, C. $\frac{1}{1}$, P. $\frac{1.2.3.4}{1.2.3.4}$, M. $\frac{1.2.0}{1.2.3 \text{ or } 0} \times 2 = 40$ or 42.

6. Macroscelides rufescens, Peters (?).

*a*. ♀. Usambiro. 1/9/89.

"Iride nigerrima. This single specimen found amongst the high dry grasses. Runs like a Gerbille. Native name 'Gosso'."—E.

This beautiful little Elephant-Shrew appears to agree in all essential characters with Peters's *M. rufescens*, although it is considerably paler and less rufescent in colour than some of the original specimens of that species now in the Museum. Its colour is in fact more like that shown on the plate of "*M. revoili*," Huet [1], a form which will, I suspect, be found to be specifically identical with the earlier described *M. rufescens*.

7. Epomophorus minor, Dobs.

*a*. ♂. Kiriamo. 16/5/89.

*b–d*. ♂ ♀. Bagamoyo. 20/2/90.

"Iride pallide umbrina. 10 to 20 individuals together on cocoa-palms, inside the town of Bagamoyo."—E.

8. Epomophorus pusillus, Pet.

*a*. ♂. Kiriamo. 14/5/89.

"Iride pallide umbrina."

9. Nyctinomus pumilus, Cretzschm.

*a*, *b*. ♂ ♀. Usambiro. 9/9/89.

*c*. ♂. Bagamoyo. 24/1/90.

"Iride fusca. Frequent among the rocks. Native name 'Katunké.'"—E.

10. Anomalurus orientalis, Peters.

*a*. Monda, Nguru Mountains.

The present is only the second specimen of this interesting species that has been obtained, the type in the British Museum having remained unique up to the present time. As that type was bought from negroes in the streets of Zanzibar by Fischer, Dr. Emin's example is the first that shows where the species really occurs wild.

*A. orientalis* is unquestionably very closely allied to the first described species of the genus, *A. fraseri*, Waterh., a native of Fernando Po.

[1] Revoil's 'Faune et Flore des Pays-Çomalis,' pl. 1 (1882).

11. Sciurus palliatus, Peters.

*a*, *b*, *c*. Monda, Nguru Mountains.

12. Sciurus rufobrachiatus, Waterh.

*a*. ♀. Buguera. 29/3/89.

"Iride fusco-umbrina. Common in the thick forest on the hill-sides."—E.

13. Sciurus pyrrhopus anerythrus, subsp. nov. (Plate XL.)

*a*. ♂. Buguera. 14/3/89. *Type* of variety.

*b*. ♀. Buguera. 31/3/89.

"Iride fusca. On trees near watercourses."—E.

For differential characters see below.

Dimensions of *a*, an adult male in skin:—Head and body 185 millim.; tail, without terminal hairs 167, with hairs 196; hind foot, without claws, 40.

The numerous and well-defined colour-variations found in *Sciurus pyrrhopus*, and commented on by Dr. Jentink in his admirable monograph of the African Squirrils [1], have always appeared to me to be of somewhat more than the merely individual value assigned to them by that author, and on laying out the Museum series of the species, 20 in number, I find that the variations are so strictly geographical in their occurrence that they deserve recognition by name.

The following are the geographical races that I would propose to recognize, with short notes on the characters which distinguish them from one another. The specific characters of the whole are given in Dr. Jentink's paper:—

A. *S. pyrrhopus leucostigma*, Temm.

Rufous extending all along sides, on cheeks, flanks, and outer sides of limbs. Pale lateral line shown up by the darkening of the hairs just external to it, the latter forming in some specimens a distinct blackish line. Belly pure white.

*Hab.* Region north and west of the Bight of Biafra.

B. *S. pyrrhopus erythrogenys*, Waterh.

Rufous dull, confined to cheeks, none on flanks or limbs. No darker line on sides. Belly white.

*Hab.* Island of Fernando Po.

C. *S. pyrrhopus typicus*, F. Cuv.

Rufous very brilliant, present on face and cheeks, fore and hind limbs, not on flanks. Belly white, often washed with rufous.

*Hab.* Gaboon and eastward through the great Congo Forest to Monbuttu, Central Africa [2].

[1] Notes Leyd. Mus. iv. p. 1 (1882).

[2] The type of this form was said to have come from Fernando Po, but as it had been kept alive as a pet, it may easily have been taken to the island by natives before it came into the hands of the French naturalists. All of the five Fernando Po specimens in the British Museum are of the *erythrogenys* variety.

D. *S. pyrrhopus ancrythrus*, subsp. nov.

No rufous present on head, body, or limbs. Pale lateral lines very indistinct, not shown up by darker external lines. Belly grey, washed with pale orange; the hairs slaty grey basally, and orange distally, none of them pure white.

*Hab.* Lake-region, S. of Albert Nyanza.

The present is a still further eastward extension of the known range of this species, which had never been recorded out of West Africa until Dr. Emin sent home the two specimens of the typical race from Monbuttu, referred to in the previous paper on his Mammals [1].

14. Sciurus congicus, Kuhl.

*a*. ♂. Mrogoro, Usagara. 24/11/89.
"Iride fusca. Native name 'Kifruma.'"—E.

15. Gerbillus, sp. inc.

*a*. Young. Mugombia, Ugogo. 2/11/89.
Too young for determination.

16. Gerbillus nanus, Blanf. (?).

*a*, *b*. ♂. Ussougo. 3/10/89.
"Iride fusca. Native name 'Nkosso.'"—E.

I am unable to distinguish these specimens from some Abyssinian individuals in the Museum collection, obtained by Mr. Blanford himself at Zoulla; but it is possible that spirit-specimens would show differences not discernible in the dried skins, and, considering the great difference in locality, it would be wiser to accept the determination with some doubt.

The species was originally described from Persia, but the Zoulla specimens are unquestionably identical with the types, now in the Museum.

[Mus rattus, L.

*a*. Bagamoyo.]

17. Mus (Isomys) borsalis, Smith.

*a*. Monda, Nguru Mountains.

18. Mus (Isomys) abyssinicus, Rüpp.

*a*. ♂. Gombe, Ikungu. 18/10/89.

19. Myoscalops [2] argenteo-cinereus, Peters (?).

*a*, *b*. Mandera. 3/90. Coll. Langheld.

It is with the greatest hesitation that I place these two specimens under one heading. Externally, no one would doubt but that they

[1] P. Z. S. 1888, p. 9.
[2] Nom. nov. *Heliophobius*, Peters, 1846, *nec* Boisduval, Index Meth., Lepidopt. p. 69 (1829).

were simply adult and young of the same animal. But in their skulls, as in other cases in the present family, the age characters are so slight and doubtful that one would at first sight say that the skull of *b* was that of an adult animal; and therefore that it could not possibly be of the same species as the very much larger one of *a*. Furthermore, *b* agrees in every respect, external and cranial (except that it has not the white frontal spot), with the type of *Georychus albifrons*, Gray, in the British Museum; and, on the other hand, *a* agrees in its skull and dentition with that of *G. pallidus*, Gr., which is unquestionably synonymous with Peters's *Heliophobius argenteo-cinereus*. The colour of *G. pallidus*, and, so far as can be judged from the figure and description, that of *H. argenteo-cinereus*, is very much paler than either of Emin's specimens, and this by itself makes it doubtful whether the latter are certainly of the same species. Without further material, however, it would not be safe to separate them on account of their colour alone.

But the difficulty arises owing to the number of the teeth. In Peters's examples, in the type of *G. pallidus*, and in *a* of the present collection there are either five or six cheek-teeth, as in typical *Myoscalops*, while in the *G. albifrons* and in *b* there are only three or four, as in *Georychus*. But the peculiar structure of the posterior palatal region is quite the same in both, as also are the proportions of the digits; and I am therefore induced for the present to look upon the two small specimens as merely younger examples of *M. argenteo-cinereus*, and to suppose that as they got older they would have developed more and more of their posterior molars.

The peculiar way in which the teeth of *Myoscalops* succeed each other behind up to a total of six renders the true homologies of the four cheek-teeth of *Georychus* a little doubtful, and instead of there being three molars and one premolar as is ordinarily supposed, it seems possible that there are really three premolars and one molar, the two molars suppressed being those that only come up in extreme old age in the allied genus *Myoscalops*.

Finally, should the difference in colour already referred to prove of specific value, the type of "*G. pallidus*" would fall under *M. argenteo-cinereus*, while the dark-coloured species would stand as *M. albifrons*, to which both of Emin's specimens would then be referable.

20. Aulacodus swindernianus, Temm.

*a*. Monda, Nguru Mountains.

21. Procavia bocagei, Gray.

*a*. ♀. Usambiro. 3/9/89.

"Iride fusco-umbrina. Found on the rocky hills round Usambiro. Native name 'Pembe.'"—E.

This is a very considerable extension of the known range of *P. bocagei*; but Dr. Emin's specimen agrees on the whole so fairly well with the Angolan examples in the Museum that I do not at present feel justified in separating it specifically.

22. Scopophorus, sp. inc.

*a*. Skin without label, too young for determination.

23. Manis temminckii, Smuts.

*a*. Mandera. 3/90. Collected by Lieut. Langheld.

† This specimen appears to have an unusually long tail, but as some of the terminal caudal scales have been lost, the exact extent of the variation cannot be recorded.

## 4. Descriptions of two new Species of the Siluroid Genus *Arges*. By G. A. Boulenger.

[Received May 28, 1890.]

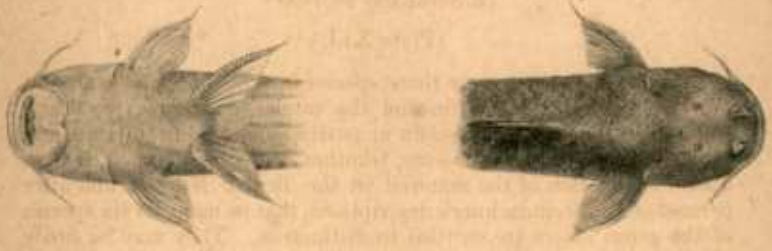
(Plate XLI.)

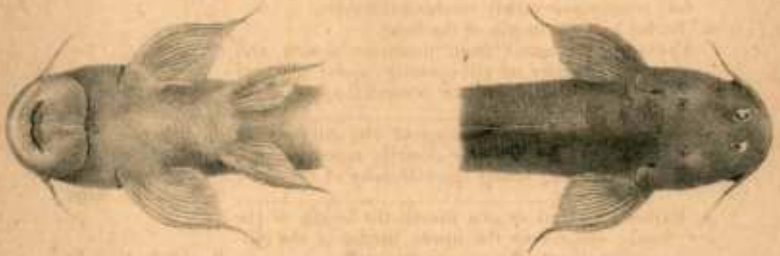
Leaving aside the two or three species in which a spine is present between the rayed dorsal fin and the caudal, whether exposed and supporting the small adipose fin or partly embedded in the skin, and for which the name *Styxgenes*, Günther, may be retained, I find, upon examination of the material in the British Museum and after perusal of Dr. Steindachner's descriptions, that as many as six species of the genus *Arges* are entitled to distinction. They may be easily identified by means of the following synopsis:—

A. First ventral ray about as long as its distance from the posterior extremity of the anal laid against the tail, reaching or nearly reaching the anus.
  *a*. Barbel half the length of the head.
    Eye equally distant from posterior nostril and upper border of gill-opening; outer pectoral ray reaching but a little beyond the base of the outer ventral ray ..... 1. *prenadilla*, C. & V.
    Eye nearer the upper border of the gill-opening than to the posterior nostril; outer pectoral ray reaching nearly the extremity of the outer ventral ray ..... 2. *longifilis*, Stdr.
  *b*. Barbel one third or one fourth the length of the head; eye nearer the upper border of the gill-opening than to the posterior nostril ..... 3. *sabalo*, C. & V.

B. First ventral ray exactly as long as its distance from the anal; anal opening nearly equally distant from the extremity of the ventral and the origin of the anal, or a little nearer the former.
  *a*. Barbel half the length of the head.
    Eye equally distant from posterior nostril and upper border of gill-opening; outer pectoral ray not reaching the middle of the outer ventral ray ..... 4. *wkymperi*, sp. n.
    Eye nearer the upper border of the gill-opening than to the posterior nostril; outer pectoral ray reaching beyond the middle of the outer ventral ray ..... 5. *tweranowskii*, sp. n.
  *b*. Barbel one third the length of the head; eye nearer the upper border of the gill-opening than to the posterior nostril ..... 6. ***peruanus*, Stdr.**

2.





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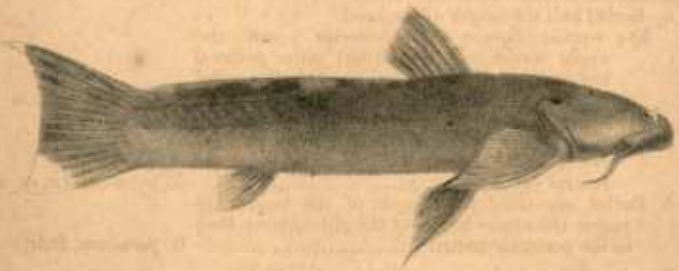

Peter Zunn del. et lith. Mintern Bros. imp.

I. ARGES TACZANOWSKII. 2. ARGES WHYMPERI.

*A. longifilis*, *sabalo*, *taczanowskii*, and *peruanus* inhabit the Andes of Peru, *A. prenadilla* and *whymperi* the Andes of Ecuador. I had originally confounded the two latter species, when Mr. Whymper submitted to me his specimens for identification some years since, but a renewed examination has convinced me that there are at least three kinds of "Preñadillas" in Ecuador, instead of one as believed by Putnam.

ARGES TACZANOWSKII, sp. n. (Plate XLI. fig. 1.)

*Arges sabalo*, part., Steindachn. Sitzungsb. Ak. Wien, lxxii. 1876, p. 598.

D. 1/6. A. 1/6. P. 1/11. V. 1/4.

Head as broad as long, one fourth of the total length (without caudal). Eyes very small, about one third the width of the interocular space, midway between the anterior nostril and the posterior border of the head, much nearer the upper extremity of the gill-cleft than to the posterior nostril; nostrils much nearer the end of the snout than to the eyes. Three rows of teeth in the præmaxillary, mostly unicuspid, the outer row comprising about twenty teeth; mandibular teeth of the outer row larger and deeply notched. Labial lobes large and granulate all over; the cleft of the mouth measures one half the width of the buccal disk; barbels measuring half the length of the head. Adipose fin one third of the total length (without caudal), very low and extending to the caudal. The origin of the first dorsal is one third nearer the end of the snout than the base of the caudal; the first ray is somewhat prolonged and its length equals the distance from the posterior nostril to the posterior extremity of the head. First pectoral ray prolonged, as long as the head, extending as far as halfway between the head and the anal, but not so far as the extremity of the ventrals. The latter fins originate slightly in advance of the dorsal, and measure exactly one half the distance between the base of their first ray (which is much thickened but scarcely prolonged) and the anal. Anal opening a little nearer the extremity of the ventrals than the origin of the anal. First anal ray three fourths the length of the ventral, halfway between the extremity of the pectoral and the caudal. The caudal fin is injured in the unique specimen examined. Yellowish, above closely marbled with pale purplish brown.

Total length (without caudal) 72 millim.; length of head 18; width of head 18; depth of body (above base of ventrals) 12.

A single specimen, from Amable Maria, Peruvian Andes, is in the British Museum. It was obtained by exchange from the Warsaw Museum, in memory of whose regretted Curator the species is named.

ARGES WHYMPERI, sp. n. (Plate XLI. fig. 2.)

D. 1/6. A. 1/6. P. 1/10. V. 1/4.

Head as broad as long, $4\frac{1}{2}$ to 5 times in the total length (caudal excluded). Eyes very small, about one fourth the width of the

interocular space, midway between the posterior nostril and the upper extremity of the gill-cleft; posterior nostril midway between the end of the snout and the eye. Five rows of teeth in the præmaxillary, nearly all bicuspid, the outer row comprising about twenty teeth; mandibular teeth scarcely larger than præmaxillaries, bicuspid. Labial lobes large and covered with granular papillæ; the cleft of the mouth measures three fifths the width of the buccal disk; barbels measuring half the length of the head. Adipose fin quite indistinct. The origin of the first dorsal is nearly twice as far from the caudal as from the end of the snout; its first ray is scarcely prolonged, measuring a little less than the distance between the posterior nostril and the posterior extremity of the head. First pectoral ray little prolonged, a little shorter than the head, measuring about one third of the distance between its base and the anal, and not extending to the middle of the outer ventral ray. Ventral fins originating slightly in advance of the dorsal; the outer ray much thickened and a little prolonged, measuring half the distance between its base and the anal. Anal opening equally distant from the extremity of the ventrals and the origin of the anal. First anal ray two thirds the length of the ventral, halfway between the extremity of the ventral and the caudal. Caudal fin crescentically notched, with the outer rays a little produced and a little shorter than the head. Olive-brown above, closely spotted with darker.

Total length 89 millim., without caudal 75; length of head 16; width of head 16; depth of body (above base of ventrals) 12.

Specimens were obtained in the Andes of Ecuador (Milligalli) by Mr. Edward Whymper.

## 5. On some new Species of Fishes from Madeira. By James Yate Johnson, C.M.Z.S.

[Received June 3, 1890.]

### Family Serranidæ.

1. Anthias mundulus, sp. n.

B. 6. D. 10/16. V. 1/5. A. 3/7. Lat. line 37.

Oblong compressed; the height being to the length without the caudal as 1 to 3¾. Body, head, and cheeks scaly. Scales of moderate size, the exposed edge finely pectinate.

*Head* compared with length without the caudal as 1 to 3. *Eyes* round, large, scarcely more than half a diameter from the snout and less than a diameter apart; they do not take part in the profile. Diameter of eye to length of head as 1 to 3. Snout short, obtuse, upper jaw protrusile; rictus very oblique, not reaching to orbit. Upper border of *mouth* formed entirely of the premaxillary; maxillary much dilated posteriorly, its scales not larger than those

of the head, its posterior extremity not reaching quite so far as the vertical from the middle of the eye.

In the upper jaw there is a narrow band of minute curved teeth with two larger conical teeth; at the front of the lower jaw a similar band of teeth with four conical ones, and at the sides behind a single series of teeth. Minute teeth on the vomer and palatines; none on the tongue. The opercular pieces are clothed with scales. There is a spine near the upper angle of the opercle and another spine a little lower down. Lower still are a few serratures. The vertical border of the preopercle is strongly serrate, and there is a spine at the angle with a smaller spine a little beyond. The rest of the lower edge is entire. All the spines are directed backwards.

The *dorsal* fin begins over the root of the pectorals and extends a little beyond the end of the anal. The first and second spines are short, the third and fourth are equal in length and have skinny tags at their tops. The soft portion of the fin is higher than the spinous portion; the last rays reach to the base of the caudal. The *pectorals* are not quite so long as the ventrals, and they reach back to the beginning of the anal, or to the end of the spinous portion of the dorsal; their bases are scaly. The *ventrals* are inserted under the root of the pectorals and reach back a little beyond the commencement of the anal. The second soft ray is elongate and filiform. The *anal* begins a little behind the middle of the base of the dorsal. The first spine is short, the second stout and the longest of the three. The soft portion of the fin is higher than the second spine, but the last rays do not reach nearly so far as the base of the caudal. The *caudal* is deeply furcate and has some of the exterior rays elongate and filiform. The membrane between the rays is scaly as in *Callanthias*.

The *lateral line* has 37 scales; it rises from the edge of the gill-cover, runs high up on the side following the curve of the back, descends rapidly under the end of the base of the dorsal, and passes along the middle of the tail to the base of the caudal.

The colour of all the specimens had faded to a pale brown; but faint traces of pink or red were visible in parts, and there seemed to have been twelve or more narrow transverse bands on the sides, alternating with paler bands.

This fish much confuses the distinction between the genera *Anthias* and *Callanthias*. With the only known member of the latter genus it agrees in having only six branchiostegal rays, in possessing much the same external form, and in having the angles of the caudal fin prolonged into filaments. It would therefore appear that the difference between the two genera is reduced to the serrature of the border of the preopercle, which is present in *Anthias* and not in *Callanthias*, a trifling artificial distinction.

The first specimen that came under my notice was found dead and dry by myself, in a cavity amongst a mass of *Ostrea* and *Chama* shells brought up from deep water. Afterwards four specimens were taken by the officers of the 'Britannia' whilst engaged in repairing

the Brazilian Submarine Company's cable in Funchal bay, two of which are now in the British Museum.

| | millim. |
|---|---|
| Length of fish without caudal | 48 |
| Height at the shoulder | 14 |
| Head, length 16; thickness nearly | 8 |
| Eye, diameter | 5·5 |
| Dorsal fin, length of base | 26 |
| Pectorals, length 14; distance of root from snout | 17 |
| Ventrals, length | 15 |
| Anal, length of base | 11 |
| Caudal, length | 19 |

Family Scopelidæ.

2. Scopelus langerhansi, sp. n.

1st D. 12. 2nd D. rudimentary. P. ca. 14. V. 8. A. ca. 24. B. M. 5?

Compressed, elongate; height to length without caudal fin 1 to $5\frac{1}{4}$.

*Colour* blackish, with numerous small silvery spots: two longitudinal rows of about 8 each on the belly; a row more widely separated halfway between the median line of the belly and the lateral line; a few just below the lateral line and a close row of about 20 at each side of the anal fin up to the base of the caudal.

*Head* large; compared with length of fish without caudal as 1 to $3\frac{2}{3}$. Profile quadratic; snout very short, about half the diameter of the *eye*, which is round and large, being nearly 11 mm. in diameter or about one third the length of the head. It is surrounded by a thin bony crest, which is more prominent above. The space between the eyes is concave, and at the fore part of it there is a thin bony crest along the snout. The inside of the mouth and gill-covers is black. The rictus reaches to about the vertical of the posterior part of the orbit. The upper border of the mouth is formed entirely of the premaxillaries. Both premaxillary and maxillary are dilated posteriorly.

Minute *teeth* in narrow brush-like bands are found in both jaws and on the palatines; the innermost teeth are rather larger. There are also teeth on the vomer, and the entopterygoids are roughened with asperities.

The *tongue* is of peculiar form, being boat-shaped, hollowed at the middle, with a small tip. The gill-covers are scaly; the fore edge of the preopercle is turned up so as to form a thin vertical crest, which is continued nearly up to the angle of the mouth. The inner edges of the mandibular pieces are also turned up into crests.

The first *dorsal* fin commences over the root of the pectorals and much in advance of the root of the ventrals; its base is only 16 mm. long; it does not extend quite so far as the end of the anal. As

the fin was mutilated, further account of it cannot be given. The rudimentary second dorsal is placed a little in advance of the posterior end of the base of the anal, and about 16 mm. from the base of the caudal. The long narrow *pectorals* are inserted near the edge of the opercle and extend back much beyond the base of the ventrals, reaching almost as far as their tips, but not quite so far as the vertical from the posterior end of the base of the dorsal. Compared with the length of the fish without the caudal, they are as 1 to $4\frac{2}{3}$. The abdominal *ventrals* were mutilated in the specimen; but the more perfect one was 15 mm. in length; they are inserted about 13 mm. behind the root of the pectorals. The *anal* begins a little behind the posterior end of the base of the first dorsal; its base has a length of 25 mm. What remained of the furcate caudal had a length of 19 mm. There were no spines on any part of the fish.

The scales had been nearly all removed; the few remaining were cycloid and thin. The *lateral line* commences at the upper angle of the opercle and falls rapidly on the side of the body until it reaches

*Scopelus langerhansi.*
Scales of lateral line, enlarged.

the middle of the base of the first dorsal, thence it runs along the middle of the height to the base of the caudal. On one side of the body, in the neighbourhood of the rudimentary dorsal, three scales of the lateral line were left to show that these scales were very large, transversely elliptical and imbricated. They were 6 mm. wide, or about half as wide as the tail at that part.

The single specimen of this fish that has occurred was obtained from a fisherman by my friend the late Prof. Dr. Langerhans, and was sent by him to the Museum of Natural History at Berlin under the name of *Alysia loricata*, Lowe. But from that fish (which Dr. Günther believes to be *Scopelus coccoi*) the fish here described differs in many important respects. On comparing the above description with Mr. Lowe's description of *Alysia*, the following differences (along with others) will be found to exist:—1. In this fish the pectoral fins extend much beyond the roots of the ventrals; in *Alysia* the ventral fins are inserted under the tips of the pectorals. 2. The ventrals have 8 rays; in *Alysia* 6. 3. The first dorsal fin begins over the root of the pectorals; in *Alysia* that fin is placed over the space between the ventrals and the anal. 4. The caudal fin is very small in *Alysia*, whilst here it is longer than the height of the fish. 5. In *Alysia* there are spines on the tail both above and below; here there are no spines. 6. In *Alysia* there is a single

row of silvery spots along the ventral line; here there are several rows of silvery spots on the sides.

| | millim. |
|---|---|
| Length without caudal..... | 110 |
| Height at root of pectorals .... | 20 |
| Thickness at root of pectorals .. | 12 |
| Head, length..... ..... | 31 |
| Premaxillary, length ..... | 17 |
| Pectoral fin, length ..... | 25 |

3. SCOPELUS SCHMITZI, sp. n.

B. M. 6. 1st D. 12. 2nd D. rudimentary. V. 7. A. 14.

Oblong, compressed; height to length without caudal as 1 to $4\frac{3}{5}$. Blackish, reflecting steel-blue from the sides and gill-covers; a row of small spots behind the vent near the ventral line on each side, a few before the vent, and a few irregularly scattered at the sides of the body. Scales cycloid, finely and concentrically striate.

*Head* to length of fish without caudal as 1 to $3\frac{3}{5}$. Snout very short. Head and cheeks scaly. *Eye* round, not quite reaching to the profile, less than half a diameter from the snout and coming nearly up to the maxilla. Diameter of eye to length of head as 1 to $3\frac{1}{2}$. A low median crest between the eyes and along the snout. Posterior margin of opercle projects with a deltoid angle over the root of the pectorals. Inside of *mouth* and gill-covers black. Rictus oblique, nearly 11 mm. long, reaching much beyond the orbit and nearly to below the lower angle of the opercle. Upper border of mouth formed entirely of the premaxillary, which is dentiferous up to its end.

*Teeth* minute, curved, sharp, in narrow brush-like bands in both jaws. In the lower jaw the band of teeth is broader than that in the upper jaw, and it is seen outside when the mouth is closed. There are teeth on the palatines and a few minute ones on the vomer; the entopterygoids are rough with points. Minute teeth along middle of tongue expanding posteriorly into a broad patch. The gill-rakers are also armed.

The first *dorsal* fin is short: it begins over the root of the ventrals or slightly in advance; the base ends a little before the beginning of the anal; its posterior rays reach back a little beyond the tips of the ventrals and as far as the commencement of the anal. The second rudimentary dorsal is very small; it is placed over the end of the base of the anal. The narrow pointed *pectorals* are inserted low down and reach back to or a little beyond the base of the ventrals. The *ventrals* reach back as far as the vent. At the upper angle of the root there is a narrow scale-like loose appendage. The *anal* fin has 14 rays; and it begins a little behind the end of the base of the dorsal. The *caudal* fin is furcate and has about 20 rays.

The *lateral line* is straight along the middle of the body and tail. There are about 38 scales in its length, and about 5 above and 5 below the lateral line.

Two specimens of this little fish were found lying on the sandy beach near what is known as the "Fossil Bed" at the east end of Madeira by the Rev. Padre Ernesto Schmitz, Director of the Seminario, Funchal, and one of the specimens is now in the British Museum. The following are the dimensions:—

| | millim. |
|---|---|
| Length without caudal | 51 |
| Height, pectoral region | 11 |
| Head, length 14; thickness | 6 |
| Pectorals, length 7; distance of base from snout | 15 |
| First dorsal, height 7; length of base | 7 |
| First dorsal, distance from snout | 21 |
| Second dorsal, distance from first | 10 |
| Ventrals, length 9; distance of root from root of pectorals | 5 |
| Anal, height 6; length of base | 8 |
| Anal, distance from snout | 30 |
| Caudal, length 13; lowest height of tail | 5 |

4. SCOPELUS FUSILLUS, sp. n.

D. 9. V. 5 or 6. A. ca. 7. M. B. 6.

Small, compressed, moderately elongate; the height compared with the length (without the caudal fin) being as 1 to 5¼. Black; scales cycloid, about 32 in the side and 7 or 8 in the height. There is no trace of silver spots on the head or body.

*Head* scaleless, not cubic or striate, top rounded; snout very short, profile not steep. Compared with the length of the fish (without the caudal) the head is as 1 to 4¼. *Eye* oval, of moderate size, not reaching the profile, compared with length of head as 1 to 3½. It is placed near the upper jaw and about half a diameter from the tip of the snout. *Rictus* very long, extending much beyond the eyes and being nearly equal to seven eighths of the length of the head. The upper border of the *mouth* is formed by the premaxillaries, which are only slightly dilated posteriorly. The styliform maxillaries lie behind. The inside of the mouth is black, and it is copiously furnished with teeth. In the lower jaw there is a band of minute glassy teeth in about four rows. In the front of the upper jaw there is a single row of similar teeth with a band of 2–3 rows on each side behind. The palatines carry a narrow band of minute teeth, and on each entopterygoid is a long broad band of teeth. On the pharyngeals are broad patches of teeth, and on the vomer about 6 teeth. A narrow band of very minute teeth runs along the middle of the tongue, expanding into an oval patch behind, where the teeth are longer and subulate. At each side of the tongue there are short transverse series of minute teeth with a longer subulate one in each series. Lastly, the gill-rakers are rough with teeth.

The short *dorsal* is placed near the middle of the back over the space between the ventrals and the anal. It is higher anteriorly than behind, and there are about nine rays. There is no second

adipose dorsal. The *pectorals* are placed low down, are narrow and pointed; they are much damaged in the specimen, but they are not rudimentary (as in *Nannobrachium*), as they reach back to the root of the ventrals. The *ventrals* have five or six rays and reach back to the vent, but not so far as the anal; they are inserted nearly under the commencement of the dorsal, 12 mm. from the snout and 5 mm. behind the root of the pectorals. The *anal* begins behind the end of the dorsal and has about 7 rays; it is about as high as the dorsal, but its base is rather longer. *Caudal* forked.

There are no spines on the tail above or below. The lateral line could not be made out.

I am much indebted to the Rev. Padre Ernesto Schmitz for the single specimen of this little fish that has occurred. It was obtained from a fisherman. It was only $1\frac{9}{16}$ inch long, with a height of $\frac{1}{4}$ inch. When it came into my hands it had been much injured, and it has therefore been impossible to speak positively as to some of the details. Perhaps it had been found in the stomach of another fish. However that may be, it had a deep-sea aspect. The following are the dimensions:—

| | millim. |
|---|---|
| Total length of the fish | 39 |
| Length to base of the caudal fin | 34 |
| Height | 6·5 |
| Head, length 8; thickness | 4 |
| Eye, longer axis 2·5. Rictus nearly | 7 |
| Dorsal fin, length of base ca. 5; height in front ca. | 5 |
| Ventral fins, distance from snout 12; from root of pectorals | 5 |
| Anal fin, height ca. 5; length of base ca | 6 |
| Anal fin, distance from end to base of caudal | 7 |

Family Sternoptychidæ.

5. Gonostoma maderense, sp. n.

B. 11. P. 10. V. 8. A. 33. C. III.+19+III.

Elongate, compressed; the height compared with the length minus the caudal fin being as 1 to $6\frac{1}{2}$. Blackish, with two rows of silvery or pale steel-blue spots along each side of the belly. The specimen seems to have been clothed with scales, but they have disappeared except from the head. The ridge of the back is rugosely warted, and apparently there have been no scales in that part.

The *head* is to the length without the caudal as 1 to $5\frac{1}{2}$. The top of the head is scaleless, and two low converging ridges meet in front of the orbits. The cheeks bear rather large scales. The opercular pieces are very thin and the gill-openings very wide. The profile is rather steep and the snout short. The round eye does not reach to the profile; its diameter is contained in the head about five times; it is distant from the snout rather more than one diameter, and from the jaw rather less. The upper border of the *mouth* is formed partly of the premaxillary and partly of the maxillary, both being armed with teeth; the latter is dilated posteriorly. The

rictus is oblique and extends much beyond the eye. The inside of the mouth and the gill-covers is black. There are no pseudobranchiæ. The under jaw for the greater part of its length fits inside the upper, and it carries a row of sharp, curved, conical teeth, with a few small ones in the intervals between them. In front there is an outer row of eight similar, but shorter teeth. In the upper jaw there is only one row of similarly shaped teeth in front; then come three on each side, the longest in the mouth, and these are about 3 millim. in length. Posteriorly the longer teeth become smaller and the intervening teeth very small. There are a few teeth on the vomer; on the palatines a row of minute sharp teeth; a patch of minute teeth on the entopterygoids; and at the tip of the very small tongue a few minute teeth.

The *dorsal* fin is placed at the middle of the back over the space between the ventral and anal. It has 11 rays and its base is 11 mm. long. It is rather injured, but what remains has a height of 13 mm. There is no adipose fin, nor are there any spines behind the dorsal or anal. The pointed *pectorals* have ten rays, are inserted low down, and do not reach so far back as the root of the ventrals. The narrow pointed abdominal *ventrals* contain 8 rays and reach back beyond the beginning of the anal; they are shorter than the pectorals. The *anal* is not so high as the dorsal, but its base is longer; it has about 33 rays. The deeply cleft *caudal* is damaged, but as it is it measures 14 mm.

The *lateral line* begins near the edge of the opercle one third of the height from the outline of the back, and falls gently until it reaches the middle of the height under the dorsal; it then runs straight to the base of the caudal. The scales having been removed could not be counted.

The two rows of spots previously mentioned are closely set low down on each side of the belly. The upper row, on which between 60 and 70 spots may be counted, begins at the throat and is continued to the base of the caudal; the lower row runs along the isthmus between the gill-openings and likewise extends to the caudal.

A single specimen of this fish was obtained in the fish-market at Funchal and is now in the British Museum. It may be readily distinguished from the known species of this genus by the number of its anal rays.

| | millim. |
|---|---|
| Length of fish without the caudal..... | 130 |
| Height at root of pectoral..... | 21 |
| Height of tail at base of caudal ..... | 7 |
| Thickness at the shoulder ... . .....8 or 9 | |
| Head, length 25 mm., thickness ..... | 8 |
| Eye, diameter..... | 5 |
| Dorsal fin, length of base ..... | 11 |
| Pectorals, length ..... | 20 |
| Pectorals, distance of root from snout .. | 30 |
| Ventrals, length ..... | 14 |
| Ventrals, distance of root from snout.... | 66 |
| Anal, length of base ..... | 41 |

June 17, 1890.

Prof. Flower, C.B., LL.D., F.R.S., President, in the Chair.

Mr. Sclater exhibited and made remarks on a mounted head of a Pallah Antelope, belonging to Capt. Freville Cookson, F.Z.S.

The specimen had been shot by Captain Cookson in August last, in Hasholand, in the neighbourhood of the Cunene River, where some

Front view of head of *Æpyceros petersi*.

twenty or more other examples had been met with, but this was the only specimen brought to England.

This form of the Pallah was at once distinguishable from the

ordinary form of the Cape Colony (*Æpyceros melampus*) by having a short line beneath each eye passing towards the nostrils and a broad band in the centre of the forehead black. Mr. Sclater supposed it to be the species designated *Æpyceros petersi* by Bocage (P. Z. S. 1878, p. 741).

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Mr. Sclater also exhibited a large photograph of Grévy's Zebra (*Equus grevyi*) taken by Mr. Gambier Bolton, F.Z.S., from the type specimen at Paris, and read the following remarks drawn up by Mr. Bolton on the subject:—

"I send herewith a photograph just taken of the mounted specimen of *Equus grevyi* now in the Natural History Museum at Paris. Judging by a photograph in the Society's library taken when this animal was alive, I should fancy that nearly all trace of the true shape of the head has been lost in the mounting; and judging by the height of the man (who is shown as feeding it) I imagine that the whole skin has been very greatly stretched, as it now appears far larger than any of the living specimens of *Equus zebra* that I have seen.

"The skin of this mounted specimen is marked with very brilliant black and white lines, looking as though it had been bleached; the white mark above the tail being very much wider than in the skin exhibited at the last meeting.

"In the Society's Proceedings for 1883 (P. Z. S. 1883, p. 175) is a paper read by Col. Grant, describing a Zebra that he found in Ugogo in 1860–5, with a woodcut of the head. Professor Flower has compared this carefully with the photograph before you, and thinks them identical."

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The Secretary exhibited on behalf of Mr. T. Southwell a mounted specimen of the Caspian Plover (*Ægialitis asiatica*), and read the following note from Mr. Southwell on the subject:—

"On the evening of the 23rd May I received from Mr. Lowne, of Yarmouth, the fresh skin of a handsome full-plumaged male of *Ægialitis asiatica*, sent me for identification.

"Subsequently I learned the following particulars with regard to this interesting occurrence. During the morning of the 23rd of May two strange birds were seen in a large market-garden bordering on the North Denes at Yarmouth, which attracted the attention of the occupier of the Gardens, but he had no opportunity of a shot till about 5.30 P.M., when they were on the Golf ground which forms a portion of the Denes. He tried to get both birds in a line for a double shot; that being unsuccessful he selected the brighter of the two, its companion being at the time about six yards distant from it; when he fired, the paler bird, presumably the female, flew off in a westerly direction and was no more seen. Very shortly after, the bird was purchased of the shooter by Mr. H. C. Knights, by whom it was taken the next morning to Mr. Lowne for preservation, who,

as before stated, forwarded the skin to me for identification. The weather at the time was very warm, and Mr. Lowne seeing that it was a valuable bird would not risk sending it to me in the flesh; hence it was that I saw only the skin, but I may mention that it had all the appearance of having been very recently removed and that there were still many living parasites remaining on the feathers. The sternum Mr. Lowne sent to Professor Newton. The total length of the bird in the flesh was 8 inches and its weight 2¼ oz. Mr. Knights was good enough to give me the first offer of the bird, and through the liberality of some friends of the Norwich Museum I was enabled to purchase this latest addition to the many local rarities for that Institution."

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Profesor Jeffrey Bell, F.Z.S., read a note which he had received from Mr. Edgar Thurston, C.M.Z.S., of the Madras Museum. He explained that his attention had been called, last autumn, by the Hon. A. E. Gathorne-Hardy, M.P., F.Z.S., to certain difficulties which he felt as to accepting the generally received statements as to the mode of life of British Pennatulids; of which difficulties Mr. Gathorne-Hardy gave an account in his interesting paper in the 'National Review' of February last. Shortly after its publication Prof. Bell received Mr. Thurston's report on the Marine Fauna of the Gulf of Manaar. As the habits of *Virgularia* are there described he called Mr. Thurston's attention to Mr. Gathorne-Hardy's paper, with the result that he received the following interesting letter from Mr. Thurston:—

"Madras Museum.
May 19, 1890.

"My attention has been directed to an article in the 'National Review' for February 1890, entitled 'Out of the Depths,' by the Hon. A. E. Gathorne-Hardy, M.P., who enters into a discussion of the habits of the genus *Virgularia*. The points at issue are twofold:—

"1. Do the animals stand up vertically with their bulb planted in the mud?

"2. Can the animals pull themselves in with force so as to nearly or quite disappear?

"I see that in my 'Notes on the Pearl and Shank Fisheries, and Marine Fauna of the Gulf of Manaar,'[1] I say (p. 74) with reference to specimens of *Virgularia*:—'The Sea-pen, *Virgularia juncea*, was collected at low water, and accords in its habits with another species, *V. patagonica*, which is described by Darwin ('Journal of Researches') as being seen projecting like stubble, with the truncate end upwards, a few inches above the surface of the muddy sand. When touched or pulled they suddenly drew themselves in with force so as to nearly or quite disappear.'

"The specimens were obtained by one of my native Sabbi divers in shallow water opposite the Kothanda Ráman Sovil (temple) on Rámésvaram Island in July 1888. His attention was attracted by

[1] Madras Government Press, 1890.

what he thought was a stick projecting a few inches above the sandy bottom, and he broke it off and gave it to one of my native collectors who was with him, and who recognized it as being the broken piece of an animal. The divers then hunted for and secured other specimens, all of which had their terminal bulbs in a perfect condition. The largest specimen, which I have just re-examined, is 16 inches in length, and tapers towards the upper end, but the extreme tip is wanting. The diver described the animals as sticking straight up in the sand, and said that, as soon as he touched them, they went deeper and deeper down in the sand, and sometimes fixed themselves so firmly that he could only secure them by digging them out with a spade.

"Though I was not present at the capture of the specimens I have no reason to discredit the evidence of the diver, who is a keen observer, wholly unacquainted with the English language, and who has certainly never seen or heard of the 'Journal of Researches.'

"EDGAR THURSTON."

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The Secretary called attention to a pamphlet presented to the Society's Library by M. P. A. Pichot, C.M.Z.S.,[1] giving an account of the localities in which the Beaver (*Castor fiber*) is at present found in the Camargue or Delta of the Rhone, and exhibited a map forwarded by M. Pichot in which these localities were exactly shown.

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Mr. W. T. Blanford, F.R.S., exhibited a photograph, lent by Mr. A. B. Wynne, of a specimen of the Indian Gaur (*Bos gaurus*) recently killed, and made some remarks on this animal.

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The following papers were read:—

## 1. A List of the Butterflies collected by Mr. William Bonny on the Journey with Mr. Stanley from Yambuya on the Aruwimi River through the Great Forest of Central Africa; with Descriptions of nine new Species. By H. GROSE SMITH, F.Z.S.

[Received June 16, 1890.]

This collection of Butterflies being the first which has been received in Europe from the Great Forest, a complete list of the species which it contains is given. It will be seen that, with the exception of the species described as new and a few others, the collection consists of species for the most part common on the West Coast, very few species peculiar to the East Coast being comprised in it.

[1] See 'Revue Britannique,' 1888, p. 49.

The collection is not in very good condition and has suffered from damp; but considering the great difficulties under which it was formed, it is surprising that under the circumstances Mr. Bonny was able to preserve the Insects so well.

PAPILIONIDÆ.

PAPILIONINÆ.

1. PAPILIO ANTIMACHUS, Drury.

One specimen; Mr. Bonny states that six or seven other specimens were seen.

2. PAPILIO ZALMOXIS, Hew.

3. PAPILIO MEROPE, Cram.

4. PAPILIO PYLADES, Fabr.

5. PAPILIO CYNORTA, Fabr.

6. PAPILIO LEONIDAS, Fabr.

7. PAPILIO DEMOLEUS, Linn.

8. PAPILIO MENESTHEUS, Drury.

9. PAPILIO TYNDARÆUS, Fabr.

10. PAPILIO BROMIUS, Doubl.

11. PAPILIO ANTHEUS, Cram.

12. PAPILIO POLICENES, Cram.

The ordinary form; and one specimen of a small dark variety in which the round green spot just beyond the end of the cell is absent.

PIERINÆ.

13. BELENOIS SYLVIA, Fabr.

14. BELENOIS THYSA, Hopff.

15. BELENOIS INFIDA, Butl.

Three males and a female.

16. BELENOIS SYLVANDER, n. sp.

*Male.—Upperside.* Anterior wings resemble *infida*, Butl., but the black bar across the end of the cell is attenuated in the middle, the upper and lower part being connected only by a black line; the apical black area is rather broader, and the white streaks in it are rather more linear. On the posterior wings the black border of *infida* is represented by large triangular spots at the ends of the veins confluent at their base, inside which, between the veins, is a row of six black spots, the uppermost, on the costal margin, the largest.

*Underside.* On the anterior wings the black bar at the end of the cell is broader than on the upperside, little attenuated in the middle, the lower part being developed into a large round spot. Posterior wings with very broad black veins, connected on the margin by rather broad black lines; the spots in the submarginal row are seven in number, larger and more quadrate than on the upperside, and touch the black veins on either side at the opposite angles of each spot.

*Female.—Upperside.* Wings greyish brown, the inner two thirds shading into greyish white tinged with pale yellow; on anterior wings is a greyish-brown broad oblique bar, and on posterior wings a distinct greyish-brown spot, each situate at the end of the cell.

*Underside.* Anterior wings as above, with pale yellow streaks at the apex between the subcostal and discoidal nervules, and indistinct greyish-white patches between the median nervules and submedian nervure near the outer margin. Posterior wings dusky white in the middle, shading into pale dusky yellow at the base and outer margin, where beyond the submarginal row of spots it is divided by the broadly greyish-black nervules into rather brighter yellow lunules; the submarginal row of spots is indistinct and confluent with the greyish-black nervules, and there is a distinct spot at the end of the cell.

Expanse of wings, male 2⅛, female 1⅞ inches.

17. Mylothris poppæa, Cram.

18. Terias orientis, Butl.

19. Terias brenda, Doubl.

20. Eronia argia, Fabr.

21. Eronia thalassina, Boisd.

22. Catopsilia pyrene, Swainson.

### Acræinæ.

23. Acræa iturina, n. sp.

*Male.—Upperside.* Both wings vitreous, with dusky brown veins; anterior wings with costal margin, apex, outer margin, and veins dusted with greyish-brown scales, basal third densely dusted with bright rufous scales, black at the base, a cluster of black confluent spots at the upperside of the cell about its middle. Posterior wings with the inner two thirds bright rufous, paler on the inner margin above the anal angle; the rufous space does not extend to the costal margin or beyond two thirds of the central area, except towards the anal angle, where it approaches nearer to the outer margin; at the base is a cluster and beyond the cell a row of seven black spots, the fourth being out of line and nearer the outer margin; between the basal cluster and this row are two spots, one above the subcostal nervure, the other on the inner margin.

*Underside* devoid of scales, except the spots on the posterior wings as on the upperside.

Expanse of wings $1\frac{7}{8}$ inch.

Nearest to *A. cerasa*, Hew., but a larger insect with more elongate wings, the rufous area comparatively smaller and on posterior wings different in shape, and the arrangement of the spots on both wings is different.

24. Acræa vesperalis, n. sp.

*Male.—Upperside.* Anterior wings vitreous, with veins, costal margin, apical and outer marginal area, a broad somewhat oblique band crossing the cell and thence nearly to the posterior angle, and a patch beyond the end of the cell, more or less densely dusted with fuliginous-brown scales. Posterior wings semivitreous, the inner three fourths pale ochreous brown, the outer fourth darker brown, which colour radiates up the veins on the disk nearly as far as the cell, a cluster of brown spots at the base, and a dark brown spot on the upper discocellular nervule at its junction with the discoidal nervule.

*Underside.* Anterior wings as above; posterior wings uniform brown, brighter than the pale brown area of the upperside; a cluster of dark brown spots at the base, followed by a row of four spots before the middle, outside which are two smaller spots beyond the cell, below the discoidal and upper median nervules respectively.

Expanse of wings $2\frac{3}{4}$ inches.

Nearest to *A. pentapolis*, Ward. In colour and general appearance it bears a superficial resemblance to the female of *Planema vesta*, Fabr.

25. Acræa circæis, Drury.

A variety larger in size and with the stramineous area of the posterior wings broader and extending nearer to the base than in the typical form. Possibly a distinct species.

26. Acræa poggei, Dewitz.

A variety with the fulvous band extending obliquely across the wings to the posterior angle, instead of curving inwardly to about one half of the inner margin. One specimen only; in the absence of more examples I hesitate to describe this as a new species.

27. Acræa cepheus, Linn.

28. Acræa menippe, Drury.

29. Acræa perenna, Doubl. & Hew.

30. Acræa lycoa, Godt.

31. Acræa cidonia, Ward.

32. Acræa serena, Fabr.

33. Acræa eponina, Cram.

34. Acræa lycia, Fabr.

35. Acræa eurita, Linn.

NYMPHALIDÆ.

DANAINÆ.

36. LIMNAS ALCIPPUS, Cram.

37. TIRUMALA PETIVERANA, Doubl.

38. AMAURIS VASHTI, Butl.

39. AMAURIS HECATE, Butl.

40. AMAURIS EGIALEA, Cram.

41. AMAURIS DAMOCLES, Beauv.

42. AMAURIS NIAVIUS, Linn.

NYMPHALINÆ.

43. ATELLA COLUMBINA, Cram.

44. JUNONIA CLELIA, Cram.

45. JUNONIA CHORIMENE, Guér.

46. SALAMIS CACTA, Fabr.

47. SALAMIS ANACARDII, Linn.

48. KALLIMA RUMIA, Westw.

A variety without the subapical oblique orange band on anterior wings.

49. NEPTIS MARPESSA, Hopff.

50. NEPTIS AGATHA, Cram.

51. NEPTIS NYSIADES, Hew.

52. NEPTIS NEMETES, Hew.

53. NEPTIS MELICERTA, Drury.

54. HYPOLIMNAS STANLEYI, n. sp.

*Male.—Upperside.* Anterior wings black, with a large, very oblique, elongate central spot white faintly tinged with pink—the upper part extends into the cell (where there is a minute spot above it) and above the median nervure, and is bifid; the lower part occupies the area between the median nervules except a small space in the angle formed by the junction of the lowest median nervule with the median nervure, and extends outwardly to nearly four fifths of the wing, being irregularly defined on its upper and outer edge; it also extends slightly below the lowest median nervule, where it is represented by some irregularly marked white scales. There is a subapical white patch divided into two by the lowest subcostal nervule, the upper part being the smallest. Posterior wings dark brown, with a white centre which is shaded externally with pinkish blue, and

traversed across the disk as far as the cell by the black nervures and rays between; a row of very minute bluish-white spots between the veins near the margin.

*Underside.* Anterior wings black at the base, shading into brown towards the apex; the patch and apical spot as above but larger, especially that part of the patch which lies within the cell, where it extends upwards till it joins the small white spot; nearer the base is another small white spot and several small white spots at the base; on the margin from above the upper median nervule to the posterior angle is a row of small white spots, in pairs, alternately longer and shorter. Posterior wings with the base and the space between the costal margin and the upper subcostal nervule broadly bright brown, with the veins and a ray between them dark brown; the central area and abdominal fold is white, shading into dull brown towards the anal angle, and traversed by the dark brown veins with rays of same colour between: a series of minute spots on the margin. A few white spots on the head; thorax and abdomen black above, brown beneath; antennæ black.

Expanse of wings 4 inches.

Nearest to *H. dinarcha*, Hew., but very distinct from that species or any of the group.

55. Hypolimnas bartelotti, n. sp.

*Male.—Upperside.* Anterior wings dark brown, a sinuate rather narrow oblique white band in the cell at ⅔ of its length, an oval spot at the end of the cell with a few white scales above it; a brownish-white patch on the disk about its middle divided into three by the upper and middle median nervules, the middle part elongate ovate, the upper part subovate, smaller, the lower part linear, almost obsolete, beyond which is a row of five round spots, the uppermost and lowest the largest, but smaller than in *dinarcha*, Hew., the three others minute; the cilia at the apex, and also minutely between the veins, white. Posterior wings paler brown, the nervures and rays between dark brown; the cell and the spaces above it, as far as the upper submedian nervule and slightly below it, stramineous; on the margin two minute white spots between the veins from the costal nervure down to the upper median nervule; the cilia also between those veins spotted with white.

*Underside.* Anterior wings paler than above towards the apex and blacker towards the base and the spots larger; above the white spot at the end of the cell are two indistinct white streaks, and between the spot across the cell and the base are four other white spots; a series of submarginal white spots between the veins, commencing beneath the upper median nervule down to the posterior angle. Posterior wings as above, the central stramineous patch being whiter and more extended, a submarginal row of minute white spots as above, but four instead of two between each vein; the cilia also spotted as above.

Expanse 3¼ inches.

Also near *H. dinarcha*, but wings browner and comparatively

broader, and the row of spots beyond the middle differs in size from that species.

56. Hypolimnas dinarcha, How.

57. Hypolimnas dubia, Boisd.

58. Hypolimnas mima, Trimen.

59. Hypolimnas salmacis, Drury.

60. Euxanthe ansellica, Butl.

61. Aterica cupavia, Cram.

62. Aterica veronica, Cram.

63. Aterica abesa, How.

64. Eurypherne mandinga, ♀.

65. Eurypherne, sp.

A brown female near to *E. brunhilda* ♀, but in the absence of the male I have not described it.

66. Eurypherne, sp.

An olive-brown female, likewise without the male.

67. Hamanumida meleagris, Cram.

68. Iobra crithea, Drury.

69. Euphædra cærulescens, n. sp.

*Female.—Upperside.* Anterior wings blue-black, with the base, basal third of cell, and basal two thirds of inner margin dull steel-blue; a broad oblique band of same colour but rather paler extends from the middle of the costal margin beyond the cell till it reaches the middle median nervule, where it terminates some distance from the outer margin, broader at its lower than at its upper end; apex tipped with bluish white. Posterior wings, basal three fourths dull steel-blue; minute white spots on the margins between the veins of both wings.

*Underside.* Both wings bluish green tinged with brown, paler and more blue in the cells, with submarginal bands of rather small, nearly contiguous dark spots. Anterior wings with a round spot near the base of the cell and two others, larger, beyond it: the end of the cell is marked by an oblique rather narrow black bar, followed by a longer parallel bar which crosses the space between the upper and middle median nervule, below which is a nearly horizontal indistinct black streak; apex indistinctly tipped with greenish white. Posterior wings with four spots in the cell, and a broad crimson band extending from the base along the costal margin about three fourths of its length, where it merges; the band is bordered on its lower edge with blackish indistinct markings, broader at the base and

curving downwards towards the end of the cell; minute white spots on the margins between the veins.

Expanse of wings 3¼ inches.

Nearest to *xypete*, Hew., and *gunsape*, Butl.

70. EUPHÆDRA PRATINAS, Doubl. & Hew.

A variety in which the submarginal row of indistinct white spots on the posterior wings is absent.

71. EUPHÆDRA JOHNSTONI, Butl.

72. EUPHÆDRA ELEUS, Drury.

73. EUPHÆDRA RUSPINA, Hew.

74. CYMOTHOË BONNYI, n. sp.

*Male.—Upperside.* Bright tawny brown, darker towards the base, the anal angle, and the outer margin of posterior wings. Anterior wings with the cell crossed by two zigzag lines. On the disk from the second median nervule to the inner margin is a vertical patch of olivaceous-brown scales, the internal edge of which is well defined; between the veins is a submarginal row of small dark brown spots, the lowest being doubly sagittate; the margin is rather broadly dusted with brown scales, forming indistinct lunules between the veins. Posterior wings crossed rather beyond the middle, from the costal margin to near the anal angle, by a band of dark olivaceous-brown scales, the inner edge of which is sharply defined, but not so externally; a submarginal row of contiguous hastate markings edged externally with bright tawny brown. The basal and anal area, outer margin and abdominal fold are irrorated with dusky brown scales.

*Underside.* Resembles *egesta*, Cram., except that the dark line which crosses the middle of both wings is very sharply defined, and the curved lines, which in *egesta* are inside this line, in *bonnyi* cross and recross it several times on the anterior wings, and on the upper part of posterior wings they are closer and shorter than in *egesta*.

*Female.* Olive-brown, darker in the middle of anterior wings, and at the base and inner two thirds of posterior wings. On the anterior wings beyond the middle are five sharply triangular brownish-white spots, the uppermost the largest, the third the smallest; situate in a straight line beneath each other between the veins from the subcostal nervules to the lowest median nervule there is a submarginal row of dark brown hastate markings, inside which is another row of brown hastate markings; the cell is crossed by two zigzag and two rather sinuate lines, and there is a sinuate line at the end of the cell. On posterior wings is a submarginal row of contiguous hastate markings, the two uppermost very broad in the middle. On the underside both wings are crossed beyond the middle by a dark line, inside and based on which are placed the triangular brownish-white markings which are conspicuous on the

upperside of the anterior wings, with an additional spot near the inner margin.

Expanse of wings, ♂ 2⅞ inches, ♀ 3½ inches.

Nearest to *C. egesta*, Cram., the male of which it somewhat resembles; the female is quite distinct.

75. Cymothoë ochreata, n. sp.

*Male.—Upperside.* Resembles *bonnyi*, but is more orange-tawny. Anterior wings without markings in the cell, and the dark band beyond the middle is only represented by an indistinct dark line; the spots in the submarginal row are smaller, and the margin is not dusted with brown except at the apex. Posterior wings very slightly darker towards the anal angle, and in place of the dark band across the middle of *bonnyi* is a narrow dark line; there are a few indistinct markings in the cell, and a curved line slightly above and at the end of the cell; the submarginal row of hastate markings as in *C. bonnyi*, but the margin is very little darker than the rest of the wings.

*Underside.* Paler than in *C. bonnyi*; a sinuate line inside the straight line which crosses the wings beyond the middle, which, on the anterior wings of *C. bonnyi*, crosses and recrosses it, in *ochreata* does not approach it, while on the upper part of the posterior wings it recedes still further from it.

*Female.—Upperside.* Both wings rather dark brown from the middle to the base, beyond which it is much paler. Anterior wings with five triangular spots based on the transverse line which crosses both wings. Posterior wings with two mitre-shaped brownish-white spots with their bases on the transverse line, the first situate below the subcostal nervure, the second below the first; the markings in the cell more prominent.

*Underside* resembles *C. bonnyi* but paler, and the dark transverse line which crosses both wings is more marked.

Expanse of wings, ♂ 2½ inches, ♀ 2¾ inches.

76. Cymothoë westermanni, Westw.

77. Cymothoë sangaris, Godt.

78. Cymothoë herminia, Grose Smith.

A darker variety.

79. Cymothoë theobena, Doubl. & Hew.

80. Cymothoë iodutta, Westw.

81. Cymothoë theodota, Hew.

Male darker rufous-brown on the underside, and the white spots on posterior wings smaller.

82. Cymothoë hypatha, ♀ var.

Whether this be a distinct species I am unable to determine in the absence of the male.

83. Charaxes castor, Cram.

The red submarginal band on the underside of the posterior wings very much wider than in either the East or West Coast forms.

84. Charaxes brutus, Cram.

85. Charaxes cynthia, Butler.

86. Charaxes candiope, Godt.

87. Charaxes etesipe, Godt.

88. Charaxes tiridates, Godt.

89. Charaxes eupalis, Drury.

90. Philognoma varanes, Cram.

91. Philognoma falcata, Butl.

Satyridæ.

92. Gnophodes chelys, Fabr.

93. Melanitis leda, Linn.

94. Idiomorphus nanodes, n. sp.

*Male.—Upperside.* Both wings blackish brown, slightly tinged with violet; anterior wings paler towards the apex and crossed by a broad purple band broader than in *hewitsoni*, Daum., from beyond the middle of the costal margin to nearly the outer angle; a minute subapical white spot. Posterior wings with a band of same colour commencing on the costal margin at about two thirds of its length, extending to the outer margin, thence gradually narrowing down the outer portion of the wings to near the anal angle.

*Underside.* Basal two thirds of both wings dark olivaceous brown, the outer edge of which is sharply defined by a narrow pale violaceous space. Anterior wings with the outer third violaceous brown in which are three spots, two being subapical and small with a pale iris, situate below the subcostal nervule and the first discoidal nervure respectively, the third spot larger with a black iris and situate between the middle and lowest median nervule; a submarginal sinuate brown line, becoming obsolete towards the posterior angle. Posterior wings with the outer third browner than it is on the anterior wings, with a violaceous space at the apex and a row of seven spots each with a black iris, the first, fifth, sixth, and seventh larger than the others, the fifth being the largest, the sixth and seventh spots at the anal angle distinct, not contiguous like the anal spots of *hewitsoni*. Outside the spots is a sinuate dark brown band, broader towards the anal angle, and on its inner edge curving round the spots.

Expanse 2½ inches.

Nearest to *I. hewitsoni*, but with longer wings and more spots on the underside. I have several specimens of a closely allied species from Cameroons, not, I believe, hitherto described.

95. Mycalesis safitza, Hew.
96. Mycalesis vulgaris, Butl.
97. Ergolis enotria, Cram.
98. Eurytela ophione, Cram.
99. Eurytela hiarbas, Drury.
100. Eurytela dryope, Cram.
101. Lybythea labdaca, Westw.
102. Hypanis ilithyia, Drury.
103. Abisara geronte, Fabr.
104. Abisara tantalus, Hew.

Lycænidæ.

105. Hypolycæna faunus, Drury.
106. Castalius isis, Drury.
107. Larinopoda lycænoides, Butl.
108. Lycænesthes larydas, Cram.
109. Tingra species near maculata.
110. Tingra species.

Hesperidæ.

111. Ismene libeon, Druce.

## 2. Report on a Collection of Rhynchota made at Yambuya, on the River Aruwimi, by Mr. W. Bonny of the Emin Pasha Relief Expedition under Mr. H. M. Stanley. By W. L. Distant.

[Received May 22, 1890.]

Among the 48 species of Rhynchota, specimens of which were collected by Mr. Bonny during this memorable Expedition, eight prove to be new to entomological science. With three exceptions the previously known species are all recorded from West Africa, principally from the Calabar district. The exceptions are *Sphærocoris ocellatus*, Klug, *Aspongopus japetus*, Dist., and *Pœciloptaltria polydorus*, Walk., which have hitherto only been received from South-east Africa.

### HETEROPTERA.

Fam. Pentatomidæ.

Subfam. Plataspinæ.

1. Ceratocoris bucephalus.

*Plataspis bucephalus*, White, Entomol. p. 136 (1841).

2. PLATASPIS VERMICELLARIS.

*Plataspis vermicellaris*, Stål, Öfv. Vet.-Ak. Förh. 1858, p. 434. 1.

3. PROBÆNOPS DROMEDARIUS.

*Probænops dromedarius*, White, Entomol. p. 406 (1842).

Subfam. SCUTELLERINÆ.

4. SOLENOSTETHIUM SEHESTEDII.

*Tetyra sehestedii*, Fabr. Syst. Rhyn. p. 130. 9 (1803).

5. STEGANOCERUS MULTIPUNCTATUS.

*Cimex multipunctatus*, Thunb. N. Ins. Sp. ii. p. 30 (1783).

6. SPHÆROCORIS OCELLATUS.

*Tetyra ocellata*, Klug, Symb. v. t. 43. f. 1–3 (1834).

7. SPHÆROCORIS UNICOLOR.

*Sphærocoris? unicolor*, Dall. List Hem. i. p. 7. 1 (1851).

Var. FLAVONOTATUS.

*Sphærocoris? flavonotatus*, Dall. List Hem. i. p. 7. 2 (1851).

8. PROCILIA MORGANI.

*Callidea morgani*, White, Mag. Nat. Hist. (2) iii. p. 542 (1839).

9. PROCILIA BONNYI, n. sp.

Closely allied in colour and markings to *P. morgani*, White, but much smaller; abdomen beneath with a large discal sanguineous patch extending across the four basal segments, and with its margins concavely sinuate (antennæ and legs mutilated). Rostrum shorter than in *P. morgani*, not extending beyond centre of basal abdominal segment.

Long. 16 millim.

10. CRYPTACRUS COMES.

*Tetyra comes*, Fabr. Syst. Rhyn. p. 130. 8 (1803).

11. CRYPTACRUS NOVEMMACULATUS.

*Callidea novemmaculata*, Sign. Rev. et Mag. Zool. 1851, p. 439. 2, t. 12. f. 2.

12. ANOPLOGONIUS NIGRICOLLIS.

*Chærocoris nigricollis*, Sign. in Thoms. Arch. Ent. ii. p. 270. 489, t. 11. f. 1 (1858).

13. HOTEA SUBFASCIATA.

*Trigonosoma subfasciatum*, Hope, Cat. i. p. 11 (1837).

14. HOTEA ACUTA.

*Hotea acuta*, Stål, Hem. Afr. i. p. 55. 3 (1864).

Subfam. Asopinæ.

15. Oplomus elongatus.

*Oplomus elongatus*, Dall. Trans. Ent. Soc. new ser. ii. p. 6, t. 1. f. 1 (1852).

16. Platynopus rostratus.

*Cimex rostratus*, Drury, Ill. Nat. Hist. iii. p. 59, t. 43. f. 3 (1782).

17. Platynopus silvaticus, n. sp.

Dark brownish ochraceous, thickly and coarsely punctate. Pronotal angles produced into stout, obtusely pointed black spines. Scutellum with a large levigate ochraceous spot at each basal angle, and an apical spot of the same colour. Connexivum ochraceous. Body beneath brownish ochraceous, and more or less thickly punctate. Sternum with central and lateral black suffusions; abdomen with a broad central, discal, and two narrow lateral black fasciæ and a series of small dark stigmatal spots. Intermediate legs ochraceous, femora spotted with castaneous (anterior and posterior legs mutilated). Rostrum ochraceous, its apex castaneous and reaching the intermediate coxæ. The punctures of the head are somewhat brassy green (antennæ mutilated).

Long. 11 millim. Exp. pronot. angl. 6 millim.

Subfam. Pentatominæ.

18. Atelocera raptoria.

*Atelocerus raptorius*, Germ. in Silb. Rev. v. p. 163. 8 (1837).

19. Atelocera, sp. ?

A species very closely allied to *A. serrata*, Fabr., but probably distinct.

20. Eractheus tibialis.

*Sciocoris tibialis*, Dall. List Hem. i. p. 138. 21 (1851).

21. Caura marginata.

*Caura marginata*, Dist. Trans. Ent. Soc. Lond. 1880, p. 150, t. v. f. 5.

22. Caura bipartita.

*Pentatoma bipartita*, Sign. Rev. et Mag. Zool. 1851, p. 444. 8.

23. Aspavia brunnea.

*Mormidea brunnea*, Sign. in Thoms. Arch. ii. p. 281. 521 (1858).

24. Aspavia ingens, n. sp.

Head ochraceous, with the lateral margins and two central longitudinal fasciæ blackish; eyes fuscous, ocelli red. Pronotum with the anterior half ochraceous, sparsely punctate, a submarginal series of dark punctures, two dark patches near anterior margin, and a

transverse series of dark punctures between the lateral angles which are produced into long, somewhat acute, and slightly ascending black spines; posterior half of the pronotum chocolate-brown, coarsely and thickly punctate. Corium and scutellum chocolate-brown and coarsely punctate, the last with three large levigate luteous spots, situate one in each basal angle and one at apex; corium with the anterior lateral margin obscurely ochraceous, followed by a marginal series of blackish punctures. Membrane bronzy. Connexivum ochraceous. Body beneath pale ochraceous; the sternal and abdominal incisures, some small sternal spots, a sublateral fascia on each side commencing at pronotal angles and terminating at apex of abdomen, a central fascia crossing the last two abdominal segments of the stigmata, black. Rostrum reaching the second abdominal segment, with its apex black. Legs mutilated. Antennæ with the basal joint ochraceous, its apex blackish, the second joint blackish (remainder mutilated).

Long. 10 millim. Exp. pronot. angl. 8 millim.

Allied to *A. grandiuscula*, Dist., from the Cameroons, but distinguished by the long and acute pronotal angles, different markings of the pronotum, &c.

25. CARBULA MELACANTHA.

*Cimex melacanthus*, Fabr. Ent. Syst. iv. p. 103. 94 (1794).

26. ZANGIS GUINEENSIS.

*Edessa guineensis*, Fabr. Syst. Rhyn. p. 151. 27 (1803).

27. NEZARA ORBICULATA, n. sp.

Broadly ovate; pale olivaceous green; lateral margins of the pronotum, basal lateral margin of corium, and margins of the connexivum very narrowly paler green. Membrane pale greyish. Upper surface very thickly and finely punctate. Body beneath somewhat paler; abdominal spine and the coxæ ochraceous. Eyes greyish brown; antennæ with the basal joint green, second and third joints pale fuscous, about subequal in length, or second joint very slightly shorter than the third (fourth and fifth joints mutilated). Abdominal spine not passing the intermediate coxæ. Rostrum brownish ochraceous, its apex pitchy and reaching the posterior coxæ.

Long. 17 millim. Max. lat. 13 millim.

This species, by its peculiar shape, is allied to the *N. o.*, Sign., from which it differs in its larger size, the paler margins to the pronotum and corium, and in the second and third joints of the antennæ being about subequal in length.

Subfam. TESSERATOMINÆ.

28. TESSERATOMA NEMORIVAGA, n. sp.

Brownish ochraceous; margins of the pronotum and basal margins of the corium very narrowly darker in hue; connexivum dull

castaneous; apex of the scutellum pale ochraceous. Sternum ochraceous, with a large black patch at the area of the odoriferous orifices; abdomen beneath dark castaneous; legs ochraceous. Abdomen above dull castaneous. Antennæ black, second joint a little longer than the third (remainder mutilated). Pronotum with the lateral margins ampliated, reflexed, and slightly rugulose, remaining upper surface very finely, thickly, and indistinctly punctate. Anterior femora with two strong spines beneath at apex.

Long. 28 to 30 millim. Exp. pronot. angl. 14 millim.

This species, as shown by the spined anterior femora, is allied to *T. hornimani*, Dist., from which it differs in its narrower and more elongate form, different colour of the abdomen above and beneath, &c. It also widely differs in its immature condition[1].

29. TESSERATOMA INDICTA, n. sp.

Brownish ochraceous; margins of the head, pronotum, base of corium, and connexivum black. Body beneath ochraceous, margined as above; a spot between anterior and intermediate tibiæ and a patch at the area of the odoriferous orifices black. A double series of central segmental spots and the stigmata dark fuscous. Legs ochraceous; apex of the rostrum pitchy. Antennæ with the basal joint ochraceous, second black (remainder mutilated). Upper surface very finely, thickly, and obscurely punctate.

Long. 25 millim. Exp. pronot. angl. 13 millim.

Allied to *T. afzelii*, Stål, from which it is easily separable by the black lateral margins and the series of abdominal spots beneath.

30. PIEZOSTERNUM CALIDUM.

*Cimex calidus*, Fabr. Mant. Ins. ii. p. 292. 128 (1787).

Subfam. DINIDORINÆ.

31. CYCLOPELTA TRISTIS.

*Dinidor tristis*, Stål, Hem. Afr. i. p. 212. 2 (1864).

32. ASPONGOPUS JAPETUS.

*Aspongopus japetus*, Dist. in Oates's 'Matabele Land,' Append. p. 387 (1889).

33. ASPONGOPUS XANTHOPTERUS, var.

*Aspongopus xanthopterus*, Fairm. in Thoms. Arch. Ent. ii. p. 291. 546 (1858).

Subfam. PHYLLOCEPHALINÆ.

34. BASICRYPTUS FUNESTUS.

*Phyllocephala funesta*, Walk. Cat. Het. iii. p. 490. n. 23 (1868).

[1] I have previously figured the immature stages of two African species: *T. æthiops*, Dist. (Waterhouse's Aid Study Ins. vol. i. t. 49), and *T. hornimani*, Dist. (*ibid.* vol. ii. t. 135).

Fam. Coreidæ.

35. Plectrocnemia cruciata.

*Mictis cruciata*, Dall. List Hem. ii. p. 396. 31 (1852).

36. Mictis metallica.

*Mictis metallica*, Sign. Rev. et Mag. Zool. 1851, p. 447. 14.

37. Anoplocnemis curvipes.

*Cimex curvipes*, Fabr. Spec. Ins. ii. p. 351. 78 (1781).

38. Homœocerus pallens.

*Cimex pallens*, Fabr. Spec. Ins. ii. p. 363. 149 (1781).

Fam. Reduviidæ.

Subfam. Reduviinæ.

39. Phonoctonus picturatus.

*Phonoctonus picturatus*, Fairm. in Thoms. Arch. ii. p. 318. 616 (1858).

40. Reduvius nitidulus.

*Reduvius nitidulus*, Fabr. Spec. Ins. ii. p. 378. 5 (1781).

41. Reduvius yambuyæ, n. sp.

Head, pronotum, and scutellum ochraceous; postocular portion of the head black; corium black, mottled with ochraceous pilosity; membrane brassy black, its apex very pale fuscous. Body beneath black; head beneath, rostrum, prosternum, and legs ochraceous; apex of rostrum, femora (excluding apical third), and the tarsi black. Postocular portion of the head a little longer than the anteocular portion; first joint of the rostrum a little longer than the second joint; anterior lobe of the pronotum longitudinally sulcated and moderately tuberculate.

Long. 22 millim.

Subfam. Ectrichodiinæ.

42. Physorhynchus lucidus.

*Reduvius lucidus*, St.-Farg. et Serv. Enc. Méth. x. p. 279. 28 (1825).

43. Centraspis imperialis, var. bicolor.

*Ectrichodia imperialis*, Westw. Trans. Ent. Soc. (2) iv. p. 119. 1, t. 7. f. 2 (1845).

*Centraspis imperialis*, var. *bicolor*, Dist. Ent. Mo. Mag. vol. xiv. p. 208 (1877).

44. Santosia luteola, n. sp.

Body above pale luteous; pronotum with two broad longitudinal black fasciæ arched and meeting together anteriorly; scutellum

black; claval area and apex of corium and the membrane black; connexivum luteous with black spots; head reddish ochraceous, with the base narrowly black; rostrum black, its base reddish ochraceous; body beneath black; margins of sternum, marginal and central discal spots to abdomen luteous; legs black, apices of femora and bases of tibiæ reddish ochraceous (anterior legs and the antennæ mutilated).

Long. 15 millim.

Allied to *S. vitticollis*, Reut., but differing from the description of that species in the colour of the connexivum, legs, &c.

Subfam. ACANTHASPIDINÆ.

45. ACANTHASPIS BILINEOLATA.

*Reduvius bilineolatus*, Pal. Beauv. Ins. p. 14, Hém. t. 1. f. 3 (1805).

## HOMOPTERA.

Fam. CICADIDÆ.

46. PŒCILOPSALTRIA POLYDORUS.

*Oxypleura polydorus*, Walk. List Hom. i. p. 32. 14 (1850).

47. PLATYPLEURA STALINA.

*Platypleura stalina*, Butl. Cist. Ent. i. p. 193. n. 39 (1874).

Fam. CERCOPIDÆ.

48. PTYELUS GROSSUS.

*Cercopis grossa*, Fabr. Ent. Syst. iv. p. 47. 1 (1794).

## 3. On some Coleopterous Insects collected by Mr. W. Bonny in the Aruwimi Valley. By H. W. BATES, F.R.S., F.L.S.

[Received June 13, 1890.]

The following is a list, with descriptions of new species, of the Coleoptera belonging to the tribes Geodephaga, Lamellicornia, and Longicornia, collected by Mr. Bonny during the recent Expedition for the Relief of Emin Pasha. Mr. Bonny informs me that they were all taken at Yambuya Camp and on the march through the forest-region towards Albert Nyanza, between the months of October 1887 and November 1888, and that the collection is only a remnant of that originally made, the greater portion of it having been destroyed for want of suitable appliances for preserving and storing the specimens.

The collection, comprising examples of only 73 species, is clearly merely a fraction of what really exists in the forest-region, similar areas in other tropical countries being known to yield at least ten times the number of species of the same families. The material is therefore not sufficient for a satisfactory estimate of the relations of

the Fauna to that of other parts of Tropical Africa: but, such as it is, it points to a close connection with West Africa, especially with the forest-regions of Cameroons and Old Calabar; and we shall not be far wrong in saying that the Coleoptera confirm what has been already advanced with regard to other departments of the Fauna, viz. that Central Africa belongs essentially to the same zoological subprovince as West Africa. The relation with Eastern Equatorial Africa, *i. e.* the coast-lands opposite to Zanzibar and the wooded regions of Usambara and Nguru, is more remote.

Mr. Bonny informs me that the rain-clouds which supply the constant humidity of the Aruwimi forests are brought by south-west winds, though squalls come generally from the north-east. Rain falls more or less throughout the year. It will probably be found that the great central forest-area is connected by means of narrow belts of wood along the courses of streams with the coast-forests. Such belts would be quite sufficient to serve as lines of migration for forest species of animals of all classes.

### Family Cicindelidæ.

Cicindela cincta, Fabr.

The specimens differ from all those I have seen from the Gold Coast and the Cameroons in the submarginal white vitta of the elytra being much narrower, and interrupted or even reduced to a short streak near the apex.

Cicindela neglecta, Dej.

### Family Carabidæ.

Craspedophorus bonnyi, n. sp.

*E majoribus, capite thoraceque relative parvis elytrisque multo amplioribus et convexioribus. Niger, nitidus, capite post oculos convexos perparum strangulato; thorace subovato etsi angulis posticis subrectis, margine basali fere recto, laterali explanato-reflexo, sat grosse punctato sparsim piloso; elytris glabris, punctulato-striatis, interstitiis in hoc genere sat sparsim et subtiliter punctatis, utrinque maculis transversis duabus stramineis, interstitia* 4–8 *tegentibus. Ventris segmenta antice haud crenulata; episterna postica quadrata, quam latitudine paullo longiora.*

Long. 23 millim.

In the proportions of head and thorax to the after-body similar to *C. eximius*, Laferté, with which it also agrees in the moderate strangulation of the neck and in the suboval outline of the thorax, which has, however, more sinuated sides behind the middle, and distinct, almost rectangular, hind angles. The elytra, in the single example which appears not to be abraded, is nearly glabrous, the lateral interstices only having a few hairs; the striæ are deep and punctured and the punctuation of the interstices is rather shallow and nowhere very dense; the fasciæ are straw-yellow, narrow, and

macular, the spot on the fifth interstice of both fasciæ being much shorter than the others; on the hinder fascia the spot on the sixth interstice is extended forward and that on the seventh prolonged behind.

TEFFLUS JAMESONI, n. sp.

T. raffrayi (*Chaud.*) *affinis, sed differt, inter alia, corpore toto glabro. Niger, thorace sat angusto hexagono, supra grosse confluenter et subrugose punctato, lateribus postice leviter sinuatis, angulis posticis obtusis; elytris graciliter ovatis, utrinque acute sexcostatis, costis prope apicem 2–6 et 3–5 conjunctis, interstitiis multo grossius quam in ceteris speciebus transverso-foveolatis et granulis medianis inter se valde distantibus. Subtus lævissimus; tibiæ anticæ extus rectæ; antennæ sicut in* T. violaceo *graciles; frons inter oculos et in sulcis longitudinalibus rugoso-punctata, medio et antice lævi, sutura epistomali distincta.*

Long. 35 millim.

This species belongs to the group defined by Kolbe as having (besides the raised suture) only six carinæ on each elytron, and differs from the other species of the group in the absence of pilosity and the very coarse sculpture and widely-spaced line of granules in the interstices. The thorax is nearly as long as it is broad, the median dilatation is strongly angular, and the sides behind the angle oblique (very slightly sinuated) to the hind angles, which are therefore obtuse as in *T. raffrayi*, and not rectangular as in *T. juvenilis*, from which also the species differs in the perfectly smooth episterna.

The specimen was contained in a small box of beetles, all that have been received in England of the Coleoptera collected by the late Mr. Jameson. Mr. Bonny also met with it.

CRASPEDOPHORUS ERICHSONII, Hope.

CRASPEDOPHORUS OXYGONUS, Chaudoir.

The two preceding species are widely distributed on the West Coast, *C. oxygonus* extending as far as Sierra Leone.

CHLÆNIUS ARUWIMIUS, n. sp.

C. lucidicolli (*Laferté*) *similis et affinis, sed valde differt elytris profunde striatis, striis pubescentibus lateribus punctulatis. Caput et thorax splendide cupreo-æneæ, hoc sparse punctato illo postice punctulato; partibus oris, antennis pedibusque rufis; elytris nigris.*

Long. 17 millim. ♂.

The abdomen and prosternum, as in *C. lucidicollis* and allies, are impunctate, but the sides of the metasternum are thickly punctured. The thorax is precisely of the same form, *i. e.*, quadrate with gently rounded sides, obtuse hind angles, and deep elongate basal foveæ. In the depth and sharpness of the elytral striæ the species resembles the *C. lissoderus* (Chaud.), from Cameroons and Gaboon, belonging to the same group; but the double line of piliferous punctures on the sides of the striæ is peculiar to *C. aruwimius*, and the thorax in

*C. lissoderus* is black and only faintly metallic. The elytral interstices in all three are impunctate. The labrum is broadly emarginated.

Family Passalidæ.

Didimus punctipectus, Kaup.

Agrees with Kaup's description of the species founded on examples from Guinea.

Family Lucanidæ.

Metopodontus savagei, Hope.

A widely distributed West-Coast species.

Homoderus mellyi, Parry.

A single female example, differing in nothing from specimens found in the Cameroons district.

Family Copridæ.

Gymnopleurus cærulescens, Olivier, var. centralis.

*A forma typica differt thorace disco politissimo, spatiis lævibus latioribus elytrisque versus suturam lævioribus, interstitio tertio sparsim (nec densissime) granulato.*

Long. 10 millim. ♂.

One male example, differing from numerous specimens of *G. cærulescens* from Senegal with which I have compared it by the larger smooth spaces of the disk of the thorax and the finer and less densely granulated sides of the elytra, in which the third interstice is partly smooth. The clypeus is 4-dentate, with the two lateral teeth, like the genæ, broad and rounded. The underside of the femora, as in the typical form, has an acute but small tooth.

Anachalcos cupreus, Fabr.

One example, agreeing with others from various parts of the West Coast of Africa.

Family Melolonthidæ.

Pseudotrochalus ——?

One much-damaged example of an apparently new species.

Family Rutelidæ.

Anomala (Rhinoplia) ——?

Two examples of a species allied to *A. forbesi* from the Niger, but not further determinable owing to the broken condition of the tarsal claws.

Family Dynastidæ.

Oryctes boas, Fabr.

A very widely-distributed African species.

Archon centaurus, Fabr.

A well-known African Dynastid, found commonly in the coast-regions of Guinea.

Family Cetoniidæ.

Ceratorhina savagei, Harris.

Several examples, differing in nothing, except the rather broader fulvous stripes and spots, from the species as found on Mt. Cameroons.

Eccoptocnemis latipes, n. sp.

E. thoreyi *simillima, sed differt* ♂ *tibiis posticis brevibus latis intus ante medium dente magno triangulari instructis, coxisque posticis* ♂ ♀ *extus fulvis vel sanguineis.*

Long. 29–33 millim. ♂ ♀.

Differs from examples of *E. thoreyi* (Schaum) from the Guinea coast in the silky-golden reflections of its green surface and the stronger sculpture, minutely rugulose-punctate with scattered larger punctures, and the reddish outer-lateral part of the posterior coxæ. The apices of the elytra are more strongly sinuated and the sutural tooth longer. In the male the hind tibiæ are conspicuously shorter and broader, and the tooth at the commencement of the deep emargination at the base is very large. The glabrous inner margin of the same tibiæ and the short, scarcely perceptible pubescence of the intermediate tibiæ distinguish it, beside colour, from *E. barthi* (Harold).

Smaragdesthes mutica, Harold.

Described originally from examples taken by Pogge in the interior. A species or local form, very closely allied and agreeing in the slight elevation of the anterior margin of the clypeus, but differing in the more elongate form of body, is common on Mt. Cameroons.

Plæsiorhina recurva, Fabr.

A single example of a variety in which the elytra are testaceous yellow, except a broad border at the shoulders and another at the apex, which remain of the general brassy-green colour. The underside of the body, legs, lateral margins of the thorax, and mesosternal epimera are reddish. Similar varieties are found on Mt. Cameroons.

Plæsiorhina cincta, Voet.

Pachnoda marginella, Fabr.

Similar to Cameroons examples.

Pachnoda inscripta, Gory & Perch.

One example, differing from Gory and Percheron's figure and description in the upper surface being testaceous-yellow like *P. picturata* (Bohem.), and the abdomen being free from white spots.

The mesosternal process is conical and obliquely inclined as in *P. impressa*, but it is not so large as in that species.

DIPLOGNATHA GAGATES, Fabr.

MACROMA CONGOENSIS, n. sp.

M. sulcicolli (*Schaum*) *simillima; differt inter alia thoracis vitta marginali antice dilatata maculamque nigram includente.*

Long. 17 millim.

Shining black, legs and middle of the abdomen pitchy red; forehead with a large triangular bright yellow spot, the base of which is in front (leaving the clypeus black) and the apex prolonged to the crown. The lateral marginal vitta is very broad in front and tapers rapidly towards the hind angles; the central yellow vitta is very narrow; the scutellum has in the middle a triangular spot variable in size, and the spot on the pygidium is broad and strongly tridentate behind. On each side of the disk of the thorax there is a large strongly-punctured area, and similar punctures are seen in the dorsal depression, which does not, as in *M. sulcicollis* according to Schaum's description, extend to the fore margin. The elytra are strongly but not closely punctured, the punctures gradually changing to transverse scratches near the sides and apex. Underneath, the episterna, the metasternum, the anterior coxæ, and sides of the abdominal segments and posterior coxæ have each a large bright yellow spot.

## Family PRIONIDÆ.

SORARUS POGGEI, Harold, Col. Hefte, xvi. p. 165, tab. 2. fig. 2 (♂).

Both Mr. Bonny and Mr. Jameson obtained examples of this fine species on the Aruwimi, where it appears to be not uncommon. It is interesting as belonging to a group (*Pœcilosominæ*) the chief members of which belong to Tropical America. Pogge obtained the male only; the female differs in the much shorter antennæ, only two thirds the length of the body, the apical joints of which are shortened and thickened, and in the smaller and narrower hexagonal thorax with more prominent lateral spines.

♀. *Elongato-oblongus, convexus, nigro-velutinus, supra capite postice elytrisque fasciis tribus roseo-rufis, fascia prima (basali) angusta, fascia tertia (apicali) utrinque prope apicem nigro-maculata; abdomine metasternoque medio fulvo-testaceis. Antennæ paullo ultra medium elytrorum extensæ; articulis granulatis, 3° et 4° haud latioribus, 9°–11^m^ abbreviatis et incrassatis. Thorax elytris multo angustior, hexagonus, margine laterali acuto denticulato, spina mediana valida acuta.*

Long. 23–32 millim.

## Family CERAMBYCIDÆ.

PLOCODERUS ——?

A much-damaged example of a species allied to *P. denticornis*, F.

PAREME VERRUCIFER, n. sp.

P. (Corethrogaster) annulipedi, *Chevr.*, *multo robustior, cinnamomea, breviter pubescens; genis ante oculos, mandibulis femoribusque apice nigris; thorace latiore, transverso tuberculo discoidali valde elevato, laterali mediano obtuse conico, lateribusque posticis valde sinuatis, angulis posticis prominentibus.*

Long. 33 millim. ♀.

Of similar elongate form to *P. annulipes*, but broader, rufescent-cinnamon in colour, with the short genæ in front of the eyes, antenniferous tubercles, and mandibles blackish, and the apical fourth of the femora and extreme base of the tibiæ also black. The whole surface is sericeous-opaque, the elytra very minutely and closely punctulate-rugose, with two extremely narrow costæ on each, the apices conjointly rounded, without trace of sutural tooth. The thorax is nearly twice as broad as long, the surface with many (four or five) flattish tubercles on each side and one in the middle of the disk elevated and subcompressed; the medio-lateral tubercle is very broad, subconical, and the sides behind it rather deeply sinuated in connection with a strong transverse subbasal groove. The antennæ reach to about four fifths the length of the elytra; the scape is thick, oblong, abruptly constricted at the base, longer than the third joint, which as well as the fourth is shorter than the fifth and following; the second, third, and fourth are slightly nodose at the apex, fifth and tenth subserrated. The antenniferous tubers are acutely dentiform. The elytra are unarmed at the sutural apex, very densely subconfluent punctate and pubescent. By the proportions of the third to fifth antennal joints and the slight nodosity of the second to fourth, this large species appears to belong to *Pareme* rather than to *Alloyaster*. Unfortunately the female only is known.

XYSTROCERA NIGRITA, Serville.

This species seems to be very widely distributed in Tropical Africa. Serville described it from Senegal examples. The specimens from the R. Aruwimi do not differ from others found in Usambara, E. Africa, with which I have compared them.

CALLICHROMA FRAGRANS, Dalman, Schönh. Syn. Ins., App. p. 150.

A robust species with concolorous elytra, *i. e.* without lighter sutural stripe, and distinguished from its nearest allies by the patches of dense silky golden-tawny pubescence on the sides of the ventral segments. The thorax is very finely transversely striated, the striæ broken and granulated on each side of the disk. In Dalman's described examples from Sierra Leone the antennæ and legs were wholly rufous; but the colour of the antennæ is variable, being sometimes dark reddish brown with the scape rufous, or entirely reddish brown and even black. I have seen specimens from Sierra Leone, Cape Coast Castle, and Cameroons. The two examples from the Aruwimi have dark antennæ.

Callichroma afrum, Linn.

Recorded from several distant points along the West-African coast—Loango, Old Calabar, and Sierra Leone.

Callichroma barbiventris, n. sp.

C. afro (*Linn.*) *affinis : differt thorace haud passim transversim striato, disco utrinque granuloso nigro-velutino, ventreque medio dense fulvo-hirsuto.*

Long. 18 millim.

Similar in form and colours to the Tropical-American *C. rugicollis* (Guér.). Bright metallic green ; elytra darker and velvety opaque, with a sutural vitta narrowing and ending before the apex of the scutellum, transversely pubescent and yellow ; labrum, antennæ, and legs red. The head is densely confluent punctulated ; the scape short, subovate-clavate, and transversely rugose. The thorax is moderately long, the anterior constriction slight, the posterior stronger and with two transverse wrinkles in the groove ; the surface is transversely wrinkled only on the two anterior slight elevations and partially on the sides, the middle part being closely confluent punctulate, with a dark velvety patch on each side. The scutellum is densely punctulate and opaque. The underside is lighter metallic green with a silky-tawny pubescence, which (at least in the male, the only sex known) on the metasternum and the middle of the ventral segments is long and erect. The fifth and sixth ventral segments are both very deeply emarginated in the same sex.

*C. piliventris* (Bates), from the Gaboon, which is similarly pubescent on the underside, much denser in the male than in the female, and has also deeply emarginated fifth and sixth segments in the male, is a more robust insect, with broader thorax, and differs, moreover, in the black colour of the antennæ and tibiæ and the pale hind tarsi.

Callichroma ——?

An apparently new species, but the single example is in too mutilated a condition to be satisfactorily described.

Mecaspis setulicollis, Quedenfeldt, Berl. ent. Zeits. 1882, p. 327.

A single very imperfect specimen agrees well with the above-cited description drawn up from Angola examples. The species is very closely allied to *M. subvestita* (Bates) from the Gaboon, differing only in its greenish-blue colour (*M. subvestita* being violaceous) and the much finer and more scattered punctuation of the more elevated part of the elytra.

Philematium virens, Linn. Mus. Lud. Ulr. p. 73.

A widely distributed insect on the West Coast of Africa. Linnæus gave the erroneous locality "America" to the species, for which, in the 12th ed. of the 'Systema Naturæ,' he substituted "India." Olivier confounded it with a West-Indian species, and consequently

stated that the femora were sometimes toothed and sometimes simple. The toothed femora are now known to be a generic character, which I believe does not occur in any American species of *Callichroma* and its immediate allies.

EUPORUS STRANGULATUS, Serville, var. PURPUREIPES.

*A forma typica differt thorace supra viridi-aurato, parte antico cum occipite, antennis pedibusque purpureo-cupreis.*

As *E. strangulatus* is known to vary in colour (*conf.* Quedenfeldt, Berl. ent. Zeits. 1883, p. 144), the present may be one of its varieties. In the sculpture and colour of the elytra it offers no difference. It seems, however, judging from the scanty material before me, to be a narrower form with stronger anterior strangulation of the thorax, and the scape of the antennæ is confusedly scabrous rather than transversely rugose as in the typical form.

PHROSYNE BREVICORNIS, Fabr.

A species widely distributed along the West-African coast, from Sierra Leone to Angola.

CLYTUS CONTRACTIFRONS, n. sp.

*Subgen.* Mecometopo *proxime affinis; frons subelongata, fere verticalis, inter cavitates antennarum angustissima. Mediocriter elongatus, cylindricus, fusco-aureus, læte sericeo-pubescens; elytris dimidio basali nigris utrinque linea curvata a scutello versus latera plaga triangulari subbasali signaturaque hamata subhumerali flavescenti-auratis, fascia obscura posteriore cinerascente; mesosterno segmentoque primo ventrali aureo-pilosis.*

Long. 10 millim.

One example. The species seems referable to a section or subgenus of *Clytus* near *Mecometopus*. The forehead is rather long and subvertical, plane, with widely open antennal cavities, which leave only a narrow space between; of antenniferous tubercles no trace. The antennæ are about two thirds the length of the body, the joints without spines, from the fourth to the ninth shortened and thickened, tenth and eleventh rapidly narrowing. The thorax is subglobular, slightly narrowed anteriorly, very convex and wider than the elytra; it is free from crests and markings, the long tawny-silky pile laid and convergent. The elytra are parallel, flexuoso-truncate at the apex, the outer angle produced in a longish spine. The hind legs are only moderately elongated, the femora not thicker than the others, armed at the apex with two very short spines.

PTYCHOLÆMUS SIMPLICICOLLIS, Thomson.

A species originally described from the Gaboon.

PARISTEMIA THEORINI, Aurivillius, Entom. Tidskr. 1886, p. 89 (*Amphidesmus*).

One example, differing from the description of Prof. Aurivillius only in the black sutural vitta near the base being expanded behind

and forming a long triangular spot. The abdomen and middle of the sterna are red, as he describes, and the species is certainly distinct from *P. apicalis*, Westw. 1843 (= *westermanni*, Guér. 1844), the typical example of which I have before me. *P. theorini* is found at the Gaboon and in the Cameroons district, whence I have received examples. It is represented at Old Calabar by a closely allied species with black abdomen[1].

Family Lamiidæ.

Monohammus ——?

A single imperfect example of a species allied to *M. ruspator*, Fabr.

Coptops fusca, Olivier.

Many examples of this widely-distributed species.

Pinacosterna nachtigali, Harold.

A species, so far as at present known, confined to the Congo and Gaboon basins.

Quimalanca regalis, Fabr.

This common West-African species was obtained in considerable numbers by Mr. Bonny.

Geloharpya amœna, Westw.

This fine species is found also on the Ogowé and Gaboon. Westwood records it from the Gold Coast; his figure agrees exactly with specimens from the Gaboon.

Sternotomis virescens, Westw.

Several examples.

Sternotomis bifasciata, Fabr. Syst. Ent. p. 175 (1775).

*Lamia imperialis*, Fabr. Syst. El. ii. p. 286 (1801).

Many examples of the common form as found on the Guinea coast.

Sternotomis variabilis, Quedenfeldt, Berl. ent. Zeits. 1881, p. 289, and 1882, p. 341.

This very distinct species appears to be abundant on the Aruwimi,

[1] Paristemia calabarica, n. sp.

*A* P. apicali *differt elytris longioribus, versus apicem magis dilatatis, supra utrinque* 4-*costatis, costa quarta submarginali, fulvis, plaga apicali nigra sicut in* P. apicali, *magna, medio antice utrinque dentata, producta, plagaque communi nigro triangulari paullo ante medium: subtus nigra; pro- et meso-sternis medio flavis; thorace vittis duabus nigris etc. sicut in* P. apicali.

Long. 21–24 millim. ♀.

Old Calabar. Two examples. I would have adopted the MS. name *P. costata* for this species, had not Murray expressly withdrawn that name and stated that his species was certainly *P. apicalis*, he having compared it with examples from Sierra Leone.

and offers similar colour-varieties to those described from the R. Quango by Quedenfeldt. It is distinguished from its allies *inter alia* by the usual green fasciæ on the thorax and base of the elytra being reduced to distinct spots. None of the numerous examples collected by Mr. Bonny show a continuous basal fascia on the elytra.

Tragocephala nobilis, Fabr.

One example of a variety in which the yellow basal fascia of the elytra is wanting.

Tragocephala —— ?

Three examples of a species apparently new, but so discoloured that they cannot be profitably described.

Tragocephala opulenta, Harold, Col. Hefte, xvi. p. 228; Quedenfeldt, Berl. ent. Zeits. 1883, t. i. f. 5.

This fine species has previously been recorded only from the Loango coast country.

Alphitopola janus, n. sp.

A. pallidæ (*Thoms.*) *quoad formam simillima (thorace latiore, transverso excepto); supra fulva immaculata, fronte, antennis, pedibus corporeque subtus nigris; subtilissime griseo-pubescens.*

Long. 18 millim. ♀.

Subcylindrical, slightly narrowed behind, clothed above with a reddish ochreous tomentum, the antennæ, legs, and under surface being shining black, with an extremely fine and short grey pile. The forehead is also black, but this may be due to abrasion in the specimen; the tawny pile of the thorax clothes the flanks up to the anterior coxæ, and the side pieces of the mesosternum are similarly but more thinly clothed. The thorax is short and broad, and its sides have a minute and acute tubercle, but the two strong basal furrows and flexuous subapical shallow sulcus are precisely as in *A. pallida*. The prosternum is narrow and simple between the coxæ, and the mesosternum produced into a conical tubercle as in the typical species of the genus. The cicatrice of the scape is limited by a sharp, incomplete ridge.

Charisthes aruwimia, n. sp.

C. bellæ (*Dalm.* = carissima, *Westw.*) *similis et affinis; differt præcipue signaturis elytrorum, viz. fascia rufa subbasali oblique ad suturam descendente et antice ramulos duos ad basin emittente; fascia rufa postmediana cum maculis duabus marginalibus conjuncta ibique guttam viridem includente; area viridi apicali maculis nigris liberis tribus, denique margine laterali sat late fusco, maculis nigris quatuor anterioribus conjuncto.*

Long. 10½ millim.

There is one (imperfect) example only of this pretty little species, which may be perhaps more correctly considered a local form of the

*C. bella* of the Guinea coast. Another equally distinct form is found at Cameroons and Cape Coast Castle [1].

CEROPLESIS CALABARICA, Chevrolat.

Specimens agreeing with others I have seen from the Gaboon and Cameroons.

CEROPLESIS 5-FASCIATA, Fabr.

One example, differing only in the slightly broader red fasciæ from others received from Mozambique and Natal.

EURYSOPS ESAU, Chevrolat.

This fine species appears not to be uncommon at Cameroons and Old Calabar. It is also recorded from Sierra Leone.

PHRYNETA AUROCINCTA, Guérin.

A single example, differing scarcely in any respect from others received from Sierra Leone and Senegal.

PHRYNETA MACULARIS, Harold.

Described by Harold from examples taken by Pogge in the Upper Congo region. Mr. Bonny's specimens have apparently lighter-coloured antennæ (Harold says "braunlich gelb"); they are tawny yellow, with scape dark brown. The elytra are clothed with long erect black hairs (like *P. nigropilosa*, Auriv.), the non-mention of which in Harold's description would lead me to doubt the identity of the species, if it were not for the exact agreement in other respects and the probability that the hairs are liable to abrasion.

PHRYNETA SPINATOR, Fabr.

The specimens belong to the variety (*Ph. obscura*, Oliv.?) in which the elytra are of a uniform dull ashy-brown above with the black spots less distinct. The same variety occurs on the Guinea coast and in Senegal.

PACHYSTOLA MIMICA, n. sp.

Phryneta maculari (*Har.*) *simillima, sed differt characteribus generiсis, viz. tibiis intermediis extus fortiter sinuatis, fronte inter antennas latiore, tuberibus antenniferis valde obliquis, thoraceque convexo simplici. Subcylindrica, cæruleo-grisea, nigro-piperita, elytris fascia lata subobliqua post medium nigro-velutina; anten-*

[1] CHARIESTHES LATISSIMA, n. sp.

*Major quam* C. bella, *supra (subtusque lateribus) late viridis, farinosa, thorace vittis angustis 5 fuscis; elytris utrinque fascia obliqua ab humero ad suturam alteraque transversa post medium ad latera bifurcata marginemque attingente, rufo-fulvis sericeis, gutta submarginali nigra unica ante medium, una discoidali antemediana duabusque in area viridi apicali, margine fusco prope apicem paullo dilatato; antennis, pedibus corporeque subtus (lateribus exceptis) fulvo-testaceis.*

Long. 11 millim.

Cameroons and Cape Coast Castle. Three examples.

*nis articulis 3°-11°, tibiis et tarsis fulvis; tuberculo mesosterni valido, prosterni minore, acuto. Antennæ (♂ ?) corpore paullo longiores, robustæ, apice acuminatæ, articulis arcte conjunctis.*

Long. 16 millim.

One example only.

A closely-allied species from the Gaboon and Cameroons mimics *Phryneta nigropilosa* (Aurivillius) in a similar way.

Pachystola decussata, Chevrolat.

A single example of this Calabar species. It is hardly a true *Pachystola*, the middle tibiæ having a straight outer edge.

Petrognatha gigas, Fabr.

A single example, agreeing perfectly with others received from Lagos.

Acmocera undulata, Quedenfeldt, Berl. ent. Zeits. 1882, pp. 185, 354.

Found originally on the Quango river, examples from which locality have been compared with those obtained by Mr. Bonny.

Olenecamptus hofmanni, Quedenfeldt, Berl. ent. Zeits. 1882, p. 355, t. vi. f. 10.

Also found on the Quango.

Frea maculicornis, Thoms.

A species apparently common in the Gaboon country on the coast.

Dichostates (?) bimaculatus, n. sp.

*Breviter et late ovatus, nigro-nitidus, maculatim albo-griseo-tomentosus; elytris grosse subconfluenter punctatis, in fundo punctorum solum tomentosis, utrinque prope apicem macula penicillata nigra; thorace brevi et lato, antice valde rotundatim angustato, lateribus inermi, basi transversim sulcato, margine basali utrinque valde sinuato; elytris basi latis, humeris oblique subtruncatis.*

Long. 11 millim.

One example. The species belongs to a small group in which the usual lateral tubercles of the thorax are absent. The short ovate and broad form and the short triangular scutellum separate it from *Eumimetes*. The antennæ are as in *Dichostates*, the scape planed beneath and much shorter than the third joint. In the example described, doubtless a ♀, the antennæ are shorter than the body and the joints 5–11 short, the last pointed. The prosternum is vertical before and behind, and the mesosternum broad and vertical in front.

Dichostates collaris, Chevrolat.

Many examples, agreeing with others received from Old Calabar, whence the species was originally described. It is found also at Lagos and Cape Coast Castle, and extends, slightly modified in

general colour, *i. e.* tawny brown with the black and white marks less clear, to Eastern Equatorial Africa, at Zanzibar and Mombasa.

NIPHONA SORDIDA, Fåhræus, Ofvers. Vet.-Ak. Förh. 1872, p. 35 (*Hecyrida*).

Many examples, not differing except in the elongate black spot in the middle of the sides of the elytra being black only on its inner border, thus forming a curved line. Fåhræus places the species in the genus *Hecyrida*, but if our species is the same, the bidentate and fasciculate apices of the elytra and the subparallel claws show it to be a *Niphona*. Von Harold says that the *H. appendiculata* of Gerstäcker is the same species, but does not mention the position of the claws. It has a wide range. I have seen examples from Grahamstown and Caffraria and Cameroons. Gerstäcker records it from Eastern Africa, at Lake Jipe.

NUPSERHA HOMEYERI, Harold.

One example. Von Harold records it from Pungo Andongo on the river Quanza.

GLENEA FASCIATA, Fabr.

Found also at Cameroons and Cape Coast Castle. *Volumnia calabarica*, Thoms., is the same or a nearly allied species.

GLENEA CHEVROLATII, Murray.

This species is also widely distributed along the West Coast. I have seen examples from Old Calabar, Cameroons, and the Batanga coast, and from Angola.

VOLUMNIA WESTERMANNI, Thomson.

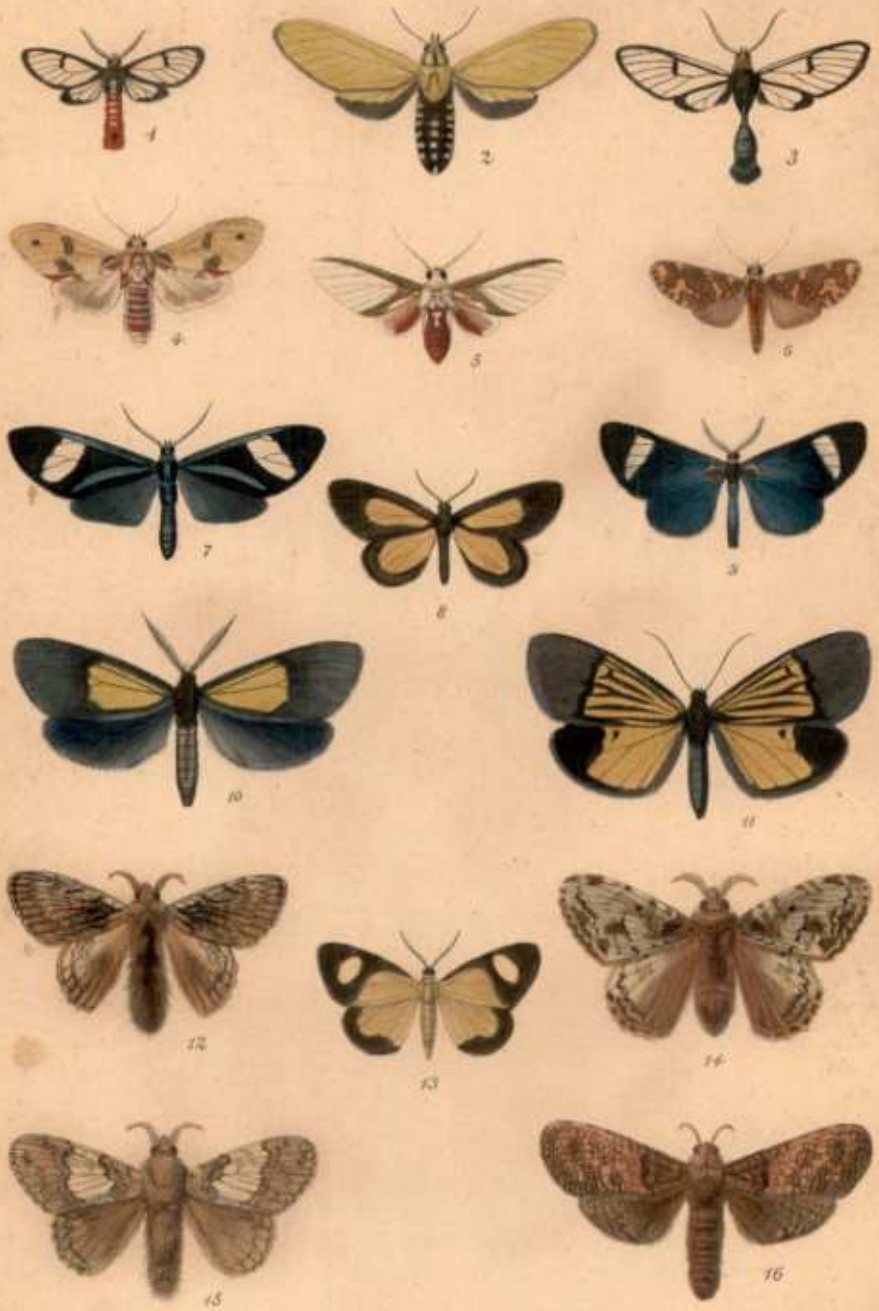
A single example, agreeing with the typical form from Natal. The species occurs also in East Africa, from Bagamoyo to the interior.

VOLUMNIA LEUCOMELÆNA, n. sp.

V. morosæ (*Pascoe*) *proxime affinis. Supra nigra, elytris utrinque linea obliqua a medio basi usque ad suturam, sutura deinde ad apicem, fascia curvata angusta mediana alteraque angustiore undulata prope apicem, albis, fronte grisea; thorace vitta laterali et linea, plerumque obsoleta, dorsali albis; scutello antennisque nigris; corpore subtus nigro-grisescente, vitta laterali a capite usque ad anum extensa, altera oblique pectorali ventreque vittis medianis duabus sordide albis; supra sat grosse punctata. Antennæ articulis primo et tertio quam in* V. westermanni *longioribus, tertio quam quarto fere duplo longiore, apice haud nodoso; elytra prope apicem magis angustata, breviter truncata.*

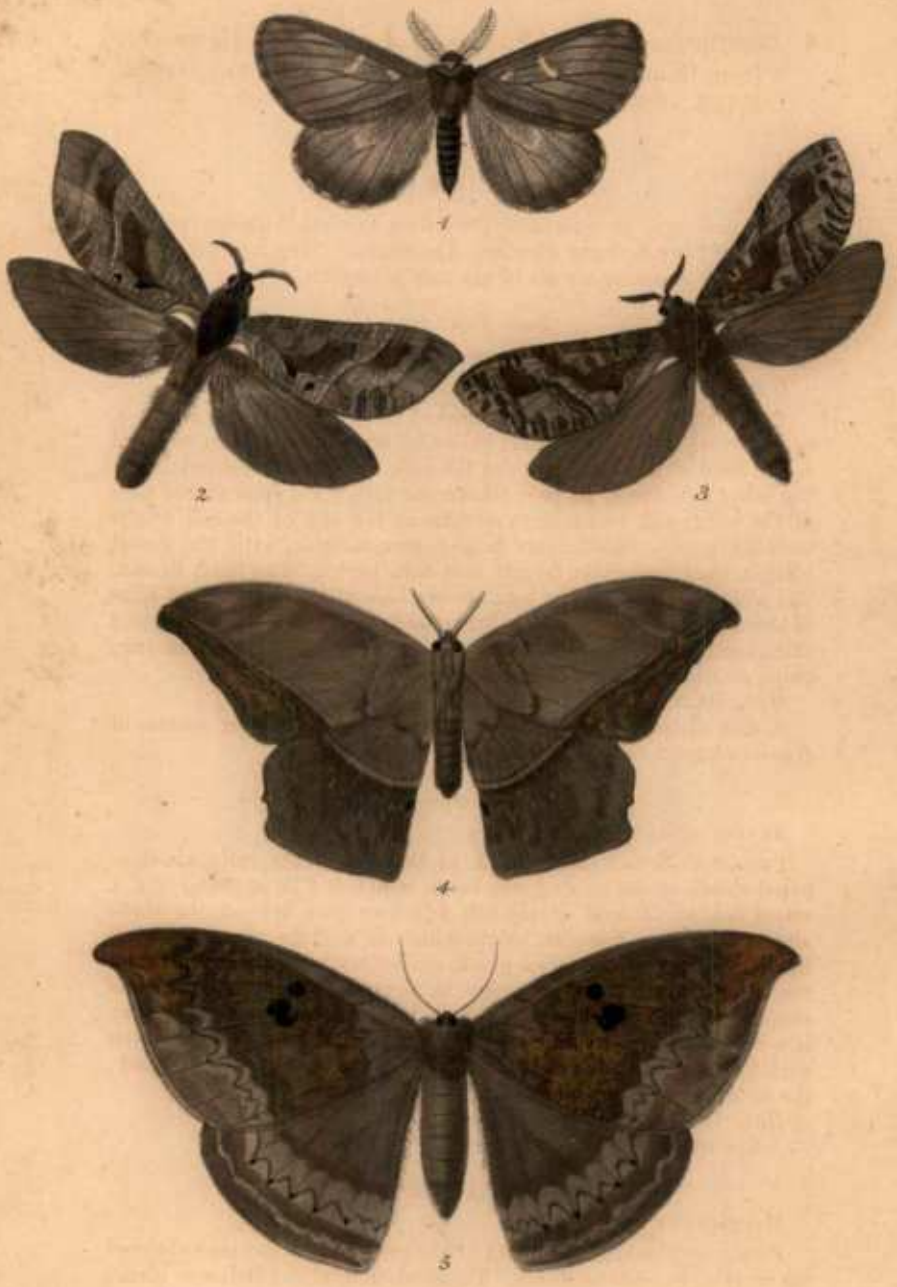
Long. 15–18 millim.

Several examples. Distinguished at once by the deep black colour of its upper surface, even in the apical area of the elytra, which is ochreous and light brown in *V. morosa*.




W. Purkiss lith. Hanhart imp.

NEW LEPIDOPTERA HETEROCERA.




W. Purkiss lith.

Hanhart imp.

NEW LEPIDOPTERA HETEROCERA.

# 4. Descriptions of new Species of Lepidoptera Heterocera from Central and South America. By Herbert Druce, F.L.S., F.Z.S., &c.

[Received June 17, 1890.]

(Plates XLII. & XLIII.)

The new species now described from Central America will be figured in the 'Biologia Centrali-Americana.' The types of those from South America are all in my own collection.

## Fam. Zygænidæ.

### Histioea, Walk.

Histioea boliviana, sp. n.

Primaries very dark brown, streaked from the base with carmine, below which the wing is pale yellowish brown; a spot in the cell and a band of four spots beyond the cell, the first and second large, the other two small, all pale ochraceous yellow; a spot at the base of the wing and two minute streaks at the end of the cell bright metallic blue. Secondaries bright rose-carmine, with the costal margin, apex, and outer margin very dark brown. The head, thorax, and abdomen black. The head, collar, base of the thorax, and sides of the abdomen spotted with bright metallic blue; the second and third segments of the abdomen pale primrose-yellow; the antennæ, palpi, and legs blackish brown. Expanse 2¾ inches.

*Hab.* Bolivia (*Mus. Druce*).

A fine distinct insect, not closely allied to any other species of *Histioea* known to me.

### Eupyra, Herrich-Schäffer.

Eupyra gigantea, sp. n.

Primaries bronzy green, black at the end of the cell; an elongated streak at the base of cell, below which is a large round spot, a round dot at the end of the cell and two just beyond, the three almost forming a triangle, below which is a large round spot, all hyaline white. Secondaries black, shaded with bronzy green round the outer margin from the apex to the anal angle; a large oval-shaped hyaline spot close to the base, beyond which nearer the apex is a band of three hyaline spots. The head, thorax, and abdomen dark bronzy green; the abdomen crossed at the base by a white band; the antennæ and legs black. Expanse 2¾ inches.

*Hab.* Interior of Colombia (*Mus. Druce*).

A fine species, allied to *E. salmoni*, Druce.

### Macrocneme, Hübner.

Macrocneme alesa, sp. n.

Primaries black, glossed with bright green from the base to beyond the middle; secondaries black. The head, thorax, and abdomen black;

the head and thorax spotted with greenish white; the tegulæ black edged with green; the abdomen with a central stripe from the base to the anus and a stripe on each side bright metallic green; the antennæ and legs black; the underside of the abdomen with two rows of minute white dots. Expanse 1½ inch.

*Hab.* Bolivia (*Mus. Druce*).

A distinct species, allied to *Macrocneme esmeralda*, Butler.

Homœocera, Felder.

Homœocera rodriguezi, sp. n.

Primaries clear hyaline, the base broadly deep black; the costal, outer, and inner margins narrowly edged with black, the veins all black; the secondaries the same as the primaries, very broadly bordered with black on the inner margin; the head, thorax, base of the abdomen, antennæ, and legs black; the upperside of the abdomen banded with yellow, with very minute white spots on each side; the tip of the antennæ is white. Expanse 1¾ inch.

*Hab.* Guatemala, in the city (*Rodriguez*).

A very distinct species, allied to *Homœocera salvini*, Butler, and *Homœocera azora*, Druce.

Dinia, Walker.

Dinia laudamia, sp. n. (Plate XLII. fig. 1.)

Primaries and secondaries hyaline, the veins and outer margins of both wings black; the head, thorax, and the base of the abdomen black, the abdomen above and the anal tuft deep carmine, with a small tuft of black hairs at the anus; a row of creamy-white spots extends down the middle of the abdomen from the base to the anus; the underside of the abdomen and the legs greyish white; the antennæ black. Expanse 1 inch.

*Hab.* Interior of Colombia (*Mus. Druce*).

A beautiful little species allied to *Dinia eagrus*, Cr.

Trichura, Hübn.

Trichura aliaria, sp. n. (Plate XLII. fig. 3.)

Primaries and secondaries hyaline, the veins and outer margins of both wings deep black; the head and collar brick-red; the thorax black; the abdomen bright glossy green, the anal tuft black; the palpi and legs white in front; the underside of the abdomen white near the base; antennæ deep black. Expanse $1\frac{3}{10}$ inch.

*Hab.* Amazons, Pebas (*Mus. Druce*).

This insect is not closely allied to any other species in the genus.

Fam. Arctiidæ.

Charidea, Dalman.

Charidea amata, sp. n.

Primaries black, shot with bright blue from the base to near the middle, a broad streak partly in the cell and partly beyond rose-

carmine: secondaries bright blue excepting at the apex, which is black; a large oval-shaped spot about the middle of the outer margin bright carmine: the head, thorax, and abdomen bright blue; the tegulæ black; the underside of the abdomen white; the legs bluish black. Expanse 1½ inch.

*Hab.* Interior of Colombia (*Mus. Druce*).

A beautiful species, unlike any other known to me, but nearest to *Charidea splendida*, Herr.-Schäff.

HELIURA, Butler.

HELIURA LELEX, sp. n.

*Male.* Closely allied to *H. apicalis*, Herr.-Sch., from which it differs as follows:—the primaries are broader, the white mark at the apex is very much smaller, the blue bands are much wider and deeper in colour; the secondaries are bright metallic blue excepting near the apex, which is black with a narrow white margin. In the female the primaries are much blacker than in the female of *H. apicalis*, and the secondaries are deep ultramarine blue, the segments of the abdomen being edged with the same colour. Expanse, ♂ 1½ inch, ♀ 1¾ inch.

*Hab.* Ecuador: Sarayacu, Chiguinda, Intaj (*Mus. Druce*).

A distinct species, allied to *Heliura apicalis*, Herr.-Sch., and *Heliura alpha*, Druce, the female being quite distinct from the females of either of them.

AUTOMOLIS, Hübner.

AUTOMOLIS LATANIA, sp. n. (Plate XLII. fig. 2.)

Primaries chrome-yellow, the apex edged with black, the fringe black. Secondaries black, with the costal margin from the base to the apex broadly banded with chrome-yellow. The head bright metallic blue; the thorax, collar, and tegulæ chrome-yellow; the abdomen black; the anus and the four anal segments spotted with bright metallic blue; the basal segments spotted with chrome-yellow on each side; the underside of the abdomen banded with chrome-yellow; antennæ and legs black. Expanse 1¾ inch.

*Hab.* Interior of Colombia (*Mus. Druce*).

A fine insect, allied to *Automolis superba*, Druce.

IDALUS, Walk.

IDALUS CITRINA, sp. n. (Plate XLII. fig. 4.)

Primaries bright yellow; a streak at the base, an elongated spot at the end of the cell, and a small round dot beyond dark grey; a spot on the inner margin close to the base and a long streak near the anal angle bright rose-red; below the spot at the end of the cell are four dark grey elongated spots, the fourth on the inner margin. Secondaries white, shaded with pink; the underside of both wings white; the costal margin, apex, and outer margin of the primaries shaded with yellow. The head and thorax greyish; the collar yellow edged with red; the tegulæ yellow, edged with red and tipped with white; the abdomen above bright red; the sides, undersides, and

anus white; the legs brownish white; the antennæ pale brown, yellowish at the tips. Expanse 1½ inch.

*Hab.* Amazons, Ceara (*Mus. Druce*).

A specimen of this beautiful little insect is in the National collection from San Paulo, Brazil.

IDALUS LEMBA, sp. n.

Primaries: the basal half, and along the costal margin to the apex, pale brownish fawn-colour, the outer half whitish hyaline; secondaries white. The head, thorax, and tegulæ fawn-colour; the collar and base of the tegulæ white; the abdomen above bright red, the underside of the abdomen white; the palpi, antennæ, and legs brownish white. Expanse 1¼ inch.

*Hab.* Amazons, Para (*Mus. Druce*).

IDALUS LARISSA, sp. n. (Plate XLII. fig. 5.)

Primaries pure hyaline white; the costal margin from the base to the apex and from the base to the anal angle pale brown; the inner margin from the base to about the middle white, with a small red streak nearest the base. Secondaries rose-carmine, the costal, outer, and inner margin white, the fringe white. The head, thorax, and tegulæ white shaded with pink; the abdomen above bright rose-carmine, the underside and two dots at the base white; the antennæ and fore legs pale brown, the other legs all white. Expanse 1⅞ inch.

*Hab.* Amazons, Santarem (*Mus. Druce*).

IDALUS LAVINIA, sp. n. (Plate XLII. fig. 6.)

Primaries red shaded with grey; three V-shaped yellow marks along the costal margin, the outer margin and a round-shaped mark above the anal angle pale primrose-yellow, two yellow dots on the inner margin; near the base a band of very distinct red spots crosses the wing about the middle, and the outer margin spotted with red; the fringe yellow. Secondaries pale reddish yellow. The head, thorax, and upperside of the abdomen red; the underside and the legs reddish yellow; the collar and base of the tegulæ bright yellow; antennæ yellowish brown. Expanse 1⅛ inch.

*Hab.* British Guiana (*Mus. Druce*).

ERCHIA, Walk.

ERCHIA LATERA, sp. n. (Plate XLII. fig. 7.)

Primaries black, crossed beyond the middle from the costal margin to near the anal angle by a wide semihyaline white band crossed by the black veins, the costal margin streaked from the base to near the apex with bright blue; a wide bright blue streak extends from the base to the anal angle, but not quite reaching it: secondaries black shot with bright blue. The head, thorax, and the abdomen dark blue; the underside of the abdomen white; the antennæ, palpi, and legs black. Expanse 1⅔ inch.

*Hab.* Ecuador (*Buckley, Mus. Druce*).

A very beautiful insect, allied to *E. porphyria*, Cram.

PHŒGOPTERA, Boisd.

PHŒGOPTERA LERIA, sp. n.

Primaries pale yellowish fawn-colour, thickly irrorated with minute black scales; an indistinct pale yellow waved submarginal line crosses the wing from the costal to the inner margin; the fringe brown and yellow. Secondaries pale yellowish white, almost hyaline near the base; the fringe yellowish white; the underside of both wings as above but paler in colour. The head and thorax pale fawn-colour; the abdomen brownish black on the upperside, the underside and the legs yellowish fawn-colour, the antennæ blackish brown. Expanse 2½ inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

PHŒGOPTERA LEDA, sp. n.

Primaries and secondaries pale yellowish hyaline, darkest along the costal and inner margins of both wings, the costal margin of the primaries dotted with brown. The head, thorax, and tegulæ pale fawn-colour, a black dot on the base of each of the tegulæ; the upperside of the abdomen pale orange-yellow, the underside yellowish white; the legs orange-yellow spotted with black; the antennæ dark brown. Expanse 3 inches.

*Hab.* Dominica (*Angas, Mus. Druce*).

This insect is allied to *P. elota*, Möschler.

PHŒGOPTERA LAUDIA, sp. n.

Primaries and secondaries uniformly pale yellowish hyaline, with all the veins dark brown; the head, thorax, abdomen, and legs orange-yellow; the antennæ black. Expanse 2¾ inches.

*Hab.* Trinidad (*Mus. Druce*).

A distinct species, very unlike any others known to me.

PHŒGOPTERA ALMOPIA, sp. n.

Primaries and secondaries pale greyish brown, the secondaries whitish near the base, the veins on the primaries darker brown than the ground-colour of the wing. The head and thorax blackish brown; the abdomen on the upperside yellow banded with black, the underside dark brown; the antennæ, palpi, and the legs almost black. Expanse 2½ inches.

*Hab.* Antioquia, Frontino (*Salmon, Mus. Druce*).

This insect is allied to *P. umber*, Cram., but is a smaller and much paler coloured species.

PHŒGOPTERA ALSA, sp. n.

Primaries reddish hyaline brown, darkest at the base and along the costal and inner margin, a very indistinct waved submarginal line crosses the wing from the costal to the inner margin above the anal angle. Secondaries almost hyaline excepting at the apex and partly round the outer margin, which is shaded with reddish brown. The head, thorax, abdomen, and legs brownish fawn-colour; antennæ black. Expanse 2½ inches.

*Hab.* Dominica (*Angas, Mus. Druce*).

PHEGOPTERA AMBROSIA, sp. n.

Primaries dark brown, with all the veins black, marked much the same as those of *P. suffusa*, Herr.-Schäff., but considerably darker; secondaries brownish hyaline. The head, thorax, and tegulæ dark brown, the collar and tegulæ banded with red; the upperside of the abdomen bright carmine: the anus and last two segments banded with black; the sides and the underside of the abdomen dark brown; the antennæ and legs brown, the palpi black. Expanse 3½ inches.

*Hab.* Antioquia, Frontino (*Salmon, Mus. Druce*).

A fine species. Allied to *P. suffusa*, Herr.-Schäff.

ARCTIA.

ARCTIA RODRIGUEZI, sp. n.

Primaries black, with a pinkish-white streak extending from the base almost to the anal angle, on the costal side of the streak beyond the middle is a large pinkish-white ≺-shaped mark, and on the costal margin near the base is a small streak crossing the wing almost to the inner margin. Secondaries bright carmine, broadly bordered with black, above which close to the anal angle is a row of three small black spots. The head, antennæ, thorax, tegulæ, and legs black, the abdomen bright carmine; the anus and underside black. Expanse 1½ inch.

*Hab.* Guatemala, in the City (*Rodriguez*).

Fam. MELAMERIDÆ.

THIRMIDA, Walk.

THIRMIDA SUPERBA, sp. n. (Plate XLII. fig. 10.)

Primaries black glossed with dark blue, the basal half of the wing bright orange, the orange colour does not extend to either the costal or inner margin; the veins crossing the orange are black: secondaries black glossed with bright dark blue; the fringe of both wings black. The antennæ, palpi, head, thorax, and legs black; the abdomen bright blue. Expanse 2 inches.

*Hab.* Upper Amazons (*Mus. Druce*).

This fine species is allied to *Scea cleonica*, Druce.

THIRMIDA DIMIDIATA. (Plate XLII. fig. 11, ♀.)

*Thirmida dimidiata*, Walk. Cat. ii. p. 466.

Walker described the male of this fine insect. I now give a figure of the female from a specimen in my own collection from Colombia; both sexes are in the Hope collection at Oxford.

FLAVINIA, Walk.

FLAVINIA ALCIDAMEA, sp. n.

Primaries and secondaries bright citron-yellow; the costal, outer, and inner margins of both wings narrowly bordered with deep black; the black is widest at the apex of the primaries. The head, thorax, antennæ, palpi, and legs black; the abdomen black, banded on the

sides with yellow. The sexes are alike, the only difference being that the antennæ of the male are pectinated, those of the female simple. Expanse 1½ inch.

*Hab.* Panama, Chiriqui (*Arcé, Mus. Druce*); Ecuador, Intaj (*Buckley, Mus. Druce*).

FLAVINIA LEMONIA, sp. n. (Plate XLII. fig. 8.)

Primaries black, with a wide central yellow streak extending from the base to the end of the cell. Secondaries bright yellow, broadly bordered with black. The head, thorax, abdomen, and legs black. Sexes are alike, excepting the antennæ of the male are pectinated, those of the female simple. Expanse 1½ inch.

*Hab.* Ecuador, Chiguinda (*Buckley, Mus. Druce*).

DEVARA, Walk.

DEVARA LASSIPPA, sp. n. (Plate XLII. fig. 13.)

Primaries with the basal half of the wing bright chrome-yellow, the costal and the apical half brownish black, with a large oval cream-coloured spot nearest the apex. Secondaries chrome-yellow, broadly bordered with black from the apex to the anal angle. The head, antennæ, and palpi black; the thorax, tegulæ, abdomen, and legs chrome-yellow, the anus tipped with black. The underside of the wings the same as above, but paler in colour. Expanse $1\frac{3}{10}$ inch.

*Hab.* Colombia, Bogota (*Mus. Druce*).

This species is allied to *Devara onoba*, Druce.

MICROGITON, Feld.

MICROGITON LARISSA, sp. n.

Primaries brownish black, crossed in the middle from the costal to the inner margin with a wide cream-coloured band. Secondaries cream-coloured, dusky at the base and broadly bordered with black from the apex to the anal angle. The head, tegulæ, and abdomen bright metallic green, the collar orange; the thorax, antennæ, and palpi dark brown, the legs cream-colour. Expanse 1¼ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

MICROGITON LATONA, sp. n.

Primaries and secondaries black, both wings broadly banded in the middle with dark yellow, the band on the secondaries not reaching the outer margin, a small metallic blue spot at the base of the primaries; the underside the same as above excepting that the base of both the wings is bright blue, and a large blue spot beyond the orange band on the primaries. The head, thorax, and abdomen black, the abdomen banded with metallic green; the collar orange; the antennæ, palpi, and legs black. Expanse 1¼ inch.

*Hab.* Ecuador, Intaj (*Buckley, Mus. Druce*).

MICROGITON ALEA, sp. n.

Primaries pale yellow, with the apex, outer and inner margins

broadly bordered with black, a black streak extending from the base along the costal margin to about the middle. Secondaries yellow, bordered with black along the costal margin, the apex and outer margin, to the anal angle. The underside the same as above but considerably paler in colour. The head and thorax brownish black; the abdomen black, striped with yellow, the underside yellowish white; antennæ and palpi black, the legs yellow. Expanse 1¼ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

PANIASIS, gen. nov.

The thorax and abdomen slender, the abdomen extending slightly beyond the wings; the head small, the palpi very minute; proboscis rather long, slender; antennæ one third the length of the wing, very deeply pectinated; the legs slender. Primaries long, narrow at the base, broad and much rounded at the apex, the costal margin straight; secondaries rather long, rounded at the apex and anal angle.

PANIASIS ALEOPETRA, sp. n. (Plate XLII. fig. 9.)

Primaries and secondaries uniformly dark glossy blue, almost black at the apex of the primaries, which are crossed from the costal to the outer margin by a white band which is slightly hyaline, the band does not extend to either of the margins; a semihyaline round spot close to the base; the fringe of both wings bluish black. The head, antennæ, and palpi black; the collar and front of the thorax orange-yellow; the thorax and abdomen dark glossy blue, the anus and legs black. Expanse 1½ inch.

*Hab.* Interior of Colombia (*Mus. Druce*).

Fam. LIPARIDÆ.

GENUSSA, Walk.

GENUSSA ALTABA, sp. n.

Primaries and secondaries semihyaline white, the costal apex, outer and inner margins bordered with greyish black; a streak at the end of the cell and the veins greyish black; the underside the same as above. The head, thorax, and abdomen white, the anus dusky white; antennæ black, legs white. Expanse 1½ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Genussa celerenaria*, Walk.

EACLES, Hübn.

EACLES LEONA, sp. n.

Primaries greyish brown; three spots close to the base, one in the cell, and two elongated streaks at the end of the cell, a row of oval-shaped spots crossing the wing beyond the middle from the costal to the inner margin, and a marginal row of elongated streaks extending from the apex to the anal angle, all creamy white. Secondaries greyish brown, the basal half of the wing and a marginal row

of elongated streaks extending from the apex to the anal angle pale primrose-yellow, the base and a large spot at the end of the cell bright red; on the underside the spots are more suffused and of a dark yellow colour, with a large red spot at the end of the cell on both wings. The head, thorax, tegulæ, and abdomen dark greyish brown, the base of the tegulæ yellow, and the thorax streaked with two wide yellow lines, the sides of the abdomen streaked with yellow, the upper and underside of the abdomen banded with red; the antennæ and legs black. Expanse 5 inches.

*Hab.* Paraguay, Uruguay (*Mus. Druce*).

A fine distinct species, allied to *E. splendens*, Druce.

COLORADIA, Pack.

COLORADIA LEPTA, sp. n.

Primaries and secondaries almost uniformly dark brown, darkest along the costal margin and at the apex of the primaries, the veins are all slightly darker than the ground-colour of the wings; the underside of the primaries are slightly greyish. The head, thorax, tegulæ, abdomen, and legs all dark brown; the antennæ black. Expanse 5½ inches.

*Hab.* Paraguay (*Mus. Druce*).

Fam. LASIOCAMPIDÆ.

DIRPHIA, Hübn.

DIRPHIA LAVERNA, sp. n. (Plate XLIII. fig. 1.)

Primaries semihyaline, black, thickly irrorated with yellow scales; the veins all deep black; a yellow spot at the base of the cell and a yellowish band at the end of the cell. Secondaries semihyaline black, with the fringe black and white. The underside of both wings pale blackish brown with a yellowish tinge, and a white spot at the end of the cell of both primaries and secondaries, the costal margin of the latter edged with yellow. The head, thorax, and tegulæ black, clothed with long yellowish hairs; the collar yellow, the abdomen black, banded with yellow; the anus and legs red; antennæ black. Expanse 2¼ inches.

*Hab.* Ecuador, Intaj (*Buckley, Mus. Druce*).

This insect is very distinct from all known to me and has not any near ally.

DIRPHIA LATEMEDIA, sp. n.

Primaries very like *D. rosea*, Druce, but much browner in colour, and instead of the straight lines that cross the wings in that species is a series of lunular-shaped yellow markings edged with black, extending from the costal to the inner margin; the darker markings are all more defined, the spot at the end of the cell being considerably larger. Secondaries dark brown, with a yellowish tinge at the base, and the black submarginal line very distinct. The head and thorax dark brown; abdomen orange-yellow banded with black,

and with a central black line from the base to the anus; the sides and underside of the abdomen black; the outer sides of the legs fawn-colour, the inner sides black; antennæ orange; palpi orange in front, black at the sides and back. The sexes are alike. Expanse, ♂ 3 inches, ♀ 4 inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

A very distinct species, allied to *D. rosea*, Druce, from Mexico.

DRACONIPTERIS, Hübn.

DRACONIPTERIS GIGANTEA, sp. n. (Plate XLIII. fig. 4.)

Primaries and secondaries pale fawn-colour, becoming almost yellow round the outer margins; the costal margin of the primaries edged with yellow; a straight yellow line edged with white on the outer side extends from the apex to about the middle of the inner margin, on the outer side of which is a row of yellowish lunular-shaped marks; the apex and part of the fringe black; the apical part of the wing clouded with white; a yellowish streak at the end of the cell; on the inner point of the streak is a very minute black dot. Secondaries crossed below the middle from the costal to the inner margin with a faint yellow line, below which is a dusky band with whitish lunular-shaped markings; the fringe at the apex black, that round the outer margin yellowish white. The underside of both wings fawn-colour shaded with yellow, and irrorated with brown scales; both wings with a submarginal brown line. The head, thorax, and abdomen pale fawn-colour; the underside of the latter rather darker; antennæ yellowish fawn-colour; palpi dark brown; legs yellowish brown. Expanse 3¼ inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

A fine distinct species, much the largest known to me belonging to the genus *Draconipteris*.

OXYTENUS, Hübn.

OXYTENUS LAVERNA, sp. n. (Plate XLIII. fig. 5.)

Primaries and secondaries uniformly yellowish fawn-colour; the primaries crossed from the costal margin near the base to the inner margin by four waved lines, and considerably beyond the middle by several very indistinct waved lines; a submarginal row of blackish lunular-shaped markings extends from the costal margin near the apex to the inner margin; two large black spots at the end of the cell, that nearest the costal the smallest; the outer portion of the wing is clouded with silvery white. Secondaries with the submarginal row of blackish lunular-shaped markings the same as on the primaries, and with a marginal waved silvery-white line extending from the apex to the anal angle. The underside yellow with a pinkish shade, and with the darker lines more distinct than they are on the upperside. The head, thorax, and abdomen fawn-colour; antennæ, palpi, and legs brownish. Expanse 4 inches.

*Hab.* Ecuador, Intaj (*Buckley, Mus. Druce*).

A fine species, not closely allied to any other known to me.

ERIOGASTER, Germer.

ERIOGASTER ALERIA, sp. n.

Primaries pale grey, shaded with dark brown and crossed from the costal to the inner margin with waved white lines; a dark-brown elongated spot at the end of the cell. Secondaries very pale grey, with a submarginal waved white line extending from the apex almost to the anal angle, but not quite reaching it; the fringe and underside of both wings pale grey. The head, thorax, and abdomen pale grey; antennæ and legs greyish brown. Expanse 2¼ inches.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

This species is allied to *Eriogaster submarginalis*, Walker, from Colombia.

HYDRIAS, Herr.-Schäff.

HYDRIAS AMATHURIA, sp. n.

Primaries brown, thickly irrorated with very minute black scales; a large black spot at the end of the cell, beyond which is a row of very minute white dots crossing the wing from the costal to the inner margin; a faint submarginal black line extends from near the apex to the anal angle. Secondaries pinkish brown; the costal margin dark brown, irrorated with minute black scales from the base to the apex. The underside of both wings uniform pale brown. The head, thorax, and base of the abdomen dark brown; the abdomen pinkish brown; the antennæ, palpi, and legs brown. Expanse 1½ inch.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

This species is allied to *Hydrias psorica*, Herr.-Schäff.

HYDRIAS LASCORIA, sp. n. (Plate XLII. fig. 12.)

Primaries reddish brown, with the veins mostly black; a dark-brown mark near the base below the cell, beyond which a narrow waved black line crosses the wing from the costal to the inner margin; the costal margin broadly streaked with greyish white. Secondaries: the costal half of the wing greyish white, slightly irrorated with brown scales; the abdominal half of the wing pale reddish brown; a submarginal dark brown waved line extends from the apex to the anal angle. The underside uniformly pale reddish brown, slightly greyish at the apex of the secondaries. The head, thorax, and abdomen dark brown, the collar grey; antennæ, palpi, and legs brown. Expanse 1¾ inch.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

HYDRIAS LAUDIA, sp. n.

Primaries dark brown; the costal margin, a wide line extending from near the apex and crossing the wing about the middle to the inner margin, creamy white; on the inner side of the line is a second narrow curved white line, which joins the first about the middle of the wing; a very indistinct waved submarginal white line extends

from the apex to the anal angle. Secondaries pale reddish brown, with a white streak at the apex; the fringe of both wings brown. The underside of both wings pale brown, with a slight reddish tinge. The head, thorax, and abdomen dark brown; antennæ, palpi, and legs greyish brown. Expanse 1½ inch.

*Hab.* Ecuador (*Buckley*, *Mus. Druce*).

This insect is not nearly allied to any species known to me.

HYDRIAS AMPIRA, sp. n. (Plate XLII. fig. 14.)

Primaries silvery white; a large spot at the base, one at the apex, and one beyond and below cell nearest the anal angle and the outer margin all reddish brown; two small spots at the end of the cell and two narrow waved lines black. Secondaries reddish brown, with the apical half of the wing silvery white; a submarginal waved black line extends from the apex to near the anal angle. The underside of both wings reddish brown; the apex of the secondaries slightly greyish. The head, thorax, abdomen, antennæ, palpi, and legs reddish brown. Expanse 1¾ inch.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

A very fine insect, quite distinct from any other known to me.

HYDRIAS AMIDA, sp. n. (Plate XLII. fig. 15.)

*Male.* Primaries pale fawn-colour; a wide white band edged with black crosses the wing about the middle from the costal to the inner margin, and a faint submarginal line extends from the apex to the anal angle. Secondaries pale fawn-colour; the costal margin broadly bordered with greyish-white irrorated fawn-coloured scales. The underside of both wings uniformly pale whitish fawn-colour. The head and thorax greyish; the antennæ, palpi, abdomen, and legs fawn-colour. The female the same as the male, but larger, and with all the markings more distinct. Expanse, ♂ 1¾ inch, ♀ 2¼ inches.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

This species differs from all the species of *Hydrias* known to me in having the wide white band across the primaries.

HYDRIAS LECCA, sp. n.

Primaries and secondaries almost uniform pale brown, slightly darkest along the costal margin of the former; primaries with a large triangular white spot close to the base; the fringe pale brown; the underside the same as above, but without the white triangular spot. The head, thorax, and abdomen pale brown; the antennæ black. Expanse 1¾ inch.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

APATELODES, Packard.

APATELODES ANAVA, sp. n.

Primaries pale fawn-colour, crossed from the costal to the inner margin with three dark-brown bands, edged on the outer side with

indistinct whitish lines; a row of minute black dots crosses the wing beyond the third band; a small hyaline white spot close to the apex, and a marginal white line extends from the apical white spot to the anal angle. Secondaries pale pinkish fawn-colour, crossed about the middle from the apex to the inner margin by two narrow brown lines; the fringe of both wings brown. The underside of both wings very pale brownish fawn-colour, with all the lines very indistinct, excepting those on the secondaries, which are darker than above. The thorax and abdomen pale fawn-colour; the head, antennæ, palpi, and legs darker brown. Expanse 2 inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Apatelodes bombycina*, Feld., but very different in colour and markings.

### Œceclostera.

Œceclostera amoria, sp. n.

Primaries pinkish fawn-colour, shaded with grey, crossed from the costal to the inner margin by three indistinct waved brown lines; a black dot at the end of the cell and a white hyaline spot close to the apex. Secondaries reddish fawn-colour, crossed from the apex to the anal angle with a narrow brown line; the fringe of both wings brown; the underside pale fawn-colour; the head, thorax, abdomen, antennæ, and legs reddish fawn-colour. Expanse 2 inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Œceclostera micropus*, Walk.

## Fam. Limacodidæ.

### Dalcera, Herr.-Schäff.

Dalcera leberna, sp. n.

Primaries creamy white, with a wide submarginal reddish-brown band extending from near the apex to the anal angle; a small reddish-brown spot at the end of the cell. Secondaries creamy white, tipped with reddish brown at the anal angle. The head, thorax, and abdomen, antennæ and legs reddish brown. The underside of the wings yellowish white, without any markings. Expanse 1½ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

A distinct species, allied to *D. abrasa*, Herr.-Schäff.

Dalcera ampela, sp. n.

Primaries white; the costal half slightly hyaline; the inner margin and anal angle shaded with pale brown; a brown streak just above the anal angle; the marginal line brown. Secondaries pure white, slightly shaded with brown on the outer margin close to the anal angle. The head, thorax, and the abdomen pale yellowish brown; the antennæ and legs slightly darker brown. Expanse 1¼ inch.

*Hab.* Bolivia (*Buckley, Mus. Druce*).

This species is not closely allied to any other known to me.

DALCERA LAXTA, sp. n.

Primaries brownish grey, crossed from the costal to the inner margin with narrow waved brown lines. Secondaries dark grey, palest at the base; the underside of both wings grey, without any markings. The head, thorax, and abdomen pale grey; the antennæ and legs pale brown. Expanse 1¼ inch.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

A distinct species, allied to *D. ampela*, Druce.

MIRESA, Walk.

MIRESA (?) AMISENA, sp. n.

Primaries pale fawn-colour, with a large reddish-brown mark close to the anal angle, and extending along the inner margin almost to the base; the dark brown is crossed by two narrow white lines, and is shaded with white nearest the anal angle. Secondaries pale fawn-colour, slightly dusky near the anal angle; the fringe of both wings pale brownish fawn-colour. The head, thorax, and abdomen, antennæ and legs pale fawn-colour; a tuft of dark reddish-brown hairs at the base of the thorax. Expanse 1¼ inch.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

A beautiful little species, very distinct from all known to me. I place it in the genus *Miresa* with considerable doubt.

Fam. BOMBYCIDÆ.

PRISMOPTERA, Butl.

PRISMOPTERA AMINULA, sp. n.

Primaries and secondaries quite hyaline; the costal, outer, and inner margins and the veins yellow; the base of the costal margin white; the secondaries with a small black spot on the inner margin a little above the anal angle. The head greyish; collar yellow; thorax and abdomen dark reddish brown; antennæ and legs yellowish brown. Expanse 1¼ inch.

*Hab.* South-east Brazil (*Mus. Druce*).

A distinct species, allied to *Prismoptera opalina*, Butler.

CARTHARA, Walk.

CARTHARA AMISENA, sp. n.

*Male.* Primaries dull brown, crossed by three waved darker brown lines, and close to the apex an elongated reddish-brown spot. Secondaries brown, with three short white streaks along the inner margin. The head, thorax, and abdomen yellowish brown; antennæ dark brown. The female is considerably larger and much darker in colour, the primaries being much irrorated with grey scales; the secondaries are also blacker. Expanse, ♂ 1¾ inch, ♀ 2 inches.

*Hab.* Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

A very distinct species, allied to *Carthara vecca*, Druce, from the Volcan de Chiriqui.

ANTHOCROCA, Butler.

ANTHOCROCA LEBETHRA, sp. n.

Primaries: the costal half of the wing pale citron-yellow, with a pinkish tinge near the apex; the inner half of the wing dusky brown; two narrow brown lines cross the wing from the costal margin close to apex to the inner margin above the anal angle. Secondaries pale reddish brown, crossed by two indistinct darker brown lines; an orange-coloured streak at the anal angle. The underside much the same as above, but with the markings more indistinct. The head, thorax, and the abdomen pale fawn-colour; the antennæ and legs brown. Expanse 1½ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

ANTHOCROCA AMPHEA, sp. n.

Primaries pinkish fawn-colour, irrorated with white and crossed from the costal to the inner margin by four narrow waved black lines; a small black dot at the end of the cell. Secondaries pale pinkish fawn-colour, darkest at the apex and round the outer margin; the base and inner margin shaded with white; a faint submarginal brown line extends from the costal margin to the anal angle; the fringe of both wings fawn-colour. The head, thorax, abdomen, antennæ, palpi, and legs pale pinkish fawn-colour. Expanse 1¼ inch.

*Hab.* Ecuador (*Buckley, Mus. Druce*).

A small and very distinct insect, allied to the preceding species.

ANTHOCROCA AMYCLA, sp. n.

Primaries pale yellowish fawn-colour, with a very indistinct waved submarginal line extending from the costal margin near the apex to the inner margin above the anal angle; a large greenish-brown spot on the costal margin close to the apex, and two small black dots at the end of the cell; on the outer side of the submarginal line the wing is shaded with yellow near the anal angle. Secondaries pale fawn-colour, shaded with yellow at the apex and partly round the outer margin. The head, thorax, and abdomen pale fawn-colour; the antennæ and legs brown. Expanse 1½ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

ASTHENIDIA, Westw.

ASTHENIDIA BUCKLEYI, sp. n.

Primaries and secondaries pale yellow, shaded with white; both wings crossed about the middle by a wide pale-brown band, beyond which on the primaries is a narrow dusky line that extends from the apex to the inner margin above the anal angle; secondaries with two submarginal waved pale-brown lines. The underside of both wings pale yellow, with brown submarginal line. The thorax and abdomen pale yellow; the head, palpi, and legs black; the antennæ dark brown. Expanse 3¾ inches.

*Hab.* Bolivia (*Buckley, Mus. Druce*); East Peru (*Mus. Druce*).

ASTHENIDIA AMPHIRA, sp. n.

Primaries and secondaries pure white, with a slight primrose shade on the costal and outer margin of both the wings. Primaries crossed by two dusky black lines, the first broad, the second narrow; the marginal line black; a short black streak at the end of the cell; the fringe white. Secondaries with two dusky black bands, the first narrow, the second broad; the fringe black; a red spot just above the tail and two black spots on the outer margin. The underside of both wings pure white. The head white, the collar yellow; thorax and abdomen white; the antennæ dusky; the palpi white in front, black at the sides; the legs black, banded with white. Expanse 3¼ inches.

*Hab.* Ecuador, Intaj (*Buckley, Mus. Druce*).

This species is allied to *Asthenidia transversaria*, Druce, from which it is at once distinguished by its much longer hind wings, and by the bands being almost black instead of pale brown.

Fam. COSSIDÆ.

COSSUS, Fabr.

COSSUS AMUNDASA, sp. n. (Plate XLII. fig. 16.)

Primaries reddish pink; the base and the outer margin dark brown; the wing is thickly streaked with minute black lines. Secondaries dark brown, with a red spot close to the anal angle. The underside pale pinkish brown, thickly streaked with very fine brown lines. The head, collar, and tegulæ red; the thorax brown; abdomen red, with a brown line down the middle, the underside brown; legs brown; antennæ and legs reddish brown. Expanse 2 inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

A fine species, quite distinct from all known to me.

Fam. HEPIALIDÆ.

HEPIALUS, Fabr.

HEPIALUS PAROPUS, sp. n.

Primaries yellowish fawn-colour, thickly streaked near the apex with very minute brown lines. Secondaries reddish fawn-colour; the costal margin slightly shaded with yellow. The head, thorax, abdomen, and legs yellowish fawn-colour; antennæ dark brown. Expanse 1¾ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is not allied to any other known to me.

HEPIALUS MOMUS, sp. n. (Plate XLIII. fig. 3.)

Primaries fawn-colour, banded along the costal margin with dark reddish-brown bands, and a large reddish-brown triangular marking below the end of the cell; a pinkish-white band crosses the wing at the end of the cell and becomes wider on the inner margin; a row

of marginal brown spots extends from the apex to the anal angle. Secondaries pinkish fawn-colour, almost pink at the base. The head, thorax, and abdomen reddish brown; antennæ and legs darker brown. Expanse 2¾ inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

A fine species, allied to *Hepialus æmulus*, Butler, from Japan.

Hepialus metellus, sp. n. (Plate XLIII. fig. 2.)

Primaries dark brown, banded with darker brown along the costal margin and near the inner margin close to the base; two narrow white lines cross the wing beyond the middle, extending from the costal to the inner margin; two large black spots about the middle of the inner margin and a metallic gold spot at the end of the cell. Secondaries blackish brown, thickly clothed with light red hairs at the base. The underside of both the wings dark brown, shaded with yellow along the costal and outer margin. The head, thorax, and lower part of the abdomen dark brown, the basal half of the latter clothed with light-red hairs; the legs almost black; the antennæ black. Expanse 2¾ inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Hepialus momus*, Druce; but it is very distinct in the markings and colours.

Fam. Notodontidæ.

Phalera, Hübn.

Phalera amphissa, sp. n.

Primaries dark grey, thickly irrorated with brown scales, and crossed from the costal to the inner margin with narrow dark-brown waved lines; a submarginal waved white line extends from the costal margin close to the apex to the anal angle; the marginal line black, edged with white on the inner side; the fringe grey. Secondaries dark brownish black, slightly streaked with grey at the anal angle; a few yellowish hairs at the base and on the inner margin; the fringe dark brown. The underside of both wings grey, shaded with dark brown, yellowish near the base. The head and front of the thorax dark brown; the thorax and tegulæ grey, mixed with dark-brown hairs; the abdomen above blackish brown, banded with yellow; the anus grey; the underside of the abdomen and legs yellow; the antennæ yellowish brown. Expanse 3 inches.

*Hab.* British Guiana (*Mus. Druce*).

A fine species. To some extent it resembles *Phalera sigmata*, Butler, from Japan; but is altogether a larger and darker-coloured insect.

Edema, Walk.

Edema lanassa, sp. n.

*Male.* Primaries olive-green, mottled with darker brown along the costal margin and beyond the cell; a silvery-white spot and streak at the end of the cell, beyond which is a yellowish mark and

a row of submarginal minute black dots; the fringe olive-brown. Secondaries dark brown, palest at the base; the fringe pale greyish brown. Underside: primaries pale brown, with a marginal row of black dots near the apex. Secondaries greyish brown, broadly bordered with darker brown round the outer margin. The head, thorax, and anus olive-green; the antennæ and abdomen on the upperside dark brown, the latter on the underside pale greyish brown; the legs pale greyish brown; the palpi olive-green, the terminal joint black. The female the same as the male, but larger, and rather paler in colour. Expanse, ♂ 1½ inch, ♀ 1¾ inch.

*Hab.* Panama, Chiriqui (*Trotsch*, *Mus. Staudinger*).

A very distinct species, allied to *Edema pulchra*, Butl., from the Amazons.

EDEMA ALATA, sp. n.

*Male.* Primaries very pale greyish fawn-colour, speckled along the costal margin and beyond the cell with small brown streaks; a row of very minute brown spots crosses the wing from the apex to about the middle of the inner margin; several black dots close to the base. Secondaries greyish white, darkest at the apex and round the outer margin. The underside as above, but paler, and with the spots on the primaries entirely absent. The head, thorax, abdomen, and legs pale fawn-colour; the antennæ darker brown. Expanse 1½ inch.

*Hab.* Panama, Volcan de Chiriqui (*Trotsch*, *Mus. Staudinger*).

One specimen in Dr. Staudinger's collection, very distinct from anything I have seen.

ŒDEMASIA, Packard.

ŒDEMASIA (?) ALCIMEDE, sp. n.

*Male.* Primaries dark brown, with a reddish-brown spot and two yellow lines close to the base; a greyish-white row of spots crosses the wing beyond the middle from the costal to the inner margin, and a submarginal row of greyish spots with black points extending from the apex to the anal angle; the fringe dark brown. Secondaries uniformly dark brown, the fringe rather paler. The underside brown, with the costal margin of both the wings and the fringe yellowish. The head and collar, the thorax and upperside of the abdomen dark brown; the tegulæ golden brown; antennæ dark brown; the underside of the abdomen and legs pale yellowish white.

*Female.* Considerably larger than the male, and much duller in colour, without the greyish line on the primaries; the base of the wing much paler in colour and without the yellow lines; the underside of a more uniform dusky brown colour. Expanse, ♂ 1¼ inch, ♀ 1¾ inch.

*Hab.* Panama: Volcan de Chiriqui, 2000 to 3000 feet (*Champion*); Chiriqui (*Ribbe*, ♂ ♀ *Mus. Staudinger*); Ecuador, Sarayacu (*Buckley*, ♀ *Mus. Druce*).

A very distinct species, of which both sexes are in Dr. Staudinger's collection. Mr. Champion captured a specimen on the Volcan de

Chiriqui. These and the female from Ecuador are all we have seen of this insect.

ROSEMA, Walk.

ROSEMA SCIRITIS, sp. n.

Primaries pea-green, darkest at the base and along the inner margin, which near the base is streaked with black, and at the anal angle it is olive-green; the fringe pea-green. Secondaries pure white, shaded near the base with pink; the underside of both the wings silky white. The head green; the thorax and base of the abdomen black; the palpi and underside of the thorax bright red; the upperside of the abdomen red, the underside yellowish white; the legs black; antennæ reddish brown. Expanse 2 inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

ROSEMA SIMOIS, sp. n.

Primaries very pale pea-green, the costal margin slightly shaded with yellow; the fringe pale green. Secondaries pure white; the underside of both wings white. The head and thorax pale green; the abdomen white; antennæ and legs yellowish white. Expanse 1½ inch.

*Hab.* Argentine Republic (*Mus. Druce*).

HEMICERAS, Guén.

HEMICERAS LISSA, sp. n.

Primaries very pale fawn-colour, crossed from the costal to the inner margin with two orange-brown lines, the first near the base, the second beyond the middle, a large round black spot at the end of the cell; the fringe dark brown. Secondaries yellowish white, almost hyaline in the middle; the fringe white. The underside of both wings white, excepting along the costal margin it is shaded with fawn-colour. The head, thorax, and abdomen pale fawn-colour; the antennæ pale brown. Expanse 1⅞ inch.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Hemiceras leucospila*, Walk.

HEMICERAS ANIA, sp. n.

Primaries silvery-grey, palest along the outer margin; a dark brown streak extends from the base to the end of the cell, and a brown band crosses from the apex to the anal angle, on the inner side of which is a row of minute black dots. Secondaries pure white, shaded with brown at the apex and round the outer margin; the fringe of both wings greyish white. The underside white; the primaries shaded with brown on the costal and outer margins. The head and thorax greyish brown; the abdomen above brown, white on the underside. Expanse 2 inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

A very distinct species, not closely allied to any other known to me. A specimen of this insect from the Volcan de Chiriqui is in Dr. Staudinger's collection.

HEMICERAS LOSA, sp. n.

Primaries pale brown, crossed by two wide dark brown bands, the first near the base, the second about the middle; the outer margin dark brown, a row of minute black spots near the apex. Secondaries fawn-colour, palest at the base. The head, thorax, abdomen, antennæ, and legs fawn-colour. Expanse 2 inches.

*Hab.* Trinidad (*Mus. Druce*).

This species is also represented in the collection of Dr. Staudinger, from the Volcan de Chiriqui.

HEMICERAS LEVANA, sp. n.

Primaries dark reddish brown, shaded with darker brown at the end of the cell and the apex; the costal margin from the base to the apex edged with white; a rather indistinct waved black line crosses the wing near the base from the costal to the inner margin, and a row of small grey spots extends from near the apex to the middle of the inner margin, the last spot being the largest; the fringe dark brown. Secondaries pale brown, whitish in the middle and on the costal margin; the fringe white. The underside of the primaries pale fawn-colour; that of the secondaries white. The head and thorax reddish brown; the abdomen above darker brown; the anus fawn-colour. The underside of the head, thorax, and abdomen pinkish white. The legs and antennæ reddish brown. Expanse $2\frac{3}{4}$ inches.

*Hab.* Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Hemiceras violascens*, Guén., from which it is at once distinguished by the white costal margin of the primaries and by its much larger size.

Fam. GLOTTULIDÆ.

CHASMINA ALCIDAMEA, sp. n.

Male pure white, excepting the antennæ and the last four segments of the abdomen, both of which are tinged with pale yellow. The female only differs from the male in having the primaries crossed beyond the middle from the costal to the inner margin by two very faint yellow lines. Expanse, ♂ and ♀ $1\frac{1}{2}$ inch.

*Hab.* Guatemala, in the City (*Rodriguez*).

This species can at once be distinguished from all the Eastern species of *Chasmina* known to me by the tibia and tarsus being quite white instead of yellow or orange spotted with black. For the female of this insect I am indebted to the kindness of M. Candèze.

Fam. APAMIDES.

CELOENA (?) LILACINA, sp. n.

Male and female alike. Primaries dark brown, crossed from the costal to the inner margin by three purplish-grey bands, the first close to the base, the second beyond the cell, and the third submarginal; the fringe dark brown. Secondaries dull brown, slightly

paler at the base; the fringe pale brown. The head, thorax, and abdomen dark brown; the anus pale brown; the underside of the wings and the abdomen pale brown. Antennæ dark brown. Expanse 1¼ inch.

*Hab.* Panama: Volcan de Chiriqui, 2000 to 3000 feet (*Champion*); Chiriqui (*Ribbe, Mus. Staudinger*).

A specimen of this species is in the collection of Mons. Dognin, from Ecuador.

PERIGEA AGNONIA, sp. n.

Primaries pale fawn-colour, in some specimens shaded with pink and striated with blackish lines, the discal spot very distinct; the fringe pinkish brown streaked with fawn-colour. Secondaries pale brownish white, dusky at the apex and outer margin. The head, thorax, and base of the abdomen brownish fawn-colour, the upperside of the abdomen dark blackish brown; the anus yellowish fawn-colour; the underside of the thorax and abdomen pale fawn-colour. The antennæ pale brown. Expanse 1¼ inch.

*Hab.* Guatemala: Volcan de Atitlan 2500 to 3500 feet (*Champion*); Panama: Chiriqui (*Ribbe, Mus. Staudinger*), Volcan de Chiriqui below 4000 feet (*Champion*).—Ecuador, Brazil.

It is possible that this insect may have been described by Walker, as it appears to be a very common species round Rio Janeiro, from which locality I have a large series; but I have been unable to find anything like it in the National Museum, or in the Saunders Collection now in the Oxford Museum.

Fam. CARADRINIDÆ.

CARADRINA ALANA, sp. n.

Primaries pale mouse-colour, crossed from the costal to the inner margin by two pale whitish-brown lines, the first near the base, the second beyond the cell; the fringe brown. Secondaries pale brown, whitish near the base; the fringe pale brown. The head, thorax, and abdomen brown, slightly paler on the underside. Antennæ and palpi brown; the legs whitish brown. Expanse 1 inch.

*Hab.* Panama, Chiriqui (*Ribbe, Mus. Staudinger*).

Two specimens of this dull-coloured insect are in Dr. Staudinger's collection.

Fam. NOCTUIDÆ.

AGROTIS LAMPTERA, sp. n.

Primaries pale pinkish fawn-colour, crossed beyond the middle by a faint brown line that extends from the costal margin near the apex to the inner margin above the anal angle; an indistinct spot in the middle of the cell, and two short pale brown lines at the end of the cell; a submarginal row of very indistinct and very minute brown spots; the fringe pinkish fawn-colour. Secondaries hyaline pinkish white, the inner margin broadly edged with black;

the fringe white. The underside of the primaries pale pinkish fawn-colour; the secondaries whitish. The head, thorax, and tegulæ pale fawn-colour; the abdomen blackish brown, excepting at the anus, which is clothed with yellowish hairs. The antennæ, palpi, and legs dark fawn-colour. Expanse 1⅜ inch.

*Hab.* Guatemala, Pantaleon, 1700 feet (*Champion*).

AGROTIS (?) LIMENIA, sp. n.

Primaries reddish brown, in some specimens pale fawn-colour, crossed beyond the middle from the costal to the inner margin by two faint waved lines; a minute black dot in the middle of the cell, and a large oval-shaped grey spot edged with dark brown at the end of the cell; a ⊂-shaped black spot close to the base. Secondaries blackish brown, darkest at the apex and round the outer margin; the fringe pale greyish brown. The head, thorax, and tegulæ reddish brown; the abdomen above black, the sides and underside reddish brown. The anus and legs brown. Expanse 2¼ inches.

*Hab.* Guatemala, in the City (*Rodriguez*).

I have received four specimens of this very distinct species: it varies very much in colour, and is not closely allied to any other species known to me.

Fam. COSMIDÆ.

COSMIA LAGRIPA, sp. n.

Primaries dark brown, crossed by two bands of paler brown, the first near the base, the second beyond the middle, and a marginal row of minute white dots. Secondaries brown, palest at the base. The head, thorax, and abdomen dark brown, the underside considerably paler. Antennæ, palpi, and legs brown. Expanse 1⅓ inch.

*Hab.* Panama, Chiriqui (*Ribbe, Mus. Staudinger*).

I have only seen the specimens of this insect in Dr. Staudinger's collection.

Fam. ORTHOSIDÆ.

XANTHIA ALALA, sp. n.

*Male.* Primaries orange-brown, shaded with paler yellow; a round spot in the cell and a large oval spot at the end of the cell, pale yellowish brown, and a submarginal row of small spots extending from the apex to the anal angle, the outer margin, and the fringe brownish. Secondaries brownish white, darkest round the outer margin. The head and thorax yellowish brown; the abdomen much paler; the antennæ and legs pale brown. The female the same as the male but darker in colour. Expanse 1½ inch.

*Hab.* Mexico, in the City (*Höge*).

A male and female of this insect are all we have received from our region.

XANTHIA ALCANDRA, sp. n.

*Male*. Primaries pale citron-yellow, shaded with dark brown at the base and along the costal margin to beyond the middle; two waved lines cross the wing from the costal to the inner margin, the first near the base, the second beyond the end of the cell; a large round spot about the middle of the cell and an oval-shaped spot at the end of the cell, both pale brown. Secondaries creamy white. The underside of both wings pale yellow. The head and thorax brownish yellow; the abdomen yellowish white; the antennæ and legs brownish yellow. Expanse 1½ inch.

*Hab.* Mexico, Tierra Colorada, in Guerrero, 2000 feet (*H. H. Smith*).

Two males of this insect were captured by Mr. Smith in the month of October 1888.

Fam. HADENIDÆ.

POLIA (?) LORINA, sp. n.

Primaries pale grey, crossed by indistinct lines of the same colour, but rather darker in shade. A black line crosses the wing near the base from the costal to the inner margin, beyond which, close to the anal angle, is a second waved narrow black line crossing the wing towards the costal margin, but not reaching it. Secondaries pure white. The underside of both wings white; the primaries shaded with grey at the apex. The head, thorax, and tegulæ pale grey; the abdomen and legs white; antennæ brown. Expanse 2¼ inches.

*Hab.* Mexico, Presidio (*Forrer*).

A fine insect, very distinct from any known to me.

POLIA (?) AMERIA, sp. n.

Primaries dark grey, crossed from the costal to the inner margin by many dark grey and black waved lines. Secondaries white, dusky round the outer margin. The marginal line of both wings black; the fringes dark grey. The head and collar dark grey; the tegulæ and thorax pale grey; the abdomen pale brownish grey; the antennæ and legs pale brown, the anus tinted with yellowish brown. Expanse 2¼ inches.

*Hab.* Guatemala, Volcan de Atitlan, 2500 to 3500 feet (*Champion*).

One specimen of this fine insect was captured by Mr. Champion. It is allied to *P. lorina*, Druce, from Mexico.

Fam. HELIOTHIDÆ.

ANARTA AGONAX, sp. n.

Primaries very dark brown, almost black; a large square white spot at the end of the cell, beyond which the wing is crossed from the costal to the inner margin by a pale yellowish-brown band, which is somewhat dentated on the outer side; the fringe pale

yellowish brown, excepting in the middle, where it is black. Secondaries black, broadly white from the base to about the middle of the inner margin; the fringe white. The underside of both wings black, with the white spots as above. The head, thorax, antennæ, and legs black. Expanse ¾ inch.

*Hab.* Mexico, Jalapa (*Höge*).

ARDISURA GRANDIS, sp. n.

Primaries bright rose-pink, with a narrow cream-coloured line extending down the middle of the wing from the base to the outer margin; the fringe cream-colour. Secondaries pure silky white, with the fringe white. The head and thorax pink; the base of the thorax and the abdomen white; the legs pinkish white; the antennæ pale pinkish brown. The underside silky white; the primaries dusky from the base to beyond the middle. Expanse 1½ inch.

*Hab.* Mexico, Lake Chapala, Jalisco (*Richardson*).

A very fine species, quite distinct from all others I have seen.

## Fam. ACONTIIDÆ.

ACONTIA SPLENDENS, sp. n.

Primaries pea-green, crossed from the costal to the inner margin by three pure white waved narrow bands, the first close to the base, the second beyond the cell, and the third submarginal; six dark brown spots along the costal margin, the three nearest the apex very minute; a dark brown streak extends from the end of the cell to the costal margin; a small spot at the end of the cell bright pink, edged with white, below which are a number of minute dark brown spots; the outer margin broadly bordered with bright pink, with a marginal row of minute black dots; the fringe greenish fawn-colour. Secondaries pale brown, palest at the base, crossed below the middle by a dark brown waved line; the outer margin and the anal angle shaded with pink. The underside brownish white, with very indistinct brown markings. The head and thorax pale greenish white; the abdomen pinkish brown; antennæ dark brown; the legs pale brownish white. Expanse 1¼ inch.

*Hab.* Panama, Volcan de Chiriqui (*Trotsch, Mus. Staudinger*).

One specimen of this beautiful little insect is in the collection of Dr. Staudinger; the head, thorax, and abdomen are so much crushed that I am not certain that my description of the colours is quite correct.

THALPOCHARES LARONIA, sp. n.

Primaries very pale fawn-colour, crossed by three broad silvery-white bands; the second band broken into two, forming an oval-shaped spot at the end of the cell; the outer margin banded with silvery white; between the first and third band the wing is shaded with bright pink; the fringe white. Secondaries white, clouded

with very pale fawn-colour. The head, thorax, and abdomen pale fawn-colour; the base of the abdomen whitish; the antennæ and legs pale brown. Expanse 1 inch.

*Hab.* Mexico, Tierra Colorada, in Guerrero, 2000 feet (*H. H. Smith*).

One specimen of this beautiful little insect was captured by Mr. Smith in October 1888; it seems to be allied to the European *T. rosea*.

THALPOCHARES LAGORE, sp. n.

Primaries: the basal half dark brown, the outer half pale purplish brown, a narrow yellow line crosses the wing about the middle from the costal to the inner margin; a black dot at the apex edged with yellow on the upperside, and three minute yellow streaks on the costal margin near the apex; the marginal line yellow, with very minute black dots on the outer edge; the fringe brown. Secondaries uniformly dark brown. The head and front of the thorax yellowish brown; the thorax and abdomen dark brown. Antennæ and legs brown. Expanse $\frac{3}{4}$ inch.

*Hab.* Mexico, Teapa, Tabasco (*H. H. Smith*); Panama, Chiriqui (*Ribbe, Mus. Staudinger*).

A small dull-coloured species allied to *T. hippotes*, Druce. Mr. Smith captured this insect in January and March 1888.

Fam. ANTHOPHILIDÆ.

XANTHOPTERA LAPHYRA, sp. n.

Primaries yellowish brown, with a pinkish tinge from the base to the middle, and crossed from the costal to the inner margin by five very indistinct pale brown lines; the costal margin, from the base to near the apex, bordered with primrose-yellow; the fringe yellowish brown. Secondaries yellowish white, darkest round the outer margin; the fringe whitish brown. The underside of the wings pinkish white. The head and front of the thorax primrose-yellow; the thorax and abdomen yellowish brown; antennæ and legs pale brown. Expanse $\frac{3}{4}$ inch.

*Hab.* Mexico, Atoyac, Vera Cruz (*H. H. Smith*); Panama, Chiriqui (*Ribbe, Mus. Staudinger*).

Mr. Smith captured this species in April 1888. It is possible that this insect may prove the same as *Xanthoptera alboflava*, Walker, from Honduras; but it does not agree with his description and I have not seen the type.

Fam. ERIOPIDÆ.

CALLOPISTRIA AGYRA, sp. n.

Primaries dark brown, with very fine yellowish-white lines along the costal margin and crossing the wing to about the middle; a black elongated spot close to the base, and several indistinct brown spots near the apex; a white spot at the end of the cell,

beyond which is a very fine waved black line extending from the costal to the inner margin; the fringe dark brown. Secondaries paler brown than the primaries, with a dark streak at the end of the cell; the fringe brown. The thorax, abdomen, legs, and antennæ dark brown; the head and anus yellowish brown. Expanse 1 inch.

*Hab.* Panama, Chiriqui (*Ribbe*, *Mus. Staudinger*).

A small species, not closely allied to any known to me.

CALLOPISTRIA LANGIA, sp. n.

Primaries brown, crossed from the costal to the inner margin by small whitish streaks somewhat like *C. floridensis*, forming a broad Y-shaped mark in the middle of the wing. Secondaries dark brown; the fringe of both wings pale brown. The head, thorax, and abdomen brown; the anus yellowish brown; antennæ and legs dark brown. Expanse 1 inch.

*Hab.* Panama, Chiriqui (*Ribbe*, *Mus. Staudinger*).

A pretty little insect, not unlike some of the European species; the specimens in Dr. Staudinger's collection are all we have seen. The female is rather larger than the male and paler in colour.

Fam. PLUSIIDÆ.

PLUSIA, Ochs.

PLUSIA ANDA, sp. n.

Primaries very pale pinkish brown, darkest about the middle, crossed from the costal to the inner margin by four narrow dark brown lines, edged on the outer side with pinkish white; three minute black spots at the end of the cell and two small metallic silver spots below the cell. Secondaries silky brown, palest at the base; the fringe of both wings greyish brown. The head, thorax, and abdomen pale brown; the antennæ pinkish brown; palpi and legs darker brown; the anal tuft yellowish brown. Expanse 1¼ inch.

*Hab.* Guatemala, in the City (*Rodriguez*).

This species is very distinct from any known to me, its nearest ally being *Plusia illustris*, Fabr.

PLUSIODES (?) LARONIA, sp. n.

Primaries dark brown, with a purplish shade near the base and along the outer margin; the wing is thickly irrorated with minute greyish-brown scales; several minute spots in the cell, and a row of spots beyond the cell, crossing the wing from the costal to the inner margin, and four spots along the outer margin nearest the apex all pale greyish brown; a greyish submarginal waved line extends from the apex to the anal angle; the fringe dark brown. Secondaries pure white, very broadly bordered with black from the apex to the anal angle; the fringe white. The head and thorax purplish brown, irrorated with minute specks of grey; the abdomen

whitish brown, palest on the underside; the anus with a slightly reddish tinge; the palpi dark blackish brown; the underside of the head, thorax, and legs brown; the antennæ reddish brown. Expanse 2 inches.

*Hab.* Panama, Volcan de Chiriqui (*Arcé, Mus. D.*); Ecuador, Sarayacu (*Buckley*).

The specimen captured by Arcé is the only example I have seen from our region; it is identical with those in my collection from Sarayacu.

PLUSIODES (?) AGENORIA, sp. n.

*Male.* Primaries purplish brown, crossed from the costal to the inner margin by darker brown lines; a greyish-black wide V-shaped mark on the costal margin, close to the apex, edged with greyish white; three pale yellowish-brown spots close to the apex; the costal margin and the cell streaked with greyish white; the fringe dark reddish brown. Secondaries white, broadly bordered with black from the apex to the anal angle; the fringe greyish white. The head, front of the thorax, and the base of the tegulæ bright red; the thorax and antennæ purplish brown; the abdomen blackish brown, considerably paler on the underside; the legs reddish brown. The female the same as the male, excepting that the secondaries are almost black to the base. Expanse ♂ 1½ inch; ♀ 1⅝ inch.

*Hab.* Mexico: Atoyac, Vera Cruz (*H. H. Smith*); Ecuador, Sarayacu (*Buckley, Mus. D.*).

We have only seen two specimens of this insect: the male from Ecuador, and the female from Mexico. Mr. H. H. Smith captured the female in May 1888.

PLUSIODES ALESA, sp. n.

Primaries purplish brown, crossed by darker brown bands beyond the cell; three brick-red streaks on the costal margin close to the base, and three on the inner margin, extending towards the middle of the wing; a narrow >-shaped yellow line crosses the wing beyond the cell, and is joined by several narrow yellow straight lines with the outer margin; a black streak at the end of the cell edged with yellow, and two curved greyish lines close to the apex; the marginal line yellow; the fringe dark brown. Secondaries pure white, broadly bordered from the apex to the inner margin with black; the fringe greyish white. The head and the base of the collar bright red; the thorax and tegulæ purplish brown; the thorax and base of the abdomen with some brick-red spots in the middle; the abdomen dark brown, paler on the underside. The antennæ, palpi, and legs dark brown. Expanse 2 inches.

*Hab.* Panama: Volcan de Chiriqui (*Arcé, Mus. D.*), Chiriqui (*Ribbe, Mus. Staudinger*); Ecuador, Sarayacu (*Buckley*).

A beautiful species, quite unlike any other known to me; the Panama specimens are identical with those from Ecuador.

PLUSIODES LAODAMIA, sp. n.

Primaries fawn-colour, shaded with darker brown from the base to beyond the middle; a dark brown line crosses the wing near the base from the costal to the inner margin; a curved brown line extends from about the middle of the inner margin across the wing almost to the apex, but it does not quite reach it; a round mark in the cell and two brown lines at the end of the cell, a half-circular dark brown mark on the costal margin close to the apex, the marginal line dark brown; the fringe yellowish fawn-colour. Secondaries dusky fawn-colour, palest at the base; the fringe pale yellowish fawn-colour. The underside of both wings pale yellowish fawn-colour; the primaries crossed beyond the middle by a dark brown line. The head, thorax, and abdomen yellowish fawn-colour; the base of the abdomen tufted with reddish-brown hairs; the antennæ, palpi, and legs yellowish brown. Expanse 1⅜ inch.

*Hab.* Mexico, Amula, in Guerrero, 6000 feet (*H. H. Smith*).

A specimen in Dr. Staudinger's collection, without any exact locality in Mexico, is considerably paler than the one captured by Mr. Smith in August 1888.

## EXPLANATION OF THE PLATES.

### PLATE XLII.

Fig. 1. *Dinia laudamia*, p. 494.
2. *Automolis latania*, p. 495.
3. *Trichura aliaria*, p. 494.
4. *Idalus citrina*, p. 495.
5. —— *larissa*, p. 496.
6. —— *lavinia*, p. 496.
7. *Erckia latera*, p. 496.
8. *Flavinia lemonia*, p. 499.
9. *Paniasis aleopetra*, p. 500.
10. *Thirmida superba*, p. 498.
11. —— *dimidiata*, p. 498.
12. *Hydrias lascoria*, p. 503.
13. *Devara lassippa*, p. 499.
14. *Hydrias ampira*, p. 504.
15. —— *amida*, p. 504.
16. *Cosmo amundasa*, p. 508.

### PLATE XLIII.

Fig. 1. *Dirphia laverna*, p. 501.
2. *Hepialus metellus*, p. 509.
3. —— *momus*, p. 508.
4. *Draconipteris gigantea*, p. 502.
5. *Oxytenus leverna*, p. 502.

## 5. Note on the Secondary Sexual Characters in the South-African Tortoises of the Genus *Homopus*. By G. A. Boulenger.

[Received June 9, 1890.]

I owe to the kindness of Mr. J. M. Leslie, F.Z.S., of Port Elizabeth, two fully adult living specimens of *Homopus areolatus*, male and female, which I have the pleasure of exhibiting before the meeting. They were sent to me in illustration of the fact that the male is armed on the back of the thighs with a bony tubercle, which I stated, on the evidence of the specimens in the British Museum, to be absent in that species. The tubercle is, however, comparatively small and rounded, not conical, very much less developed than in *H. femoralis* and *H. signatus*; it is to be found, but in a quite rudimentary condition, in the female from Port Elizabeth.

It may be well, on this occasion, to point out the very marked external characters which distinguish the fully adult male:—First, the size of the head, which is much greater, as may be seen from the measurements given below. Second, the shape of the snout; the beak ends in a much stronger point, and its profile descends slightly forwards, whereas in the female the profile slants in the opposite direction. Third, the much greater length of the mandibular symphysis, which measures nearly half the total length of the mandible, as against about one third in the female. Fourth, the greater size of the large detached scale on the inner side of the elbow. And lastly, in this specimen, but not in the others I have hitherto examined, the presence, on the upper side of the tail near its end, of a small bony tubercle similar to that on the hinder side of the thighs. The plastron shows no concavity whatever.

On comparing this male specimen with specimens of the same sex of *H. femoralis* and *H. signatus*, I find that it differs from them in the following points, apart from the characters which I have given in the Catalogue of Chelonians:—From *H. femoralis* in the much longer mandibular symphysis (see measurements below) and the much smaller size of the femoral tubercle; from *H. signatus* in both the above characters and in the absence of a plastral concavity, which is well marked in the male of that species.

*Measurements*, in millimetres.

| | *H. areolatus.* | | *H. femoralis.* | | *H. signatus.* | |
|---|---|---|---|---|---|---|
| | ♂. | ♀. | ♂. | ♀. | ♂. | ♀. |
| Length of carapace | 90 | 93 | 82 | 128 | 83 | 68 |
| Length of plastron | 75 | 84 | 74 | 115 | 70 | 61 |
| Length of head | 23 | 20 | 19 | 23 | 20 | 14 |
| Width of head | 19 | 17 | 15 | 18 | 15 | 11 |
| Length of mandible | 18 | 14 | 13 | 18 | 14 | 11 |
| Length of mandibular symphysis | 8·5 | 5 | 4 | 6 | 5 | 3 |
| Length of femoral tubercle | 2 | — | 5 | 6 | 3 | 2·5 |

## 6. Notes on some Indian Rats and Mice. By W. L. Sclater, B.A., F.Z.S., Deputy Superintendent of the Indian Museum.

[Received June 3, 1890.]

(Plates XLIV. & XLV.)

The following notes were written during the preparation of the catalogue of the specimens of Rats and Mice in the Indian Museum; they may be considered as forming a supplement to Mr. Thomas's paper published in the 'Proceedings of the Zoological Society' for 1881, which is the foundation of all accurate knowledge of the Indian Muridæ.

Mr. Thomas's paper dealt only with those species which were found in India and the Himalayas, and excluded those species found only in Assam and Burmah; but in the following notes the Assamese and Burmese species have been also alluded to, and somewhat more detailed descriptions are given of one or two species hitherto not adequately described. Appended to the paper is a complete list of all the types of Muridæ now in the Indian Museum, which may perhaps be useful to some naturalists.

All the species found within the Indian Empire are mentioned in order whether the Indian Museum possesses examples of them or not.

There is, on the whole, a very good collection of Rats and Mice in the Indian Museum, but there are still one or two districts whence collections are much wanted; among others the North-west Himálayas, Ceylon, and Upper Burma are places from which the Museum contains few or no specimens of this family.

1. Nesokia hardwickii (Gray); Thomas, P. Z. S. 1881, p. 524.

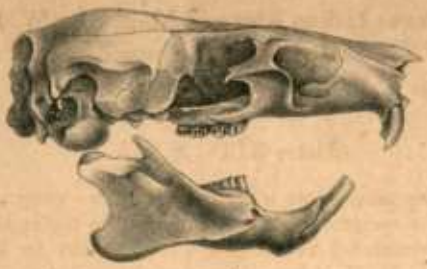
From an examination of the large series of this species in the Museum, it does not seem to be possible to distinguish *N. huttoni* of Blyth from *N. hardwickii*, even as a geographical race. Thomas gives the length of the hind foot as the principal distinction, but this does not seem to hold good when a large number of specimens are measured. The difference of the fur of the two so-called races also breaks down in the case of the specimens in the Museum coming from Sind, from which place we have specimens exhibiting both varieties of fur. It is possible, however, that the character of the fur is directly due to climate and season, but of this it is difficult to obtain direct evidence without carefully dated specimens.

There is in the Museum one example of this species obtained at Purneah in Bengal, showing a considerable eastward extension of the range of the species.

2. Nesokia scullyi, Wood-Mason, Proc. As. Soc. Beng. 1876, p. 80.

A species (*Nesokia brachyura*) has recently been described

1a.



2.

1b.

3a.

3b.

3c

4a

4b.

4c.

5a.

5b.

5c.

J. Smit. del. et lith.

Mintern Bros. imp.

INDIAN MURIDÆ.

6a.

6b.

7a.

7b.

7c.

8.

9.

10a.

10b.

11a.

11b.

12a.

12b.

J. Smit lith.

Mintern Bros. imp.

INDIAN MURIDÆ.

by Büchner in the account of the Mammals obtained by Przewalski in Central Asia, which seems to resemble *Nesokia scullyi* very closely, and which, when the types are compared, will probably be found to be identical with it.

Przewalski's species is somewhat larger than the type of *N. scullyi* and has a somewhat shorter tail.

3. Nesokia bengalensis (Gray); Thomas, P. Z. S. 1881, p. 526.

This is one of the commonest of all the Indian Rats and is found all over India; there are specimens in the Museum from Srinugger, Sind, North-west Provinces, Bombay, Central Provinces, and Bengal; there are also specimens from Cachar and other parts of Assam, Burma, and Mergui. In the south of India and Ceylon it is replaced by a geographical race, differing merely in being somewhat smaller; of this, there are examples from the Nilgiris, Trichinopoly, and Ceylon.

4. Nesokia bandicota (Bechst.); Thomas, P. Z. S. 1881, p. 528.

The true Bandicoot is only found in Peninsular India, that is in India south of the Ganges and Indus. It has frequently been reported from Calcutta, but on investigation the specimens are found to be either unusually large individuals of *Mus decumanus* or the rarer *Nesokia nemorivaga*.

5. Nesokia nemorivaga (Hodgs.); Thomas, P. Z. S. 1881, p. 529.

This species replaces the last in the Eastern Himalayas, Eastern Bengal, and Assam; it is also found in Formosa; whether it is the same as the *Mus bandicota* of Cantor from the Malay Peninsula and *Mus setifer* of Horsfield from Java it is, in the absence of specimens from those localites, impossible to say.

There is in the Museum a very small series of this species of *Nesokia*; the four specimens come from the following localities—Purneah, Alipur (Calcutta), and Sibsengar, Assam. Specimens of this Bandicoot from Assam, Burmah, or the Malay Peninsula would be most welcome additions to our collection.

6. Mus decumanus, Pallas; Thomas, P. Z. S. 1881, p. 532.

The Norway or Brown Rat does not seem to have spread much over India; all our specimens with one exception come from seaports where, especially in Calcutta, this species is excessively common; besides those from Indian ports there are in the Museum examples of this species from the Andamans and the Persian Gulf.

7. Mus rattus, Linnæus; Thomas, P. Z. S. 1881, p. 533.

Subsp. *a*. alexandrinus.
Subsp. *b*. nitidus.
Subsp. *c*. rufescens.

Mr. Thomas now considers that the Alexandrine Rat (*Mus*

*alexandrinus*) is merely a geographical race of the old English Black Rat (*Mus rattus*), from which it is distinguishable by its softer reddish or greyish fur and by its white belly. This race (*Mus rattus alexandrinus*) was originally described from Egypt; it has also been recorded from other countries bordering on the Mediterranean and Palestine. Specimens indistinguishable from this form were got by Dr. Scully from Gilgit and are now in the Museum.

*Mus rattus rufescens*, the common Tree-Rat, is found over the whole of India, Ceylon, Assam, and Burma, ranging south as far as Mergui certainly, perhaps as far as the Malay Peninsula.

To the already long list of synonyms of this subspecies may be added *Mus sladeni* and *M. yunnanensis* of Anderson, which seem to be identical in every way with the typical *Mus rattus rufescens*. This Tree-Rat is only distinguished from the Alexandrine Rat by its slightly smaller size.

The Hill-Rat (*Mus rattus nitidus*) is another variety, distinguished by its rather shorter tail and reddish colour; it is found in the eastern Himalayas and in parts of Assam.

8. Mus bowersii, Anderson, Anat. & Zool. Res. p. 304, pl. xvii.

Mr. Thomas (P. Z. S. 1886, p. 62) has, since Dr. Anderson's original description of this species, recorded the occurrence of a Rat probably identical from Munipur.

This Rat is apparently allied to *Mus rattus rufescens*, but is distinguished at once by its very large size—its length from muzzle to vent being 9·0 inches and that of its tail 10·26 inches; the corresponding measurements of a typical specimen of *Mus rattus rufescens* being 5·5 and 6·7 inches.

The skull is not distinguished by any marked peculiarity except that the antorbital plate does not project above in the marked way in which it does in *Mus rattus rufescens*, but is evenly rounded and slightly sloping forward (see Plate XLIV. fig. 2).

9. Mus rubricosa, Anderson, Anat. & Zool. Res. p. 306.

This species was described from a unique specimen procured by Dr. Anderson in Yunnan. It does not seem to differ from the ordinary Hill-Rat (*Mus rattus nitidus*), except in its very dark ventral surface; whether this is merely an individual variation or a constant character can only be proved by the examination of more specimens. The skull does not present any very special features.

10. Mus fulvescens, Gray; Thomas, P. Z. S. 1881, p. 537.

Thomas (*l. c.*) identifies with this species *Mus cinnamomeus* of Blyth, which was procured by Major Berdmore in the Schwegyeen District of Burmah. The type of *Mus cinnamomeus* agrees in every respect with the description given by Thomas of *Mus fulvescens*, so that there is a little doubt of the correctness of his identification. It seems that this species must be an exceedingly scarce one, as

although there are in the Museum large collections of Rats and Mice from Sikhim, there are no examples that can be referred to this species. The only specimens in the Museum are the two originally sent by Major Berdmore to Mr. Blyth from Burmah, of the skull of which I send figures (Plate XLIV. fig. 1).

11. Mus jerdoni (Blyth); Thomas, P. Z. S. 1881, p. 537.

This is a very distinct species of Rat; it can be at once identified by its tail, which is brown above and white below, and very long. There are in the Museum examples of this species from Darjeeling and from Cherra Punji in the Khasi hills.

12. Mus niviventer, Hodgson; Thomas, P. Z. S. 1881, p. 540.

There are in the Museum two old stuffed specimens from Landour near Mussoorie, which were originally identified by Blyth with this species; he afterwards, however, in his Catalogue considered it to be identical with *Mus rufescens*. An examination of the specimens rather confirms Blyth's second thought: the tails do not show any sign of white below so characteristic of this species, and the dimensions are large for *Mus niviventer*. The skulls, however, are so broken up that it is impossible to make anything of them.

There are no other examples of this species in the Museum, and I should be very grateful to any one who could procure specimens for us.

13. Mus blanfordi, Thomas, P. Z. S. 1881, p. 541, pl. 50.

There is nothing to be added to Thomas's excellent description of this distinctly marked species; the Indian Museum has recently received an example from the Shevaroy hills in the Madras Presidency, collected by Mr. William Daly; this adds another locality, as the original specimen was found at Cudapah, also in the Madras Presidency.

14. Mus berdmorei, Blyth; Thomas, P. Z. S. 1886, p. 62.

This species was first described by Blyth (J. A. S. B. xx. p. 173), from a single flat skin and skull procured in Mergui; he, however, afterwards merged it with his *Mus robustulus*, which has since been shown by Blanford and Thomas to be indistinguishable from *Mus rattus rufescens*, the common Tree-Rat of the whole of India.

Mr. Thomas has since (*l. s. c.*) applied Blyth's old name to a peculiar Rat forming part of the Hume Munipur collection, which Rat, according to Mr. Thomas, agrees so well with the original description of Mr. Blyth, that he has no hesitation in identifying the two, and this notwithstanding the fact that Blyth's specimen was from Mergui, which is a long way off, and has a very different fauna from Munipur.

The flat skin which is mentioned in Mr. Blyth's Catalogue of the Mammals of the Asiatic Society's Museum has unfortunately disappeared; the skull, however, though not complete, is still in the

collection, and so far as it goes confirms Mr. Thomas's identification. The measurements (see table, p. 536) correspond very closely with those of the Munipur examples mentioned by Mr. Thomas in his description; the type also agrees very well in regard to the great distance between the upper incisors and the molars and the paleness and forward direction of the incisors, which are the points described by Mr. Thomas as specially characteristic of the Munipur skulls.

15. Mus concolor, Blyth, J. A. S. B. xxviii. p. 295 (1859).

This species is somewhat intermediate in size between the Rats and Mice; it should, however, be considered rather as a small Rat than as a large Mouse, since the hind pad of the hind foot is elongate as in the Rats, not rounded as in the Mice.

This species does not seem to have been described since the original description by Blyth in 1859; it may therefore be as well to give some additional particulars and measurements which may be useful to students of Indian Mammalogy.

The fur is largely composed of flattened spines with long black hairs and fine fur intermixed; the tips of the spines are reddish in colour, and the hairs, which are longer, are black, so that the colour above is brownish: beneath, the spines are not so numerous nor are their tips red, the long black hairs are absent, and the general colour is dark grey, considerably lighter than the back.

The ears are clothed without rather thickly (for a Rat) with brown hairs and within with the usual white glistening hairs; they are rounded and of moderate size, bent forward they hardly reach the eyes.

The feet are not remarkable in any way; the usual 5 pads are present on the fore feet and the usual 6 on hind feet; the pads on the hind feet are rather small, and the proximal one, as mentioned above, is elongate; the soles are dark-coloured.

The tail, which is slightly longer than the head and body, is quite uniform, and provided with the usual rings, about four to the tenth of an inch.

The mammæ, in the only specimen in which they could be made out, were 8 in number—two pairs of inguinal, two pairs of pectoral. The cæcum is rather large and measures about 0·67 inch.

There are examples of this species in the Museum from the Schwegyeen District of Pegu, from Tenasserim, and from Malacca; and a very closely allied species, *Mus ephippium*, Jentink, has been recorded from Sumatra and from Mt. Kina Balu in Borneo.

The skull of *Mus concolor* resembles that of *Mus rattus rufescens* in almost every particular; the interparietal of the latter is perhaps somewhat narrower.

If, however, the skull of *Mus concolor* be compared with that of *Mus urbanus*, the former will be found to be considerably longer and narrower in proportion, and also to possess a much shorter anterior palatine foramen, barely reaching the level of the front ends

of the molars. These points are at once apparent on examination of the second table of measurements of all the skulls (given below, pp. 536, 537), where the measurements have been reduced to a percentage of the total length of the skull.

I send figures of the skull (see Plate XLIV. fig. 3).

The following are the measurements in inches of examples preserved in spirit, taken in the same way as the measurements given in Mr. Thomas's paper (*l. c.*):—

| | ♂. | ♀. |
|---|---|---|
| Head and body .... | 4·70 | 4·40 |
| Tail ..... | — | 5·07 |
| Hind foot..... | 0·93 | 0·90 |
| Forearm and hand .. | 1·10 | 1·08 |
| Ear-conch ..... | 0·58 | 0·50 |
| Muzzle to ear ..... | 1·20 | 1·45 |

16. Mus urbanus, Hodgs.; Thomas, P. Z. S. 1881, p. 544.

This, the common House-Mouse of India, is doubtfully different from the almost universally distributed *Mus musculus*, the European House-Mouse; it has been treated by Thomas in his paper as distinct, and has therefore been left so in the present paper. Blyth stated that *Mus musculus* has larger ears, smaller eyes, and broader paws than *Mus urbanus*, and further that the tail of *Mus musculus* is one-fourth shorter; none of these differences, however, hold good when many specimens are examined.

To the synonymy given by Mr. Thomas, *Mus kakhyensis* and *Mus viculorum*, described by Dr. Anderson (Yunnan Exp. i. pp. 307, 308) from two specimens procured in Yunnan, may be added, as a careful examination of the specimens fails to show any characters by which they may be distinguished from the ordinary Indian House-Mouse.

Mr. Thomas gives the whole of India as the habitat of this species; there are not, however, any examples of it in the Indian Museum from the Punjab or North-west of India, where *Mus bactrianus* seems to take its place. On the other hand, there are specimens from Ceylon, from various places in Assam and Cachar, from Burma, and from the Andamans and Nicobars.

17. Mus bactrianus, Thomas, P. Z. S. 1881, p. 546.

This species replaces the last as the common House-Mouse in the North-west of India; it differs from *Mus urbanus* in its white belly and pale colour; the skull also seems to differ from that of *Mus urbanus* in being longer and narrower (*cf.* table of reduced measurements, p. 537).

There are examples of this species in the Museum from the Punjab and Sind, from Ladak and the Pir Pinjal Pass, and from Simla; also from Baluchistan, Southern Persia, Palestine, and Egypt.

18. Mus sublimis, Blanford, Yarkand Mammals, p. 51.

This species is closely allied to *Mus urbanus*; it differs in having a slightly longer hind foot, with the tubercles very far apart from each other; the skull differs from those of *Mus urbanus* and *M. bactrianus* in having the zygomatic arches very strongly incurved; the palate is also peculiar, the posterior nasal opening being particularly wide, and its edges and the pterygoids all very much thickened, so that the under surface of the skull has a very different appearance from that of *Mus urbanus*.

This species has been only found in the higher regions of Central Asia—once by Stoliczka west of the Pankong Lake in Ladak, at a height of 13,000 feet above the sea, and once by Col. Biddulph (Scully, Ann. Mag. N. H. (5) viii. p. 99) in the Astor district of Kashmir, at a height of 11,000 feet.

19. Mus arianus, Blanf.; Thomas, P. Z. S. 1881, p. 548.

This species is closely allied to *Mus sylvaticus* of Europe; it is, as Thomas has pointed out, distinguishable by its shorter hind foot; the following measurements seem to show that though the length of the hind foot of *Mus sylvaticus* does not invariably surpass the distance between the muzzle and the ear, yet the difference between the two is much less than in *Mus arianus*:—

| | *Mus sylvaticus.* | | | | *Mus arianus.* | |
|---|---|---|---|---|---|---|
| | *a.* | *b.* | *d.* | *f.* | *q.* | *p.* |
| Hind foot..... | ·86 | ·90 | ·88 | ·84 | ·80 | ·80 |
| Muzzle to ear .. | ·89 | ·95 | ·80 | ·80 | ·97 | ·97 |

The skull of *Mus arianus* is considerably larger than that of *Mus urbanus*, but the proportions are much the same except with regard to the nasals, which are very much longer, and to the anterior palatine foramen, which is much shorter and does not reach the level of anterior line of the molars.

20. Mus wagneri, Eversmann.

*Mus pachycercus*, Blanford, Yarkand Mammals, p. 53.

The short-tailed House-Mouse of Central Asia, described as a new species by Blanford, has been since identified by Büchner (Result. Przewalsky's Reise, Säugethiere, p. 88) with a species described by Eversmann in 1848 from a specimen collected on the steppes between the Volga and the Ural. Examples of it were got by Przewalsky from a great number of localities throughout Turkestan and Mongolia, and it seems to be the common House-Mouse of all Central Asia. There is also a skin of a Mouse procured by Mr. Blanford at Resht on the Caspian, which has hitherto remained unnamed, and which seems referable to this species.

This Mouse cannot in any way be considered an Indian species, as it has never occurred this side of the Kuenluen Mountains; it has, however, been included in this paper, because the types of *Mus pachycercus* of Blanford are in the Indian Museum.

21. Mus cervicolor, Hodgs.; Thomas, P. Z. S. 1881, p. 547.

There does not seem to be any true distinction between this species and *Mus* (*Leggada*) *buduga*. Thomas allows that they are nearly allied, but asserts that they can be distinguished by the length of their ears; this distinction, however, does not seem to hold good when the measurements of many individuals are taken. *Mus cuniculoris* of Blyth, as is suggested by Thomas, seems to be in every way identical with *Mus cervicolor*.

The specimens procured by Blyth from near Calcutta mentioned by Thomas seem to be better placed under *Mus* (*Leggada*) *buduga* than under this species, since they are particularly short-eared, and some of them show distinct traces of the extra anterior cusp to the molar, which is the distinctive, though by no means constant, mark of the genus *Leggada*.

22. Mus nitidulus, Blyth; Thomas, P. Z. S. 1881, p. 550.

The type of this species, which should be in the Indian Museum, is nowhere to be found; it was, perhaps, lost during the transference of the Asiatic Society's collections to the present Museum. It is therefore impossible to be certain whether Thomas's identification of this species is correct or not.

There is in the Indian Museum a collection of mice from Darjeeling presented by Dr. G. King, and another single specimen from the Khasia Hills, which seem to resemble in certain particulars *Mus nitidulus* of Thomas. In these the fur is long, and in some of the specimens spiny; the tail, which varies somewhat in length, is bicolorous, brown above and white below; but the anterior edge of the outer wall of the infraorbital foramen is not slanting, except perhaps slightly so in one specimen from the Khasia Hills; and the hind foot does not seem to be longer than the distance from the muzzle to the ear. Until, however, authenticated specimens of Thomas's Darjeeling species can be examined, our specimens may remain as *Mus nitidulus*, since there is certainly no other species hitherto described with which they can be identified.

23. Mus humei, Thomas, P. Z. S. 1886, p. 63, pl. v.

This species was described by Thomas from specimens procured by Mr. Hume in Munipur; it appears to be allied to *Mus erythrotis*, from which it differs in being considerably larger. There are no specimens of it in the Indian Museum.

24. Mus erythrotis, Blyth, J. A. S. B. xxiv. p. 721.

The type of this species, of which, unfortunately, the skull appears to have been mislaid, seems to be immature; there is, however, in the Museum another specimen from the same locality, Cherra Punji, which agrees with the type in every way except that it is slightly larger.

The fur in this species is soft, not shining; it is above of a very dark slate-colour for three quarters of its length, the remaining quarter being of a chestnut colour; posteriorly towards the tail the chestnut-coloured portion of the fur increases at the expense of the slate, so that its general appearance is very much redder posteriorly; below, the fur is of a dirty greyish white, getting more and more reddish posteriorly, the bases of the hairs being still slate-coloured.

The tail is somewhat longer than the body; it is slightly more lightly-coloured below than above, and is well-haired but not pencilled. The ear is very small, and is almost concealed by the very long fur all round it; it is further remarkable for a thin tuft of long hairs springing from the middle of the conch, a character which seems to distinguish this species from all other Indian *Muridæ* except *Mus humei*.

The mammæ are eight in number.

The fifth toe of the front foot does not seem abnormally short as it is described to be in *Mus humei*; it reaches well beyond the bottom of the division between the 2nd and 3rd toes almost to a level with the joint of the 1st and 2nd phalanges of the 3rd toe; the pads of the hind toe are large and not very well defined, but the proximal one, which is in all other Indian Mice rounded, is in this species distinctly oval and rat-like.

The skull of this species (Plate XLIV. fig. 5) can be at once recognized by the fact that the external wall of the antorbital foramen is perfectly perpendicular. In this it resembles *Mus humei*, in which, however, the modification has gone further and the wall is concave. The zygoma itself is slightly concave and the anterior palatine foramen ends at the anterior line of the front molars.

The hinder part of the hard palate formed by the pterygoids is characteristic, it forms two little concave cups separated in the median line and from each other by a slight ridge (*cf.* fig. 5 *a*). The posterior nasal opening is exceedingly wide, much wider than the corresponding opening in *Mus urbanus*, and the bulla is much more inflated. Altogether *Mus erythrotis* is a much more distinct species than most of the Indian Mice.

Of the specimens in the Indian Museum six, including the type, are from Cherra Punji on the Khasia Hills, in Assam. Another specimen, a skin, unfortunately without a skull, procured by Col. Godwin-Austen in South Munipur, must also be referred to this species.

The following are the measurements of the adult female above alluded to, in inches:—

Head and body 2·85, tail 3·25, hind foot without claw ·68, fore arm and hand ·83, ear-conch ·32, nose to ear (skull extracted) ·82.

25. Mus mettada (Gray); Thomas, P. Z. S. 1881, p. 550.

This Rat has been fully described and figured by Blanford (J. A. S. B. xlvi. p. 290) and by Thomas, so that there is little to add to the descriptions already published.

The Indian Museum possesses examples of this species from the Etawah and Banda districts of the North-west Provinces, from Karachi in Sind, and the Madras Presidency; Blanford has recorded it from Admednagur, and Sir W. Elliot from the Deccan. This Rat, therefore, seems to be found only in the western and southern parts of India.

26. Mus gleadowi, Murray, P. Z. S. 1885, p. 809, pl. li.

This species seems to be very closely allied to *Mus mettada*, from which it is distinguished by its considerably smaller size and by its much shorter and narrower tarsus. Moreover, *Mus gleadowi* never seems to possess more than four pads on the hind foot, while all the specimens of *Mus mettada* in our Museum possess the proximal fifth pad.

The skull (*cf.* table of measurements, p. 537) resembles that of *Mus mettada* very closely, except that it is slightly smaller in all its dimensions.

The examples of this species in the Indian Museum are all males, so that I am unable to confirm Mr. Blanford's statement that the mammæ are six in number, instead of eight as in *Mus mettada*.

The measurements of the three specimens in the Indian Museum agree very well with those given by Mr. Blanford in a note appended to the original description, *i. e.* head and body 3·40, tail 2·80, hind foot ·70, forearm and hand ·80, ear-conch ·61, auditory meatus to muzzle ·91. The type of the species described by Murray was procured near Kurrachee in Sind; the specimens in the Indian Museum are from Goona in Gwalior and from Kutch.

27. Mus (Leggada) platythrix (Bennett); Thomas, P.Z.S. 1881, p. 553.

To the synonyms of this species *Mus spinulosus* of Blyth (J. A. S. B. xxiii. p. 734) may be added. Blyth's type, which was procured in the Punjab by Mr. Theobald, agrees in every way with the descriptions and with the other undoubted specimens of *Mus* (*Leggada*) *platythrix*; unfortunately the skull, which has been extracted from the type, seems to have been changed for another skull, for the one which is marked as belonging to the type specimen is certainly not identical with the skull of the *Mus* (*Leggada*) *platythrix*, nor is it that of a *Leggada* at all.

There are in the Indian Museum examples of this species from the Punjab, Kurrachee, Bhandara in the Central Provinces, Khandula in Bombay Presidency, and from South Malabar, and the Collagelly Hills in the Madras Presidency. This considerably extends the distribution as given by Thomas.

28. Mus (Leggada) buduga, Gray; Thomas, P. Z. S. 1881, p. 553.

Blyth's specimens of *Mus cervicolor* seem to be rather referable to

this species, as several of them possess fairly well-developed the extra cusp to the front edge of the anterior molar. The specimens from about Calcutta and Northern India are remarkably free from spines in the fur; this is specially the case with the specimens named by Blyth *Mus terricolor*, all of which seem to be immature. The type of *Mus fulvidiventris* is in very bad condition, but there does not seem to be any reasonable doubt that it is conspecific with this species.

There are examples of this species in the large Museum series from nearly all over India, viz. Karachi in Sind; Futtegurh, Etawah, Banda, and Allahabad, N.W.P.; Bhandura and Chanda, C. P.; Poona in Bombay; Madras, Shevaroy Hills, Trichinopoly, and Ganjan in Madras P.; Trincomali in Ceylon; Sirgunja, Midnapur, Maunbhoon, and Calcutta, in Bengal. It is also recorded from Burmah under the name of *Mus beavani* by Blyth in the 'Mammals of Burma' (J. A. S. B. xliv.); but this is probably a mistake, as *Mus beavani* was described by Peters from Maunbhoon, not from Burma.

29. VANDELEURIA OLERACEA (Bennett); Thomas, P. Z. S. 1881, p. 556.

This Mouse is a very distinct form and leads away towards the two other genera *Chiropodomys* and *Hapalomys* described below. Dr. Anderson has given a very full account of the species in his 'Zoological and Anatomical Researches,' to which nothing more can be added, except perhaps the fact that it has hitherto not been recorded from Ceylon. I send figures of the skull (Plate XLIV. fig. 4) and of the dentition (Plate XLV. fig. 10).

30. CHIROPODOMYS GLIROIDES.

*Mus gliroides*, Blyth, J. A. S. B. xxiv. p. 721 (1856).

*Mus peguensis*, Blyth, J. A. S. B. xxviii. p. 295 (1859).

? *Chiropodomys penicillatus*, Peters, Monatsber. Akad. Berlin, 1868, p. 448, pl. i.; Doria, Ann. Mus. Civ. Genoa, (2) iv. p. 631.

*Chiropodomys gliroides*, Thomas, P. Z. S. 1886, p. 78, and 1889, p. 235.

The unique type of *Mus gliroides* of Blyth has unfortunately disappeared from the Museum, so that it is not possible to be absolutely sure as to whether *Mus peguensis* is identical with it or not; there seems, however, to be no reasonable doubt on the subject, since there is in the Museum a Mouse from Cherra Punji, whence the type originally came, which entirely agrees with the description of *Mus gliroides*, and this specimen is certainly conspecific with the type of *Mus peguensis*. Of *Chiropodomys penicillatus*, which is the type of the genus, it is not possible to be certain without a direct comparison of the types, but there is nothing in the description to prevent its being absolutely identical with *Mus gliroides* of Blyth.

In this form the fur is long and soft and not spiny; on the back it is slate-coloured for about three-quarters of its length, the other

quarter being chestnut. The body beneath, including the chin, throat, and sides of the muzzle, is white without any slate-coloured base; the two colours are abruptly separated from one another.

The sides of the snout from which the whiskers spring are considerably swollen; the ears are large, rounded, and covered with very scanty short single hairs, so that unless looked at carefully they appear to be naked: when bent forward they easily reach the eye.

The tail is very long, much longer than the head and body; the basal portion is comparatively bare; the distal portion is covered with gradually increasing quantities of hair, those at the tip of the tail reaching a length sometimes of ·20 of an inch; the tail is quite uniformly coloured, it is not lighter above than below.

On the fore feet there are four well-developed toes, all clawed; the first digit is represented by a mere stump springing from the inner proximal sole-pad and is provided with a flat nail; the toes are all much swollen distally by the great development of the toe-pads, which is very well shown in Peters's plate (*l. c.*); in the hind foot the first digit is very stumpy, and only reaches to the level of the base of the division between the second and third toes, it is provided with a flat nail; the toe-pads are swollen in the same way as are those of the fore feet; the sole-pads are large and well-developed, and the proximal inner one is oblong and rat-like.

In the only specimen in which the mammæ could be made out, they were four in number, and all situated abdominally on either side on a level with the femur; no traces of pectoral or inguinal mammæ were to be found; whether this is a constant character or not must be decided by the examination of more specimens.

The skull of *Chiropodomys* (Plate XLV. fig. 6) resembles that of *Vandeleuria* more than that of any other Indian Mouse; in general appearance it is very wide and short, its breadth being greater than that of any other Indian Mouse or Rat. The nasal bones are so short that the nasal processes of the premaxillæ reach back to a considerable distance behind their posterior ends; this is also the case in *Vandeleuria*, but it is not nearly so marked a feature.

The interparietal is crescent-shaped, with an anterior median projection between the two parietals. The antorbital plate is perfectly straight and perpendicular, as in *Vandeleuria* and *Mus erythrotis*; below the anterior palatine foramina are very short, shorter than in any other Indian Rat, they are also rather broad, and present a kidney-shapped appearance. The posterior nasal opening is very wide, almost as wide as the hard palate; it is equal to more than half the length of the anterior palatine foramen, while in *Vandeleuria* its width is very much less than half the length of the anterior palatine foramen.

The dentition of this species (Plate XLV. fig. 11) appears to be somewhat intermediate between that of *Vandeleuria* and typical *Mus*. The anterior upper molar in *Mus* consists of three central, three external, and two internal cusps, the posterior internal cusps being absent; in *Vandeleuria* there are eight cusps as in *Mus*, but

it is the external posterior, not the internal posterior, cusp that is missing. In *Chiropodomys* there are three central, three external, and generally two internal cusps, but in some specimens small traces of the third posterior cusp can be seen. The median molar in *Mus* consists of two central, two external, and two internal cusps; in *Vandeleuria* of two central, one external, and three internal; in *Chiropodomys* of two median, two external, and two internal cusps, with perhaps traces of the third posterior cusp.

The molars of the lower jaw are much the same in *Mus* and *Vandeleuria*, the anterior consisting of six cusps in two rows bilaterally symmetrical, and the median of four cusps in two rows, also bilaterally symmetrical. In *Chiropodomys* the condition seems more primitive, as in addition to the cusps present in *Mus* and *Vandeleuria* there is a strong external cingulum present which seems to me to represent the true external cusps present in the upper jaws of the molar.

*Chiropodomys* appears therefore to be, so far as the dentition is concerned, a somewhat primitive form combining the dental characters of both *Mus* and *Vandeleuria*, and in addition to that showing distinct traces of the way in which the bilaterally symmetrical molars of the lower jaw of typical Rats have been derived from a form of tooth consisting of a row of central cusps with lateral cusps such as are still found in the upper jaw.

This speculation is rather supported by the condition of the dentition in *Hapalomys*, as will be seen below.

The following are the measurements of a specimen in spirit from Cherra Punji in Assam:—Head and body 3·35, tail 5·15, tarsus ·70, arm and hand 1·0, ear-conch ·53, muzzle to ear (skull extracted) ·90.

The examples of *Chiropodomys gliroides* in the Museum collection are from the following localities:—Cherra Punji in Assam, Munipur, and the valley of the Sitang River in Burmah. This species has also been recorded from the Malay Peninsula (*Hume coll.*), Upper Burma (*Doria*), Borneo (*Wallace*), and Java (*Doria*).

31. HAPALOMYS LONGICAUDATUS, Blyth, J. A. S. B. xxviii. p. 296.

The specimens from which this species was described have hitherto remained, so far as I am aware, unique; they were procured by Major Berdmore in the valley of the Sitang River in Burma. The following description contains considerable additional matter to the short one published by Blyth (*l. s. c.*) thirty-one years ago.

The fur is soft, contains no trace of spines; it is very long, measuring about three-quarters of an inch on the back; the basal three-fourths is very dark slate-coloured, the tips a paler chestnut, with few or no traces of longer black hairs. The body beneath, including the chin and the tip of the muzzle, is white with no trace of the slate-coloured bases to the fur.

The tail is very long, and resembles that of *Chiropodomys* in being clothed with hairs gradually increasing in length distally till

at its tip they reach a length of nearly half an inch; the tail is covered with square scales forming a series of rings which run to about 20 to an inch; the tail is of a light brown colour above and below.

In the hind foot (Plate XLV. fig. 8) the toes are very long, they form about $\frac{1}{2}$ of the total length of the hind foot: the three middle digits are all equal in length and bear well-developed claws; the fifth digit is smaller and bears a very small claw that does not nearly reach beyond the pad; the first digit is about the same length as the fifth, and is very much swollen transversely, it bears a flat nail as in *Chiropodomys*. The toe-pads are very large and swollen, so that the claws hardly extend beyond them; dorsally below the claw, they consist of two flat plates divided by a median groove; ventrally, they consist of the usual series of transverse plates, but much more developed than usual. The sole-pads are six in number; they are large and well-developed, and the proximal internal one very long and curved as in Rats.

The digits of the fore feet (Plate XLV. fig. 9) are four in number; each bears a very small claw, which is almost embedded in the toe-pad; the first digit forms a slight projection on the inner side of the hand, but has no trace of a nail; the toe-pads are swollen like those of the hind feet; the sole-pads are five in number as usual. The ears are very small and rounded; the edge of the conch bears a fringe of long hairs all round, more than $\frac{1}{2}$ an inch in length; the short hairs inside the conch are white, outside brown. The mammæ are 8 in number—two pairs of pectoral, two pairs abdominal.

The skull (Plate XLV. fig. 7) has the same general appearance as that of *Chiropodomys*, being considerably shorter and wider than that of *Mus*; the nasals and the anterior part of the skull are much shorter than in *Mus*; the interparietal is broader and more rounded in outline than in *Chiropodomys*; the anterior wall of the antorbital foramen is perpendicular and does not project at all; below, the anterior palatine foramina are of moderate length, not markedly short as in *Chiropodomys*; they end some distance in front of the line of the anterior molars. The palate is somewhat narrower than that of *Mus rufescens*, and ends on a level with the line of the hind ends of the posterior molars, whereas in *Mus rufescens* the palate projects an appreciable distance further back; the bulla is larger than that of *Mus rufescens*, and is not provided with the thickened anterior edge to the bony meatus which is found in *Mus rattus*.

It is, however, the teeth which present the most distinctive characters. The incisors are quite smooth and have no trace of a groove or of any markings on them: the lower incisors are very broad, resembling those of *Nesokia* and much broader than in *Mus*; the anterior upper molar consists of three central, three external, and three internal cusps all arranged in a remarkably regular way, as will best be understood by reference to the drawing (Plate XLV. fig. 12). The cusps are all more or less equal to one another; the second upper molar exactly resembles the anterior molar, but consists of six cusps only; the posterior molar consists of one central, one

TABLE I.—*Measurements of the Skulls of Indian* Muridæ *in inches.*

| | *M. decumanus.* | *M. rufescens.* | *M. nitidus.* | *M. bowersi.* | *M. fulvescens.* | *M. jerdoni.* | *M. Masfordi.* | *M. berdmorei.* | *M. concolor.* | *M. urbanus.* | *M. bactrianus.* | *M. subhimis.* | *M. erythrus.* | *M. wroughtoni.* | *M. cervicolor.* | *M. nitidulus.* | *M. erythrotis.* | *M. metadis.* | *M. gleadowi.* | *M. platythrix.* | *M. badiogaster.* | *V. oleracea.* | *C. gleroides.* | *H. longicaudatus.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total length | 2·0 | 1·4 | 1·44 | 2·0 | 1·30 | 1·38 | 1·25 | 1·60 ? | 1·15 | ·75 | ·85 | ·83 | ·97 | ·74 | ·76 | ·87 | ·80 | 1·10 | ·95 | ·95 | ·83 | ·77 | ·95 | 1·40 |
| Greatest breadth | 1·0 | ·74 | ·74 | ... | ·70 | ·65 | ... | ·85 | ·58 | ·44 | ·45 | ·49 | ·55 | ·45 | ... | ·46 | ·42 | ·57 | ·50 | ·50? | ·46 | ·43 | ·60 | ·80 |
| Lower jaw—length | 1·2 | ·86 | ·90 | 1·32 | ·80 | ·83 | ·80 | 1·02 | ·70 | ·44 | ·50 | ·53 | ·58 | ·42 | ·50 | ·54 | ·57 | ·67 | ·58 | ·60 | ·48 | ·55 | ·59 | ·90 |
| Nasals | ·84 | ·54 | ·55 | ·81 | ·56 | ·66 | ·53 | ·64 | ·45 | ·29 | ·35 | ·32 | ·46 | ·27 | ·30 | ·38 | ·27 | ·45 | ·42 | ·42 | ·30 | ·28 | ·33 | ·44 |
| Breadth at orbits | ·30 | ·22 | ·22 | ·29 | ·25 | ·24 | ·22 | ·26 | ·18 | ·15 | ·14 | ·18 | ·19 | ·15 | ·15 | ·16 | ·15 | ·18 | ·15 | ·21? | ·15 | ·13 | ·18 | ·21 |
| Anterior palatal foramen | ·40 | ·26 | ·30 | ·35 | ·22 | ·26 | ·28 | ·31 | ·22 | ·19 | ·20 | ·20 | ·18 | ·18 | ·17 | ·21 | ·17 | ·27 | ·24 | ·25 | ·18 | ·14 | ·15 | ·25 |
| Incisors to 1st upper molars | ·60 | ·38 | ·40 | ·65 | ·30 | ·38 | ·35 | ·55 | ·34 | ·20 | ·25 | ·23 | ·28 | ·20 | ·21 | ·25 | ·21 | ·33 | ·27 | ·26 | ·24 | ·20 | ·26 | ·37 |
| Interparietal breadth | ·50 | ·40 | ·40 | ·62 | ·43 | ·45 | ·40 | ... | ·36 | ·32 | ·33 | ·32 | ·35 | ·25 | ·30 | ·35 | ·28 | ·33 | ·35 | ·36 | ·30 | ·30 | ·40 | ·45 |
| Length of molars | ·30 | ·26 | ·30 | ·35 | ·25 | ·25 | ·27 | ·25 | ·20 | ·15 | ·15 | ·15 | ·16 | ·14 | ·15 | ·16 | ·15 | ·22 | ·19 | ·20 | ·15 | ·14 | ·15 | ·30 |

TABLE II.—*Measurements of the Skulls of Indian* Muridæ *reduced in terms of the total length.*

| | *M. dasymanus.* | *M. rufescens.* | *M. wilsoni.* | *M. bowersi.* | *M. fulvescens.* | *M. jerdoni.* | *M. blanfordi.* | *M. berdmorei.* | *M. concolor.* | *M. urbanus.* | *M. bactrianus.* | *M. sublimis.* | *M. arianus.* | *M. wagneri.* | *M. coxinga.* | *M. nitidulus.* | *M. erythrotis.* | *M. mettada.* | *M. gleadowi.* | *M. platythrix.* | *M. badaga.* | *V. oleracea.* | *C. gliroides.* | *H. longicaudatus.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total length | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Greatest breadth | 50 | 52 | 51 | ... | 53 | 47 | ... | 53 | 50 | 58 | 52 | 58 | 56 | 60 | ... | 52 | 52 | 51 | 52 | 52 | 55 | 55 | 63 | 57 |
| Lower jaw—length | 60 | 61 | 62 | 66 | 61 | 60 | 64 | 63 | 60 | 58 | 58 | 63 | 59 | 56 | 65 | 62 | 71 | 60 | 61 | 63 | 57 | 71 | 62 | 64 |
| Nasals | 42 | 38 | 38 | 40 | 43 | 47 | 42 | 40 | 39 | 38 | 41 | 38 | 47 | 36 | 39 | 43 | 33 | 40 | 44 | 44 | 36 | 36 | 34 | 31 |
| Breadth at orbits | 15 | 15 | 15 | 14 | 19 | 17 | 17 | 16 | 15 | 20 | 16 | 21 | 19 | 20 | 19 | 18 | 18 | 16 | 15 | 22 | 18 | 16 | 18 | 15 |
| Anterior palatal foramen | 20 | 18 | 20 | 17 | 17 | 18 | 22 | 19 | 19 | 25 | 23 | 24 | 18 | 24 | 22 | 24 | 21 | 24 | 25 | 26 | 21 | 18 | 15 | 17 |
| Incisors to 1st upper molar | 30 | 27 | 27 | 32 | 23 | 27 | 28 | 34 | 29 | 26 | 29 | 27 | 28 | 27 | 27 | 28 | 26 | 30 | 28 | 27 | 28 | 25 | 27 | 26 |
| Interparietal breadth | 25 | 28 | 27 | 31 | 33 | 32 | 32 | ... | 31 | 42 | 38 | 38 | 36 | 33 | 39 | 40 | 35 | 30 | 36 | 37 | 36 | 38 | 42 | 32 |
| Length of molars | 15 | 18 | 20 | 17 | 19 | 18 | 20 | 21 | 17 | 20 | 17 | 18 | 16 | 18 | 19 | 18 | 18 | 20 | 20 | 21 | 18 | 18 | 15 | 21 |

internal, one posterior cusp, and in addition has externally a slight projection which seems to represent a rudimentary external cusp.

The molars of the lower jaw are even more remarkable: the anterior one consists of eight cusps arranged exactly as those of the molar of the upper jaw, but the anterior external cusp is wanting; the second lower molar consists of six cusps arranged as in the corresponding tooth above, while the posterior molar consists of four cusps only, representing the two central and two external cusps, with a slight trace of the anterior external cusp.

This curious dentition, taken in conjunction with the facts above mentioned about the dentition of *Chiropodomys*, seems to lead to the inference that we have in *Hapalomys* a very primitive form of Rat, by which the dentition of *Mus* may to a certain extent be explained. The upper molars of *Mus* are easily derivable from a molar such as that of *Hapalomys* by the increase in size of the central row of cusps and the suppression of one of the lateral ones; so, too, with *Vandeleuria*. In the case of the molars of the lower jaw the condition in *Mus* and *Vandeleuria* seems to be directly connected with that in *Hapalomys* by the intermediate condition as exhibited in *Chiropodomys*; in *Hapalomys* the external row of cusps is already slightly inferior in development to the central and internal rows, and in the case of the anterior molar one cusp is already lost; in *Chiropodomys* the outer row of cusps has been reduced to the cingulum running along the external face of the molars described above; while in *Vandeleuria* and *Mus* the outer cusps have altogether disappeared, not leaving any trace even of the cingulum, and the molar is bilaterally symmetrical.

These remarks are merely suggested as a method by which a small step in the evolution of Murine molars may have taken place; it would be absurd to lay any great stress on this theory, as I have only been able to examine the skulls of Indian Rats, and I do not claim to have any acquaintance with the numerous exotic forms.

The following are the measurements of the unique spirit-specimen of *Hapalomys longicaudatus*:—Head and body 5·27, tail 7·9, hind foot 1·05, forearm and hand 1·58, ear-conch ·35, muzzle to ear (skull extracted) 1·40.

*List of the Types of* Muridæ *in the Indian Museum.*

| | Names. | Author. | Remarks. |
|---|---|---|---|
| 1 skin. | *Nesokia scullyi.* | Wood-Mason. | |
| 1 al. | *Nesokia barclayanus.* | Anderson. | = *N. bengalensis.* |
| 3 al. | *Nesokia elliotanus.* | Anderson. | = *N. nemorivaga.* |
| 1 al. | *Mus robustulus.* | Blyth. | = *Mus rattus rufescens.* |
| 8 al. | *Mus sladeni.* | Anderson. | = *Mus rattus rufescens.* |
| 3 al. | *Mus yunnanensis.* | Anderson. | = *Mus rattus rufescens.* |
| 2 skins. | *Mus nemoralis.* | Blyth. | = *Mus rattus rufescens.* |

| | Names. | Author. | Remarks. |
|---|---|---|---|
| 1 skin. | *Mus infralineatus.* | Elliot and Blyth. | = *Mus rattus rufescens.* |
| 2 skins. | *Mus andamanensis.* | Blyth. | |
| 1 al. | *Mus bowersii.* | Anderson. | |
| 1 al. | *Mus rubricosa.* | Anderson. | |
| 1 skin, 1 al. | *Mus cinnamomeus.* | Blyth. | = *Mus fulvescens.* |
| 1 skin. | *Mus jerdoni.* | Blyth. | |
| 1 skull. | *Mus berdmorei.* | Blyth. | |
| 2 al. | *Mus concolor.* | Blyth. | |
| 1 al. | *Mus kakhyensis.* | Anderson. | = *Mus urbanus.* |
| 2 al. | *Mus viculorum.* | Anderson. | = *Mus urbanus.* |
| 1 skin. | *Mus gerbillinus.* | Blyth. | = *Mus bactrianus.* |
| Al. | *Mus sublimis.* | Blanford. | |
| 2 al. | *Mus erythronotus.* | Blanford. | = *Mus arianus* (only name changed). |
| 2 al. | *Mus pachycercus.* | Blanford. | = *Mus wagneri.* |
| 3 al. | *Mus cuniculatis.* | Blyth. | = *Mus cervicolor.* |
| 1 al. | *Mus erythrotis.* | Blyth. | |
| Skin. | *Mus fulvidiventris.* | Blyth. | = *Mus* (*Leggada*) *buduga.* |
| 2 al. | *Mus terricolor.* | Blyth. | = *Mus* (*Leggada*) *buduga.* |
| 1 skin, 1 al. | *Mus peguensis.* | Blyth. | = *Chiropodomys gliroides.* |
| 1 skin, 1 al. | *Hapalomys longicaudatus.* | Blyth. | |

## EXPLANATION OF THE PLATES.

### PLATE XLIV.

Fig. 1. Skull of *Mus fulvescens*, p. 525. *a*, palatal view; *b*, lateral view.
2. Skull of *Mus bowersii*, p. 524. Lateral view.
3. Skull of *Mus concolor*, p. 527. *a*, palatal view; *b*, lateral view; *c*, from above.
4. Skull of *Vandeleuria oleracea*, p. 532. *a*, palatal view; *b*, lateral view; *c*, from above.
5. Skull of *Mus erythrotis*, p. 530. *a*, palatal view; *b*, lateral view; *c*, from above.

### PLATE XLV.

Fig. 6. Skull of *Chiropodomys gliroides*, p. 533. *a*, palatal view; *b*, lateral view.
7. Skull of *Hapalomys longicaudatus*, p. 535. *a*, palatal view; *b*, lateral view; *c*, from above.
8. Hind foot of *Hapalomys longicaudatus*, p. 535.
9. Fore foot of *Hapalomys longicaudatus*, p. 535.
10. Dentition of *Vandeleuria oleracea*, p. 533. *a*, upper left, *b*, lower left molars. × 3 diam.
11. Dentition of *Chiropodomys gliroides*, p. 533. *a*, upper left, *b*, lower left molars. × 3.
12. Dentition of *Hapalomys longicaudatus*, p. 535. *a*, upper left, *b*, lower left molars. × 2.

## 7. On Secondary Sexual Characters in the Genus *Arnoglossus*. By J. T. Cunningham, M.A., F.R.S.E., Naturalist to the Marine Biological Association.

[Received June 10, 1890.]

### I. Arnoglossus laterna, Günther.

The history of the species *Arnoglossus lophotes*, Günther, has been quite recently reviewed by Dr. A. Günther in the Proceedings of this Society[1]. I need not therefore repeat it here in detail. But it is necessary to mention that Couch in his 'History of British Fishes' (1864) recorded that he had examined a dried skin of the form in question at the house of Lieutenant Spence, R.N., at Plymouth, this specimen having been taken, we are told, in the neighbourhood of that port. The only entire specimens examined by Dr. Günther were one trawled by Prof. Moseley in 1882 near Lundy Island, and one sent from Palermo.

Until December 1889 I had never met with any specimens in the course of my observations at Plymouth which exhibited the characters ascribed to *A. lophotes*. At the beginning of that month I collected specimens of *A. laterna* in order to make an attentive examination of its characters. I asked a man employed on the fish-quay to bring me a number of full-grown specimens of the 'Scald-fish,' as the species is called at Plymouth, from the trawling-smacks which came in from the fishing-grounds. Among the specimens he brought me I was much surprised as well as pleased to find a number which presented the peculiarities of *A. lophotes*. In fact, whenever the man brought a number of Scald-fish from the trawl refuse, there were more *A. lophotes* than *A. laterna* among them. The specimens were obtained at all parts of the trawling-grounds off Plymouth, that is from 3 to 15 or 20 miles off the south coast of Devon and East Cornwall. On subsequent excursions in trawlers, both in the neighbourhood of Plymouth, off Mounts Bay, and in the Bristol Channel, I found that the *lophotes* form always occurred along with *A. laterna* and was more abundant than the latter.

I of course made a careful examination of the specimens obtained, and was for some time puzzled by the close similarity between the two forms in the majority of their characters. I found, too, on examining smaller and therefore younger specimens that none of them exhibited the elongation of the anterior dorsal fin-rays which characterizes *A. lophotes*, but that this character was confined to specimens above a certain size. I began to think that if the two forms were really distinct species, they were more exactly similar in the majority of their characters than two distinct species usually are. Then it occurred to me to ascertain the sex of every specimen; and I found that specimens of *A. lophotes* were invariably males, and adult specimens of *A. laterna* invariably females. Having found

[1] "A Contribution to our Knowledge of British Pleuronectidæ," P. Z. S. 1890, p. 40.

that this was true in every case without exception, and having traced the gradual development of the peculiar character in the males, I no longer had any doubt that the two forms belong to a single sexually dimorphic species. I will now describe the differences between the two forms in some detail.

The largest specimens of the male, or *lophotes* form, are 20 cm. long including the tail. The first dorsal ray is not elongated, and its length is contained $4\frac{1}{2}$ times in the length of the head; it is thin and flexible and arises from the right side of the head, not from the edge. The 2nd, 3rd, 4th, 5th, and 6th dorsal fin-rays are elongated, the order of magnitude being 4th, 3rd, 5th, 2nd, 6th; the fourth ray in a specimen of the length just mentioned measured 3·2 cm. or five sixths of the length of the head.

The rays of the left pelvic fin, excepting the first, are also elongated as compared with those of the female, the 4th being the longest. In the specimen mentioned it was 2 cm. long, or half the length of the head.

The eyes in the male are slightly larger than those of the female, as the following measurements show (the total length given includes the tail; the eyes were measured along the longitudinal diameter):—

| | Total length. | Diameter of eye. |
|---|---|---|
| Males ..... | 13·2 cm. | 6·5 mm. |
| | 17·4 cm. | 8·75 mm. |
| | 18·4 cm. | 10·0 mm. |
| Females .... | 13·7 cm. | 7·0 mm. |
| | 17·6 cm. | 8·5 mm. |
| | 18·7 cm. | 9·25 mm. |

The length of the upper jaw measured from its anterior extremity to the posterior end of the maxilla on the upper side is slightly smaller in the male than in the female, as the following measurements show:—

| | Total length. | Length of upper jaw. |
|---|---|---|
| Males ..... | 19·1 cm. | 11·25 mm. |
| | 18·4 cm. | 10·5 mm. |
| Females.... | 18·7 cm. | 12·0 mm. |
| | 18·5 cm. | 11·25 mm. |

Up to the length of 13·2 cm. the males do not show any elongation of the rays of the dorsal or pelvic fins, and therefore do not differ in this respect from the females. But in male specimens 14·7 cm. long the character is already well-marked, the longest dorsal ray in a specimen of this length being five sixths of the length of the head, as in a full-grown specimen.

In the full-grown adult female the character so conspicuous in the male is slightly but distinctly developed, that is to say some of the anterior dorsal fin-rays are slightly elongated. The 2nd, 3rd,

4th, and 5th rays are longer than the 6th, the third being the longest. In a female specimen 20 cm. long the 3rd ray was 14·5 mm. long or two fifths the length of the head. At the same time the 3rd ray in the adult female is not so long as the longest rays of the fin, which are behind the middle of the body and are half the length of the head as in *A. laterna*, according to Dr. Günther's description. The longest ray in the left pelvic fin in the female specimen just mentioned was about the same length as the 3rd dorsal, namely 15 mm.

In young specimens of either sex less than 13·2 cm. in length, no elongation of the anterior dorsal fin-rays exists, but the rays increase gradually in length from the 2nd backwards.

I have now to guard against the possible objection that the large adult specimens I have described are males and females of a distinct species *A. lophotes*, and the small specimens are *A. laterna*. The truth of my conclusion is almost sufficiently established by these facts, that I have examined a large number of specimens taken indiscriminately by the trawl in various localities and at all depths, that among these specimens all those in which the anterior dorsal rays are elongated and thickened are males, all those in which the anterior dorsal rays are very slightly elongated are females more than 13 cm. long, and all specimens less than 13 cm. in length are of either sex and show no elongation of the rays. But all possible doubt is overcome by the fact that with the exception of the three characters already discussed, namely, the length of the anterior dorsal fin-rays, the length of the upper jaw, and the size of the eyes, all my specimens essentially agree with descriptions given by previous writers of the species *A. laterna*. To show this I will describe some of the characters in my specimens.

The following are the numbers of fin-rays found in three specimens:—

| | | | | | |
|---|---|---|---|---|---|
| Male 19·3 cm. long .... | D. 101. | A. 78. | P. 10. | V. 6. | C. 17. |
| Female 20 cm. long.... | D. 96. | A. 75. | P. 10. | V. 6. | C. 17. |
| Female 10·2 cm. long . | D. 92. | A. 69. | P. 10. | V. 6. | C. 17. |

The extreme tenderness of the skin and slight attachment of the scales are equally exhibited by all the specimens; in fact all those brought to me from the deep-sea trawlers have lost the whole of the scales and skin from both sides, except the scales of the lateral line on the upper side. The membrane of the longitudinal fins also possesses this tenderness, so that the rays are usually much separated in captured specimens. The elongated rays in the male are free for the greater part of their length, and not fringed or bordered with membrane. The shape of the body and of the lateral line are the same in all the specimens. The bight of the lateral line above the pectoral is almost rectangular. The broadest part of the body is across the end of the pectoral fin, whence the edges curve gradually backwards, more steeply forwards. The anterior extremity of the body is pointed, the mouth-cleft opening at the apex, and the apex being nearer the ventral than the dorsal edge.

The scales are extremly thin; those of the upper side are larger and have a single row of minute spines along the posterior edge, those of the lower side are smaller and are smooth with an entire edge without spines. The scales along the lateral line of the lower side are not pierced by a dermal tube and are not tubular; the lateral sensory tube is either rudimentary or absent on this side. On the upper side the lateral dermal tube pierces a series of tubular scales as usual.

Dr. Günther has made a mistake in stating that no author mentions a prolongation of fin-rays in the common British species of Scald-fish. Couch, in his 'Fishes of the British Islands,' in his description of the species says:—"The dorsal fin begins in front of the upper eye, and commonly is narrow at its origin, becoming wider at half its length, but in the example described several of the first rays were considerably lengthened into separate threads." The character thus mentioned is represented in Couch's figure, and agrees exactly with the condition I have described in my larger female specimens. Couch cannot be supposed to have confused the two forms, for he gives a separate description and woodcut of *A. lophotes*.

Day also in his description of *Arnoglossus laterna* says "the dorsal commences on the snout, its first few rays being occasionally somewhat separated one from the other and a little elevated."

The total number of specimens brought to me in the beginning of last December and on which this paper is founded was 43. I determined the sex of all of these by opening the body-cavity. There were 30 males and only 13 females. As the specimens were collected indiscriminately, it is evident that the males are far more numerous than the females. The testes of the males are extremely small in comparison with the size of the ovaries in the females, and this fact is doubtless correlated with the numerical superiority of the males. The relations of the sexes in the common Sole, as shown in my treatise on that species, are quite similar. In size the sexes of *A. laterna* show no difference, the largest specimens both of males and females being 20·4 cm. in length, or just over 8 inches.

I have examined those specimens of this species which are preserved entire in spirit in the collection of the British Museum of Natural History, with the following results. The specimen of *A. laterna* marked *o*, obtained by Mr. Murray in Kilbrennan Sound in the Firth of Clyde, is a female and resembles in all respects my own female specimens. There are only two entire specimens of *A. lophotes*—one obtained by Prof. Moseley off Cardiff in 1882, another sent by Prof. Doderlein from Palermo. Both are of the male sex. The first is $5\frac{1}{2}$ inches long, the second $6\frac{3}{4}$ inches. Both resemble my male specimens in all respects. In the Cardiff specimen the 4th dorsal ray is the longest, in the Palermo specimen the 5th.

I have already stated that adult and full-grown individuals of the Scald-fish are abundant off the Devon and Cornish coasts up to the depth of 40 fathoms. Young specimens of all sizes from 1 cm. or even less up to 11 or 12 cm. are very abundant in Cawsand Bay, Plymouth Sound, at a depth of 2 to 6 fathoms.

In justice to Dr. Günther I must explain here that in December last, when I first obtained specimens resembling his species *A. lophotes*, I had some correspondence with him on the subject. After I had informed him of my belief that they were the males of *laterna*, and found that he was publishing a paper on *Arnoglossus*, I requested him to include in his paper my conclusion and the evidence for it, if he thought the conclusion sound. But he replied that his paper had already been sent to the Secretary of this Society, and that he preferred to leave it as it stood, so that I might publish my observations quite independently.

II. Arnoglossus grohmanni, Günther.

It is recorded in Dr. Günther's paper that hitherto only one specimen of this species has been found in British waters, namely one obtained by the Rev. W. S. Green from a depth of 10 fathoms in the Kenmare River on the S.W. coast of Ireland. I have to record another specimen, which was found by Mr. Walter Garstang, on March 20th of the present year, among material obtained by the small beam-trawl in Cawsand Bay, Plymouth Sound, at a depth of 4 or 5 fathoms. In nearly all the specific characters mentioned by Dr. Günther this specimen resembles *A. grohmanni*. The specimen measures 15·3 cm. in length including the caudal fin, and 5·7 cm. in greatest height. The numbers of fin-rays are :—

D. 87, A. 66, P. 10, V. 6, C. 17,

thus agreeing very closely indeed with the numbers in Dr. Günther's specimens. In the shape of the anterior part of the body, the size of the eyes, the character of the mouth and jaws, the form of the lateral line, the characters of the scales, and in colour the specimen agrees with *A. grohmanni*, and there can be no doubt that it belongs to that species. But in some interesting peculiarities the specimen differs considerably from those described either by Dr. Günther or any other ichthyologist. The anterior part of the specimen is represented in the accompanying drawing (see p. 545). The 2nd, 3rd, and 4th dorsal fin-rays are elongate, the 2nd being much the longest. The 2nd ray is very nearly as long as the head, being 28 mm. in length, while the head measures 29·5 mm. from the edge of the operculum to the apex of the lower jaw. This ray is therefore considerably longer than in previously described specimens. The same ray is fringed anteriorly and posteriorly by a broad plicated membrane which is quite independent of the rest of the fin, so that the ray presents the appearance of a feather, the broadest part of the fringe being near its proximal end, where it measures 1 cm. in breadth. The breadth of the fringed ray diminishes gradually to zero at the apex. Thus this ray is both longer and its fringing membrane much broader than in Dr. Günther's specimens. The first ray is short and fringed with a very narrow membrane, which is continued at the base and posteriorly on to the root of the 2nd ray. The 3rd ray is two thirds the length of the head, and very slightly fringed with membrane at its outer part; this ray is sepa-

rated from the second but connected posteriorly with the membrane of the dorsal fin. The 4th ray is slightly longer than the 5th; from the 5th backwards the rays increase gradually in height as usual. The specimen is also higher in proportion to its length than those described in Dr. Günther's paper, the greatest height being contained $2\frac{1}{2}$ times in the total length including the caudal fin.

My specimen is a male, and there can be no doubt that those characters I have described in which it differs from previously known specimens of *Arnoglossus grohmanni* are secondary sexual characters peculiar to the male sex. Thus an interesting sexual dimorphism occurs in both these species of *Arnoglossus*. It is worth noting that the sexual dimorphism of *Callionymus lyra*, in which the two sexes were originally described as distinct species, consists principally

Head of *Arnoglossus grohmanni*, ♂.

in a difference of the same kind as that in the genus *Arnoglossus*, namely a great elongation in the male of the anterior dorsal fin-rays.

The specimen here described, when first found in a pan of trawled material, was dead but perfectly fresh. Nearly all the scales except those of the lateral line were wanting, but the skin was nearly entire and showed the colour and markings distinctly. The general colour was rather dark and sombre, the markings consisted of black and orange blotches and streaks. The black blotches were arranged on the upper side as in the common Sole, namely in three principal longitudinal rows, one along the lateral line and one along each

edge of the body, with two intermediate rows of smaller blotches. There were also black marks at intervals along the dorsal and anal fins. The scales are considerably larger than in *A. laterna*, those in the middle of the upper side being 3·5 mm. in breadth. As in that species, the scales of the upper side have a single row of short spines along the posterior edge, while in those of the lower side the edge is entire.

## 8. Notes on Specimens in the Hume Collection of Birds.—No. 6. On the Coraciidæ of the Indian Region, with Descriptions of some new Species[1]. By R. Bowdler Sharpe, F.L.S., &c.

[Received June 16, 1890.]

During the time that my friend Mr. Oates has been engaged in writing on the Passeres of the 'Fauna of British India,' I have refrained from publishing any critical notices of the Hume Collection. Since, however, every representation to the Government of India has failed in procuring for Mr. Oates the extension of leave from his duties in Burma, necessary for him to complete his work, which has therefore come to a standstill at the end of the Passeres, I feel myself at liberty to turn my attention once more to the study of the Hume Collection.

Since I wrote my last paper thousands of specimens have been registered and incorporated in the cabinets of the British Museum; and the superb series collected by Mr. Hume enables one to thoroughly work out every species of Indian bird; but it is surprising what a field still lies open for inquiry in the study of the Hume Collection. Witness the discovery that three species of *Eurystomus* have been confused under the heading of *E. orientalis*, to disentangle which confusion is one of the objects of the present paper.

As it is obviously impossible to publish a complete list of all the Hume specimens in the 'Proceedings,' and as they will shortly appear in their proper place in the 'Catalogue of Birds,' I have thought it best to try and condense my few remarks into the form adopted by Mr. Oates in his work, to which this paper may be taken as a supplement.

### Fam. Coraciidæ.

The front plantar leading to the hallux. Well-defined lateral bare tracts on the neck. Spinal feather-tract forked on the upper back. Oil-gland nude or absent. (*H. Seebohm.*)

### Subfam. Coraciinæ.

There are two genera of *Coraciinæ* found in Africa and India. They consist of the brilliant Roller, commonly called the "Jay" by

[1] For No. 5, see P. Z. S. 1887, p. 470.

Anglo-Indians, and the Broad-billed Blue Roller, a much less familiar species.

*Key to the Genera.*

a. Bill long and slender, compressed, much longer than it is broad ..... CORACIAS, p. 547.
b. Bill stout and depressed, as well as slightly hooked, as broad at gape as it is high ..... EURYSTOMUS, p. 550.

On comparing the skulls of *Coracias* and *Eurystomus* the differences above noted will be found to be emphasized, the skull being everywhere broader and more massive, and especially remarkable for its very broad palatine bones. The nasal aperture is apparently linear in *Coracias*, and triangular in *Eurystomus*.

As with other Picarian birds, the Rollers nest in holes of trees or buildings and lay white eggs. They get their name of "Roller" from their peculiar flight; but the broad-billed *Eurystomi* are more forest-loving, and by no means such birds of the open as the species of *Coracias*.

## Genus CORACIAS, Linnæus, 1766.

Three species of *Coracias* occur in the Indian Region, all of them well represented in Mr. Hume's collection. There appears to be very little doubt that *C. indica* and *C. affinis* interbreed on the confines of their respective ranges, and this is probably one of the few absolutely indisputable instances of hybridization between birds taking place in a state of nature. Dr. Jerdon and Mr. Blyth also speak of the crossing of *C. indica* with *C. garrula* in the extreme North-west, but I have not seen any instance of this phenomenon exhibited in the Hume series.

*Key to the Species.*

a. With a subterminal band of silvery blue on the quills.
a'. Tail with a broad terminal band of purplish blue; upper tail-coverts purplish blue, darker than the rump ..... *indica*, p. 547.
b'. Tail with no terminal band, though occasionally a blackish spot at the end of the feathers is present; upper tail-coverts light silvery blue, paler than the rump ..... *affinis*, p. 548.
b. With no subterminal blue band on the quills, the basal part only being light; primary-coverts silvery blue; back light bay ..... *garrula*, p. 549.

### 1. CORACIAS INDICA. *The Indian Roller.*

*Coracias indica*, Linn. Syst. Nat. i. p. 157; Blyth, Cat. p. 51; Horsf. & Moore, Cat. ii. p. 571; Jerd. B. I. i. p. 214; Gould, B. Asia, i. pl. 54; Hume, Cat. no. 123; Legge, B. Ceyl. p. 281.

*Coloration.* Base of forehead and lores sandy white; head greenish blue, with a wash of bright blue over the eye; round the hind neck a collar of lilac-rufous; back drab, washed with oily green; lower back and rump bright blue; upper tail-coverts purplish blue; wing-coverts greenish blue, as well as the base of the quills; lesser coverts purplish blue; remainder of quills purplish blue, the primaries with a subterminal band of bright blue; inner secondaries

like back; centre tail-feathers green, the remainder silvery blue, with a purplish-blue base and a band of the same colour at the tip; chin and base of cheeks white; sides of face, throat, and breast lilac-brown, purplish on the throat, which is streaked with white; remainder of under surface light blue. "Bill blackish brown, paler at base of lower mandible; inside of mouth pale greenish yellow; feet brownish yellow; eyelid and naked skin round the eye pale gamboge; iris greyish brown" (*E. A. Butler*).

Length about 12 inches, tail 5, wing 7·3, tarsus 0·95, bill from gape 1·7.

The specimens from Southern India are rather darker and more richly coloured than the birds of the North-western plains, those from the N.W. Provinces being decidedly lighter in colour.

*Distribution.* Nearly the whole of India and Ceylon, not ascending the hills. It extends from Asia Minor to Persia, Northern Arabia, and Baluchistan, and thence over the greater part of the plains of India. Its range extends to the Nepal Valley, where Dr. Scully procured authentic specimens, and here it meets with *C. affinis* from Assam, and intermediate specimens occur in which the strain of *C. indica* predominates. Its eastern limit appears to be Dacca and the vicinity of Calcutta, where intermediates between it and *C. affinis* again occur rather frequently. Over Central and Southern India it is likewise generally spread, but it is apparently not nearly so plentiful as in Upper India; and in the Deccan it is migratory, retiring to the better-wooded tracts to breed, according to Colonel Butler and the Rev. S. B. Fairbank.

*Habits, &c.* Breeds from the end of March right into July according to Hume, who also states that in Upper India the great majority of the birds lay in April and June. The Indian Roller, like its congeners, nests in holes, sometimes making a considerable nest of feathers, grass, &c. The situation chosen is the hole of a tree or old walls, or in roofs and under the eaves of bungalows. The eggs are white, and measure from about 1·3 inch in length by about 1·06 inch in breadth.

CORACIAS AFFINIS. *The Burmese Roller.*

*Coracias affinis*, McClell. P. Z. S. 1839, p. 164; Blyth, Cat. p. 51 (1849); Horsf. & M. Cat. ii. p. 574 (1856); Jerd. B. I. i. p. 217 (1862); Godw.-Aust. J. A. S. B. xxxix. p. 95 (1873); Blyth & Wald. B. Burm. p. 72 (1875); Hume & Davis. Str. F. vi. p. 72 (1878); Anders. Yunnan Exped., Aves, p. 581 (1878); Hume, Cat. no. 124; Oates, B. B. ii. p. 69 (1883); Salvad. Ann. Mus. Genov. (2) iv. p. 589 (1887); Hume, S. F. xi. p. 48 (1888).

*Coloration.* Upper surface dingy olive-brown; lower back and rump purplish blue, but the upper tail-coverts silvery cobalt; wings and tail as in *C. indica*, excepting that there is no blue terminal band to the latter, the outer feather alone having a black spot at the end; crown of head greenish blue, with a lighter and more verditer-blue shade on the forehead and eyebrow; sides of face and throat and breast brown, becoming paler on the latter; chin

greenish white; throat streaked with lilac-blue; abdomen and under tail-coverts light cobalt; thighs purplish blue. "Bill dark brownish black; mouth yellow; edges of the eyelids, lores, and skin at the back of the eye yellowish orange; iris brown; legs yellowish brown; claws black" (*Oates*).

Length about 12 inches, tail 4·7, wing 7·6, tarsus 1, bill from gape 1·75.

*Distribution.* From Nepal to Darjiling and Bhutan, thence throughout Assam and Cachar as far west as Dacca and the neighbourhood of Calcutta. It is spread all over Burma and Tenasserim, except in the extreme south, and ranges eastwards to Siam and Cochin China. Specimens in the Hume Collection from Nepal (*J. Scully*), Native and British Sikhim (*L. Mandelli*), Tippera, and Calcutta are apparently hybrids between the present species and *Coracias indica*, and belong to the intermediate form which I call *Coracias indica affinis*.

*Habits, &c.* Similar to those of *C. indica*. Mr. Oates has found the bird breeding in Pegu in March and April. The eggs are glossy white, four or five in number, laid on the bare wood at the bottom of large natural hollows in decayed branches of large trees. The average of twelve eggs was 1·37 inch by 1·09.

3. CORACIAS GARRULA. *The Common Roller.*

*Coracias garrula*, Linn. S. N. i. p. 159 (1766); Horsf. & M. Cat. ii. p. 570 (1856); Hume, N. & E. p. 104 (1813); Hume, Cat. no. 125; Bidd. Ibis, 1881, p. 48; Scully, t. c. p. 429; C. Swinh. Ibis, 1882, p. 102.

*Coloration.* Upper surface light cinnamon, including the scapulars and inner secondaries; lower back and rump dark ultramarine; upper tail-coverts greenish blue washed with ultramarine; wing-coverts round the bend of the wing ultramarine; rest of the coverts greenish blue, as well as the base of the quills; bastard-wing green, blue at the end; primary-coverts greenish blue with a dark blue tip; remainder of quills black; two centre tail-feathers dull greenish; remainder of the feathers dark blue, externally green and internally black, all the feathers light silvery blue near the ends, the outermost with a black terminal spot; crown, sides of head, and under surface of body pale greenish blue, the base of the forehead and the chin white; the throat and chest as well as the sides of the face streaked with silvery green.

Young birds are much duller in colour than the adults, and have the breast pervaded with a brown shade. Although no difference can be found between adult Rollers from Europe and those from Cashmere, the young specimens from the latter locality and N.W. India are generally much paler than European birds of similar age.

*Distribution.* The European Roller extends from Southern and Central Europe through Persia to Afghanistan, where it breeds, as well as in Cashmere. In the autumn it visits various parts of North-western India, occurring regularly in the vicinity of Simla, and specimens are in the Hume Collection from Masuri and Gurhwal.

## Genus Eurystomus, Vieill., 1816.

The Broad-billed Rollers inhabit Africa, Madagascar, and the greater part of the Indian and Australian regions. One species ranges as high as Manchuria and Eastern Siberia.

The habits of these birds differ considerably from those of the true Rollers (*Coracias*). They affect the forests rather than the open country, and are of a sluggish nature during the daytime, becoming active in pursuit of food in the morning and evening only.

A curious consensus of opinion is expressed by writers on Indian ornithology that there is only one species of *Eurystomus* occurring within Indian limits, and that specimens from the Malay Archipelago are identical with those from the Indian Peninsula; but after a careful examination of the series in the Hume Collection, there appears to be no doubt that there are *three* Indian species, each with well-defined characters and a definite range.

### *Key to the Species.*

*a*. Terminal half of tail entirely black, not shaded with purplish blue.
  *a'*. Larger; under surface decidedly greenish; head brownish black; secondaries black with no blue shade externally ..... *orientalis*, p. 550.
  *b'*. Smaller; under surface decidedly blue; head black; secondaries black, washed with purplish blue near the base of the outer web ..... *lætior*, p. 551.
*b*. Terminal half of the tail black, but conspicuously washed with purplish blue ..... *calonyx*, p. 551.

### 1. Eurystomus orientalis.

*Coracias orientalis*, Linn. S. N. i. p. 159 (1766).

*Eurystomus orientalis* (Linn.), Steph. Gen. Zool. vii. p. 403 (1809); Horsf. & M. Cat. i. p. 121 (1854); Hume, S. F. ii. p. 164 (1874); Blyth & Wald. B. B. p. 72 (1875); Hume & Davison, S. F. vi. p. 72 (1878); Hume, Cat. no. 126 (pt.); Oates, B. B. ii. p. 70 (1883).

*Coloration*. Bluish green, the wing-coverts and scapulars a little brighter than the back, as also the inner secondaries; head blackish brown, the hind neck, sides of head, and sides of neck brown and washed with green; under surface of body greenish blue, duller on the fore neck and chest; the throat violet-blue, each feather with a mesial streak of brighter blue; primary-coverts black, with a narrow edging of purplish blue; quills black, the primaries purplish blue at the base, followed by a subbasal band of silvery blue, which is again succeeded by a purplish shade; most of the secondaries entirely black, some of the inner ones with a slight edging of purplish blue; tail black, with a purplish and blue shade near the base.

Bill, legs, and feet dull vermilion, the tip of the bill black; iris dark brown; gape yellowish.

Length about 11·5 inches, tail 4·1, wing 7·4, tarsus 0·65, bill from gape 1·45.

*Distribution.* Locally distributed over the Burmese provinces, extending as far north as Cachar, and southward through Tenasserim and the Malayan Peninsula to Sumatra, Java, Borneo, and the Philippines. Major Wardlaw-Ramsay records the species from the Karen Hills, but as no specimens were preserved it is possible that the bird there noticed was *E. calonyx*. It is also found in the Andamans, the birds from this locality being remarkable for a somewhat larger bill.

2. Eurystomus læticus, sp. n.

*Eurystomus orientalis* (nec L.), Vipan, S. F. i. p. 495 (1873); Morgan, S. F. ii. p. 531 (1874); Hume, S. F. iv. p. 382 (1876); Legge, B. Ceylon, p. 285 (1878); Davison, S. F. x. p. 351 (1883).

*Coloration.* Similar to *E. orientalis*, and, like that species, having the end of the tail black without any mark of purplish blue. Differs in its somewhat smaller size, blacker head, brighter blue under surface, and also in having the black secondaries washed with purplish blue near the base of the outer web.

Bill deep orange-red, the tip of the upper mandible black; orbital skin red; tarsi and feet orange-red; feet duskier than the tarsus; iris hazel-brown.

Length about 11 inches, tail 4, wing 7·8, tarsus 0·65, bill from gape 1·5.

*Distribution.* The forests of Malabar (where Mr. R. W. Morgan procured specimens at Nellumbore) and the Nilghiris. It breeds in the Travancore Hills, but, according to Mr. Bourdillon, it is apparently not a resident. In Ceylon it is an extremely rare bird, and but few instances of its occurrence are recorded by Colonel Legge.

*Habits.* Mr. Bourdillon found a pair breeding in Travancore, where they ejected a pair of Mynahs (*Eulabes religiosa*) from their hole in a tree-stump at about 40 feet from the ground. The eggs are like those of the Indian Roller, but are somewhat larger, very broad ovals, pure white and fairly glossy (*Hume*).

3. Eurystomus calonyx.

*Eurystomus calonyx*, Hodgs. in Gray's Zool. Misc. p. 82 (*nom nudum*).

*Eurystomus orientalis* (nec L.), Hodgs. t. c. p. 82 (1844); Gray, Cat. Hodgs. Coll. p. 55 (1846); Blyth, Cat. p. 51 (1849); Jerd. B. Ind. i. p. 219 (1862); Hume, N. & E. p. 105 (1873); id. Cat. no. 126 (pt.).

*Coloration.* Similar to *E. orientalis*. Differs in having the end of the tail black washed with purplish blue, and the whole of the black secondaries also washed with purplish blue. "Bill and feet coral-red; iris red" (*W. E. M. James*).

Length 11 inches, tail 3·9, wing 7·4, tarsus 0·75, bill from gape 1·45.

*Distribution.* Extends throughout the Himalayan Terai from

Kumaon to Darjiling and Upper Assam, probably breeding throughout the whole of this range. Mr. Thompson states that they are found from the Sardah to the Ganges, but particularly abound in the Kotree Doon. The species is also found in summer in Eastern Siberia and Northern China, and it appears to winter in Southern Tenasserim and the Malayan Peninsula, specimens being in the Hume Collection from Copah, Malacca, Pulo Seban, and the native State of Kuroo near Malacca. It is probably this species which Jerdon believed to winter in Central India.

*Habits, &c.* Arrives, according to Mr. Thompson, in the Terai below Kumaon in April, breeding in May and finally leaving the forests in July and August. They breed in the loftiest sál trees in holes in the higher branches (never less than 50 feet from the ground), and they are confined to the sál forests.

Although this species has never yet been described and its differences from *E. orientalis* pointed out, I have thought it best to adopt Hodgson's name. This has before now been quoted, but only as a synonym of *E. orientalis*, which is the black-tailed bird.

While on the subject of the Eastern *Eurystomi*, I may point out that the Roller of the Solomon Islands, usually identified with *E. crassirostris*, is a distinct species, entirely wanting the black tip to the culmen which is found in all the other *Eurystomi*. Although originally supposed to come from the Solomon Islands, there is no doubt that the type specimen of *E. crassirostris* came from New Ireland, like many other birds out of the same collection. I have not seen the type specimen recently, but it is distinctly described by Count Salvadori as having a black-tipped culmen, and I therefore call the allied bird from the Solomons

EURYSTOMUS SOLOMONENSIS, sp. n.

E. *similis* E. crassirostri, *sed rostro omnino rubro, culmine minime nigro terminato distinguendus. Long. tot.* 12·0, *culm.* 1·45, *ala* 7·7, *caud.* 5·2, *tarsi* 0·7.

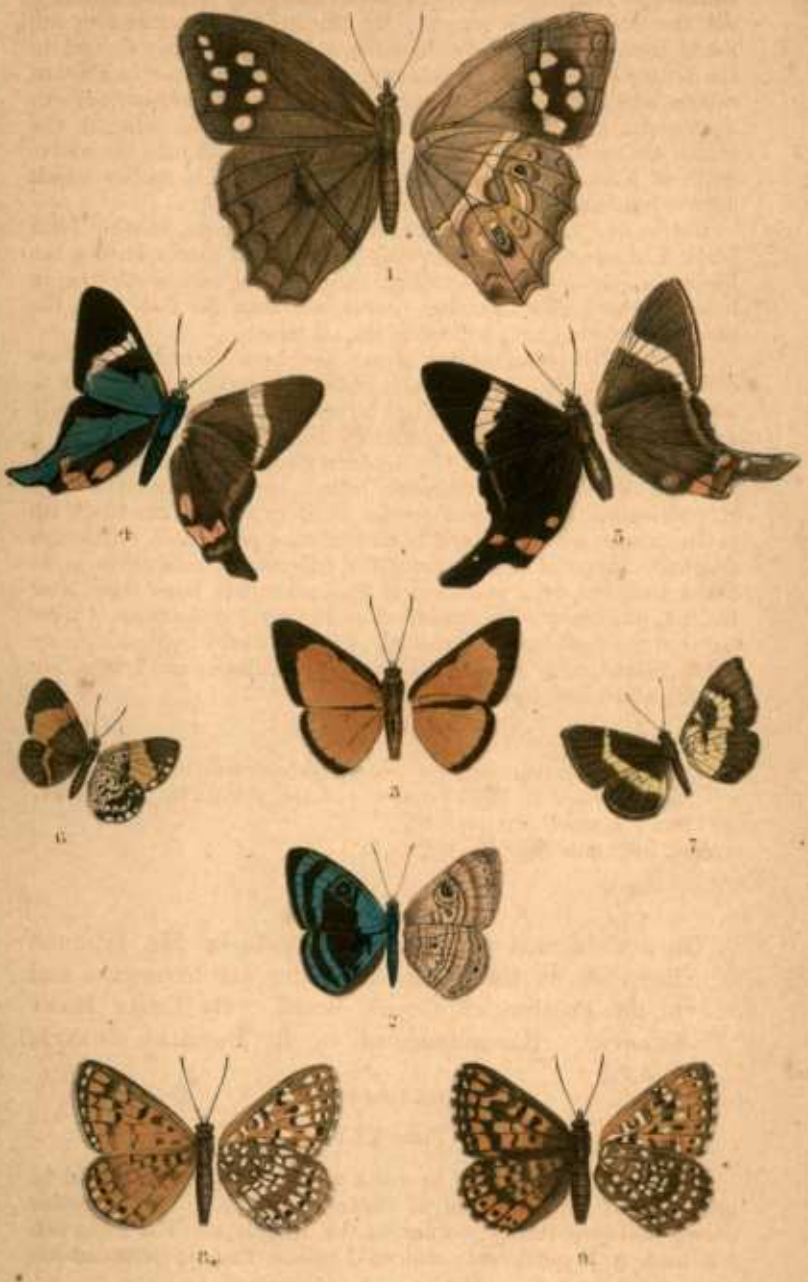
*Hab.* in insulis Solomonensibus.

## 9. On a Collection of Lepidoptera made by Mr. Edmund Reynolds on the Rivers Tocantins and Araguaya and in the Province of Goyaz, Brazil. By EMILY MARY SHARPE. (Communicated by R. BOWDLER SHARPE, F.Z.S.)

[Received June 16, 1890.]

(Plate XLVI.)

It has seemed to me to be worth while that a record should be preserved of the collection of Butterflies made by Mr. Reynolds during his adventurous journey on the Araguaya. The collection was made with great care; and, as I believe that no naturalist has



Mintern Brothers, Chromo. Lith.

NEW SPECIES OF NEOTROPICAL LEPIDOPTERA.

penetrated so far up the Araguaya River as Mr. Reynolds, the list may be useful as showing the distribution of Amazonian Butterflies.

I have to return my grateful thanks to Mr. F. D. Godman and Mr. Osbert Salvin for help in determining many difficult species. My principal work on the collection has been done at the Natural History Museum; and I cannot sufficiently thank Mr. A. G. Butler for his kindness in helping me with my determinations, which, with the imprimatur of three such experienced Lepidopterists, will, I trust, be found to be in the main correct.

Mr. C. O. Waterhouse has also assisted me greatly with his advice in my descriptions of the new species.

Mr. Reynolds has sent me the following account of his journey:—

"The Butterflies in question form part of a small collection made by me while in the interior of Brazil; and as I was not on a Natural History expedition, but on one that had for its object the exploration of the Araguaya and other rivers, I had to do my collecting under considerable difficulty.

"When barely 300 miles from Pará our steam-launch was wrecked in the first rapid on the Lower Tocantins, and although after great delay and trouble we succeeded in getting her off the rocks and patched her up, we found it impossible, in the low state of the river, to make our expedition in her; so my companion (Mr. Middleton) and I decided to continue our journey in a canoe. We therefore sent back the launch with all hands, instructing the engineer to stop at the first settlement to buy a boat and hire a black crew, and send them up to where we were encamped above the rapids. I may mention here that after the wreck of the launch we got ashore on a small rocky island in the middle of the rapids, and as we could not get off for several days I had time to collect what little there was to catch in the way of Butterflies, among them being specimens of *Mylothris iphigenia* and *Heliconius antiochus*.

"There was little room in our boat for more than a few necessaries; but I managed to stow away a net, some camphor, and a book of paper for wrapping up the Butterflies, and also a couple of old biscuit-tins for storing them in. We expected to reach a settlement on the Araguaya called Leopoldina in about three and a half months, intending from there to go overland to the city of Goyaz, then to return by the River Vermelho, and cross the country between the Araguaya and Upper Tocantins Rivers, and on reaching the latter to return by it to Para. We had therefore a very long journey before us; so, to avoid delaying the canoe, I used to take the opportunity of our getting into the rapids or a very strong current to land and go into the forests, making my way through them as the boat was working up the stream, and in this way my principal collecting was done. Any one who has been in a tropical Brazilian forest will understand the difficulties I had to contend with. Occasionally I would come across a bit of comparatively clear ground where I could collect; but generally my way lay through the densest of vegetation, and it took me all my time with my cutlass to make any progress at all. If I thought that the

canoe was gaining on me, I had to cut my way out to the river and collect on the stretches of sand where I came across them, which I frequently did, as the river was low.

"On the sand I could make better time; but I could seldom afford the luxury of following up any particular specimen if I happened to miss it with the first stroke of my net, as I had to keep up with the canoe. All this was of course a serious handicap to collecting. Any damp spot on the sand was sure, at a certain time of the day, to be crowded with Butterflies, and sometimes they were in such vast quantities that if one got up to where they were drinking, it was difficult to capture any particular insect without getting thirty others into the net at the same time, and in their struggles to get free they broke each other's wings, and you often found your particular specimen utterly ruined. In these great gatherings of thirsty Butterflies drinking, I always noticed twenty or more of a yellow or white colour to one of any other. On the Araguaya, between a small military settlement called Martyrios and a larger one 200 miles further up called Santa Maria, lies the country of the Caraja Indians, and collecting becomes very risky. In fact, as we had to pass about ten of their large 'aldeas,' or settlements on the river, we had to keep together as much as possible. When after Butterflies I never troubled to carry a rifle or gun, finding myself hampered enough with a cutlass; but even if I had done so, I should have had a very poor chance against Indians in the forest.

"The Indians have certainly chosen the most lovely part of the river—a paradise for a naturalist; and, in spite of the difficulties, I managed to get some good specimens, but of Butterflies only, as I found it impossible to collect birds or other animals, seeing that we should have to leave our boat farther up and make our way 150 miles by land. Near Santa Maria, on the other side of the river, some twenty miles inland, is a large settlement of Cayapo Indians. I wanted very much indeed to go over; but the Commandant of the place would not give me permission, or even let me hire a couple of men to paddle me to the opposite shore, as one or two people who went across some time back had been killed: in fact, the inhabitants at Santa Maria keep entirely to their own side of the river.

"From Santa Maria to some way past the island of Bananal (a very large island, nearly 300 miles long, and said to contain its own rivers and mountains) there are no white settlers, the country being in the hands of another branch of the Carajas, on the west side of the island. This tribe is supposed to be more 'manse[illegible] than the Carajas between Martyrio and Santa Maria, w[illegible] are said to be very 'bravos,' or fierce. From what I could judge (and I saw a good deal of both tribes), I would rather trust myself to the latter. I got some good specimens round about the city of Goyaz and on our trip down the Vermelho River; the latter full of fever and every conceivable fly that bites.

"I had great difficulty in getting my specimens across the Araguaya to the Upper Tocantins; but once in the latter river, we got a small canoe at a settlement, and after ascending the river for some

distance finally descended it to Pará. My only chance of collecting on the homeward voyage was during the short time that we landed for meals, as my friend was very ill with fever, and every day's delay, without proper nourishment and medicines, lessened his chance of getting out of the country alive.

"The greater portion of the specimens I collected on the way back I lost by the upsetting of our canoe in the rapids; but I managed to get out, after about six months and a journey of some 4000 miles, with some 1300 specimens, amongst which I am glad to find several new ones. In addition to my Butterflies and Indian curiosities, two panther-skins were all we brought out, though at different parts of our journey we had collected all sorts of skins. As I have said before, my journey was an exploring one, and it would be unfair to judge of the country as a field for a naturalist from the results of my collecting; but I am sure that if any naturalist, who could afford the time and money, and could endure the thought of his body furnishing food during many months for every imaginable species of insect, would make the expedition properly, he would be amply rewarded."

### Fam. Papilionidæ.

[*Cf.* Bates, H. W., "Contributions to an Insect Fauna of the Amazon Valley—*Papilionidæ*," Journ. Ent. vol. i. (1861).]

1. Papilio polydamas.

*Papilio polydamas*, Linn.; Kirby, Syn. Cat. Diurn. Lepid. p. 521; Bates, Journ. Ent. vol. i. (1861), p. 224.

Province of Goyaz.

2. Papilio sesostris.

*Papilio sesostris*, Cram.; Kirby, t. c. p. 525; Bates, t. c. p. 225.

Province of Goyaz.

3. Papilio parsodes.

*Papilio parsodes*, Gray; Kirby, t. c. p. 529.

Province of Goyaz.

The type is in the British Museum, from Pará (*cf.* Gray, Cat. Lepid. pt. i. p. 54, pl. viii. fig. 3).

4. Papilio thoas.

*Papilio thoas*, Linn.; Kirby, t. c. p. 541; Bates, t. c. p. 228.

River Araguaya.

5. Papilio protesilaus.

*Papilio protesilaus*, Linn.; Kirby, t. c. p. 555; Bates, t. c. p. 229.

River Araguaya.

6. Papilio agesilaus.

*Papilio agesilaus*, Boisd.; Kirby, t. c. p. 555.

River Araguaya.

27. Terias athalia.

*Eurema athalia*, Feld.; Kirby, t. c. p. 445.
River Araguaya.

28. Terias elathea.

*Eurema elathea*, Cram.; Kirby, t. c. p. 444.
*Terias elathea*, Bates, t. c. p. 242.
River Araguaya.

29. Terias albula.

*Eurema albula*, Cram.; Kirby, t. c. 446.
*Terias albula*, Bates, t. c. p. 243.
River Araguaya.

30. Terias mana.

*Eurema mana*, Boisd.; Kirby, t. c. p. 446.
*Terias mana*, Bates, t. c. p. 243.
River Araguaya.
Mr. Bates procured it at Pará.

Fam. Danaidæ.

[*Cf.* H. W. Bates, "Contributions to an Insect Fauna of the Amazon Valley—*Heliconidæ*," Trans. Linn. Soc. vol. xxxiii. (1861) p. 495.]

31. Lycorea halia.

*Lycorea halia*, Hübn.; Kirby, t. c. p. 18; Bates, Trans. Linn. Soc. vol. xxxiii. (1861) p. 518.
River Tocantins; River Araguaya.

32. Thyridia ceto.

*Aprotopos ceto*, Feld.; Kirby, t. c. p. 19.
River Araguaya.

33. Ithomia epidero.

*Dircenna epidero*, Bates, t. c. p. 521; Kirby, t. c. p. 20.
River Araguaya.

34. Ithomia dorilla.

*Ithomia dorilla*, Bates; Kirby, t. c. p. 29.
River Tocantins.

35. Ithomia neso.

*Ithomia neso*, Hübn.; Kirby, t. c. p. 29.
River Tocantins.

36. Ithomia nise.

*Ithomia nise*, Cram.; Kirby, t. c. p. 29; Bates, t. c. p. 539.
River Tocantins.

37. Ithomia galata.

*Ithomia galata*, Hew.; Kirby, t. c. p. 28.
River Tocantins.

38. Ithomia sylvo.

*Ithomia sylvo*, Hübn.; Kirby, t. c. p. 30.
River Tocantins.

39. Ithomia sylvella.

*Ithomia sylvella*, Hew.; Kirby, t. c. p. 30.
River Tocantins; River Araguaya.

40. Ceratinia vallonia.

*Ceratinia vallonia*, Hew.; Kirby, t. c. p. 22; Bates, t. c. p. 525.
River Tocantins.

41. Sais rosalia.

*Sais rosalia*, Cram.; Kirby, t. c. p. 22; Bates, t. c. p. 527.
River Tocantins.

42. Mechanitis polymnia.

*Mechanitis polymnia*, Linn.; Kirby, t. c. p. 23; Bates, t. c. p. 529.
River Tocantins.

43. Mechanitis lysimnia.

*Mechanitis lysimnia*, Fabr., Kirby, t. c. p. 24.
River Tocantins.

44. Milinæa egina.

*Milinæa egina*, Cram., Kirby, t. c. p. 33; Bates, t. c. p. 550.
River Tocantins.

45. Milinæa mnasias.

*Milinæa mnasias*, Hew.: Kirby, t. c. p. 34; Bates, t. c. p. 552.
River Tocantins.

46. Tithorea pseudethra.

*Tithorea pseudethra*, Butl.; Kirby, t. c. Suppl. p. 697.
River Tocantins.

Fam. Heliconiidæ.

47. Heliconius antiocha.

*Heliconius antiocha*, Linn.; Kirby, t. c. p. 139; Bates, t. c. p. 556.
Lower Tocantins River; Araguaya River.

48. Heliconius clytia.

*Heliconius clytia*, Cram.; Kirby, t. c. p. 140; Bates, t. c. p. 556.
Lower Tocantins River; Araguaya River.

49. Heliconius rhea.

*Heliconius rhea*, Cram.; Kirby, t. c. p. 140; Bates, t. c. p. 556.
Lower Tocantins River; Araguaya River.

50. Heliconius doris.

*Heliconius doris*, Linn.; Kirby, t. c. p. 141; Bates, Trans. Ent. Soc. (3) v. p. 537 (1867).
Lower Tocantins River; Araguaya River.

51. Heliconius thelxiope.

*Heliconius thelxiope*, Hübn.; Kirby, t. c. p. 142; Bates, Trans. Linn. Soc. xxxiii. p. 559 (1863); id. Trans. Ent. Soc. (3) v. p. 538 (1867).
Lower Tocantins River; Araguaya River.

52. Heliconius ædæ.

*Heliconius ædæ*, Hübn.; Kirby, t. c. p. 144; Bates, Trans. Linn. Soc. xxxiii. p. 561.
Lower Tocantins River; Araguaya River.

53. Heliconius quirina.

*Heliconius quirina*, Cram.; Kirby, t. c. p. 142.
Lower Tocantins River; Araguaya River.

54. Heliconius numata.

*Heliconius numata*, Cram.; Kirby, t. c. p. 138; Bates, t. c. p. 553.
Lower Tocantins River; Araguaya River.

Fam. Nymphalidæ [1].

55. Agraulis juno.

*Dione juno* (Cram.); Kirby, t. c. p. 148.
*Agraulis juno*, Bates, Journ. Ent. ii. p. 187 (1866).
Araguaya River; Upper Tocantins River.

56. Agraulis vanillæ.

*Dione vanillæ*, Linn.; Kirby, t. c. p. 148.
*Agraulis vanillæ*, Bates, t. c. p. 187.
Araguaya River; Upper Tocantins River.

57. Agraulis julia.

*Colænis julia*, Fabr.; Kirby, t. c. p. 147; Bates, t. c. p. 186.
Araguaya River; Upper Tocantins River.

[1] *Cf.* H. W. Bates, Nymphalidæ, Journ. Ent. vol. ii. (1866).

58. Agraulis phærusa.

*Colænis phærusa*, Linn.; Kirby, t. c. p. 147; Bates, t. c. p. 186.
Araguaya River.

59. Pyrameis myrinna.

*Pyrameis myrinna*, Doubl.; Kirby, t. c. p. 186.
Upper Tocantins River.

60. Cybdelis caresa.

*Eunica caresa*, Hew.; Kirby, t. c. p. 199; Bates, t. c. p. 197.
Province of Goyaz.
Mr. Bates met with this species at Ega.

61. Cybdelis orphise.

*Eunica orphise*, Cram.; Kirby, t. c. p. 200; Bates, t. c. p. 199.
Province of Goyaz.
Mr. Bates found the species at Ega, where, however, it was not common.

62. Cybdelis cælina.

*Eunica cælina*, Godt.; Kirby, t. c. p. 199; Bates, t. c. p. 197.
Province of Goyaz.
Very rare on the Upper Amazon, according to Mr. Bates.

63. Cybdelis bechina.

*Eunica bechina*, Hew.; Kirby, t. c. p. 199; Bates, t. c. p. 197.
Province of Goyaz.
Common on the Upper Amazons, teste Bates.

64. Cybdelis viola.

*Eunica viola*, Bates, t. c. p. 199; Kirby, t. c. p. 200.
Province of Goyaz.
Found by Mr. Bates at Tunantins and San Paulo, and extending as far as Ega, but very rare at the latter.

65. Cybdelis margarita.

*Eunica margarita*, Godt.; Kirby, t. c. p. 200.
Province of Goyaz.

66. Libythina cuvierii.

*Libythina cuvierii*, Godt.; Kirby, t. c. p. 201; Bates, t. c. p. 200.
Province of Goyaz.
"Found, in the Amazons region, only in the neighbourhood of Santarem and on the shores of the Lower Tapajos" (*Bates*).

67. Eubagis ævata.

*Eubagis ævata*, Butl. Trans. Ent. Soc. 1877, p. 117.
Paraguay; Vermelho River.

68. Eubagis decima.

*Dynamine decima*, Hew.; Kirby, t. c. p. 206; Bates, t. c. p. 323.
Paraguay; River Vermelho.

69. Eubagis arene.

*Dynamine arene*, Hübn.; Kirby, t. c. p. 207.
*Eubagis arene*, Bates, t. c. p. 327.
Paraguay; River Vermelho.

70. Eubagis pieridoides.

*Dynamine pieridoides*, Feld.; Kirby, t. c. p. 205.
River Vermelho.

71. Catagramma marchalii.

*Callicore marchalii*, Guér.; Kirby, t. c. p. 207.
Paraguay; Upper Tocantins River.

72. Catagramma hydaspes.

*Catagramma hydaspes*, Dru.; Kirby, t. c. p. 210.
Paraguay.

73. Catagramma candrena.

*Callicore candrena*, Godt.; Kirby, t. c. p. 208.
Paraguay; Province of Goyaz.

74. Catagramma sorana.

*Catagramma sorana*, Godt.; Kirby, t. c. p. 212.
Paraguay; Province of Goyaz.

75. Catagramma thamyras.

*Catagramma thamyras*, Mén.; Kirby, t. c. p. 211.
Paraguay.

76. Catagramma texa.

*Catagramma texa*, Hew.; Kirby, t. c. p. 211; Bates, t. c. p. 207.
Province of Goyaz.

77. Catagramma miles.

*Catagramma miles*, Bates, t. c. p. 207; Kirby, t. c. p. 212.
Province of Goyaz.

78. Hæmatera pyramus.

*Hæmatera pyramus*, Fabr.; Kirby, t. c. p. 212.
Province of Goyaz.

79. Euptoieta hegesia.

*Euptoieta hegesia*, Cram.; Kirby, t. c. p. 154; Bates, t. c. p. 188.
Tocantins River.

80. Aganisthos orion.

*Aganisthos orion*, Fabr.; Kirby, t. c. p. 263; Bates, t. c. p. 335.
Province of Goyaz.

81. Phyciodes hermas.

*Phyciodes hermas*, Hew.; Kirby, t. c. p. 174.
Araguaya River.

82. Phyciodes letitia.

*Phyciodes letitia*, Hew.; Kirby, t. c. p. 176.
River Vermelho.

83. Phyciodes thymetus.

*Phyciodes thymetus*, Fabr.; Kirby, t. c. p. 172.
River Vermelho.

84. Junonia lavinia.

*Junonia lavinia*, Cram.; Kirby, t. c. p. 187; Bates, t. c. p. 194.
Araguaya River.

85. Anartia jatrophæ.

*Anartia jatrophæ*, Linn.; Kirby, t. c. p. 194; Bates, t. c. p. 193.
River Tocantins; Araguaya River.

86. Anartia amalthea.

*Anartia amalthea*, Linn.; Kirby, t. c. p. 194; Bates, t. c. p. 193.
River Tocantins; Araguaya River.

87. Epicalia antinoë.

*Catonephele antinoë*, Godt.; Kirby, t. c. p. 203.
*Epicalia antinoë*, Bates, t. c. p. 202.
Araguaya River.
Mr. Bates met with this species at Obydos, on the Guiana side of the Lower Amazons, and again at San Paulo on the Upper Amazons.

88. Epicalia numilia.

*Catonephele numilia*, Cram.; Kirby, t. c. p. 203.
*Epicalia numilia*, Bates, t. c. p. 202.
Araguaya River.

89. Epicalia obrinus.

*Catonephele obrinus*, Linn.; Kirby, t. c. p. 203.
Araguaya River.

90. Myscelia cantharа.

*Nica cantharа*, Doubl.; Kirby, t. c. p. 205.
Province of Goyaz.

91. Gynæcia dirce.

*Gynæcia dirce*, Linn.; Kirby, t. c. p. 214; Bates, t. c. p. 212.
Araguaya River.

92. Ectima iona.

*Ectima iona*, Hew.; Kirby, t. c. p. 214; Bates, t. c. p. 212.
Araguaya River.

93. Ageronia feronia.

*Ageronia feronia*, Linn.; Kirby, t. c. p. 215; Bates, t. c. p. 312.
Araguaya River; Rio.
"The commonest species in the Amazons region" (*Bates*).

94. Ageronia ferentina.

*Ageronia ferentina*, Godt.; Kirby, t. c. p. 215; Bates, t. c. p. 312.
Araguaya River; Rio.

95. Ageronia amphinome.

*Ageronia amphinome*, Linn.; Kirby, t. c. p. 216; Bates, t. c. p. 314.
Araguaya River.

96. Ageronia chloë.

*Ageronia chloë*, Stoll; Kirby, t. c. p. 215; Bates, t. c. p. 312.
Araguaya River.
Found by Mr. Bates at Pará and on the Lower Amazons.

97. Ageronia arete.

*Ageronia arete*, Doubl., Hew.; Kirby, t. c. p. 216.
Araguaya River.

98. Didonis biblis.

*Didonis biblis*, Fabr.; Kirby, t. c. p. 216; Bates, t. c. p. 316.
Araguaya River.

99. Pyrrhogyra neærea.

*Pyrrhogyra neærea*, Linn.; Kirby, t. c. p. 218; Bates, t. c. p. 319.
Province of Goyaz; Araguaya River.

100. Pyrrhogyra amphira.

*Pyrrhogyra amphira*, Bates, t. c. p. 319; Kirby, t. c. p. 218.
Province of Goyaz; Araguaya River.
Found by Mr. Bates on the Upper Amazons, at Ega and S. Paulo, where it was common.

101. TIMETES NORICA.

*Megalura norica*, Hew.; Kirby, t. c. p. 221; Bates, t. c. p. 330.
Araguaya River.
Occurs, according to Mr. Bates, at Ega, and, according to Dr. Felder, on the Upper Rio Negro.

102. TIMETES CHIRON.

*Timetes chiron*, Fabr.; Kirby, t. c. p. 221; Bates, t. c. p. 327.
Araguaya River.

103. MARPESIA PELEUS.

*Megalura peleus*, Sulz.; Kirby, t. c. p. 222.
Araguaya River.

104. VICTORINA STENELES.

*Victorina steneles*, Linn.; Kirby, t. c. p. 223; Bates, t. c. p. 320.
Pará; Araguaya River.

105. HETEROCHROA EROTIA.

*Adelpha erotia*, Hew.; Kirby, t. c. p. 232.
*Heterochroa erotia*, Bates, t. c. p. 332.
Province of Pará; Province of Goyaz.

106. HETEROCHROA IPHICLA.

*Adelpha iphicla*, Linn.; Kirby, t. c. p. 230.
*Heterochroa iphicla*, Bates, t. c. p. 331.
Province of Pará; Province of Goyaz.

107. HETEROCHROA MESSANA.

*Adelpha messana*, Feld.; Kirby, t. c. p. 232.
Province of Goyaz; Province of Pará.

108. HETEROCHROA CYTHEREA.

*Adelpha cytherea*, Linn.; Kirby, t. c. p. 233.
*Heterochroa cytherea*, Bates, t. c. p. 333.
Province of Pará; Province of Goyaz.

109. CHLORIPPE SELINA.

*Apatura selina*, Bates, t. c. p. 334; Kirby, t. c. p. 261.
Araguaya River.

110. CHLORIPPE MARSE.

*Apatura marse*, Hübn.; Kirby, t. c. p. 261.
Araguaya River.

111. CHLORIPPE CHALCIOPE.

*Prepona chalciope*, Hübn.; Kirby, t. c. p. 265.
Araguaya River.

112. Prepona meander.

*Prepona meander*, Cram.; Kirby, t. c. p. 264; Bates, t. c. p. 336.
Araguaya River.

113. Paphia ryphea.

*Anæa ryphea*, Cram.; Kirby, t. c. p. 276.
Paraguay.

114. Siderone ellops.

*Siderone ellops*, Mén.; Kirby, t. c. p. 280.
Paraguay.

115. Siderone isidora.

*Siderone isidora*, Cram.; Kirby, t. c. p. 280; Bates, t. c. p. 343.
Paraguay.

Fam. Morphidæ.

116. Caligo idomeneus.

*Caligo idomeneus*, Linn.; Kirby, t. c. p. 127.
Pará.

117. Caligo oberon.

*Caligo oberon*, Butl.; Kirby, t. c. p. 646.
Pará; Araguaya River.

118. Morpho menelaus.

*Morpho menelaus*, Linn.; Kirby, t. c. p. 122; Bates, t. c. p. 344.
Araguaya River.

119. Morpho achilles.

*Morpho achilles*, Linn.; Kirby, t. c. p. 123; Bates, t. c. p. 345.
Araguaya River.

Fam. Brassolidæ.

120. Opsiphanes quiteria.

*Opsiphanes quiteria*, Cram.; Kirby, t. c. p. 126.
Province of Goyaz.

121. Opsiphanes berecynthus.

*Opsiphanes berecynthus*, Cram.; Kirby, t. c. p. 126.
Province of Goyaz.

122. Opsiphanes inveræ.

*Opsiphanes inveræ*, Hübn.; Kirby, t. c. p. 127.
Province of Goyaz.

123. Brassolis sophoræ.

*Brassolis sophoræ*, Linn.; Kirby, t. c. p. 125.
Province of Goyaz.

124. Dynastor darius.

*Dynastor darius*, Fabr.; Kirby, t. c. p. 127.
Paraguay.

Fam. Satyridæ.

125. Hætera piera.

*Papilio piera*, Linn.; Kirby, t. c. p. 37.
Araguaya River.

126. Taygetis erubescens.

*Taygetis erubescens*, Butl.; Kirby, t. c. p. 109.
Araguaya River.

127. Taygetis andromeda.

*Taygetis andromeda*, Cram.; Kirby, t. c. p. 109.
Araguaya River.

128. Taygetis echo.

*Taygetis echo*, Cram.; Kirby, t. c. p. 109.
Araguaya River.

129. Taygetis euptychidia.

*Taygetis euptychidia*, Butl.; Kirby, t. c. p. 110.
Araguaya River.

130. Taygetis tenebrosus.

*Taygetis tenebrosus*, Blanch.; Kirby, t. c. p. 109.
Araguaya River.

131. Taygetis rebecca.

*Taygetis rebecca*, Fabr.; Kirby, t. c. p. 109.
Araguaya River.

132. Taygetis cleopatra.

*Taygetis cleopatra*, Feld.; Kirby, t. c. p. 110.
Araguaya River.

133. Taygetis penelea.

*Taygetis penelea*, Cram.; Kirby, t. c. p. 110.
Araguaya River.

134. Amphidecta reynoldsi, sp. n. (Plate XLVI. fig. 1.)

Nearest to *A. pignerator*, Butler, but is distinguished by the white band which commences at the costal nervure and extends across the

under side of the hind wing. Below this white band there are six silvery spots, situated between the nervures, bordered with sandy yellow on the side next to the white band, and with light brown on the outer side; the 1st, 2nd, 5th, and 6th are more or less black in the centre. The fore wing has eight distinct white spots on a darker brown ground near the apical portion of the wing.

Expanse 52 mm.

*Hab.* Araguaya River.

135. PIERELLA LENA.

*Pierella lena*, Linn.; Kirby, t. c. p. 38.

Araguaya River.

136. EUPTYCHIA OCYPETE.

*Euptychia ocypete*, Fabr.; Kirby, t. c. p. 47.

Araguaya River.

137. EUPTYCHIA MYNCEA.

*Euptychia myncea*, Cram.; Kirby, t. c. p. 47.

Araguaya River.

138. EUPTYCHIA OCIRRHOË.

*Euptychia ocirrhoë*, Fabr.; Kirby, t. c. p. 47.

Araguaya River.

139. EUPTYCHIA TERRESTRIS.

*Euptychia terrestris*, Butl.; Kirby, t. c. p. 48.

Araguaya River.

140. EUPTYCHIA HUEBNERI.

*Euptychia huebneri*, Butl.; Kirby, t. c. p. 49.

Araguaya River.

141. EUPTYCHIA PENELOPE.

*Euptychia penelope*, Fabr.; Kirby, t. c. p. 48.

Araguaya River.

142. EUPTYCHIA CELMIS.

*Euptychia celmis*, Godt.; Kirby, t. c. p. 49.

Araguaya River.

143. EUPTYCHIA ARGANTE.

*Euptychia argante*, Cram.; Kirby, t. c. p. 49.

Araguaya River.

144. EUPTYCHIA UNDULATA.

*Euptychia undulata*, Butl.; Kirby, t. c. p. 50.

Araguaya River.

145. EUPTYCHIA ARMILLA.

*Euptychia armilla*, Butl.; Kirby, t. c. p. 50.
Araguaya River.

146. EUPTYCHIA HERMES.

*Euptychia hermes*, Fabr.; Kirby, t. c. p. 50.
Araguaya River.

147. EUPTYCHIA CHLORIS.

*Euptychia chloris*, Cram.; Kirby, t. c. p. 53.
Araguaya River.

148. EUPTYCHIA ARNÆA.

*Euptychia arnæa*, Fabr.; Kirby, t. c. p. 53.
Araguaya River.

149. EUPTYCHIA ITONIS.

*Euptychia itonis*, Hew.; Kirby, t. c. p. 55.
Araguaya River.

150. EUPTYCHIA FURINA.

*Euptychia furina*, Hew.; Kirby, t. c. p. 54.
Araguaya River.

Fam. ERYCINIDÆ[1].

151. LIBYTHEA CARINENTA.

*Libythea carinenta*, Cram.; Kirby, t. c. p. 282.
Province of Goyaz.

152. EURYBIA LYCISCA.

*Eurybia lyciscu*, Doubl. & Hew.; Kirby, t. c. p. 287; Bates, t. c. p. 415.
Vermelho River.

153. EURYBIA JUTURNA.

*Eurybia juturna*, Feld.; Kirby, t. c. p. 287; Bates, t. c. p. 415.
Vermelho River.

154. MESOSEMIA NESTI.

*Mesosemia nesti*, Hew.; Kirby, t. c. p. 288; Bates, t. c. p. 416.
Province of Goyaz.

155. MESOSEMIA BELLA, sp. n. (Plate XLVI. fig. 2.)

Similar to *M. antærice*, Hew., but differing in the black apical border of the fore wing, which is continued along the hind margin of both wings. The general colour is black, with two narrow bands of

[1] [*Cf.* "A Catalogue of Erycinidæ." By H. W. Bates. Journ. Linn. Soc. vol. ix. (1868) p. 367.]

metallic blue on the fore wing, and with a faintly marked ocellus at the end of the discoidal cell. The hind wing resembles the fore wing in having the two blue bands. There is some blue at the base of both wings, and on the hind wings this extends along the inner margins.

Expanse 30 mm.

*Hab.* River Araguaya.

156. MESOSEMIA METOPE.

*Mesosemia metope*, Hew.; Kirby, t. c. p. 290; Bates, t. c. p. 418.

Province of Goyaz.

157. MESOSEMIA MELPIA.

*Mesosemia melpia*, Hew.; Kirby, t. c. p. 291; Bates, t. c. p. 418.

Province of Goyaz.

158. MESOSEMIA PHILEMON.

*Mesosemia philemon*, Cram.; Kirby, t. c. p. 291; Bates, t. c. p. 419.

Province of Goyaz.

159. MESOSEMIA MACARIS.

*Mesosemia macaris*, Hew.; Kirby, t. c. p. 292; Bates, t. c. p. 419.

Province of Goyaz.

160. EURYGONA HYGENIUS.

*Euselasia hygenius*, Stoll; Kirby, t. c. p. 295.
*Eurygona hygenius*, Bates, t. c. p. 422.

Province of Goyaz.

161. EURYGONA EUTYCHUS.

*Euselasia eutychus*, Hew.; Kirby, t. c. p. 295.
*Eurygona eutychus*, Bates, t. c. p. 421.

Province of Goyaz.

162. EURYGONA MYS.

*Euselasia mys*, Herr.-Schäff.; Kirby, t. c. p. 295.
*Eurygona mys*, Bates, t. c. p. 422.

Province of Goyaz.

163. EURYGONA CAFUSA.

*Eurygona cafusa*, Bates, t. c. p. 422.
*Euselasia cafusa* (Bates); Kirby, t. c. p. 295.

Province of Goyaz.

164. EURYGONA GELANOR.

*Euselasia gelanor* (Cram.); Kirby, t. c. p. 296.
*Eurygona gelanor*, Bates, t. c. p. 423.

Province of Goyaz.

165. Eurygona eugæon.

*Euselasia eugæon* (Hew.); Kirby, t. c. p. 298.
*Eurygona eugæon*, Bates, t. c. p. 424.
Province of Goyaz.

166. Eurygona euoras.

*Euselasia euoras* (Hew.); Kirby, t. c. p. 296.
*Eurygona euoras*, Bates, t. c. p. 422.
Province of Goyaz.

167. Notheme eumeus.

*Notheme eumeus* (Fabr.); Kirby, t. c. p. 299.
Province of Goyaz.

168. Panara barsacus.

*Panara barsacus*, Westw.; Kirby, t. c. p. 300.
*P. phereclus*, pt., Bates, t. c. p. 425.
Province of Goyaz.

169. Isapis agyrtus.

*Isapis agyrtus*, Cram.; Kirby, t. c. p. 307; Bates, t. c. p. 431.
Province of Goyaz.

170. Lymnas melander.

*Lymnas melander*, Cram.; Kirby, t. c. p. 300; Bates, t. c. p. 426.
Province of Goyaz.

171. Lymnas zoega.

*Lymnas zoega*, Hew.; Kirby, t. c. p. 300; Bates, t. c. p. 426.
Province of Goyaz.

172. Lymnas isabellæ, sp. n. (Plate XLVI. fig. 3.)

Allied to *L. inaria*, Hew., but differs in having a much narrower black border on the hind margin of the fore wing, and there is no black border along the inner margin. The black marginal border on the hind wing is very narrow; there is a black stripe near the costal margin. The underside is similar to that of *L. inaria*, but the black is much narrower. The orange on the costal margin of the hind wing is more extended.

Expanse 33 mm.
*Hab.* Araguaya River.

173. Lymnas thyatira.

*Lymnas thyatira*, Hew.; Kirby, t. c. p. 301; Bates, t. c. p. 426.
Province of Goyaz.

174. Lymnas jesse.

*Lymnas jesse*, Butl.; Kirby, t. c. p. 301.
Province of Goyaz.

175. Diorhina periander.

*Diorhina periander*, Cram.; Kirby, t. c. p. 304; Bates, t. c. p. 429.

Araguaya River.

176. Diorhina arthuriana, sp. n. (Plate XLVI. figs. 4, 5.)

Allied to *E. periander*, Cramer, which it exactly resembles on the upperside, but is easily distinguished by having only one white band on the under surface, the white band near the base of the wings being absent.

♂ exp. 34 mm., ♀ 37 mm.

*Hab.* Araguaya River.

177. Zeonia amazona.

*Zeonia amazona*, Saund.; Kirby, t. c. p. 305; Bates, t. c. p. 430.

Araguaya River.

178. Ithomeis satellites.

*Ithomeis satellites*, Bates, t. c. p. 431; Kirby, t. c. p. 306.

Araguaya River.

179. Riodina lysippus.

*Riodina lysippus*, Linn.; Kirby, t. c. p. 309; Bates, t. c. p. 434.

Araguaya River.

180. Amarynthis meneria.

*Amarynthis meneria*, Cram.; Kirby, t. c. p. 309; Bates, t. c. p. 434.

Araguaya River.

181. Helicopis cupido.

*Helicopis cupido*, Linn.; Kirby, t. c. p. 310; Bates, t. c. p. 435.

Lower Tocantins.

182. Helicopis acis.

*Helicopis acis*, Fabr.; Kirby, t. c. p. 310.

Lower Tocantins.

183. Emesis spreta.

*Emesis spreta*, Bates, t. c. p. 436; Kirby, t. c. p. 312.

Araguaya River.

184. Emesis arminius.

*Emesis arminius*, Fabr.; Kirby, t. c. p. 312.

Araguaya River.

185. Emesis mandana.

*Emesis mandana*, Cram.; Kirby, t. c. p. 312; Bates, t. c. p. 436.

Araguaya River.

186. Mesene phareus.

*Mesene phareus*, Cram.; Kirby, t. c. p. 315; Bates, t. c. p. 439.
Araguaya River.

187. Mesene simplex.

*Mesene simplex*, Bates, t. c. pp. 387, 440; Kirby, t. c. p. 316.
Araguaya River; Province of Goyaz.

188. Mesene epaphus.

*Mesene epaphus*, Cram.; Kirby, t. c. p. 316; Bates, t. c. p. 440.
Araguaya River; Province of Goyaz.

189. Mesene clarissa, sp. n. (Plate XLVI. fig. 6.)

Allied to *M. trucidata*, Butler, but differs in having a much narrower band of orange-red on the hind wing; the orange-red band on the fore wing is much broader and widens perceptibly towards the inner margin. The marginal fringe of the fore wing is dotted with white. The underside differs in having the base of the hind wing greyish white spotted with black. There are two rows of white spots on the hind wing near the outer margin.

Expanse 22 mm.

*Hab.* Araguaya River.

190. Calydna catana.

*Calydna catana*, Hew.; Kirby, t. c. p. 317; Bates, t. c. p. 442.
Araguaya River.

191. Calydna caieta.

*Calydna caieta*, Hew.; Kirby, t. c. p. 217; Bates, t. c. p. 442.
Araguaya River.

192. Charis theodora.

*Charis theodora*, Feld.; Kirby, t. c. p. 318; Bates, t. c. p. 443.
Araguaya River.

193. Charis cleodora.

*Charis cleodora*, Godt.; Kirby, t. c. p. 318; Bates, t. c. p. 443.
Araguaya River.

194. Charis cleonus.

*Charis cleonus*, Cram.; Kirby, t. c. p. 318; Bates, t. c. p. 443.
Araguaya River.

195. Bæotis johannæ, sp. n. (Plate XLVI. fig. 7.)

Similar to *B. melanis*, Hübn., but differs in being blackish brown, with a transverse band of pale ochre-yellow across both wings. This yellow band commences at the costa of the fore wing and gradually widens to the inner margin of the hind wing. The underside of the fore wing has the band of yellow well marked, but on

the hind wing it spreads and partially unites with the yellow at the base of the wing, so that nearly the whole of the basal area is yellow.

Expanse 24 mm.

*Hab.* Araguaya River.

196. METACHARIS LUCIUS.

*Metacharis lucius*, Fabr.; Kirby, t. c. p. 320.

Araguaya River.

197. LASAIA MERIS.

*Lasaia meris*, Cram.; Kirby, t. c. p. 321; Bates, t. c. p. 445.

Araguaya River.

198. LEMONIAS NEPIOIDES.

*Lemonias nepioides*, Butl.; Kirby, t. c. p. 322.
*Lemonias pseudocuspis*, pt., Bates, t. c. p. 447.

Araguaya River.

199. LEMONIAS CEREALIS.

*Lemonias cerealis*, Hew.; Kirby, t. c. p. 323; Bates, t. c. p. 447.

Araguaya River.

200. LEMONIAS ARISTUS.

*Echenais aristus*, Stoll; Kirby, t. c. p. 325; Bates, t. c. p. 449.

Araguaya River.

201. ANATOLE MIDDLETONI, sp. n. (Plate XLVI. figs. 8, 9.)

Nearest to *A. epulus*, Cramer, but is much larger; the upperside of the male is much brighter, and has a row of white spots on a black external border; the spots in the central area of the fore wing are of a deep reddish ochreous colour, whereas in *A. epulus* they are white. The underside of the hind wing is darker with a submarginal row of elongate oval white spots with a black centre to each. There are numerous white spots scattered over the basal area.

The female is darker, with the white spots on the black external border not so well defined as on the upperside of the male. The hind wing is bordered with brownish orange, and the ovate white spots are divided by the orange-colour so as to form two rows of white spots.

♂, exp. 33 mm.; ♀, 35 mm.

*Hab.* Araguaya River.

202. STALACHTIS PHLEGETONIA.

*Stalachtis phlegetonia*, Perty; Kirby, t. c. p. 333.
*Stalachtis phlegia*, pt., Bates, t. c. p. 457.

Araguaya River.

203. STALACHTIS LINEATA.

*Stalachtis lineata*, Guér.; Kirby, t. c. p. 334; Bates, t. c. p. 458.

Araguaya River.

204. Stalachtis phædusa.
*Stalachtis phædusa*, Hübn.; Kirby, t. c. p. 334; Bates, t. c. p. 458.
Araguaya River.

205. Stalachtis calliope.
*Stalachtis calliope*, Linn.; Kirby, t. c. p. 334; Bates, t. c. p. 457.
Araguaya River.

206. Alesa amesis.
*Alesa amesis*, Cram.; Kirby, t. c. p. 287; Bates, t. c. p. 415.
Araguaya River.

Fam. Lycænidæ.

207. Thecla echion.
*Thecla echion*, Linn.; Kirby, t. c. p. 385.
Araguaya River.

208. Thecla vesulus.
*Thecla vesulus*, Cram.; Kirby, t. c. p. 394.
Araguaya River.

209. Thecla cinniana.
*Thecla cinniana*, Hew.; Kirby, t. c. Suppl. p. 856.
Araguaya River.

210. Cycnus togarna.
*Thecla togarna*, Hew.; Kirby, t. c. p. 384.
Araguaya River.

211. Thecla venulius.
*Thecla venulius*, Cram.; Kirby, t. c. p. 380.
Near Pará.

212. Thecla satyroides.
*Thecla satyroides*, Hew.; Kirby, t. c. p. 380.
Araguaya River.

213. Mithras hemon.
*Thecla hemon*, Cram.; Kirby, t. c. p. 381.
Araguaya River.

214. Parrhasius bitias.
*Thecla bitias*, Cram.; Kirby, t. c. p. 391.
Araguaya River.

215. Bithys stilbia.
*Thecla stilbia*, Hew.; Kirby, t. c. p. 391.
Araguaya River.

216. Œnomaus doryasa.
*Thecla doryasa*, Hew.; Kirby, t. c. Suppl. p. 779.
Araguaya River.

217. Chalybs marsyas.
*Thecla marsyas*, Linn.; Kirby, t. c. p. 383.
Araguaya River.

218. Cupido monops.
*Lycæna monops*, Zeller, in litt.
Province of Goyaz.

219. Cupido cassius.
*Cupido cassius*, Cram.; Kirby, t. c. p. 351.
Province of Goyaz.

Fam. Hesperidæ.

220. Goniuris catillus.
*Thymele catillus*, Cram.; Kirby, t. c. p. 570.
Araguaya River.

221. Telegonus talus.
*Telegonus talus*, Cram.; Kirby, t. c. p. 572.
Araguaya River.

222. Telegonus anaphus.
*Telegonus anaphus*, Cram.; Kirby, t. c. p. 574.
Araguaya River.

223. Phanus leucomelas.
*Eutheus leucomelas*, Hübn.; Kirby, t. c. p. 579.
Araguaya River.

224. Pyrrhopyge acastus.
*Pyrrhopyge acastus*, Cram.; Kirby, t. c. p. 585.
Araguaya River.

225. Pyrrhopyge fluminis.
*Pyrrhopyge fluminis*, Butl.; Kirby, t. c. p. 821.
Araguaya River.

226. Erycides palemon.
*Erycides palemon*, Cram.; Kirby, t. c. p. 588.
Araguaya River.

227. Erycides pygmalion.
*Erycides pygmalion*, Cram.; Kirby, t. c. p. 588.
Araguaya River.

228. Eutheus marchalii.
*Pamphila marchalii*, Boisd.; Kirby, t. c. Suppl. p. 824.
Araguaya River.

229. Proteides idas.
*Proteides idas*, Cram.; Kirby, t. c. p. 595.
Araguaya River.

230. Achlyodes bromius.
*Achlyodes bromius*, Stoll; Kirby, t. c. p. 632.
Araguaya River.

231. Achlyodes petius.
*Pellicia petius*, Möschl.; Kirby, t. c. Suppl. p. 829.
Araguaya River.

232. Achlyodes trifasciata.
*Achlyodes trifasciata*, Hew.; Kirby, t. c. p. 631.
Araguaya River.

233. Achlyodes ozema.
*Achlyodes ozema*, Butl.; Kirby, t. c. p. 657.
Araguaya River.

EXPLANATION OF PLATE XLVI.

Fig. 1. *Amphidecta reynoldsi*, p. 567.
2. *Mesosemia bella*, p. 569.
3. *Lymnas isabellæ*, p. 571.
4, 5. *Diorhina arthuriana*, p. 572.
6. *Mesene clarissa*, p. 573.
7. *Bœotis johannæ*, p. 573.
8, 9. *Anatole widdletoni*, p. 574.

## 10. On a Case of the Occurrence of a persistent Right Posterior Cardinal Vein in the Rabbit. By Edmund S. Hall, Student of Guy's Hospital. (Communicated by F. E. Beddard, M.A., Prosector to the Society, Lecturer on Biology at Guy's Hospital.)

[Received June 16, 1890.]

...issection of a male Rabbit on June 5th at Guy's Hospital, ...hat, in the thoracic region, the azygos cardinal vein ...gs, its diameter being a third of the size of that ... cava, though its position and branches ...ith those of the normal vein of any other

...om the thoracic region towards the pos- ...he following points were noted:—That,

instead of, as in the ordinary Rabbit, ending or (more correctly) beginning in its branches, the intercostal veins, the azygos vein pierced the diaphragm by an aperture to the right of that of the aorta, and continued its course posteriorly with a very slight diminution in size and in the same relative position as in the thorax with regard to the aorta and the vertebral column.

At the point where the posterior vena cava reached the dorsal wall of the abdominal cavity, the aorta curved slightly upwards and ran dorsally to the cava; the azygos continuing its course in a straight line, ran parallel with and to the right of that vein, finally opening into it by a large aperture on the right side about half an inch above where it received the right renal vein. Since this aperture was as large as the vein it opened into, the anterior part of the latter might be regarded as a branch of the azygos, the posterior part becoming

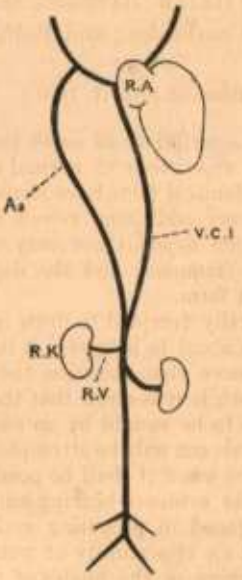



Diagram showing abnormal relations of the Azygos Vein in a Rabbit.
*Az.*, azygos vein. *V.C.I*, vena cava posterior. *R.V.*, right renal vein. *R.A.*, right auricle. *R.K.*, right kidney.

the prolongation of that vein, and not the posterio
total length of the vein from its junction with
it joined (or received) the posterior ven
relatively large size would naturally lead
the greater part of the blood brought by t
branches of the posterior vena cava fro
body was returned direct to the right aur

228. EUTHEUS MARCHALII.
*Pamphila marchalii*, Boisd.; Kirby, t. c. Suppl. p. 824.
Araguaya River.

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*Achlyodes trifasciata*, Hew.; Kirby, t. c. p. 631.
Araguaya River.

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*Achlyodes ozema*, Butl.; Kirby, t. c. p. 657.
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## 10. On a Case of the Occurrence of a persistent Right Posterior Cardinal Vein in the Rabbit. By EDMUND S. HALL, Student of Guy's Hospital. (Communicated by F. E. BEDDARD, M.A., Prosector to the Society, Lecturer on Biology at Guy's Hospital.)

[Received June 16, 1890.]

In the dissection of a male Rabbit on June 5th at Guy's Hospital, it was noticed that, in the thoracic region, the azygos cardinal vein was of great thickness, its diameter being a third of the size of that of the right anterior vena cava, though its position and branches were exactly comparable with those of the normal vein of any other Rabbit.

In following this vein from the thoracic region towards the posterior end of the body, the following points were noted:—That,

instead of, as in the ordinary Rabbit, ending or (more correctly) beginning in its branches, the intercostal veins, the azygos vein pierced the diaphragm by an aperture to the right of that of the aorta, and continued its course posteriorly with a very slight diminution in size and in the same relative position as in the thorax with regard to the aorta and the vertebral column.

At the point where the posterior vena cava reached the dorsal wall of the abdominal cavity, the aorta curved slightly upwards and ran dorsally to the cava; the azygos continuing its course in a straight line, ran parallel with and to the right of that vein, finally opening into it by a large aperture on the right side about half an inch above where it received the right renal vein. Since this aperture was as large as the vein it opened into, the anterior part of the latter might be regarded as a branch of the azygos, the posterior part becoming

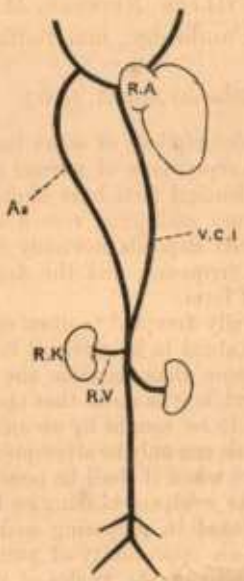



Diagram showing abnormal relations of the Azygos Vein in a Rabbit.
*Az.*, azygos vein. *V.C.I*, vena cava posterior. *R.V.*, right renal vein. *R.A.*, right auricle. *R.K.*, right kidney.

the prolongation of that vein, and not the posterior vena cava. The total length of the vein from its junction with the anterior to where it joined (or received) the posterior vena cava was six inches. Its relatively large size would naturally lead one to the supposition that the greater part of the blood brought by the iliacs, femoral, and other branches of the posterior vena cava from the posterior ends of the body was returned direct to the right auricle by means of this extra-

ordinary prolongation of the azygos cardinal vein, though the vena cava was quite of the normal size.

It will be observed that the continuity between the inter-renal portion of the vena cava and the azygos is quite in accord with the discoveries of Hochstetter[1] in the development of these veins. Contrary to the generally received opinion (*cf.* for example the diagram illustrating the origin of these veins in Wiedersheim's 'Grundriss der vergleichenden Anatomie der Wirbelthiere,' Jena, 1888, p. 329), Hochstetter found in the Rabbit and the Pig that the vena cava from where it receives the renal veins to a point behind the opening of the ilio-lumbar veins is formed from the right cardinal.

## 11. On some Cases of Abnormal Repetition of Parts in Animals. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge, and Balfour Student in the University.

[Received June 17, 1890.]

This paper contains descriptions of some instances of variations consisting in abnormal repetitions of normal structures. A large number of similar or identical facts have already been recorded by many observers, yet every additional record is valuable; for the significance of a variation depends not only on the form which it takes, but also on the frequency and the degree of completeness with which it takes that form.

Though one is naturally tempted to draw seemingly obvious deductions from the facts about to be given, it is not proposed on the present occasion to do more than describe the actual structures as they are found. For while it is clear that the key to some of the problems of variation is to be sought by an analysis of this class of facts, yet such an analysis can only be attempted after a wide survey of the whole ground, and when it shall be possible to bring forward a large collection of the evidence bearing on the subject. I have been for some time engaged in preparing such a collection, and I hope before long to find an opportunity of putting it in order with a view to a full discussion of the modes of variation of Multiple Parts. In the meantime it is best to describe the forms without comment.

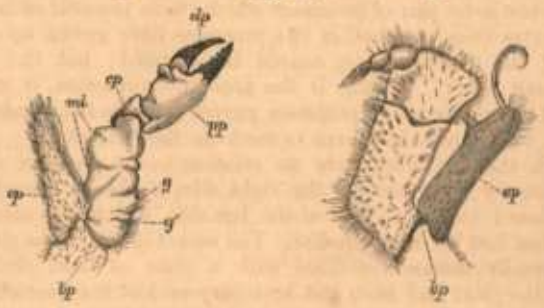
### I.—*Crab* (Cancer pagurus) *having the Endopodite of the Third Maxillipede represented by a Chela.*

This animal was brought by a fisherman to the Laboratory of the Marine Biological Association at Plymouth. It is a male, measuring five inches from one side of the carapace to the other. All the

[1] "Ueber die Bildung der hinteren Hohlvene bei den Saügethieren," Anat. Anz. Bd. ii. p. 517.

parts appear to be normal with the exception of the third maxillipede of the right side. This structure, however, has the form shown in fig. 1, A, differing entirely from the ordinary condition of the appendage. Fig. 1, B, is taken from the third maxillipede of the left side and shows the ordinary structure of the same parts. On comparing the two figures, it will be seen that the protopodite does not differ in the limbs of the two sides; that the exopodite of the right side is essentially like that of the left, but that it lacks the inner process and the flagellum which are borne by the normal part. There was some indication that this branch of the limb had been injured, and perhaps the flagellum may have been torn away, but the appearances were not such as to warrant a conclusion on this point. The branchial epipodites (not shown in the figures) were normal in both cases. The endopodite of the right side was entirely

A Fig. 1. B




A represents the abnormal third maxillipede of the right side. B shows the same parts on the left side, which are normal.

*bp*, protopodite; *cp*, epipodite; *dp*, dactylopodite; *pp*, propodite; *cp*, carpopodite; *mi*, meropodite and ischiopodite ankylosed together, *g* indicates the line of their separation; *g'* corresponds to the groove at which a chela can be thrown off.

peculiar and was, in fact, literally transmuted into the likeness of one of the great chelæ. It consists of a single joint (*mi*), articulating with the protopodite centrally and bearing the carpopodite. This single joint represents, as it were, the ischiopodite and meropodite of an ordinary chela, but these two parts are ankylosed together, and the articulation between them is only represented by a groove (*g*); another groove (*g'*) represents the groove upon the ischiopodite of the chela at which the limb is commonly thrown off by the animal if it is injured. The carpopodite, propodite, and dactylopodite are feebly movable on each other and hardly differ, save in absolute size, from those of the normal chela. The shape, proportions, and texture are all those of the chela.

Cases like the foregoing, of the complete transformation of a part into the likeness of another part, though very common among

plants, are rare amongst animals. This variation is especially interesting from the fact that a precisely similar case of the transformation of the third maxillipede (left) into a chela has been already observed in *C. pagurus* (Cornish, T., Zoologist (3), viii. p. 349).

II.—*Cases of Repetition of the Pincers of the Chelæ in Crabs* (Cancer pagurus).

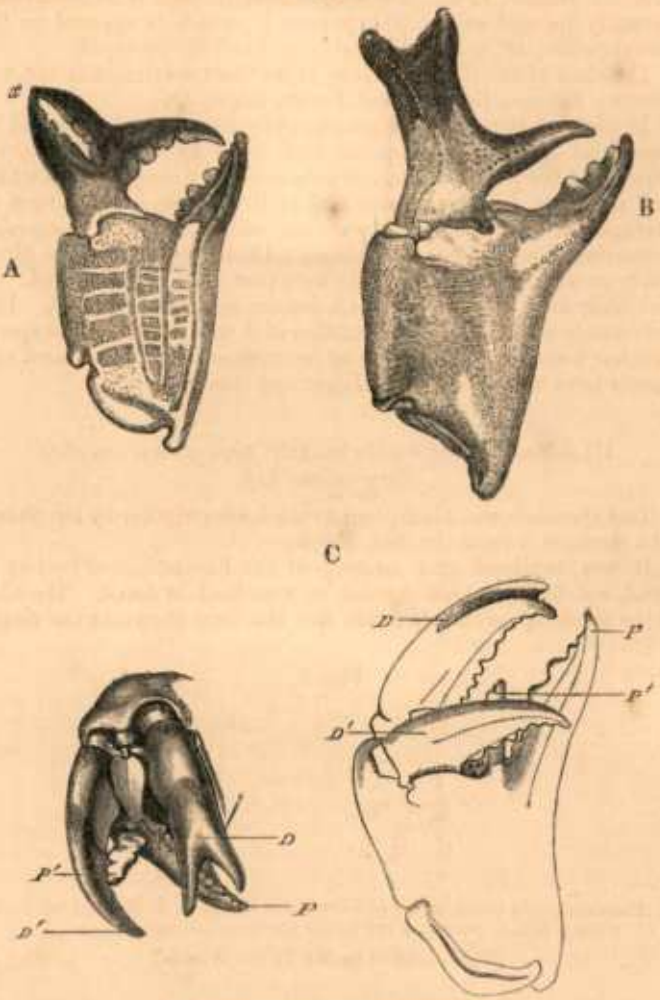
A & B. These two specimens were brought by fishermen to the Plymouth Laboratory. The greatest measurement of the carapace was in each case about five inches. The one specimen was a male, but the sex of the other was not noted. With the exception of the varying structures about to be described, the animals seemed normal and healthy. In A the chela of the right side had the form shown in fig. 2, A (p. 582), which represents the limb seen from the outside. The dactylopodite bears two supernumerary, fixed processes. Whether the *outer* pair of processes which curve towards each other are the extra ones, or whether two processes have grown up on the inside of the dactylopodite, cannot be affirmed; but the latter seems more likely. If this is the true interpretation, it will be seen that one of the extra processes curves towards the "index" of the limb, while the other turns to meet the dactylopodite.

Though the fact may have no relation to the presence of this supernumerary structure on the right side, it should nevertheless be mentioned that the chela of the left side, which was otherwise perfect, had lost its dactylopodite. The socket in which the dactylopodite usually moves was filled with a plate of hard shell, but whether the joint had been lost by injury or had been congenitally absent could not be affirmed. Since mutilated limbs are generally thrown off by Crabs, the presence of such a chela without the dactylopodite is so far evidence that this joint had not been lost by an accident. As, however, according to the observations of Heineken (Zool. Journ. vol. iv.), such mutilated parts are occasionally retained, much stress cannot be laid on this consideration.

The left chela of B is shown in the figure as seen from the inside. The dactylopodite bears a thick process which divides peripherally into two stumpy projections which bear teeth on their inner faces. These projections are like the normal pincers in consistency and colour.

C. This specimen was kindly lent to me for description by Mr. J. Carter, F.R.C.S., of Cambridge. It is the right chela of a *Cancer pagurus*. In it the repetition of parts is far more extensive than in either of the preceding specimens. As is shown in fig. 2, C, it bears two dactylopodites, each complete in all respects, and to each of these dactylopodites is opposed a fixed process. In addition to this, one of the two dactylopodites is partially divided longitudinally into two, and at its free end terminates in a pair of toothed processes. The teeth on these processes are continued downwards on the inner surface of the joint in two complete rows. The total number of points borne by this claw is five.

Fig. 2.




Abnormal claws of *Cancer pagurus*.

A, is shown from the outside; B, from the inside; C, is represented as seen from the end and from the outside.

(The two processes overlap, but do not meet, at the point *x*.)

(Figures B and C were drawn for me by Miss M. J. Davidson.)

Though there is not sufficient evidence for determining the question, it may be mentioned that the general appearance suggests that the double dactylopodite, D, is the normal one of the limb and that the process, P, which is warped over to meet it, is the process normally opposed to it. The process P', which is opposed to the dactylopodite, D', is comparatively small and ill-developed.

The class of variation shown by these three specimens is not uncommon amongst Decapoda (*cf.* Faxon, Léger, &c.).

In addition to these cases an especially interesting one should be mentioned which was communicated to me by Mr. G. C. Bourne, Director of the Marine Biological Laboratory. This specimen, which was not seen by myself, was sent to Mr. Bourne by Mr. Dunn of Mevagissey, Cornwall. It was an edible Crab (*C. pagurus*), measuring about 2·5 inches across. In this specimen the three posterior walking-legs of one side were seen to be each repeated. It had lately moulted and was much decomposed when received. Unfortunately an imperfect examination of it was made and the specimen has been destroyed. Similar occurrences among Crustacea and insects have been recorded by Léger and others.

### III.—*Beetle* (Chrysomela banksii) *having three complete Tarsi on one Leg.*

This specimen was kindly lent to me for description by Dr. Sharp, who obtained it from the New Forest.

It was exhibited at a meeting of the Entomological Society in 1862, but has not been figured or described in detail. The tibia of the third leg on the right side has the form shown in the figure.

Fig. 3.

A, Abnormal right posterior leg of *Chrysomela banksii*. B, Normal leg in the same position, from a rather larger specimen (enlarged to scale).

(Figures drawn by Mr. Edwin Wilson.)

Its outer extremity, which is widened into a flat, club-shaped structure, bears three complete tarsi, each of which is perfect in all its four joints and carries a pair of normal claws. These three tarsi are equal in size, but are very slightly smaller than those of the same leg on the other side.

In addition to the three tarsi the tibia is produced into a small horn, which projects from it rigidly, having no articulation. At the

apex of this horn is a small circular pit which is apparently closed by membrane. The other appendages are normal.

A considerable number of cases similar to the above have been collected, especially by Kraatz, Mocquerys, and Jayne.

### IV.—Antedon rosacea *with Abnormal Repetition of the Brachial Structures.*

This individual was found amongst a number of other specimens of *A. rosacea* collected by a party that had been dredging for the Plymouth Laboratory in the Hamoaze, near Beggar's Island.

In normal individuals of this species the arms after leaving the radial plates do not again divide, but are continued to their ends as a single row of brachial plates, which bear pinnules on either side alternately. The present specimen, however, bears two arms, which, after being continued normally for a certain distance, break up into several secondary arms. The diagram (fig. 4, A) shows the relation of these two varying arms (lettered $b_2$ and $e_1$) to the mouth and anus. It is seen, therefore, that they are *symmetrically* placed.

As I am inexperienced in the use of Crinoid terminology, I sent this specimen to Dr. P. H. Carpenter, who has very kindly supplied the following description of it:—

"The abnormal arms of this remarkable specimen are symmetrically placed as regards the mouth and anus, being the posterior arms, $b_2$ and $e_1$, of the two anterolateral rays. The arm $b_2$ has been regenerated at the syzygy in its 15th brachial. But the pinnule on the new epizygal is on the same side (abradial or outer) as that on the 14th brachial, and not opposite to it as would normally be the case, so that there are two pinnules in succession on the same side of the arm. The next twelve pinnules alternate regularly on opposite sides, those of the 19th and 27th brachials having much enlarged basal joints. That on the 28th brachial is considerably larger than its predecessors and more like a bifid armlet. It commences with five large joints, the last of which bears two pinnules, the one continuing the main axis being rather stouter than its fellow. The 29th brachial is a syzygy and its epizygal axillary. The abradial or outer facet bears an arm, of which some 75 joints remain. It has pinnules on the 2nd and 4th, the latter of which is a syzygy; but there is none on the 3rd, which would normally be a syzygy and bear a pinnule. On the larger, adradial, facet of the axillary 29th brachial is another axillary (30th br.), but without a syzygy. One of its facets bears the continuation of the primary arm, on the next joint of which (31st br.) is an abnormal trifid armlet with three enlarged basal joints, the second being a syzygy with a pinnule-stump on the epizygal, while the fourth bears two pinnules. The 32nd brachial is again axillary with a syzygy, its epizygal bearing two subequal arms of some 60 joints each. The second joint of the left-hand one which continues the primary arm has a bifid pinnule with its basal joints enlarged, and the following pinnules alternate regularly on opposite sides. The arm borne on the

Fig. 4.

A, Diagram showing the position of the abnormal arms, $b_2$ and $e_1$, to the mouth and anus. B, is a semidiagrammatic enlargement of the arm, $b_2$.

(Drawn by Mr. Edwin Wilson.)

right or adradial facet of the axillary 32nd brachial has no pinnule till its third joint, which is not a syzygy, though the fourth is; but in other respects the arm is normal. The second facet of the axillary 30th brachial bears a normal arm of about 60 joints, with a pinnule on the second and a syzygy on the third. Thus, then, the axillary 29th brachial of the primary arm $b_2$ gives rise to four well-developed arms, two of which bear bifid or trifid armlets, in addition to the larger bifid armlet on the 28th brachial.

"The primary arm $e_1$ does not seem to have undergone any regeneration and is normal to the 40th brachial. The 41st is a syzygy and the appendage of its epizygal is a short armlet of three joints, the second and third of which bear pinnules laterally, while its main axis is also continued on in the form of a pinnule. The 42nd brachial has a similar armlet, with but one lateral pinnule. The 43rd is axillary without a syzygy, its adradial branch being a normal arm with some 40 joints remaining, the second and fourth of which have pinnules, though the third has not. The 44th joint of the primary arm seems to be a syzygy; and its epizygal, though not regularly axillary, supports an arm which has the first pinnule, as usual, on the second joint, but on the inner instead of on the outer side. The next five joints are all enlarged and bear bifid or trifid armlets, while the remainder of the arm is normal, with regularly alternating pinnules."

Variations in the number of parts and even in the primary symmetries are well known among Echinoderms, but Dr. Carpenter informs me that this specimen is quite unlike anything of the kind which he has previously met with.

### V.—*Pilchards* (Clupea pilchardus) *with the Number of Scales abnormally increased.*

In the 'Proceedings' of this Society for 1887 (p. 129) the late Mr. F. Day described a specimen which he believed to be a hybrid between the Herring (*C. harengus*) and the Pilchard. The specimen was sent by Mr. Dunn, of Mevagissey. Its peculiarity lay in the fact that the scales on the left side were very many more in number than those on the right side. The number of scales along the lateral line is given as 32 on the right side and 51 on the left. Mr. Day adds that the ridges on the operculum, which are characteristic of the Pilchard as compared with the Herring, were better marked on the right side than they were on the left, though they are stated to have been very distinct on the left side also.

In the specimen described the gill-rakers were 61 in the "lower branch of the outer branchial arch" (viz. the bar consisting of the first hypobranchial and ceratobranchial), and it is mentioned that this number is intermediate between that found in a Pilchard (71) and in a Herring (48); but whether this intermediate number was found on the side showing the "hybrid" characters, or on the other, or on both, is not stated. These gill-rakers are also said to have been intermediate in length between those of a Pilchard and those

of a Herring. From these points of structure Mr. Day concluded that the specimen was a hybrid between the Herring and the Pilchard.

Before discussing the propriety of this view, I will describe two specimens showing somewhat similar characters, which were given to me by Mr. Dunn during the summer of 1889. Mr. Dunn told me that among the large number of Pilchards which come under his notice as director of the pilchard-curing factories at Mevagissey, specimens showing this singular reduplication of the scales on one side are not uncommon. Owing, however, to the fact that the fresh Pilchards are shovelled wholesale into the brine-vats, it is generally not until the fish are picked over for packing after the salting process that any individual peculiarities are noticed. This was the case with the present specimens, which were given to me as they came salted from the presses. Nevertheless, when received, they were in good condition.

The first specimen measures 8 inches to the base of the caudal fin. The head and opercula of both sides are normal. *The number of scales along the lateral line on the left side is* 32, *and the number on the right side is* 56 *or* 57. Examined closely, it can be seen that for the distance of about an inch behind the operculum the scales are not much smaller than those of the normal Pilchard, but that behind this point each scale is of about half the normal size.

The second specimen differs from the first in that the reduplication occurs on the *left* side instead of on the *right*. Furthermore, the scales are normal in size as far as the anterior end of the dorsal fin, behind which place they are of about half the normal size. The transition is much more abrupt in this specimen than in the other. The scales of this fish had been somewhat rubbed, and I was not able to satisfy myself of the accuracy of the counting, but the total number along the lateral line was approximately 48.

In the figure of Mr. Day's specimen, given in P. Z. S. 1887, pl. xv., no transition is indicated between normal and abnormal scales, but there is a general appearance of uniformity.

These three specimens all agree in showing repetition of the scales on one side. The distance to which this repetition extends differs in each case, but in all the condition of the scales is uniform and regular so far as it extends. In my judgment these specimens should be considered as examples of variation in number of parts. Since, however, it has been suggested that they are of hybrid origin, a few words may be permitted in criticism of this view.

No direct evidence is adduced which points to hybrid parentage. The suggestion is derived from (1) the condition of the scales, (2) the number of the gill-rakers, (3) the alleged difference in the opercula of the two sides. In view of the first point, viz. that the number of the scales on one side is intermediate between that of the Pilchard and that of the Herring, it seemed desirable to know whether the resemblance extended to the minute structure of the scales or was restricted to their number only. On comparing microscopically the scales of the Pilchard and the Herring, I find

that those of the Herring bear concentric lines which are almost always smooth and without serrations, while those of the Pilchard are marked with lines which are waved into very characteristic crenelated serrations. On comparing the scales which are repeated, it was found that they also show these characteristic serrations and that in pattern they differ in nowise from the scales of the Pilchard. This evidence appears to tell very strongly against the theory that the small scales are derived from a Herring parent.

The evidence from the gill-rakers seems to be also unreliable. In a normal Pilchard Mr. Day found 71 on the hypo- and cerato-branchials of the first gill-bar, and in a specimen examined by me 72 were present and in normal Herrings 48. But in the two specimens showing the repeated scales there were present, on the normal sides 79 and 67 respectively, and on the abnormal sides 78 in the one fish and 67 in the other. In size and shape the gill-rakers were like those of the Pilchard, being smooth, and unlike those of the Herring, which bear well-marked teeth.

As it is stated that the serrations characteristic of the operculum of the Pilchard were very distinct on the abnormal side, it is impossible to place much stress on the circumstance that they were less distinct than those of the other side.

In addition to the considerations given above, there are several *à priori* objections to the hypothesis of the hybrid origin of these forms; as, for example, that unilateral division of parental characters is certainly not a common phenomenon, if it occurs at all, and so on. But since the evidence advanced for the theory of hybrid parentage is already open to criticism, it is perhaps unnecessary to discuss these further difficulties.

On the whole, therefore, it seems simpler to look on these abnormalities as instances of the phenomenon of Repetition of Parts, which is so common a form of variation. Though on the present occasion a discussion of the nature of these variations is to be avoided, it may be useful to mention in this connexion that such repetitions are especially common among exoskeletal structures; and though, in the absence of fuller treatment, the comparison may seem somewhat crude, reference may be permitted to such cases as that of the Merino Sheep &c., in which the number of hair-follicles in a given area is enormously greater than that in the common varieties. Such variations are well known among many wild and domesticated animals. The unilateral occurrence of such a variation, however, is exceptional.

The fact that these fishes were full-grown and in good condition, swimming with the shoal, should be specially remarked.

For the reasons given above it is felt to be unadvisable to consider the significance of these facts until it shall be possible to discuss the whole question of the Variation of Multiple Parts.

November 4, 1890.

Prof. W. H. Flower, C.B., 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 1890:—

The registered additions to the Society's Menagerie during the month of June were 157, of which 24 were by birth, 108 by presentation, 12 by purchase, and 13 were received on deposit. The number of departures during the same period by death and removals was 95.

The most noticeable acquisitions during the month were:—

1. A young male of the Wild Cattle of Chartley Park, Staffordshire, presented by Earl Ferrers. This is the first example of any of the original breeds of English Wild Cattle that has been exhibited in the Society's Gardens.

2. A young male Water-buck Antelope (*Cobus ellipsiprymnus*) from Kisumayu, on the Somali Coast, E. Africa, presented by George S. Mackenize, Esq., F.Z.S. This is the first example of the Water-buck that has been received by the Society for many years.

The registered additions to the Society's Menagerie during the month of July were 141; of these 39 were acquired by presentation, 19 by purchase, 2 by exchange, 68 by birth, and 13 were received on deposit. The number of departures during the same period by death and removals was 92.

The registered additions to the Society's Menagerie during the month of August were 61; of these 34 were acquired by presentation, 17 by purchase, 7 by birth, 2 by exchange, and 1 was received on deposit. The number of departures during the same period by death and removals was 98.

The registered additions to the Society's Menagerie during the month of September were 77; of these 38 were acquired by presentation, 14 by purchase, 8 by exchange, 11 were bred in the Gardens, and 6 were received on deposit. The number of departures during the same period by death and removals was 86.

The most noticeable additions during the month were:—

1. A Common Bee-eater (*Merops apiaster*), purchased Sept. 15th, being the first example of any species of the family Meropidæ that we have received alive.

2. A young example of the Horned Screamer (*Palamedea cornuta*), purchased Sept. 29th. This is a rare bird. I believe no example of it has been received in London since the specimen presented by Lord Harris in 1851, which lived for some time in the Gardens.

The number of registered additions to the Society's Menagerie during the month of October were 78, of which 10 were by birth, 48 by presentation, 11 by purchase, 2 by exchange, and 7 were received on deposit. The number of departures during the same period by death and removals was 128.

The most noticeable additions during the month were :—

1. Two Purple Porphyrios (*Porphyrio cæruleus*), presented by J. I. S. Whitaker, Esq., F.Z.S., of Palermo. These are the first specimens of the South-European Porphyrio received by the Society direct from Sicily, where they are said to be not uncommon in the marshes of the south-eastern portion of the island.

2. A young female of Speke's Antelope (*Tragelaphus spekii*), presented by James A. Nicolls, Esq., October 14th, being the first specimen of this rare and little-known Antelope that has reached Europe alive. The specimen was captured in the marshes north of Lake Ngami by Mr. Nicolls and his companions, under circumstances mentioned in that gentleman's letters to the 'Field' newspaper[1], and was carried in their waggons 800 miles to Kimberley, whence it was brought to this country by rail and steamer. We have placed it in a sheltered compartment of the Gazelle sheds and covered the yard with dried peat fibre, as its peculiar elongated hoofs render it hardly able to move on a smooth surface.

The accompanying sketch by Mr. Smit (Plate XLVII.) will give a good idea of the external form of this Antelope. It will be observed that the animal, although not much more than two years old, is nearly free from bars and spots.

3. A female Bay Colobus (*Colobus ferrugineus*), purchased of a dealer, October 16th, which, however, I regret to say, did not live many days in the Menagerie. This is the first specimen of this well-marked Colobus which I have ever seen alive. The sketch, which I exhibit, by Mr. Smit (Plate XLVIII.) will give a good idea of its appearance in life.

This is a West-African species, of which positively ascertained localities are Gambia (*Rendall*) and Gold Coast (*Pel*).

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The Secretary exhibited, on behalf of Dr. A. B. Meyer, C.M.Z.S., a coloured photograph of a singular variety of the Rose-coloured Pastor (*Pastor roseus*) with a red head, and read the following note from him on the subject :—

"It is well known that the invasion of Europe by the Rose-coloured Pastor in 1889 was repeated this year and that Bulgaria was again overrun with flocks of this bird. They arrived near Sofia on June the 4th, the same day as they made their appearance in the previous year. They came from the east, were observed in Philippopel, and bred again 8 km. south of Sofia, at Knjajevo, in flocks numbering altogether about 30,000. In 1889 the eggs were so numerous that the inhabitants made omelettes of them. The birds are not at all shy, and one can approach to within about 10 feet of them without disturbing them. One specimen with a red head was caught alive and lived a fortnight in the possession of H.R.H. the Prince Ferdinand of Bulgaria, who sent me the foregoing notes and the photo-

[1] See "Travel and Sport along the Botletle River and around Lake Ngami." 'Field,' Feb. 22, 1890, p. 289; March 1, 1890, p. 325; March 8, 1890, p. 363.

J. Smit lith. Mintern imp.

TRAGELAPHUS SPEKII ♀

J. Smit lith. Hanhart imp.

COLOBUS FERRUGINEUS.

graph of this bird, which I have the pleasure of submitting. I am not aware that a similar individual variety of *Pastor roseus* has been described before. It differs from the typical bird in having the head and neck red, with the exception of a few feathers on the crown and forehead and an irregular band round the neck, which are black, whereas in the normal bird the black extends from the red breast to the mandible."

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Mr. Boulenger drew attention to an early reference to the Syrian Newt, *Molge vittata*, Gray, and made the following remarks:—

On recently perusing Thomas Shaw's 'Travels in Barbary and the Levant' (Oxford, 1738), I came across a figure of a Newt which, though of very unsatisfactory execution, is so far recognizable that I at once identified it as *Molge vittata*; and this determination is confirmed by reference to the text, which runs thus:—"The Skinkôre" (p. 375) . . . "found in great numbers in a fountain near Bellmont [a few miles south of Tripoly], being of the Lizard kind, all over spotted, and differ from the common Water Efts in the extent and fashion of their fins. These, in the males, commence from the tip of the nose, and running the whole length of the neck and back to the very extremity of the tail, are continued afterwards along the under part of the tail quite to the navel; whereas the tails only of the female are finned. The body and tail of this animal are accounted to be great provocatives, and are therefore bought up by the Turks at an extravagant price."

Except that the anus is taken for the navel, Shaw's description is perfectly correct, and it is interesting to find a record of this rare Newt a century prior to its first scientific description.

It will be remembered that *Molge vittata* was regarded as a British animal up to the year 1877, when M. Lataste demonstrated in a remarkable paper that its habitat is Syria and Asia Minor. The locality where the Newt was found by Shaw affords no addition of importance to our knowledge of its distribution, it having been already recorded in Syria from the Lebanon Coast (*Lataste*) and Beyrut (*F. Müller, Boettger*).

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Mr. J. J. Lister, F.Z.S., gave an account of his visit to the Phœnix Islands, South Pacific, in June and July 1889, during a cruise of H.M.S. 'Egeria,' and exhibited specimens of the birds and eggs obtained there.

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The following papers were read:—

# 1. On the Gaur (*Bos gaurus*) and its Allies.

By W. T. Blanford, F.R.S., F.Z.S., &c.

[Received June 18, 1890.]

(Plate XLIX.)

Very little has been added to our knowledge of the classification, habits, and distribution of the wild Indian *Bovidæ* since Blyth, thirty years ago, wrote an excellent account of the "flat-horned taurine cattle of India"[1]. But an important addition to the opportunities hitherto afforded to residents in London of studying the living animals of this section of the genus *Bos* has been made by the arrival at the Society's Gardens of a young male 'Gaur' or 'Sladang,' *Bos gaurus*, in the autumn of 1889[2]. Despite many previous attempts to introduce this animal, no other individual is known to have reached Europe alive. Examples of both the other species belonging to the same section have lived in the Gardens.

The young animal[3] now in the Gardens at Regent's Park was one of a herd of twenty-four animals captured by the Sultan of Pahang in the Malay Peninsula, as described by Mr. A. H. Wall in the 'Field' (June 1st, 1889, p. 767). A stockade or kraal, similar in form to that used for capturing Elephants, was constructed on a promontory, covered with high grass and bushes, on the Pahang river, and the herd of Gaur were driven into the enclosure by about 1500 beaters. The frightened animals charged and fought each other until one half were killed or mortally wounded, the survivors were driven into a long narrow passage leading to the river, and isolated from each other by bamboo poles.

The section of the genus *Bos* comprising *Bos gaurus* and its allies was separated by Hodgson[4] under the name of *Bibos* in 1837. It comprises three well-marked forms, and is distinguished by the horns being flattened or subelliptical in section, especially towards the base, by the tail being short, only reaching the hocks, and by the spinous processes of the dorsal vertebræ being long and those of the

[1] J. A. S. B. xxix. p. 282 (1860). The substance of this paper was subsequently republished with additions in a series of articles on "Wild types and sources of Domestic Animals," that appeared in 'Land and Water,' vol. iii. 1867, pp. 287, 345, 395, 422, 476, 630.

[2] See P. Z. S. 1889, p. 447.

[3] This animal is now (Nov. 1890) in excellent health and condition, and has grown nearly to his full stature.

[4] J. A. S. B. vi. p. 747; see also J. A. S. B. x. p. 447, and xvi. p. 706. Blyth, in his 'Catalogue of the Mammalia in the Museum of the Asiatic Society,' 1863, p. 160, adopted the generic term *Gaveus*, Hamilton Smith. In this he was followed by Jerdon (Mammals of India, p. 301). I cannot find any publication of the name *Gaveus* as a generic term by Hamilton Smith. In Griffith's 'Cuvier,' iv. p. 406, and v. p. 375, the Gayal is described under the name of *Bos gaveus*, and placed in the subgenus *Bison*. Hodgson subsequently, in 1847 (J. A. S. B. xvi. p. 705), separated the Gayal from *Bibos*, and made it the type of a distinct genus *Gaveus*, and both genera were admitted in Horsfield's 'Catalogue of the Mammalia in the Museum of the Hon. East India Company.'

J. Smit, Lith. Hanhart imp.

BOS GAURUS

lumbar vertebræ short, the change in length taking place abruptly, so that there is along the anterior half of the back, from the shoulders, a high ridge which terminates suddenly about halfway down the trunk. This character, however, is less marked in *Bos sondaicus* than in the other two species, and the flattening of the horns is less conspicuous in females than in males and is sometimes not to be detected in cows of the species just named.

All the species have a peculiar and characteristic coloration, the old males being dark brown or almost black, the females and younger males paler or reddish brown, the legs from just above the knee and hocks downwards white or whitish.

The three known forms may be thus distinguished :—

A. No white caudal disk; dorsal ridge high. Females dark umber or sepia-brown.
   *a*. Forehead very concave; a high ridge, the upper border of which is very convex, between the horns. Horns curving much, the points turned inwards. *Bos gaurus* (the Gaur).
   *b*. Forehead nearly flat, no elevated ridge between the horns. Horns curving but little, points not turned inwards. *Bos frontalis* (the Gayal or Mithan).

B. A white caudal disk. Females reddish brown approaching chestnut. Dorsal ridge much lower, termination inconspicuous. Forehead narrower and skull longer than in the other species. Horns smaller and more curved than in either, the points turned in. *Bos sondaicus* (the Banteng).

Coloured figures of the Gayal have already appeared in the Society's 'Proceedings' (♂, 1866, pl. i.; ♀ and young, 1882, pl. x. p. 233). Excellent coloured representations of the Banteng are to be found in Sal. Müller and Schlegel's 'Verhandelingen Nat. Gesch. Ned. overz. Bez.' The accompanying figure [1] (Plate XLIX.) of the young male of *Bos gaurus*, now in the Gardens, is probably the first taken from a living example, though many figures have been given in illustration of Indian sporting and zoological works [2]. Not one of these, however, appears to me to be a really good representation of the animal, and I am doubtful whether the portrait of the young tame bull now published will convey a correct idea of an adult Gaur in his native haunts. The photograph of a dead Gaur (apparently a bull just mature), which I now exhibit (see woodcut, p. 594), affords a better conception of the animal than any drawing I have ever seen [3].

A figure of the bull Gayal (*Bos frontalis*), which serves to show the proportions, and to some extent the differences of that type, is given in another photograph, kindly lent to me for the purpose

[1] This figure is copied from photographs taken in the Gardens by Major J. Fortune Nott, F.Z.S., who has very kindly allowed them to be used for the Plate.

[2] The most spirited and artistic is that by Wolf in Col. Walter Campbell's 'My Indian Journal,' but it is incorrect in several points. Figures of it are given in Forsyth's 'Highlands of Central India,' Sanderson's 'Thirteen Years among the Wild Beasts of India,' Sterndale's 'Seonee,' the same author's Natural History of the Mammalia of India and Ceylon,' and Hornaday's 'Two Years in the Jungle.'

[3] I am indebted for the loan of this photograph to Dr. V. Ball, C.B., and Mr. A. B. Wynne. I regret to say that the original photographer is not known.

Fig. 1.

Dead Gaur (*Bos gaurus*) in Bamboo jungle. From a photograph.

by Dr. J. Anderson, who had the original in his possession in Calcutta. It was a superb specimen, and was intended for the Society's Gardens, but unfortunately met with an accident, from the result of which it died, when being shipped for England. The shorter legs, large dewlap, shorter head, and differently formed horns are shown in the photograph (see fig. 2).

I cannot concur in the view taken by Hodgson, Gray, Blyth, and Horsfield that there is a difference amounting to generic distinction between this group of flat-horned bovines and typical *Bos*, e. g.

Fig. 2.

*Bos frontalis*, ♂. From a photograph.

*B. taurus* and *B. indicus*; indeed I feel grave doubts as to the generic distinction of the Bisons and Buffaloes from the taurine cattle. *Bos sondaicus* is in some respects intermediate between *Bos gaurus* and the typical forms, whilst the distinctions between *Bos caffer* and *Bos bubalus*, or between *Bos bonassus* and *Bos grunniens*, appear very similar in kind to those between *Bos taurus*, *Bos bonassus*, and *Bos bubalus*, and not very different in degree. But if the genus *Bos* be divided, the most natural sections appear to be the taurine, bisontine, and bubaline; and the members of the flat-horned section agree far better, as has been, I think, shown by Lydekker in his discussion of the fossil forms, with the taurine than with the

bisontine subdivision, although they were referred to the latter by Hamilton Smith and others.

Our present knowledge of the range of the three species of this section of *Bos* may be thus summarized:—

*Bos gaurus*.—The Gaur is found in all the larger forest-tracts of the Indian Peninsula from the Ganges to Cape Comorin, but not in Ceylon. Its extreme north-western range, at present, I believe to be in the neighbourhood of the river Nerbudda east of Broach, and west of long. 80° E. the valley of the Nerbudda forms approximately its northern limit, though it may in places exist a little further north. It does not inhabit the grass-jungles of the great Indus and Ganges plain, except to the eastward in the neighbourhood of the Himalayas; in fact this animal is seldom, if ever, found far away from hilly ground. It occurs in the forests along the base of the Himalayas as far west as Nepal, and is met with in the hill-regions south of Assam and thence in all suitable localities throughout Burma and the other countries immediately east of the Bay of Bengal down to the southern extremity of the Malay Peninsula, where its occurrence is no new discovery, for Blyth recorded its existence there in the paper already quoted [1]. The range of the Gaur in Siam, Cochin China, Tonquin, &c. does not appear to have been ascertained with any certainty; it is said to occur in Siam, but I can find no record of its occurrence further east, and no mention of the existence of any flat-horned bovine in South China is made by Swinhoe.

The Gaur is unknown in the Malay islands and in Ceylon, but the statement has repeatedly been made that it formerly inhabited the latter. I am disposed to think this doubtful, and I quite agree with Sanderson [2] in my surprise that the Gaur should have disappeared from a region where wild Elephants are still found in large numbers. Throughout the Peninsula of India the reverse is the case; the Elephant has, I think, clearly been the first to disappear, as in the Satpuras, the Northern Syhádri, and throughout parts of Chutia Nagpur, where the Gaur still occurs. A belief in the former occurrence of *Bos gaurus* in Ceylon is partly founded on the fact that Knox, writing in 1681, mentioned under the name of *Guavera* an animal kept tame at Kandy, and partly on Kelaart's statement [3] that "the Kandyans also say that the *Goura* once roamed through those forests which to the present day are called after the Goura, Goura-Ellia, Goura-Koodie, &c." On the other hand, it is by no means improbable that the Gaur, like the Tiger, never inhabited Ceylon, a circumstance very possibly due to the animal not having migrated into Southern India until after Ceylon had been separated by sea.

*Bos sondaicus*.—The Banteng is entirely confined to countries east of the Bay of Bengal. The northernmost localities from which it

[1] Cantor too, in 1846, stated that the Gaur was "numerous in the Malayan Peninsula" (J. A. S. B. xv. p. 273).

[2] 'Thirteen Years among the Wild Beasts of India,' p. 243.

[3] Prodromus Faun. Zeyl. p. 87. In Griffith's 'Cuvier,' v. p. 410, too, it is stated that the wild ox or Guavera of Ceylon was shot by British parties during the war with Kandy. But the animals shot may have been wild Buffaloes.

has been distinctly recorded are Northern Pegu and Arrakan west of Pegu; but Blyth has shown (J. A. S. B. xxix. p. 294) that it probably occurs in the ranges east of Chittagong. It is common in Tenasserim, and is probably found in Siam, the Malay Peninsula, and Sumatra. It occurs in Java, Bali, and Borneo, and besides the wild animals large herds exist in Java and perhaps in Sumatra in a domesticated state.

*Bos frontalis.*—I have left this to the last, as the question of the range and even of the existence of the wild animal is disputed. The Gayal or Mithan is kept tame by the hill-tribes on both sides of the Assam valley and throughout the Chittagong hills as far south as the neighbourhood of Akyab in Arrakan. According to the earlier accounts, both wild and tame animals are found in the hill-ranges south of Assam; and an elaborate account was given in the Linnean Transactions, vol. vii. p. 303, by Mr. Macrae (quoted by Mr. Lambert) of the manner in which the Kukis captured the wild herds by the help of the tame Gayals. It is quite possible that this story may have been devised by the inventive faculty of Mr. Macrae's informant, though the account in itself has more innate probability than most of the legends about animals that we owe to the imagination of the natives of India, whether civilized or not. Some recent writers, and especially Mr. J. Sarbo[1], who writes apparently with good opportunities for knowing, declare that there is no such animal as a wild *Bos frontalis* known, at all events in the country extending from Assam to Arrakan. Blyth, too[2], only notices the wild race as numerous in the Mishmi hills and other hill-ranges bordering on Upper Assam, and states that it is the domestic race that extends southward to near Akyab.

It has even been suggested (though certainly not by Mr. Sarbo, who clearly appreciates the distinction between the two) that *Bos frontalis* is a domestic race of *Bos gaurus*. This is not impossible, but at the same time it is not, I think, a probable view, because if it were the case, as both animals inhabit the same forests, and as the tame herds of *Bos frontalis* are said to roam freely during the day, merely returning at night to their owner's village, the two would assuredly interbreed; and it is incredible that the difference between *Bos gaurus* and *Bos frontalis* should be so constant as it is, and so very much more marked than in the case of the wild and tame Buffalo, although the range of the tame animal in the latter case is very far from coinciding with that of the wild race. Hybrids between *Bos frontalis* and the humped cattle *B. indicus* are said to be common; but the skulls of *B. frontalis* brought from localities as far apart as Upper Assam and the Chittagong hills appear, so far as can be judged from the accounts given, to be similar to each other, and to be all similarly distinguished from those of *B. gaurus*. Further information on this point is desirable; but as to the absolute distinction of the two and the absence of intermediate forms we have

[1] P. Z. S. 1883, p. 143.
[2] Cat. Mamm. Mus. As. Soc. 1863, p. 162.

the important testimony of so good and trustworthy an observer as Mr. S. E. Peal [1].

There are two facts that should be borne in mind in any endeavour to disentangle the somewhat complicated history of *Bos frontalis*.

1. The names of animals used by various nations and tribes are just as carelessly and loosely applied as English terms are employed by English-speaking people. In America the English term selected for the Bison is the name of that particular bovine to which perhaps the Bison is least related and which it least resembles—the Buffalo—whilst in India the common English name for *Bos gaurus* is Bison. It is not therefore surprising that terms like Gaur and Gayal are interchangeable. In fact, in a number of Indian languages, the name applied to *Bos gaurus* means wild buffalo [2]. I have myself heard the name Gayal used for *Bos gaurus* in Orissa, where *Bos frontalis* is unknown. Probably the same name Gayal is used by such inhabitants of Tipperah, Chittagong, &c. as speak Hindi or Bengali (foreign languages to the majority) indifferently for *Bos gaurus* and *Bos frontalis*. Mr. Peal states that in Upper Assam both are known as *Mithan*. It is easy to understand the confusion that may thus have been caused to naturalists of a generation or two back, who appear, judging by their writings, to have regarded such names as restricted to particular species.

2. Blyth has given at length [3] some very curious evidence obtained by him, which, if correct, certainly appears to show that *Bos gaurus* itself is domesticated by some of the hill-tribes in the Tippera hills. If this were substantiated, it might account for the descriptions by Mr. Macrae of the taming of wild 'Gayals' by the Kukis, the Gayals in question being *Bos gaurus*. As I have already stated, Mr. Macrae's story has a distinct appearance of truth.

I think it highly probable that Mr. Sarbo is right in his opinion that *Bos frontalis* does not exist wild south of Assam. It is true that we know very little of the great hill-area south of Manipur between the Kyendwen river and its tributaries to the east and Tipperah, Chittagong, Arrakan, &c., to the west. But it is scarcely probable that three wild forms so nearly allied as *Bos gaurus*, *Bos frontalis*, and *Bos sondaicus* should be found living wild in the same area. It is far from improbable that *B. sondaicus* is the representative in comparatively level country of the hill-loving *Bos gaurus*, and that the two do not actually inhabit the same tract, but both *Bos gaurus* and *Bos frontalis* are distinctly inhabitants of hill-forests and are spendid climbers [4]. It is more probable that these

[1] Nature, Nov. 5th, 1885, vol. xxxiii. p. 7.

[2] *Ran-hila*, *Ran-pada* in Mahratti and Guzaratti, and *Jangli Khilyá* as quoted by Jerdon. I have even heard the name *Arna*, the correct appellation of a wild buffalo, applied to *Bos gaurus*.

[3] J. A. S. B. xxix. p. 294; see also Cat. Mamm. Mus. As. Soc. p. 162, *Gaveus gaurus*, specimen D.

[4] To the powers of *Bos gaurus* in this respect I can speak from personal observation. I have seen them go at speed down slopes where I could only follow by holding on to the bamboos and shrubs, and all observers have re-

two are representative species, inhabiting distinct areas. *Bos frontalis* may be the wild ox of the Mishmi hills and of the mountains extending eastwards from Assam. These hills have scarcely been penetrated by any Europeans and are extremely difficult of access. In some MS. notes, for which I am indebted to Mr. Hume, he gives measurements of the horns on a skull, which was sent to him as that of a wild animal from the South Mishmi hills. The measurements are those, I think, of *B. frontalis*, the tips of the horns being 37 inches apart.

There is one more point on which a remark is necessary. The animal described briefly by Mr. Davison[1] as the 'Sapio' of the Malays may be *Bos sondaicus*. It is not impossible that the white of the 'stockings' may be rufous in some individuals of either *B. gaurus* or *B. sondaicus* (I have seen them deep yellow in a bull *B. frontalis*)[2]. The insides of the legs are not unfrequently of a golden brown and may occasionally be chestnut. It seems hardly probable that an additional species besides *Bos gaurus* and *Bos sondaicus* remains to be discovered in the Malay Peninsula.

## 2. Description of a new Squirrel from the Philippine Islands. By A. B. MEYER, M.D., Director of the Royal Zoological Museum, Dresden, C.M.Z.S., &c.

[Received August 28, 1890.]

There were, till quite recently, but few species of Squirrels known from the Philippines, though the great islands in the south of the Indian Archipelago (Celebes and Borneo) had already been shown to possess a large series, and new species are being discovered there nearly every year. Putting aside Borneo, which, being more intimately related to the continent of Asia, is rich in Squirrels, Celebes, together with its small adjacent islands, is known to possess seven species, viz. :—

*Sciurus murinus*, M. & Schl., from North Celebes.
,, *rubriventer*, M. & Schl., from North Celebes.
,, *leucomus*, M. & Schl., from North Celebes.
,, *prevosti*, Desm., from North Celebes.

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marked on the climbing propensities of *Bos frontalis*. *Bos sondaicus* is, as Blyth points out, a more leggy animal than its two allies, and I think *B. gaurus* has proportionally longer legs than *B. frontalis*.

[1] P. Z. S. 1889, p. 448. It is worthy of notice that Cantor (J. A. S. B. xv. p. 272), in his Catalogue of the Mammalia inhabiting the Malayan Peninsula and islands, does not mention *Bos sondaicus* and gives Sâki utan (which means, I believe, simply wild cattle) as the Malay name of *Bos gaurus*.

[2] Since the above was written, I have seen the bull Gayal in the Society's Gardens, with a distinctly ferruginous tinge on parts of his white 'stockings.' I can well believe that all the lower part of each leg may be stained red in some animals. The coloration is due, Mr. Bartlett tells me, to an exudation, that becomes much more copious in hot weather.

*Sciurus rosenbergi*, Jent., from Sangi Island to the north of Celebes.
„ *weberi*, Jent., from Central Celebes.
„ *notatus*, Bodd., from South Celebes and the island of Saleyer to the south of Celebes.

On the other hand, from the Philippines only three species were known, viz. :—

(1) *Sciurus philippinensis*, Waterh., from Mindanao (P. Z. S. 1839, p. 117) and Basilan (*fide* Steere), which is insufficiently described, but is said to be closely allied to *Sc. tenuis*, Horsf., a widespread species (*cf.* Jentink, Notes, 1883, p. 125).
(2) *S. steerii*, Gthr., from the islands of Balabac and Palawan (P. Z. S. 1876, p. 735, plate lxix.), which is a brown-red species. And the small
(3) *S. concinnus*, Thomas, from the island of Basilan (Ann. Mag. N. H. 6th ser. ii. p. 407, 1888), which is similar to the widely spread *Sc. exilis*, M. & Schl.

To these three species two have been quite recently added by Prof. Steere, though only provisionally and insufficiently described, viz. :—
*Sciurus mindanensis*, Steere, from Mindanao; and
*Sciurus samarensis*, Steere, from the islands of Samar and Leyte (see "A List of the Birds and Mammals collected by the Steere Exped.," Ann Arbour, Mich., July 14, 1890, p. 29 *et seq.*).

The new species, which I am about to describe, has, so far as I see, nothing to do with these five species already known from the Philippines. I propose to name it

SCIURUS CAGSI, n. sp.

Fur short and rather stiff. Upper parts entirely blackish, variegated or grizzled with light yellowish brown, each hair being black, ringed with yellow near the tip; bristles entirely black as well as the whiskers; ears covered with short hair of same colour as body; cheeks and side parts of head and neck rather more yellowish. Underparts greyish or brownish white, under base of tail more or less ferruginous. Tail bushy, variegated with reddish brown, black, and white above; beneath brown, edged laterally on each side by a longitudinal black stripe, bordered externally with white; end of tail white.

Skull rather elongated; premolars $\frac{2}{1}$, the anterior minute molars broad; $m.^2$ 3 mm. in breadth; the series of dentition parallel.

*Measurements of type* (an adult skin, No. 2007 Mus. Dresd.).

| | millim. |
|---|---|
| Head and body | 220 |
| Tail without hairs | c. 170 |
| Tail with hairs | c. 270 |
| Hind foot | 47 |

| | millim. |
|---|---|
| Heel to front of naked sole ..... | 32 |
| Ear ..... | 12 |
| Length of whiskers ..... | 47 |

*Measurements of smallest specimen* (skin, No. 2015 M. Dr.).

| | millim. |
|---|---|
| Head and body ..... | 190 |
| Tail without hairs .....c. | 170 |
| Tail with hairs .....c. | 220 |
| Hind foot ..... | 44 |
| Heel to front of naked sole ..... | 31 |
| Length of whiskers ..... | 40 |

*Measurements of Skulls and Skeletons.* (The Dresden Museum received from Prof. Semper two skeletons (Nos. 291 and 292) of a Squirrel from "Mindanao," without determination of species, but I do not doubt that they belong to *Sc. cagsi*.)

| | No. 2009 M. Dr. | No. 2007 M. Dr. | No. 291 M. Dr. | No. 292 M. Dr. |
|---|---|---|---|---|
| | mm. | mm. | mm. | mm. |
| Total length of skull ..... | c. 48 | c. 50·5 | 51·5 | 49 |
| Basal length of skull (see Nehring, Stzb. natf. Fr. Berl. 1889, p. 5, n. 2) ..... | def. | def. | 43·5 | 42 |
| Tip of nasals to bregma ..... | 33 | 35·5 | 35 | 34 |
| Length of nasals ..... | 14·5 | 15 | 15·5 | 15·5 |
| Zygomatic breadth ..... | 29·5 | 31·5 | 30·5 | 28·5 |
| Interorbital breadth ..... | 17·5 | 19 | 17·7 | 17 |
| Breadth of nasals anteriorly ... | 7·2 | 7·5 | 7 | 6 |
| Breadth of nasals posteriorly ... | 4 | 5 | 5 | 4·5 |
| Length of palate ..... | 22 | 22·5 | 23·5 | 22·5 |
| Diastema ..... | 11·5 | 12 | 12 | 12 |
| Length of tooth-series ..... | 9 | 9·8 | 9·5 | 9·5 |
| Length of scapula ..... | ..... | ..... | 29·5 | 27·5 |
| Length of humerus ..... | ..... | ..... | 35 | 33·5 |
| Length of radius ..... | ..... | ..... | 39 | 37 |
| Length of femur ..... | ..... | ..... | 43 | 41·5 |
| Length of tibia ..... | ..... | ..... | 47 | 43·5 |
| Length of tarsus without claws . | ..... | ..... | 45 | 41·5 |
| Length of pelvis ..... | ..... | ..... | 38·2 | 34 |

Number of costal vertebræ 12, of lumbar 8 (7 in no. 292), of sacral 3, of caudal 26 (tail in no. 292 defective); *Sciurus europæus* has after different authors 12, 7, 3 and 21–25 respectively.

*Hab.* Davao, South Mindanao (*Platen*), "Mindanao" (*Semper*). Native name: Cagsi.

The general coloration of this Squirrel is similar to that of the widespread *Sc. tenuis*, Horsf., but that species is only half its size and has no white on the tail. *Sc. cagsi* also reminds one of *Sc. leucomus*, M. & Schl., from Celebes, in its general coloration; but the last-named species has white behind the ears, which are long-haired, and reddish underparts, and offers, besides, other differences.

## 3. On a Cervine Jaw from Algeria.

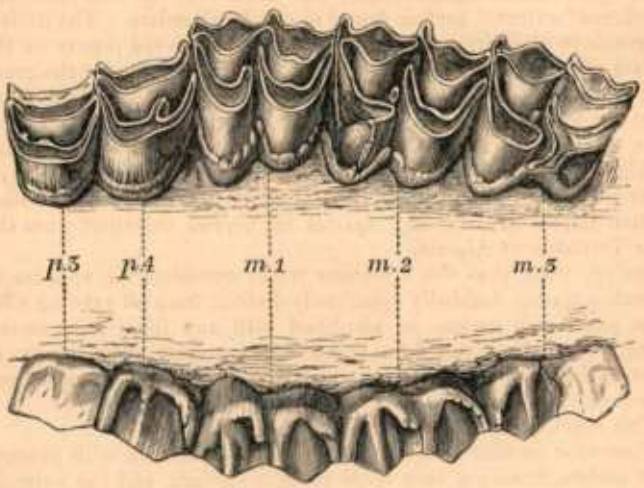
By R. Lydekker, B.A., F.Z.S.

[Received September 1, 1890.]

The specimen forming the subject of the present communication was sent by Dr. John Murray to the Natural History Museum, where it was submitted to my notice. It had been forwarded to Dr. Murray by Monsieur Rouyer, of Hammam Meskoutin, near Guelma, Algeria; and is stated to have been found at that place in a tufaceous deposit, at a depth of one metre from the surface.

The specimen consists of a fragment of the left maxilla of a Ruminant containing the last five cheek-teeth, of which the third premolar and the second and third molars are somewhat imperfect. It is somewhat impregnated with mineral matter of a full buff colour, but the enamel of the teeth is but slightly changed from its original tint. The condition of the specimen recalls that of the Mammalian remains obtained from the Karnul cavern-deposits of Madras; and I should consider it probable that the deposit whence it was obtained was of Pleistocene age.

Two views of the teeth of this specimen are given in the accompanying drawing, from which their chief structural characters will be apparent.




*Cervus algericus.*

Oral and outer views of the last five left upper cheek-teeth. ½.

The teeth are about one-third worn, and thus indicate a fully adult animal. The molars have square and extremely brachydont

crowns, with a very bold internal cingulum, rising between the two inner columns into a flattened triangular accessory column. On the outer or external aspect these teeth are remarkable for the excessive development of the oblique ridges forming the lateral borders of the outer columns, or crescents, so that distinct cavities are produced on the outer surface by the reflection of these bordering ridges. The antero-external extremity of the second inner crescent runs up nearly to the extremity of the interval between the outer crescents after the fashion of the *Cervidæ*.

The premolars are likewise characterized by the strong development of the internal cingulum, and the reflection of the lateral ridges of the external surface of the outer crescent.

From the general characters of the teeth, as detailed above, more especially the brachydontism of the crowns, the form of the inner accessory column, and the outward extension of the antero-internal angle of the second inner crescent, I have no doubt that the specimen is referable to one of the *Cervidæ*. It indicates a Stag of somewhat smaller dimensions than *Cervus cashmirianus*. No existing species of *Cervus* that has come under my observation has teeth with the large inner cingulum and complex outer surface which characterizes the present specimen.

I have, indeed, found a few isolated teeth of the extinct *C. giganteus*, as exemplified by specimens in the Natural History Museum, presenting an inner cingulum approximating to that found in the molars of the jaw under consideration; but such teeth do not show the 'pocketed' external surface found in the fossil molars. The nearest approach to the latter feature that I have observed occurs in the molars of some of the larger species of the Rusine group of the genus *Cervus*; but all the members of that group are widely differentiated from the fossil by their hypsodontism.

In the memoirs of Monsieur P. Thomas on the Fossil Mammals of Algeria, published in the Mém. Soc. Géol. France and elsewhere, there is no mention of any teeth like those of the specimen before us, nor indeed is there any species of *Cervus* described from the later Tertiaries of Algeria.

Seeing, then, that the specimen under consideration appears to indicate a species decidedly specifically distinct from all existing *Cervidæ*, and which cannot be identified with any fossil form known to me, I may be justified in regarding it, at least provisionally, as representing a new species, for which I propose the name of *Cervus algericus*.

This species may be defined as follows:—

Somewhat smaller in size than *Cervus cashmirianus*, with brachydont molars, having a very large inner cingulum, and the external surface complicated by the excessive development and reflection of the lateral ridges of the outer crescents so as to form distinct pockets on this surface at the base of the ridges in question.

The teeth of this specimen appear to represent the most complex type of brachydont and selenodont molars yet described; and I venture to hope that the description of this specimen may lead

to further investigation which will result in the discovery of the skull and antlers of this species.

It may be added that a cast of the specimen has been deposited in the Natural History Museum.

## 4. Note on the Skull of the East-African Reed-buck (*Cervicapra bohor*). By Dr. A. Günther, F.R.S.

[Received September 10, 1890.]

Among the specimens collected by Mr. H. C. V. Hunter, F.Z.S., in Eastern Central Africa, and presented by him to the British Museum, there is the skull of an adult male Reed-buck, to which Mr. Hunter

Fig. 1.

Skull of *Cervicapra redunca*.

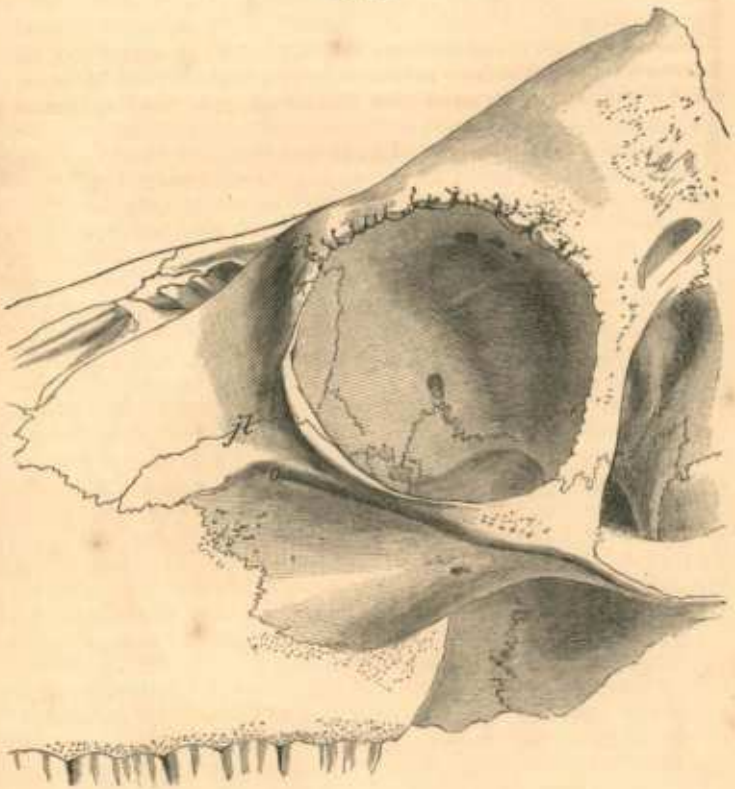
*j*, jugal; *l*, lacrymal.

has especially directed my attention and which is the subject of the present paper.

In Sir J. Willoughby's 'East Africa and its Big Game,' p. 289[1], Mr. Hunter alludes to this East-African Reed-buck in the following words:—

"This Antelope obtained by us differs from the South-African one, and will probably prove to be a new species; the horns in this are thicker and more bent forward at the tips. It is found in the early morning and evening feeding near the edges of reedy swamps,

Fig. 2




Skull of *Cervicapra bohor*.

*jl*, jugo-lacrymal suture; *o*, lower edge of infraorbital rim.

and when disturbed immediately runs into the rushes. It was very common round a large swamp near Mikunduni, in the Masai country,

[1] In the same list (p. 290) Mr. Hunter mentions a Duiker from Kilimanjaro, alt. 10,000 ft., with remarkably dense and long fur. I believe this to be a climatic variety of *Cephalophus grimmii*.

south-west of the mountain. It is of a light yellow colour, the hair being rather long and coarse."

The British Museum possesses skulls of the Common Reed-buck (*Cervicapra arundinacea*) and of the species to which the name *Cervicapra redunca* has been applied by Gray. Our specimens of the latter species are from the Cape Colony (coll. Burchell) and from the Orange River. But we do not possess specimens of this species from West Africa, so that I cannot offer an opinion as to whether the so-called West-African *C. redunca* is really identical with, or distinct from, our South-African specimens. This, however, is a collateral question which, as we shall see presently, has no bearing upon the determination of the Masai Reed-buck.

Rüppell (N. Wirb. p. 20, Taf. vii. fig. 1) describes the Abyssinian Reed-buck under the name of *Antilope redunca*; but at a later period, after he had had an opportunity of comparing its skull with one from West Africa, he came to the conclusion that it is distinct, changing its name into *Redunca bohor* (Verz. Mus. Senckenb., Säugeth. 1842, p. 38). I have no doubt that this Abyssinian Reed-buck is the same as the one from the Masai country. Although Rüppell's craniological notes are extremely meagre, they apply pretty well to the skull brought home by Mr. Hunter and another obtained by Capt. Speke.

There cannot be the least doubt that (as stated by Mr. Hunter) this animal differs widely from the common Reed-buck (*Cervicapra arundinacea*), being of considerably smaller size and having horns of an entirely different shape. In fact the Masai Reed-buck comes nearer to the South-African specimens in the British Museum named *Cervicapra redunca*, but the cranial differences sufficiently indicate a distinct species.

*Cervicapra redunca* (fig. 1, p. 604) is distinguished by its very large orbit; in a skull 230 millim. long the vertical dimensions of the orbit is 45 millim.; the eyeball is supported below by a largely expanded concavity of the jugal bone, the lower edge of the orbit being particularly sharp and thin, merging into the suture between the jugal and lacrymal bones. The cheek part of the skull is flat, rather concave, so that the facial portion of the cranium between the orbit and the antorbital foramen appears rather compressed when viewed from above. The ascending ramus of the intermaxillary reaches to, or nearly to, the nasal bone. The horns are but slightly divergent and very little bent forwards.

In *Cervicapra bohor* (fig. 2, p. 605) the orbit is comparatively smaller; in a skull 245 millim. long the vertical diameter of the orbit is only 40 millim.; the jugal bone is much less expanded to form the bottom of the orbital cavity; the lower rim of the orbit has two edges, the lower of which does not merge into the jugo-lacrymal suture, but runs parallel to it at a distance of about 8 millim. The cheek part of the skull is swollen and convex, so that the facial portion of the cranium above the molar teeth cannot be termed compressed. The ascending ramus of the intermaxillary is short, terminating at a considerable distance from the nasal bone.

The horns are much stronger and larger than in our specimens of *Cervicapra redunca*; their basal portion is somewhat flattened from the front backwards, but similarly corrugated; they diverge very slightly, and have their points strongly curved forwards.

The skull of a female Antelope brought home by Capt. Speke and given to the Museum in 1863 evidently belongs to the same species [1]; it has the basal portion of the nasal bones raised into a slight convexity, whilst this part is flat in the male. A similar sexual difference exists in the skulls of *Cervicapra arundinacea*.

Sir Samuel Baker seems to have met with the same species, to judge from the sketch which he has kindly given me of a skull in his possession. In the notes added to this sketch he states that the Antelope is of the size of a Fallow-deer, and that its native name among the Madi tribe is "Oboor;" that it is never seen in herds, but generally in pairs, excepting when a young calf is with the parents. He found it between 4° and 2° 30′ N. lat.

## 5. A Graphic Formula to express Geographical Distribution. By P. Chalmers Mitchell, B.A., Senior Demonstrator in the Morphological Laboratory, Oxford. (Communicated by F. E. Beddard, M.A., Prosector to the Society.)

[Received September 26, 1890.]

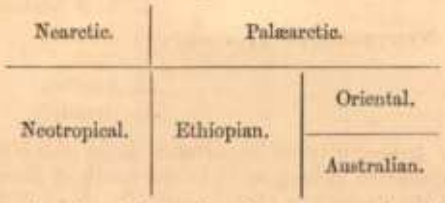
In lecturing on the Geographical Distribution of Animals, I have found pictorial representation of the facts a considerable difficulty. The construction of a sufficient number of coloured maps is troublesome and tedious, and it is impossible for students to copy them. I have designed a graphic formula to supply their place. The formula can be drawn, copied, or printed with great ease.

Take a map of the world on Mercator's projection and draw across it an equatorial line. Through the middle of this let a vertical line be drawn at right angles to the equatorial line. Next let the lower right-hand space be bisected by a vertical line, and let the space to the right of this new line be bisected by a horizontal line. These lines map out the world into the zoogeographical regions. As the relative positions of the spaces correspond to the relative positions of the regions, it is unnecessary in the formula to inscribe in them the names of the regions represented. A set of lines which can

[1] This skull is referred to in Sclater's list of the animals observed by Speke and Grant (Proc. Zool. Soc. 1864, p. 103) as no. 23, *Kobus* sp. ?, with a note by Speke "that its native name is Ndjezza, and that it is found among the grasses near water in Uganda." Speke, however, was mistaken in thinking that he met with females only of this Antelope, for it is evident that the "*Heleotragus redunceus*" (no. 20 of the same list), of which Grant shot an example in Usagara, was a male of *Cervicapra bohor*.

be drawn with four strokes of the pen thus indicates the regions in their relative positions, fig. 1.

Fig. 1.

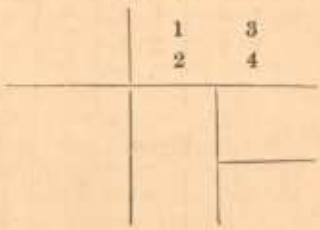



The four subregions in each region except in the Nearctic region lie, in a general way, two to the north, two to the south, two to the east, two to the west. In the Palæarctic region, for instance, the North-European and Siberian subregions are the northern pair; the Mediterranean and Manchurian the southern pair; the North-European and Mediterranean are the western, the Siberian and Manchurian the eastern subregions. If the subregions are numbered thus:—

North-European..... 1
Mediterranean ..... 2
Siberian ..... 3
Manchurian ..... 4

and if the numbers be placed as indicated in figure 2, it will be seen that the numbers are in the relative position of the regions they denote.

Fig. 2.




The numbers 1, 2, 3, 4 are placed in similar relative position in the spaces corresponding to the other regions except the Nearctic, and obviously represent subregions as in the following list:—

Ethiopian Region .... 1. West Africa.
2. South Africa.
3. East Africa.
4. Madagascar.

Oriental ..... 1. Hindostan.
2. Ceylon.
3. Indo-China.
4. Indo-Malay.

| | |
|---|---|
| AUSTRALIAN ..... | 1. Austro-Malay. |
| | 2. Australia. |
| | 3. Polynesia. |
| | 4. New Zealand. |
| NEOTROPICAL ..... | 1. Mexico. |
| | 2. Chili. |
| | 3. Antilles. |
| | 4. Brazil. |

The only irregularity of importance is in the Nearctic region. There the Canadian subregion is to the north of three other subregions, and the figure 1 is placed vertically above 2, 3, 4.

| | |
|---|---|
| NEARCTIC..... | 1. Canada. |
| | 2. California. |
| | 3. Rockies. |
| | 4. Eastern States. |

The distribution of an animal or of a group is represented by writing in their proper positions the subregions in which the animal or group occurs. Thus a universal distribution is indicated by fig. 3. A partial distribution, for instance the distribution of the Lemurs, is given in fig. 4.

Fig. 3.

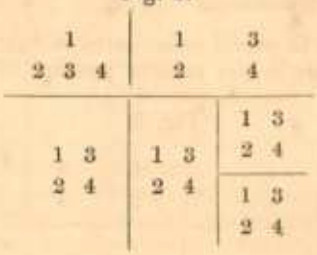
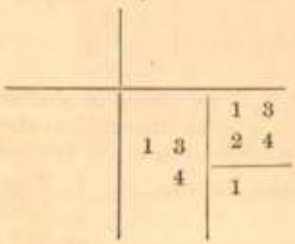



Fig. 4.




The formula represents the facts almost as faithfully as does a coloured map. It can be written and copied with the utmost rapidity, and it can be printed without engraving by the use of type-lines. Elaboration is easy, but the simplicity of the formula in its present form seems an advantage.

## 6. On a new Genus and Species of Rodents of the Family *Dipodidæ* from Central Asia. By W. L. Sclater, M.A., F.Z.S.

[Received October 25, 1890.]

(Plate L.)

While engaged in examining and cataloguing the collection of Mammals in the Indian Museum, Calcutta, I came across two specimens which seemed to belong to a species of the genus *Alactaga*. On removing the skull from one of the specimens, I found that I was quite unable to identify it with any species of *Alactaga* hitherto described. Nor have I, in the course of fresh researches, been able to find any specimens, either in the Indian or the British Museums, which in any way resemble it. In fact the skull in question differs so strikingly from that of all the other forms of *Dipodidæ*, that it seems necessary to make a new genus for its reception. I therefore propose the generic name *Euchoreutes* (εὖ *bene* et χορευτὴς *saltator*) for this Rodent, with the specific term *naso*, on account of its prominent and pig-like snout.

Euchoreutes naso, sp. nov. (Plate L.)

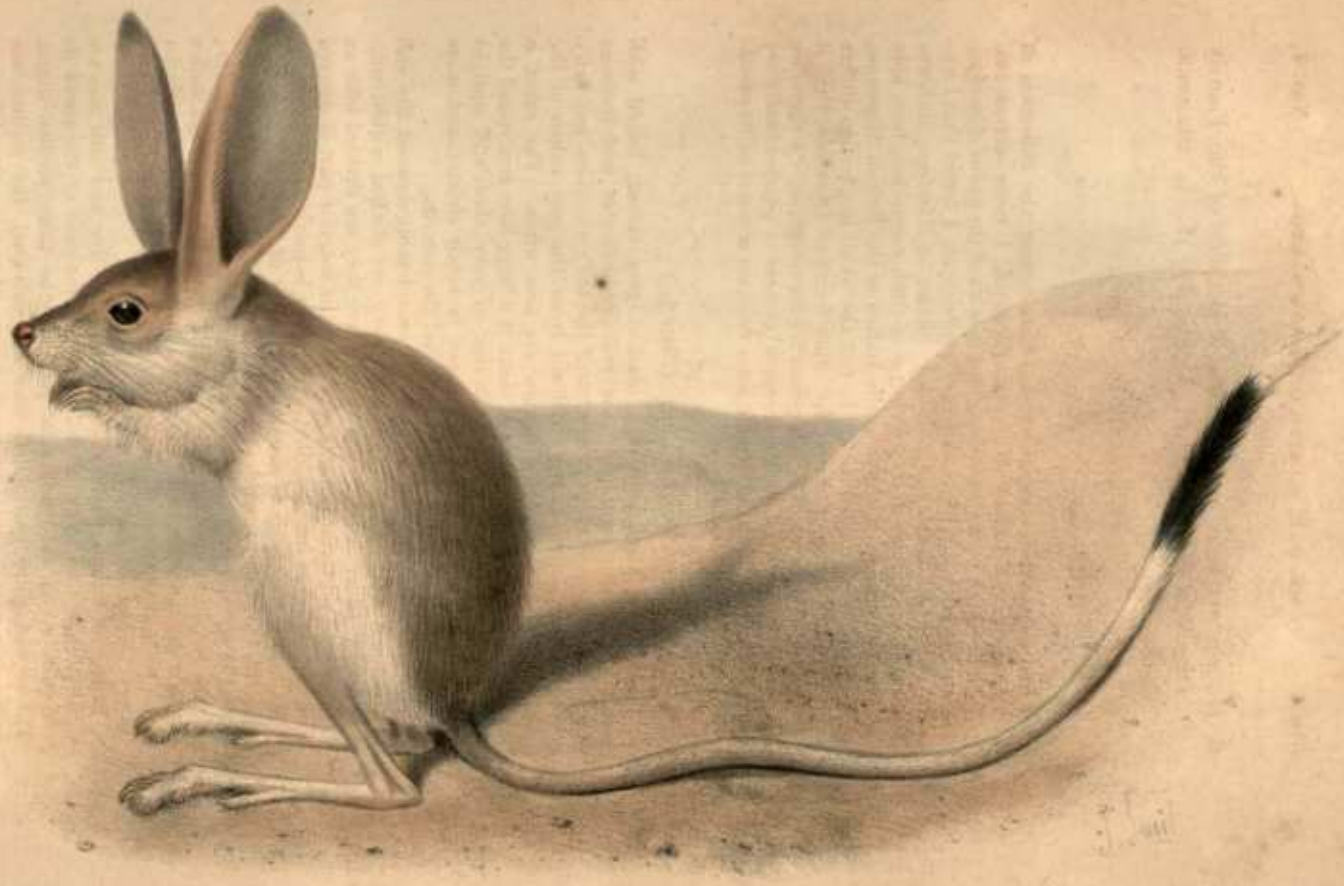
The fur is soft and long, of a blackish-grey colour, mixed with red on the back; posteriorly the red predominates and becomes much more conspicuous at the root of the tail; the sides and belly are pure white, quite sharply defined from the grey colour of the back; the snout, cheeks, and chin are also white. The snout is very projecting and pig-like, and there is a large bare area round the nostrils, which is surrounded by a ring of very short stiff upright hairs. In *Alactaga indica* the snout is much shorter and more rounded, and there is no bare area round the nostrils.

The ears are very long, and extend considerably beyond the end of the snout when pressed forward; they are clothed within with fine scanty silver hairs; externally, where they are divided into an anterior and posterior portion by a fold, the anterior part is covered with a few silvery hairs, while the posterior is hairless.

There are four pairs of mammæ—one pair of pectoral, one pair of inguinal, and two pairs intermediate.

In the anterior limb the digits and claws are very long and slender; all the five digits are distinctly clawed, whereas in *Alactaga indica* the first digit bears a nail. There are four carpal pads, two smaller distal pads at the base of the fourth and fifth digits, and two larger subequal proximal pads.

In the hind limb, which is rather long, the first and fifth toes are subequal, the first being slightly longer; the ends of the claws do not quite reach the metatarsal joints of the three median digits. The second, third, and fourth toes are subequal, the median one being only very slightly longer than the other two; the difference



J. Smit, lith. Hanhart, imp.

EUCHOREUTES NASO.

in length between these toes is very much greater in *A. indica* and in all other species of *Alactaga* that I have been able to examine.

Beneath the three median toes of all Jerboas there are large laterally compressed pads, which are marked with parallel constrictions. In *Euchoreutes* there are four constrictions on each toe-pad, while in *Alactaga* there are four constrictions on the median toe and only three on the second and fourth toes.

The tail resembles that of *Alactaga*; it is very long and tufted, with long hairs at the end; the tuft is basally white, but black in the middle and white again at the tip. The hairs of the tuft are equally developed all round, and do not seem to be arranged in so distichous a manner as in *Alactaga*.

Skull of *Euchoreutes naso*.

The skull of *Euchoreutes* is of a much longer and more slender type than that of any other species of Jerboa, and is altogether very distinct in general appearance.

The nasals are very long and narrow and the bullæ much inflated, so that when the skull is viewed from above they project both laterally and posteriorly, and give it a very different appearance from that of all other Jerboas. There is also a very marked constriction of the frontal bones in the middle of their length just above the eye; this is quite unrepresented in the skull of *Alactaga*.

The zygoma is very weak and thin, and the vertical portion, which separates the optic from the antorbital foramen, is also very thin, and slopes from above downwards posteriorly, while in *Alactaga* the corresponding part of the zygoma is either vertical or anteriorly directed; in consequence of this the antorbital foramen is very differently shaped, being about half the size of the optic foramen; there is, as in *Dipus*, a separate canal at the base of the foramen for the exit of the nerve.

Another very distinctive feature of the skull of *Euchoreutes*, when viewed laterally, is the long anterior trumpet-shaped prolongation of the nasal cavity formed by the nasals and premaxillæ, the opening of which is considerably in front of the anterior line of the incisors, while the reverse is the case in all the other skulls of Jerboas which I have been able to examine.

Viewed from below, the anterior palatine foramina will be seen to be very large and to extend back to behind the anterior line of the molars, while in *Alactaga* they do not extend so far as the anterior line of the premolars.

Behind the large anterior palatine foramina there are found, between the posterior molars, a large pair of posterior palatine foramina, which are only represented by very minute passages in the other Jerboas.

The very large size of the bullæ in *Euchoreutes* causes them nearly to meet in the median line, where, as in all other Jerboas, there is a considerable interval between the two bullæ in the region of the basioccipital.

In the lower jaw of *Alactaga* there is between the condyle and the angle an outwardly and backwardly projecting thick process of bone, which is very conspicuous in all the species of that genus that I have been able to examine; this process is quite unrepresented in *Euchoreutes*.

The dentition of *Euchoreutes* is similar to that of *Alactaga*, and consists of one premolar and three molars above, and three molars below; the crowns of the molars, however, are much shorter, and the cusps much longer and sharper than those of other Jerboas. The incisors, as in *Alactaga*, are not grooved.

The following measurements are in inches and decimals :—

| | |
|---|---|
| Total length from snout to base of tail | 3·25 |
| Tail to end of vertebræ | 5·85 |
| „ with hairs | 6·40 |
| Length of ears from vertex | 1·55 |
| Distance from snout to ear (in extracted skull) | 1·20 |
| Fore limb from elbow-joint to end of toes | 1·10 |
| Tarsus to end of 1st digit | 1·15 |
| „ „ 2nd „ | 1·65 |
| „ „ 3rd „ | 1·70 |
| „ „ 4th „ | 1·65 |
| „ „ 5th „ | 1·10 |
| Total length of skull | 1·15 |
| Breadth of zygoma | ·50 |
| „ at brain-case | ·53 |
| „ at interorbital constriction | ·30 |
| Length of nasals | ·45 |
| Anterior palatine foramen | ·20 |
| Length of molars and premolars | ·20 |
| „ lower jaw from the condyle to the incisors | ·70 |

*Habitat*. The two specimens of *Euchoreutes naso* were procured by the Hon. Charles Ellis, during his journey through Eastern or Chinese Turkestan, and presented to the Indian Museum. They were probably obtained by him in the sandy plains round the city of Yarkand, but no exact locality is attached to them.

The new genus *Euchoreutes* belongs essentially to the *Dipodinæ* as defined by Alston (P. Z. S. 1876, p. 89), of which subfamily it will form a fourth genus. I subjoin a table of the principal characters of the four genera.

| | *Dipus.* | *Euchoreutes.* | *Alactaga.* | *Platycercomys.* |
|---|---|---|---|---|
| Hind feet ... | with 3 digits. | with 5 digits. | with 5 digits. | with 5 digits. |
| Tail ..... | cylindrical and tufted. | cylindrical and tufted. | cylindrical and tufted. | flattened and lanceolate-shaped. |
| Auditory bullæ ... | large. | very large. | moderate. | |
| Antorbital foramen | with a separate passage for nerve. | with a separate passage for nerve. | with no separate passage for nerve. | |
| Incisors ..... | grooved. | smooth. | smooth. | |
| Premolars ... | generally absent. | Premolar present above. | Premolar present above. | No premolars. |

In addition to these characters, *Euchoreutes* differs from all other forms of the *Dipodidæ* which I have been able to examine in :—

1. Its long pig-like snout, which is accompanied by a corresponding development of the anterior part of the skull.
2. The very large size of the auditory bullæ.
3. The interorbital constriction of the frontal bones.
4. The large size of the posterior palatine foramina.
5. The absence of the process on the lower jaw between the condyle and the angle.

I have to thank Mr. Oldfield Thomas for assistance and advice when examining the specimens in the British Museum.

## 7. Note on the Occurrence of the Saiga Antelope in the Pleistocene Deposits of the Thames Valley. By A. Smith Woodward, F.Z.S.

[Received November 4, 1890.]

The extensive Western range of the Saiga Antelope (*Saiga tatarica*) during the Pleistocene Period has long been well known through the researches especially of French palæontologists. Not only do its bones and teeth occur in considerable numbers in certain of the cave-deposits in the Departments of Vienne, Dordogne, Tarn-et-Garonne, and Haute-Garonne [1], but at least one recognizable sketch of the head of the animal has been found upon an artificially incised bone, of the kind so often met with in the caverns where relics of human handiwork occur [2]. The Saiga thus inhabited Western Europe as late as the era of Palæolithic man, and was doubtless one of the objects of his chase.

Until the present time, however, no evidence of the occurrence of this animal in the British area has been discovered among the

[1] Details are given by A. Gaudry, 'Matériaux pour l'Histoire des Temps Quaternaires,' fasc. ii. (1880), with four plates.

[2] P. Gervais, Journ. de Zool. vol. ii. (1873), p. 229, woodcut.

innumerable fossil bones disinterred from almost all caverns and valley deposits where excavations have been made. So long ago as 1757, it is true, Dr. J. Collet incidentally mentioned the discovery

Frontlet and horn-cores of *Saiga tatarica*, ♂. Half nat. size.

of the horns of an antelope near Newbury, in Berkshire [1]; and some have supposed that the Saiga may possibly be the species in question. But the fossil on which the determination was based was never described, while it is now unknown; and there is thus considerable doubt as to whether it was not merely a fragment of the common goat [2].

A recent discovery by Dr. J. R. Leeson, of Twickenham, in the Pleistocene deposits of that neighbourhood, at last affords some

[1] Phil. Trans. 1757, p. 112.
[2] E. T. Newton, Quart. Journ. Geol. Soc. vol. xl. (1884), p. 290.

definite information on the subject. During excavations lately made in Orleans Road, Twickenham, the workmen met with the fine example of the frontlet and horn-cores of an adult male *Saiga tatarica* now exhibited to the Society. The specimen was secured by Dr. Leeson, who kindly forwarded it to the present writer for determination; and the fragment is fortunately so characteristic, that the genus and species to which it pertains are at once apparent beyond all doubt.

With regard to the circumstances of the discovery, Dr. Leeson remarks that the spot in Orleans Road is about ¼ mile distant from the N. bank of the Thames, and perhaps not more than six feet above high-water mark. The section exposed consists of two feet of loam and other surface material, resting upon about ten feet of gravel and sand in alternating layers, this being immediately underlain by the London Clay. The specimen was met with in one of the sandy layers about seven feet from the surface. No associated bones were found, and Dr. Leeson's researches have not led to the discovery of any other mammalian remains in the corresponding beds in other parts of the neighbourhood. The nature of the section, however, proves conclusively that the fossil is of Pleistocene age.

The specimen, which is shown, of one half the natural size, in the accompanying drawing (see p. 614), exhibits the fused parietals, the frontals, and the greater part of the horn-cores. The cranial roof agrees precisely with that of a recent skull, as described in Dr. Murie's memoir[1]; and the horn-cores, which are preserved for a length of 0·1, are strongly marked with longitudinal ridges and grooves. In every respect, indeed, except in the comparatively erect position of the horns, the fossil agrees with the recent skull of a male in the British Museum (no. 613 *d*), obtained from Sarepta, even the various measurements in the two cases being almost identical. Whether the less divergent character of the horns in the British Pleistocene type be a racial difference, or whether the same feature be sometimes observed as a merely individual peculiarity in the existing Saiga, cannot be determined from the lack of specimens for comparison. It suffices to add, that a frontal figured by Gaudry (*op. cit.*), from the Pleistocene of France, agrees in the character just mentioned with the English specimen.

As already remarked, the remains of the Saiga are widely distributed in the French cavern-deposits; and M. Dupont has recorded evidence of its former range over Belgium[2]. Being thus well known in the West, it is somewhat remarkable that no remains of the animal have hitherto been definitely described from the wide areas of Germany and Russian Poland intervening between the present limit of its range and its former extension.

Prof. A. Nehring, of Berlin, however, is of opinion[3] that a careful study of existing collections of Pleistocene bones from the German

[1] P. Z. S. 1870, p. 459.

[2] E. Dupont, 'L'Homme pendant les Ages de la Pierre dans les environs de Dinant sur Meuse,' ed. 2, p. 187.

[3] 'Tundren und Steppen' (1890), p. 187.

caves would afford undoubted proof of the occurrence of the Saiga in several localities. The Professor has kindly called the present writer's attention to some incidental allusions to the discovery of antelope-remains in the Harz Mountains[1], in the vicinity of Quedinburg[2], Westeregeln[3], and Nuremberg[4], as also in the neighbourhood of Kaschau in Hungary[5]; and it seems probable that, in most instances, these fossils will prove to pertain to the remarkable species under consideration.

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November 18, 1890.

Dr. St. George Mivart, F.R.S., in the Chair.

Mr. F. Menteith Ogilvie, F.Z.S., exhibited a specimen of the Red-breasted Flycatcher (*Muscicapa parva*), and made the following remarks:—

I have thought this specimen might be of sufficient interest to be exhibited, partly on account of its rarity as a British bird, partly because there seem to be a few errors in the descriptions of this Flycatcher in the latest ornithological text-books. In the 4th ed. of Yarrell the tail is said to consist of 10 feathers, in place of 12; and Mr. Saunders, in his lately published Manual, while he describes the tail as of 12 feathers, states that they all have conspicuous white bases except the *central pair*, which are black. In this specimen the four outer feathers on either side have more or less white on their basal halves, but the four *central* feathers are black. In length this specimen measured $5\frac{3}{8}$ inches, in place of $4\frac{1}{2}$ in his description; the legs were black, and the irides so dark a brown as to appear black at first sight.

This bird I shot on the beach at Cley-next-the-Sea, Norfolk, Sept. 13th, 1890, during a week's visit to that place with a view to watching the autumn migration.

I flushed it twice from the 'scrub'[6] before I was able to secure it, following it for about five minutes. It uttered no note during this time. Its flight was peaceful and buoyant and always at some height from the ground, differing in this from the other birds I saw in the scrub, chiefly Warblers[7], which flew very low and were flushed with some difficulty from their hiding-places.

The weather during the week was very fine with hot sun, and light wind mostly from the west and north-west. On the 15th,

[1] H. Grotrian, Zeitschr. deutsch. geol. Ges. vol. xxxii. (1880), p. 751.
[2] A. Nehring, *ibid.* p. 473.
[3] A. Nehring, *ibid.* p. 475.
[4] A. Nehring, *ibid.* p. 488.
[5] A. Nehring, Berl. Zeitschr. f. Ethnologie, 1881, pp. 103, 106.
[6] As the sea-blite (*Suæda fruticosa*) is called, which covers the beach at Cley and Blakeney.
[7] Willow-Wrens, Chiffchaffs.

wind was east at daylight, then north-east, going round to south in the afternoon.

The following description was taken a few hours after death. Mr. T. E. Gunn, the well-known Norwich naturalist, dissected the bird before me, and I am also indebted to him for verifying my description and measurements.

*Red-breasted Flycatcher.* ♀ (? 2nd year), Sept. 15th, 1890.

*Weight* 4·3 drs.

*Length* $5\frac{3}{8}$ inches; *wing* $2\frac{11}{16}$ inches; *tail* $1\frac{7}{8}$ inches. [Beak $\frac{3}{8}$; tibia $\frac{13}{16}$; tarsus $\frac{11}{16}$.]

*Mandibles*, upper dark horn-colour; lower the same, getting lighter towards the base.

*Irides* blackish brown. The irides were far darker than the artificial ones which have been used: in fact, they were so dark that I thought at first the iris was absolutely black.

*Legs* and *toes* black.

*Cheeks* ashy brown; crown, nape, back, and wing-coverts mouse-colour. *Primaries* and *secondaries* a shade darker, with slightly paler margins. *Chin*, *throat*, and *flanks* warm buff, a faint transverse line between throat and upper breast. *Belly* and *under tail-coverts* white, the latter faintly tinged with buff. *Upper tail-coverts* mouse-colour above, lower feathers black tipped with wood-brown.

*Tail* 12 feathers. Basal portion of four outer feathers on either side white (except part of outer web of outer feather and inner web of fourth feather, which are nearly black), four central feathers (and apical portion of other feathers) dark brown or black.

By dissection ♀; ovary large and well-defined (no ova visible on examination with a lens). Crop empty. Stomach containing large quantity of insect remains[1].

No doubt many of the ornithologists present will be able to give an authoritative opinion as to the age of this specimen.

It seems probable to me that it is at least a second year's bird; there does not seem to be any very evident traces of immaturity about the feathers, and the size and appearance of the ovary rather support this view.

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Prof. F. Jeffrey Bell, F.Z.S., exhibited a specimen of *Holothuria nigra*, and made the following remarks thereon:—The Holothurian now exhibited is an example of the Cotton-Spinner (*Holothuria nigra*), taken this summer off the west coast of Ireland, and has been sent to me for determination by Prof. Herdman. Its interest lies chiefly in the fact that it has been caught in its own toils, for, as will be seen, it is a good deal covered with "cotton."

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Mr. Boulenger exhibited the skull of a large specimen of a Sea-

[1] [These were very kindly examined for me by Mr. James Edwards, F.E.S., of Norwich, and proved to consist mainly of earwigs; there were also fragments of two species of ground-beetles (*Dyschirius globosus*, *Dichirotrichus obsoletus*) and of a homopterous insect (*Acocephalus nervosus*).]

Snake, *Distira cyanocincta*, from Ceylon, belonging to the Museum of the College of Surgeons, showing grooves not only upon all the maxillary teeth, as normal in that genus of Sea-Snakes, but also upon the mandibular teeth. The groove on the latter teeth, although very shallow, was yet perfectly distinct when viewed under an ordinary lens; it ran along the antero-outer side of the tooth. This appeared to be the first notice of grooved mandibular teeth in a Snake; but the presence of a groove on the posterior maxillary teeth had been several times recorded in Sea-Snakes, for the first time by Thomas Smith, Phil. Trans. cviii. 1818, p. 472, who had remarked:—"In this Serpent (*Hydrus*), as in many others nearly allied to it (les Hydres of M. Cuvier), there are simple teeth on the same bone which supports the poisonous fangs. These teeth so much resemble the fangs, that it requires a very close investigation to distinguish between them; and this arises from the simple tooth having not only a longitudinal furrow exactly resembling the edges of the slit of the poisonous fang, but also a very visible cavity at the base, where the foramen occurs in the others; and I have even found a fine tube in a tooth of this sort; it was, however, confined to the parietes, and did not affect the cavity of the tooth."

Mr. Boulenger also exhibited three skulls of the Green Turtle (*Chelone mydas*), likewise from the Museum of the College of Surgeons. In one of these the præ- and postfrontal bones were in contact, excluding the frontal from the periphery of the orbit; in another, the frontal separated the præfrontal from the postfrontal; whilst in the third, the former disposition was shown on the right side and the latter on the left. Attention was drawn to the variability of this character, because it had recently been proposed to make use of it for diagnosing the genera of Turtles, the genus *Chelone*, to which the Green Turtle belongs, being described by Baur (Am. Nat. 1890, p. 486) as having the "Orbit formed by prefrontal, frontal, postfronto-orbital, jugal, maxillary." It was further observed that the same variability occurs, though not so frequently, in the genus *Thalassochelys*. The skull of a half-grown Loggerhead from Ceylon, preserved in the British Museum, had the frontal bone excluded from the orbital periphery on the right side and not on the left. That specimen had, besides, the maxillaries separated by the vomer, instead of the maxillary suture commonly found in *Thalassochelys*; a skull of Loggerhead in the College of Surgeons was, in this respect, intermediate between the two extremes, the præmaxillo-maxillary and maxillo-vomerine sutures forming an X-shaped intersection.

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Mr. G. A. Boulenger, F.Z.S., read a paper upon the Reptiles and Batrachians of Barbary (Morocco, Algeria, Tunisia), based chiefly upon the notes and collections made in 1880–84 by M. Fernand Lataste.

This paper will be printed entire in the Society's 'Transactions.'

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Peter Smit. del. et lith.

ALLIGATOR SINENSIS.

Mintern Bros. imp.

Peter Smit del. et lith. Mintern Bros. imp. 417

ALLIGATOR SINENSIS.

The following papers were read:—

## 1. Remarks on the Chinese Alligator.

By G. A. Boulenger.

[Received October 7, 1890.]

(Plates LI. & LII.)

Although the first intimation of the existence of a Crocodilian in the Yang-tze-kiang appeared in these Proceedings in 1870[1], it was not until nine years later that M. Fauvel, a French gentleman in the service of the Chinese Customs, made us acquainted with the animal, which surprisingly proved to belong to the American genus *Alligator*. In his excellent paper[2] M. Fauvel not only gave a very satisfactory description of the new Alligator, for which he proposed the name of *A. sinensis*, but dwelt at great length with the former records of it in Chinese literature. A stuffed specimen was forwarded by M. Fauvel to the Paris Museum, where I had the pleasure of examining it in 1880; two others, kept for some time alive by the German Consul von Möllendorff, were after their death transmitted to the Berlin Museum, as we are informed by Boettger[3]. It was not until last year that two specimens, obtained at Kiu Kiang by Mr. Styan, were received in this country, one of which was retained for the British Museum.

The Society has now the advantage of exhibiting two living specimens in its Menagerie[4], presented by Mr. D. C. Janson of Shanghai, on August 26th. Upon these and the stuffed specimen in the British Museum, I propose to offer some remarks, accompanied by a figure of the animal.

The Chinese Alligator belongs to the genus *Alligator* in the restricted sense; its nearest ally is the North-American *A. mississippiensis*, which differs from the Central and South-American forms (*Caiman*) chiefly in the presence of a bony septum dividing the commonly single nasal aperture. However, the Chinese species approaches the Caïmans in the greater development of the bony plate in the upper eyelid and in the presence of ossifications in the ventral shields. These ossifications, however, are wide apart, neither juxtaposed nor imbricate on any portion of the ventral region.

Among the characters hitherto given as diagnostic of *A. sinensis*, two prove not to be constant:—

1. The three pairs of nuchal scutes may be reduced to two, as shown by the larger specimen in the Society's Menagerie; the other specimen has an additional fifth scute on the right side, but it is small. The three pairs are all present in the British-Museum specimen.

[1] Swinhoe, P. Z. S. 1870, p. 410.

[2] A. A. Fauvel, "Alligators in China," Journ. N. China Br. As. Soc. (2) xiii. 1879, pp. 1–30, figs.

[3] O. Boettger, Ber. Offenb. Ver. Nat. 1888, p. 112.

[4] I hear from my friend Dr. Boettger that two specimens have just been received by the Zoological Gardens of Frankfort-on-the-Main.

2. The larger specimen in the Menagerie has as many as eight scutes in the fifth transverse dorsal row, instead of six, which is the highest number in all other specimens known. Except in trivial points the three specimens otherwise agree with Fauvel's description.

In the following enumeration, I designate by *a* the larger specimen in the Zoological Gardens, by *b* the smaller, by *c* the specimen in the British Museum :—

| | *a*. | *b*. | *c*. |
|---|---|---|---|
| Number of teeth | $\frac{17}{19}$ | $\frac{17}{19}$ | $\frac{17}{19}$ |
| Transverse rows of dorsal scutes | 17 | 18 | 17 |
| Caudal whorls | 33 | 37 | 37 |

Specimen *b* is blackish above, speckled or vermiculated with yellowish on the head and nape, and on the cross bands on the body, limbs, and base of tail. Iris dark, bronzy, vermiculated with black. Specimen *a* is nearly uniform black, with mere traces, here and there, of light vermiculations.

## EXPLANATION OF THE PLATES.

PLATE LI.

The smaller specimen (*b*) of *Alligator sinensis* in the Society's Gardens, from life, reduced about ¼.

PLATE LII.

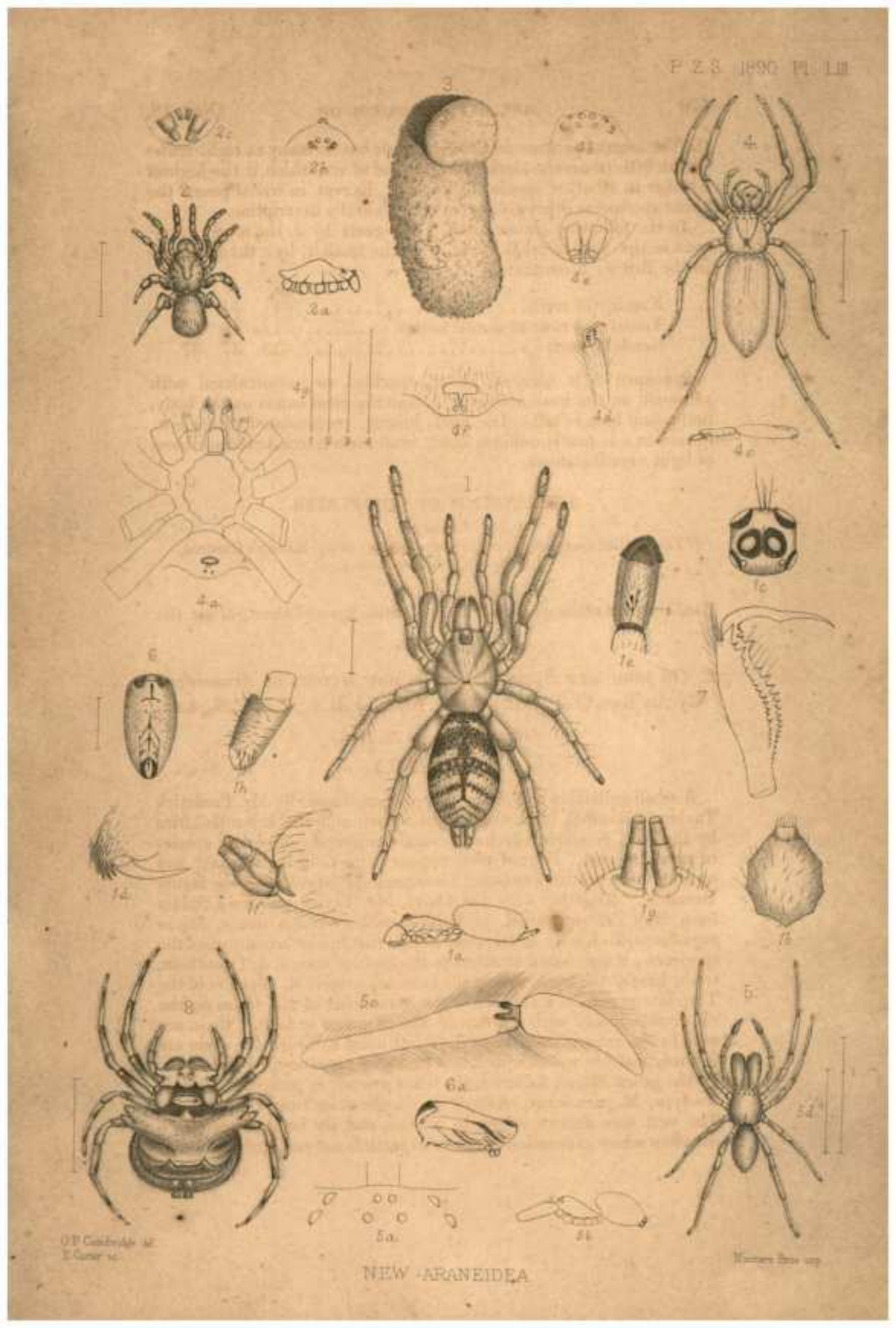
Head and nape of the specimen (*c*) in the British Museum, about ⅔ of nat. size.

## 2. On some new Species and two new Genera of *Araneidea*. By the Rev. O. P. CAMBRIDGE, M.A., F.R.S., C.M.Z.S., &c.

[Received October 23, 1890.]

(Plate LIII.)

A small collection of Spiders placed in my hands by Mr. Frederick Taylor, of Rainhill, Lancashire, most of them collected in South Africa by the Rev. Nendick Abraham, contains examples of several species of much interest. Four of them appear to me to be undescribed, and on one I have ventured to found a new genus (*Platyoides*) in the family Drassidæ. Together with the above, Mr. Taylor sent me a Spider from New Zealand which is, I think, without much doubt, *Migas paradoxus*, L. Koch. A trapdoor nest of this Spider accompanied the specimen ; it was found attached to the roots of fern, *i. e.*, I conclude, to the base of the stem, among the loose soil around it. Spiders of the Trapdoor group, as a rule, have the extremities of the falces on the upper side armed with a group of strong spines or teeth ; these are used in the excavation of the cylindrical holes in which the nests are formed, and are well adapted, and probably necessary, for this work. In the genus *Migas*, however, the falces are not so armed, and hence the type, *M. paradoxus*, received its specific name from Dr. L. Koch. The nest now figured is new to science, and its being formed in a situation where excavation in the solid earth is not required somewhat


3
4
2
1
6
7
8
5
5a
6a
NEW ARANEIDEA

confirms the interpretation above implied from the absence of the spines on the falces. This, however, cannot be taken as conclusive, inasmuch as in the genus *Moggridgea*, Cambr., there is a similar absence of spines on the falces, while in an allied genus (*Dendricon*, Cambr.) they are present; but the known Spiders of each of these two genera form their trapdoor nests in similar situations, *i. e.* in the interstices of the rough bark of trees. I am also glad to be able to give a figure and description, in the present paper, of *Dendricon rastratum*, Cambr., a genus and species characterized and described some time since (P. Z. S. 1889, p. 250) from a few dried fragments of the Spider, which had been crushed to pieces in transit. The perfect specimen, now in the British Museum, bears out the generic distinction accorded to the fragments mentioned. Another very remarkable Theraphosid described below was received from India, from Dr. Walsh (of the General Hospital, Calcutta). It possesses only two spinners, and consequently needs not only a new genus, but a new subfamily for its reception.

Along with the above-mentioned species is also described a fine Spider, nearly allied to the very remarkable *Robsonia marina*, Hector, which last lives in holes of the rocks in the sea below high-water mark, in New Zealand. I received no information as to the habits of the present Spider, but should imagine them to be like those of Dr. Hector's species. Among Mr. Abraham's S.-African Spiders were several adult specimens of *Stegodyphus gregarius*, Cambr., of which the large nest, numerously inhabited by Spiders of all ages, some time ago in the Society's Gardens[1], came from the same quarter of the globe. Mr. Abraham, however, says that the nest of this Spider sometimes attains the enormous dimensions of twelve feet.

### Fam. THERAPHOSIDÆ.

### Subfam. DIPLOTHELIDÆ. (Spinners 2.)

### DIPLOTHELE, gen. nov.

#### *Characters of the Genus.*

*Cephalothorax* oval, rather truncated in front.

*Eyes* very unequal in size, placed on a distinct protuberance, forming a square; the fore laterals and hind laterals occupy the four corners of the square, and are placed obliquely, cutting off the angles; the fore and hind centrals form a transverse quadrangle within the square, nearest the hinder part.

*Legs* rather strong, moderately long, 4, 1, 2, 3, but not differing greatly in length; furnished with hairs and bristles only, a few of the latter beneath the tibiæ and metatarsi of the third and fourth pairs being of a spinous character; the tarsi of the first two pairs terminate with a strong compact claw-tuft, pointed in front; the terminal claws appeared to be two, curved, but not strong, and without, so far as could be seen, any denticulation. The claw-tuft on the two hinder pairs is less compact, not pointed, and more

[1] Presented by Lord Walsingham.

divided. Each tarsus has a not very dense scopula beneath it, least dense on those of the third and fourth pairs.

*Falces* strong, projecting, and armed with some strong, curved claws at the fore extremity, just in front of the base of the fang.

*Maxillæ* cylindrical, divergent; the inner corner of the anterior extremity very slightly prominent.

*Labium* short, slightly hollow-truncate at the apex, which is but little less wide than the base.

*Sternum* oval, rather broadest behind.

*Spinners* two only; moderate in length and strength, two-jointed, and upturned.

DIPLOTHELE WALSHI, sp. n. (Plate XLIII. fig. 1.)

Length of an immature female, rather over 4 lines.

The colour of the *cephalothorax* and *falces* is pale yellow-brown, the normal converging indentations marked by darker lines; the thoracic indentation is moderate in depth, curved, the convexity of the curve directed backwards; the surface is furnished with hairs and slender bristles. The profile line of the caput is slightly curved behind the ocular protuberance, but runs off pretty evenly and gradually to the hinder margin. The posterior side of the ocular protuberance is abrupt, the anterior rather less so.

The fore lateral *eyes* are largest of the eight, next are the fore centrals, and the hind centrals are the smallest; these last are contiguous to the hind laterals, and with them are of a shining white colour; the fore laterals are pearly, the fore centrals dark grey. The latter are placed on a largish black patch, the rest are more or less widely edged with a similar colour. The fore laterals are seated on the anterior slope of the protuberance and look straight forward; between them are a few strong black recurved bristles.

The *legs* (together with the *palpi*, which are leg-like and similarly furnished) are of a yellow hue, as also are the maxillæ, labium, and sternum; towards the hinder extremity of the upperside of the tarsus of each of the first two pairs of legs and of the palpi is a group of three or four black, clavate, or racquet-shaped hairs.

The *falces* are furnished with numerous hairs and strong bristles, besides the *râteau* of curved spines at their fore extremity on the upperside. The fang is strong, curved, and of moderate length.

The *abdomen* is oval, of a dull clay-yellow colour, marked on the upper part and sides with broken transverse black fasciæ of varied width and clearness of definition, those on the anterior half being the strongest and best defined; it is clothed above with hairs and a few slender bristles, underneath with hairs only.

The *spinners* are two only in number and two-jointed, unless the small but distinct portion at the extremity, on which the spinnerets (or spinning-tubes) are placed, be taken to form a *third* joint.

An immature female of this very interesting and remarkable Spider was sent to me from Orissa, Calcutta, by Dr. Walsh (of the Calcutta General Hospital). The possession of only two spinners differentiates it from all others of the *Theraphosidæ* known to me, and by this, as well as by other important characters, such as the possession of spines

at the extremities of the falces, but no spiny armature on the legs, the position of the eyes, and the form of the claw-tufts, it may be readily distinguished. A nest accompanied the Spider, but was unfortunately too much damaged to enable me to do more than to note that it was a round cylindrical hole, lined with white silk and covered with a hinged lid or door somewhat between the cork and wafer types in character.

Genus DENDRICON, Cambr. P. Z. S. 1889, p. 250.

*Pseudidiops*, Simon, Ann. Soc. Ent. Fr. 1889, sér. 6, tom. ix. pp. 182, 215, pl. i. fig. 3.

In characterizing this genus (*l. c. suprà*) the only materials available were a few fragments of the Spider, but as these comprised a fore leg, a falx, the labium, and one of the maxillæ, it appeared to me sufficient to establish the genus upon. Subsequent examination of a perfect specimen, as well as the characters given by M. Simon (*l. c. suprà*), have justified this opinion. A conjecture, however, hazarded as to the affinity of this genus to *Moggridgea*, Cambr. (based on the character and position of its trapdoor nest and some points of structures), is not borne out. The position of the eyes, in the perfect specimen which has since come under my notice, shows that it is more nearly allied to *Idiops*, Perty. There seems little doubt but that it is identical with the Spider described by M. Simon from Cayenne.

DENDRICON RASTRATUM, Cambr. (Plate LIII. fig. 2.)

An adult female.

The *cephalothorax* and *falces* are of a pitchy black colour. The *legs* rather paler, with an olive tinge. The *abdomen* is of a deep purplish brown. Spinners four; those of the inferior pair are small and cylindrical, the superior ones short, two-jointed, upturned, not visible when looked down at from above. The relative length of the legs is 4, 1, 3, 2, or 4, 1, 2, 3. The caput just at the occipital junction is strongly prominent.

The *eyes* are in two widely separated groups, two very near together occupying a small prominence at the middle of the fore extremity of the caput, the remaining six in a transverse oval figure at some distance behind; four of these six form a curved transverse line, the convexity of the curve directed backwards, and a little way in front are the other two, being the largest of the eight, and separated (apparently) by rather less than a diameter's interval. The two central eyes of the curved row are widely separated, and each is about (or perhaps less than) a diameter's distance from the end eye on its side.

Another example, examined at the same time as the one above described, may possibly turn out to be of a different species, though without further examination (which I am at present unable to make) I hesitate to describe it as distinct. In this specimen the general hue was yellow-brown, the proportionate length and breadth of the cephalothorax seemed slightly different, the eyes were more

closely grouped together and varied a little in their relative position, and the Spider itself was smaller. The above examples are in the British Museum, and were kindly submitted to me by Mr. Pocock. Two nests accompanied them, one of which was exactly like the one described (P. Z. S. 1889, p. 250); the other was a little different, though not more so than might be quite consistent with the identity of their species.

*Hab.* Bahia.

### Genus Migas, L. Koch.

Migas paradoxus, L. Koch, Arachn. Austr. i. p. 467, t. xxxvi. f. 1.

An adult female of this Spider from New Zealand was contained in the collection submitted to me by Mr. F. Taylor, as well as one of its trapdoor nests (Plate LIII. fig. 3) found at the roots of fern. It was about an inch and a half in length, covered with particles of soil and decayed vegetable matter, and protected by a thin wafer-lid attached by a weak silken hinge. I do not believe that the nest of this Spider has been described before, and its being found attached to the roots of fern, where the Spider could obtain a suitable position without itself excavating an independent hole in the soil, is quite in accordance with the absence of those strong spines at the extremity of the falces with which Spiders whose known habits are to excavate their dwellings in the hard soil are invariably furnished.

### Family Drassidæ.

#### Platyoides, gen. nov.

*Cephalothorax* a little longer than broad, broadest behind, flattened above, the caput and thorax being on the same level; normal indentations distinct but not strong, except the thoracic indentation, which is rather long and deep.

*Eyes* in two transverse, slightly curved rows, the convexity of which is directed forwards, the anterior row shortest and close to the lower margin of the clypeus; small and not greatly differing in size; the hind centrals slightly smallest and wider apart, as well as forming a longer line than those of the fore central pair. Those of the lateral pairs seated on slight tubercles. The four centrals form a square whose posterior side is longer than the rest. The hind centrals are much nearer to each other than each is to the hind lateral on its side, and the same holds good, though in a less degree, in respect to the fore central eyes.

*Falces* long, projecting, abruptly prominent above towards the base, divergent, and thickly furnished with hairs on their inner sides. The fang is long, sharp-pointed, and much curved.

*Legs* moderately long, and not differing very greatly in length, 4, 2, 1, 3. The coxæ and genuæ are of rather unusual comparative length, especially the coxæ of the fourth pair, which are double the length of those of the first pair, while the genua of the second pair is the longest and that of the third pair the shortest. The tarsi are all very short, and terminate with two curved claws, each furnished

with two small teeth near the middle on its inner side. The legs are furnished with slender bristles and hairs only, many of which had probably been rubbed off, no spines being visible.

*Palpi* slender, and similar to the legs in armature.

*Maxillæ* long, moderately strong, and of very characteristic form, rather inclined towards the labium, enlarged near the extremities, where they are obliquely truncated from the outer side inwards, the truncation thickly clothed with hairs; the palpi arising from about halfway towards the extremity.

*Labium* slightly more than half the length of the maxillæ, sides parallel, rounded at the apex.

*Sternum* oval, rather broadest behind.

*Abdomen* oblong, rather flattened above, somewhat truncated before, and obtusely pointed behind. Spinners short, compact, inferior pair rather longest and strongest, and placed immediately beneath the hinder extremity of the abdomen.

PLATYOIDES ABRAHAMI, sp. n. (Plate LIII. fig. 4.)

*Adult female*, length (not including the falces) very nearly 6 lines. The colour of the cephalothorax and falces is a liver-coloured brown, the normal grooves and indentations blackish.

The *legs* have the tarsi, metatarsi, tibiæ, and genuæ of a rather olive-brown, the remainder dull orange-yellow.

The *palpi* are olive-brown, as also are the *maxillæ* and *labium*, the last being darkest.

The *sternum* is dull orange, with a narrow reddish-brown margin.

The *abdomen* is thinly clothed with short hairs, and of an almost uniform dull black above, paler along the middle of the upperside, and with traces of transverse pale oblique lines just above the spinners, but no distinct pattern visible, though this may have been owing to the rather damaged condition of the type specimen; the underside is of a uniform pale dull yellow-brown.

*Hab.* S. Africa.

## Genus ROBSONIA, Cambr.

ROBSONIA FORMIDABILIS, sp. n. (Plate LIII. fig. 5.)

Adult male, length 4½ to nearly 7 lines, to end of falces 7 to 9½ lines; length of female, including the falces, 9½ lines.

*Cephalothorax*, *falces*, *labium*, *maxillæ*, and *sternum* rich liver-colour. *Legs* and *palpi* yellow-brown, tinged with reddish. *Abdomen* dull brown.

The *cephalothorax* is slightly longer than the falces, of a broad-oval form, truncated in front; the lateral marginal constriction at the caput is slight; the caput and thorax are uniformly convex, with very slightly marked normal indentations, and the surface is clothed, but not densely, with rather short, light brownish fine hairs.

The *falces* are long, slightly shorter than the cephalothorax, powerful, projecting, and curved, with strong teeth on their inner sides, where they are also furnished with numerous hairs. The fang lies a little obliquely; it is long and strong, and slightly curved.

The *eyes* are in the normal position, but those of the hind central pair are much nearer together than each is to the lateral eye on its side in the same row, the interval being nearly double the extent of that between the centrals.

The *legs* are moderate in length and strength, 1, 4, 2, 3, destitute of spines, but pretty densely clothed with hairs, those beneath the metatarsi and tarsi almost amounting to a scopula; terminal claws strong, those of the superior pair furnished with 6–7 small close-set teeth towards their base.

The *palpi* are rather long, slender. The radial joint is double the length of the cubital, and has a bifid projection at its outer extremity, the lower limb being longest and strongest. The digital joint is long narrow-oval. The palpal organs are simple, not very prominent, with a slender reddish filiform spine round their margins on the outer side.

The *abdomen* is densely clothed with short pale brownish hairs. Spinners normal.

The sexes resemble each other.

This fine Spider is nearly allied to *Robsonia marina*, Hector, a New-Zealand species (P. Z. S. 1879, p. 687, pl. lii. fig. 4), resembling it closely in general form and structure; but it may easily be distinguished by its larger size, stouter form, much denser hairy clothing, and (notably) by the total absence of spines on the legs, and the relative position of the eyes, those of the posterior row in *R. marina* being separated from each other by equal intervals, while in the present species the interval between the central pair is nearly, if not quite, double that between each and the lateral eye next to it.

I have no information respecting the habits of this Spider, but from its near alliance to the New-Zealand species I should imagine it to be semi-aquatic like that one.

*Hab.* Cape of Good Hope.

### Fam. Eresidæ.

#### Genus Stegodyphus, Sim.

Stegodyphus gregarius, Cambr. P. Z. S. 1889, p. 42, pl. ii. figs. 4, 5.

Several adult females of this Spider were among those submitted to me by Mr. F. Taylor from S. Africa, and forwarded to him by the Rev. Nendick Abraham. Nests of this species appear, from Mr. Abraham's account, to attain a great size, sometimes as much as 12 feet in extent. Their habits in nature, from Mr. Abraham's account, seem to correspond very closely with those evidenced by them in captivity in the Society's Gardens (see *l. c. suprà*).

### Fam. Epeiridæ.

#### Genus Argyroepeira.

Argyroepeira blanda, sp. n. (Plate LIII. fig. 6.)

Length of an immature female, 4 lines.

This species is of the ordinary form. The whole of the fore part (including the *cephalothorax*, legs, and falces) yellow. *Legs* rather

short, 1, 2, 4, 3, the spines few and slender. The *falces* strong, vertical, and prominent at their base in front. The *eyes* are small, seated on black spots; the four centrals form a small trapezoid a little longer than broad; the laterals not being greatly removed from the centrals, seated on a small tubercle, and contiguous to each other. The curve of the anterior row of eyes is the strongest, the curves, as usual, opposed—*i. e.* that of the anterior row directed forwards, and of the posterior backwards.

The *sternum* is black-brown, furnished at its fore part with long hairs.

The *abdomen* is large, oblong, slightly tapering to the spinners, and projects over the thorax; it is of a uniform closely reticulated silvery hue above, excepting an irregular blackish patch close to a low prominence on each side near the fore extremity; there is also a slender blackish longitudinal central line, emitting a fine black cross-line in front, still finer oblique lines on each side of the hinder half, and two black elongate patches at the posterior extremity, near together and converging to the spinners. The sides of the abdomen, the hinder part of which projects well over the spinners, are blackish, obliquely streaked with silver; the underside has a large central, uniform, silver area, parallel on the sides, square before, and rounded behind. The spinners are encircled with four round silvery spots, the anterior pair being the largest and widest apart.

This Spider, though much resembling some species from Ceylon and South America, is, I think, new to science.

*Hab.* S. Africa.

### Genus Tetragnatha.

Tetragnatha taylori, sp. n. (Plate LIII. fig. 7.)

Adult female, length 5 lines. Length of the falces over 2 lines, and exceeding in length that of the cephalothorax.

This Spider is of the ordinary *T. extensa* form, but the falces are very divergent, and project more in the same plane with the cephalothorax than in that species. The fang is very long and strong, bicurvate, with a slight projecting point in the middle on the inner side, and abruptly bent at the base close to its articulation with the falx, and has a small tooth there on the outer side. On each side of this articulation the falx has a strong sharp tooth; that on the under (and outer) side is much the strongest and close to the articulation. The inner side of the falx is armed (next to the fang) with two strong teeth placed transversely; these are followed by two converging longitudinal closely-set rows of other teeth, which decrease in size towards the base of the falx; the inner row being the shortest, but its teeth the strongest.

The *legs* are long—1, 4, 2, 3; the spines few and slender.

The *eyes* are placed in two transverse, almost concentric, curved rows; the interval between the laterals being nearly equal to that which separates the central pairs. The four central eyes form a square whose anterior side is rather the shortest; and those of the hind central pair are slightly nearer together than each is to the hind lateral eye on its side. The clypeus is vertical, and its height

equals half that of the facial space. The colour of the cephalothorax is a deep blackish brown; the ocular area, a longitudinal central line on the caput, and some converging streaks on the thorax yellow. Looked at in profile, the caput is rather raised above the thorax.

The *legs* and *falces* are yellow-brown; the fang deep black-brown, and towards the extremity red-brown.

The *abdomen*, in the only example examined, was of a uniform blackish hue, but this probably arose from its imperfect state of preservation. It was large in front, tapering to an obtuse termination behind.

*Hab.* S. Africa.

CERROSTRIS ALBICEPS, sp. n. (Plate LIII. fig. 8.)

Adult female, length 7½ lines.

*Cephalothorax* short, broad, and of the characteristic form belonging to this genus. The upper part of the caput is white, densely clothed with shining white pubescence. Clypeus black, clothed with short grey and brownish hairs; thorax behind black, on the sides bright and red, almost scarlet.

*Eyes* small. Four centrals, on a protuberance, form a trapezoid, of which the posterior end is longest and the sides shortest.

*Falces* powerful, vertical, black, clothed with brownish hairs.

*Legs* not very long, strong, relative length 4, 1, 2, 3?, difficult to decide owing to their damaged state. Femora thinly clothed with fine hairs, bright shining chestnut-red, with the anterior extremities shining purple-black; the rest thinly clothed with grey, white, and brownish hairs and pubescence, black beneath the extremities of the tibiæ, and irregularly annulated with black and white on the metatarsi and tarsi.

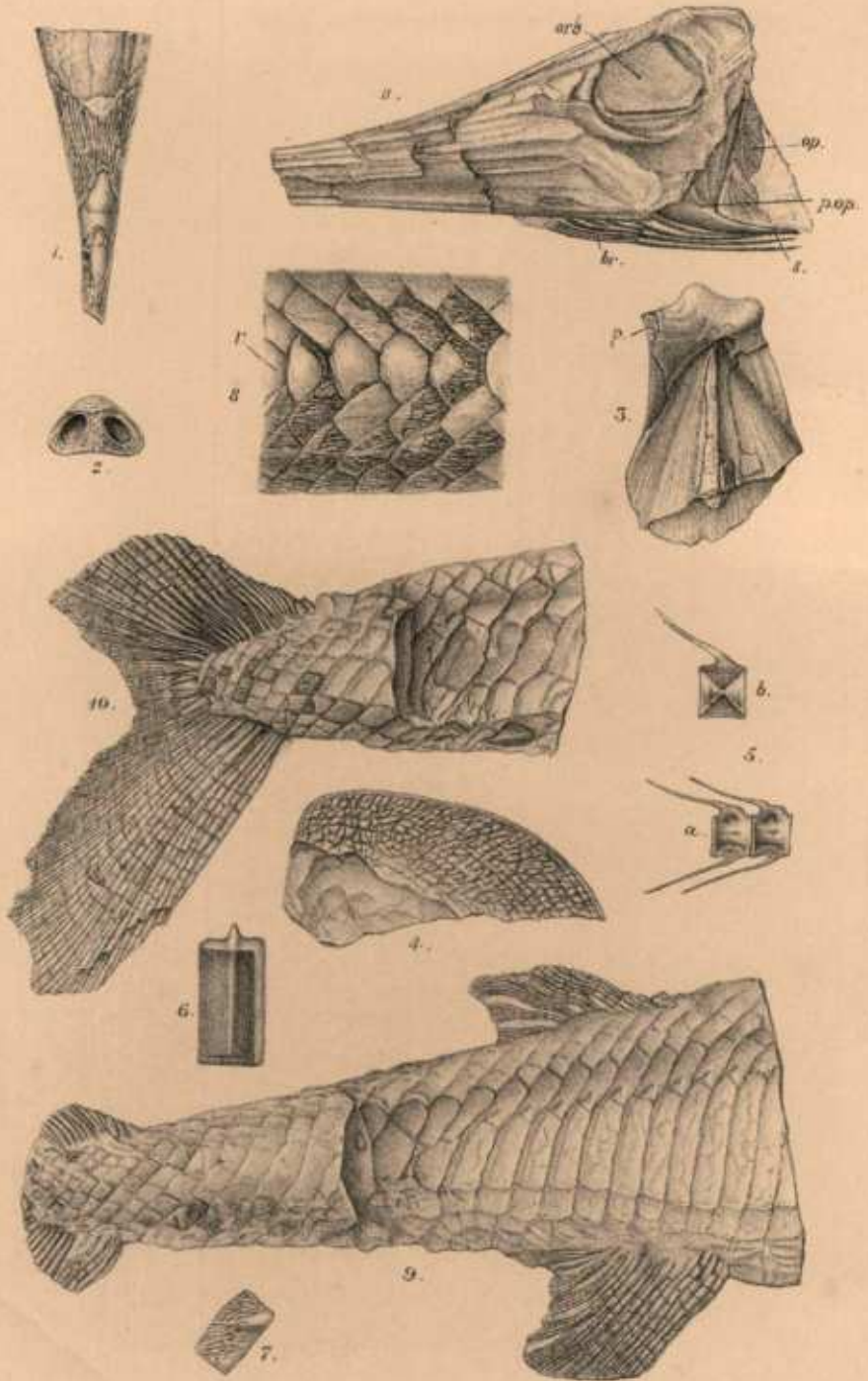
*Abdomen* large, somewhat round, with two very large long divergent protuberances on the fore half of the upperside of a slightly tapering form, and cleft into two parts, or bifid, at the extremities. Slightly in front of and between these is a small, sharp, conical hump, and two smaller ones also in a transverse line wide apart, behind, towards the spinners. The colour of the abdomen is black-brown, clothed with greyish and brownish pubescence, excepting a large subtriangular patch at the fore extremity densely clothed with short shining white hairs. Perhaps in well-preserved examples there may be some distinct pattern visible, but the only example seen was dried, and from injury and shrinking it was difficult to get more than a general idea of its form, colours, and indument.

A fine and striking-looking species owing to the strong contrast of the colours of the cephalothorax. It is nearly allied to *C. cowani*, Butl., a Madagascar species (P. Z. S. 1882, p. 103, pl. vi. fig. 4), but is a very much larger Spider, and I think distinct, though I suspect that when the various African species of *Cerostris* come to be collected in lengthened series from different localities, great variations will be found to exist both in size and other specific characters.

Burjeau & Bagshaw del. et lith.

Mintern Bros. imp.

BELONOSTOMUS COMPTONI.




Bergman & Highley del. et lith. M.& N. Hanhart imp.

1, 10. BELONOSTOMUS COMPTONI.
11. APATEOPHOLIS LANIATUS.

EXPLANATION OF PLATE LIII.

Fig. 1. *Diplothele walshi*, p. 622.
1 *a*, Spider in profile, without legs; 1 *b*, sternum and labium; 1 *c*, eyes from above and behind; 1 *d*, extremity of falx; 1 *e*, tarsus of leg of 1st pair; 1 *f*, hinder part of abdomen, and spinners in profile; 1 *g*, ditto from below; 1 *h*, one of the maxillæ.
2. *Dendricon rastratum*, p. 623.
2 *a*, cephalothorax in profile, without legs; 2 *b*, eyes from above and behind; 2 *c*, spinners from below.
3. *Migas paradoxus*, p. 624. Nest.
4. *Platyoides abrahami*, p. 625.
4 *a*, underside, showing maxillæ, labium, and sternum; 4 *b*, eyes from above and behind; 4 *c*, Spider in profile, without legs; 4 *d*, extremity of tarsus of 3rd pair of legs; 4 *e*, spinners from below; 4 *f*, genital aperture; 4 *g*, lengths of the four legs.
5. *Robsonia formidabilis*, p. 625.
5 *a*, eyes from above and behind; 5 *b*, Spider in profile, without legs; 5 *c*, right palpus from outer side; 5 *d*, lengths of two examples.
6. *Argyroepeira blanda*, p. 627. Abdomen, upperside.
6 *a*, ditto in profile.
7. *Tetragnatha taylori*, p. 627. One of the falces.
8. *Carrestris albiceps*, p. 628.

## 3. On some Upper Cretaceous Fishes of the Family of *Aspidorhynchidæ*. By A. Smith Woodward, F.Z.S., of the British Museum (Natural History).

[Received November 4, 1890.]

(Plates LIV. & LV.)

Among the fishes met with in Upper Cretaceous rocks, there are very few representatives of the "ganoid" types so characteristic of earlier Mesozoic formations. Solitary survivors, however, do occur in almost every fish-fauna of late Cretaceous date hitherto discovered; and conspicuous among these are members of the remarkably specialized family of Aspidorhynchidæ. It is of much interest to compare the latest species of such a family with those by which it was represented at earlier periods; and a large series of specimens in the British Museum now enables this comparison to be made in a more satisfactory manner than has hitherto been possible. A number of undescribed fossils from the Upper Cretaceous of Brazil are referable to the genus *Belonostomus*, and reveal most of the principal external characters of the species they represent; while some fine examples of another genus, as yet imperfectly described and inaccurately determined, prove the occurrence of an allied, though more specialized, fish in the corresponding formation of Mount Lebanon, Syria.

### Genus Belonostomus.

[L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 140.]

Belonostomus comptoni. (Plate LIV., Plate LV. figs. 1–10.)

1841. *Aspidorhynchus comptoni*, L. Agassiz, Edinb. New Phil. Journ. vol. xxx. p. 83.

1844. *Aspidorhynchus comptoni*, L. Agassiz, Comptes Rendus, vol. xviii. p. 1009.

The horizon from which the Brazilian fossils were obtained has long been well known. The fish-fauna was briefly noticed by Agassiz so long ago as 1841 and 1844 (*loc. cit.*), and Prof. Cope described one of the genera in 1871 [1], while the present writer treated another genus at still greater length in the 'Proceedings' of this Society, June 23rd, 1887 [2]. As in the case of *Rhacolepis*, already described, the examples of *Belonostomus* occur in nodules in a beautiful state of preservation, though, on account of the form of the fish, the specimens are always incomplete. As a rule, the long body is bent upon itself at about the middle point, the tail thus lying in close proximity to the head (Plate LIV.); and in no instance is the slender elongated snout completely preserved. Several typical portions of the fish are shown in the accompanying drawings (Plates LIV., LV.), and the Brit. Mus. register-numbers of some of the more important specimens are placed in brackets after the various descriptions of anatomical characters which they specially demonstrate. All measurements are given in decimal fractions of the metre.

*General Form.*—Owing to the death-contortion, it is not readily possible to estimate the precise proportions of the fish under consideration. The trunk, however, must have sometimes attained a total length of not less than 0·55; and the maximum depth of such an individual, shortly behind the pectoral arch, would be about 0·08. The total length of the head and opercular apparatus of a fish of this size would probably not exceed 0·24. As usual in the genus, the head and trunk are much laterally compressed, and the fins are relatively small.

*Head and Opercular Apparatus.*—The long, narrow cranial roof is flattened in the middle and beautifully ornamented with close, thick, vermiculating rugæ of ganoine, which have numerous short branches, and are chiefly disposed in a longitudinal direction upon the rostral region (no. 15495 *a*). Behind the parietals, a pair of large supratemporal plates continues the roof backwards as far as the hinder extremity of the upper border of the operculum (no. P. 975 *b*). In advance of the frontals, the snout tapers rapidly into a very slender rostrum, of which the base is shown from above in Plate LV. fig. 1. Seen in profile (no. P. 3810), the much elongated frontal and rostral region inclines gradually downwards from the short parietal region, which continues the dorsal plane of the trunk; and the narrow, well-developed parasphenoid bone is parallel with the parietal roof. There are extensive ossifications in the otic region, but no interorbital septum occurs. A remarkable pair of large longitudinal tubular ossifications is also shown in transverse sections of the rostrum (Plate LV. fig. 2), these structures extending almost or quite as far backwards as the orbital space. They are probably ethmoidal in character, and destined for the protection of the elongate pedicles of the olfactory lobes. The bones of the mandibular suspensorium

[1] *Anadiopogon*, E. D. Cope, Proc. Amer. Phil. Soc. vol. xii. (1871), p. 53. (Founded upon the undescribed *Cladocyclus gardneri*, Agass.)

[2] *Rhacolepis*, Smith Woodward, P. Z. S. 1887, pp. 535-542, pls. xlvi., xlvii.

and pterygo-quadrate arch are relatively large and expanded laminæ, of which the hyomandibular (Plate LV. fig. 3) is the only element well displayed in the fossils under consideration. The truncated upper extremity of this bone is less than half as broad as its inferior expansion, and a few irregular ridges radiate from the middle of its upper moiety, opposite the point at which the short and stout process (*p.*) for articulation with the operculum occurs. The entopterygoid is a long, narrow, lenticular bone, adjoining the upper margin of the short metapterygoid and large ectopterygoid elements (no. P. 3810). There is no definite information concerning the mandibular and maxillary bones, and the only teeth to be observed are very minute slender conical cusps, which seem to have been arranged in clustered series upon a hinder bone of the upper jaw and the splenial (nos. 28616 and P. 975 *b*). Round the eye some very small membrane bones represent a discontinuous or rudimentary circumorbital ring (Plate LIV. fig. 1, *c.o.*); and two trapezoidal elements of a large suborbital series (*s.o.*) cover the whole of the space between the circumorbitals and the preoperculum, while a third irregularly triangular bone adjoins these below. The preoperculum (*p.op.*) is of very large size, triangular in shape, terminating in a pointed upper extremity almost at the antero-superior angle of the operculum, and gradually expanding downwards and forwards, finally bounded by a long, straight or gently curved inferior margin, well below the level of the suborbital ring; the maximum depth of the bone equals somewhat less than twice the length of this margin. The operculum (*op.*) is also very large, slightly deeper than its maximum breadth, and nearly flat, though bent inwards above. It is irregularly quadrate in shape, and the postero-superior angle is obliquely truncated, so that its upper border is scarcely two-thirds as long as the lower border. The suboperculum (*s.op.*) is comparatively small, long and narrow, deepest and truncated in front, and its inferior margin gradually curving upwards to a posterior apex. All the suborbital and opercular bones are ornamented with thick vermiculating rugæ of ganoine with short branches, as shown in the illustration (Plate LV. fig. 4) taken from the operculum, the arrangement on this bone and on the expanded inferior portion of the suboperculum being more or less concentric with the borders.

*Axial Skeleton of Trunk.*—Well ossified vertebræ occur throughout both the abdominal and caudal regions. The centra (Plate LV. fig. 5) are in the form of stout double-cones, but they are always perforated by a small thread of persistent notochord. The pedicles of the arches seem to be fused with the centra; and the firmly united neural and hæmal spines are very slender, except the hæmals at the base of the caudal fin, which are much expanded distally (no. P. 975 *d*). Ribs have not been observed.

*Appendicular Skeleton.*—The fins are relatively small, and, so far as known, agree precisely with those of the typical Jurassic *Belonostomus*. The rays are stout, laterally compressed, and unarticulated for a short space from their insertion, but soon become distantly jointed and branched. The more robust portions of the rays are also often coated with smooth ganoine. The pectoral fin (Plate LIV. fig. 1,

*pet.*) is not completely known, but its rays clearly exhibit the characters just described. Its supporting elements are attached to a long, slender, gently arched clavicle, externally marked with delicate, irregular longitudinal striations; and there is a large supraclavicle above this, adjoining the truncated angle of the operculum (*s.cl.*), broad above, tapering below, and transversely marked with numerous, closely arranged coarse rounded rugæ of ganoine. The dorsal and anal fins are precisely opposed, not far from the caudal extremity, as shown in Plate LV. fig. 9, and the lobes of the deeply forked caudal fin (Plate LV. fig. 10) seem to be obtusely pointed, with a convex posterior-inner border, of which the subdivisions of the branched rays are extremely numerous and delicate. There are indications of minute fulcra on each of the median fins.

*Squamation.*—The squamation is continuous, and all the scales are thick and bony, with a superficial layer of ganoine. They are slightly imbricating, and the posterior border is either smooth or feebly crimped. Except quite at the extremity of the tail, the greater part of the flank is covered by a single very deep longitudinal series of scales, along the upper part of which extends the lateral line, as indicated by the row of short transverse ridges by which its course is marked. In the anterior part of the trunk, one of these scales is between five and six times as deep as broad, abruptly truncated below, but somewhat tapering and slightly reflexed forwards above the position of the lateral line. On the inner face of the scale there is a vertical median ridge, terminating above in a feeble articular peg, and excavated below by a small socket. Into the latter fits the upper articular peg of another scale, two and a half times as deep as broad, which is slightly overlapped by the principal flank-scale, and is similarly strengthened by a prominent ridge within. The ventral margin is completed by three or four small scales, one above the other, as broad as those above, but having an extremely short vertical measurement. There are no indications of ventral ridge-scales. At the upper end of each principal flank-scale there occurs a rhomboidal scale scarcely twice as deep as broad, having a slight oblique ridge about its middle (Plate LIV., Plate LV. figs. 7, 8). Another nearly similar but less deep scale adjoins the anteriorly directed upper border of the latter; and a small azygous ridge-scale (Plate LV. fig. 8, *r.*), irregularly sexangular, narrower in front than behind, completes the vertical series above. The writer has not observed any peg-and-socket articulation in these upper scales, and it is probable that their borders simply overlap. Towards the caudal region (Plate LV. figs. 9, 10) the depth of the principal flank-scales becomes relatively less, while the very narrow ventral scales are more nearly equilateral; at the extremity of the tail, indeed, all the scales are diamond-shaped and of nearly uniform dimensions. The scale ornament varies considerably in different individuals and upon different parts of the body, but it is essentially similar to that of the external head and opercular bones already described, though perhaps less prominent. In small (probably young) specimens, both the bones and scales are very feebly ornamented, but in fully grown individuals the rugose ganoine is always conspicuous. Each scale of the two

deep series of the flank is characterized in the abdominal and anterior caudal region by a prominent mesial vertical ridge, nearly corresponding in position to the internal keel; and the chief ornament consists of irregular, thick, transverse rugæ, which not only impart to the ridge a nodular appearance, but also frequently pass into a series of feeble crenulations at the hinder border. The dorsal and ventral scales are similarly rugose, but more finely marked; and in the caudal region, too, there is a diminution in the prominence of the ornament.

*Generic Determination.*—As already remarked, the species now described was briefly noticed by Agassiz under the name of *Aspidorhynchus comptoni*. In 1841, as at the present time, the jaws were undiscovered, and the most conspicuous character separating *Aspidorhynchus* from *Belonostomus* was thus not available for reference. Two features now made known, however, appear to suffice for the generic determination of the fish with absolute certainty. The suborbital ring is in direct contact with the preoperculum throughout its length, there being no supplementary cheek-plate, such as characterizes *Aspidorhynchus*[1]; and only two series of flank-scales are deepened—one excessively so—while in *Aspidorhynchus* there are invariably three such series, more nearly equal in their vertical measurement[2]. These being special characters of *Belonostomus*, and the Brazilian fish agreeing with the typical species of that genus both in the arrangement and proportions of the fins and in the development of the vertebral axis, there seems no reason to doubt the generic determination here adopted.

*Specific Determination.*—The Brazilian Cretaceous fish is the largest species of *Belonostomus* of which any definite account has hitherto been published. The fragmentary skull from the Cretaceous of India, described under the name of *Belonostomus* (?) *indicus*[3], will, if correctly determined, indicate even a slightly larger member of the genus; but the smoothness of the external bones readily separates this form from the highly-ornate species now under consideration. The large English Cretaceous species[4] is also distinguished from the Brazilian fish, among other points, by the feeble character of its external ornamentation; and the small associated species[5] is too imperfectly known for satisfactory comparison. The other Cretaceous members of the genus, *B. crassirostris*[6] and *B. lesind-*

[1] O. M. Reis, "Ueber *Belonostomus*, *Aspidorhynchus*, und ihre Beziehungen zum lebenden *Lepidosteus*," SB. k. bay. Akad. Wiss., math.-naturw. Cl. 1887, p. 173, pl. ii. fig. 7.

[2] B. Vetter, "Die Fische aus dem lithographischen Schiefer im Dresdener Museum," Mitth. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, p. 89.

[3] Smith Woodward, "Description of a Fish-skull," Rec. Geol. Surv. India, vol. xxiii. (1890), p. 23.

[4] *Belonostomus cinctus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1843), p. 142, pl. xvi. *a*. figs. 10–13; F. Dixon, Geol. Sussex, p. 367, pl. xxxv. figs. 3, 3*; Smith Woodward, Quart. Journ. Geol. Soc. vol. xliv. p. 145, pl. vii. figs. 7–13.

[5] *B. attenuatus*, F. Dixon, Geol. Sussex (1850), p. 368, pl. xxxv. figs. 4, 4*.

[6] O. G. Costa, Paleont. Regno Napoli, pt. ii. (1856), p. 33, pl. ii. figs. 1, 2 (including *B. gracilis*, Costa, *ibid.* p. 35, pl. ii. fig. 3).

*ensis*[1], as also the typical species *B. sphyrænoides*[2], *B. muensteri*[3], *B. kochi*[4], and *B. tenuirostris*[5], from the Bavarian and French Lithographic Stone, are distinguished, among other characters, by the much more slender proportions of the trunk. The determination of the Brazilian fossils as a hitherto undefined species is thus justified, and we propose to adopt the specific name originally suggested by Agassiz, terming the fish *Belonostomus comptoni*.

*Formation and Locality.*—The species occurs in a bed of nodules met with on the slopes of the Serra de Araripe, in the Province of Ceara, North Brazil. As remarked on a former occasion[6], the formation seems to be of late Cretaceous date.

### Genus Apateopholis, novum.

Body much laterally compressed. Head relatively large; mandible equalling the snout in length; dentition consisting of conical teeth, mostly small, sometimes obtuse, but a single series of large, well-spaced laniaries occupying the anterior half of the mandible. Preoperculum deep and triangular, with a long, robust, posteriorly-directed spine at its postero-inferior angle. Vertebræ well ossified, and the ribs robust. Dorsal fin at least as long as deep, in advance of the anal fin, which is remote, elongated, and relatively low; caudal fin deeply cleft. Scales very thin and feebly ornamented; a single series of deep scales occupying the greater part of the flank.

The type and only known species of this new genus has not hitherto been satisfactorily described. The original specimens, however, are preserved in the British Museum, and an opportunity is thus afforded for contributing some additional notes.

### Apateopholis laniatus. (Plate LV. fig. 11.)

1887. *Rhinellus laniatus*, J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. p. 612, pl. xxxvii. figs. 1, 7.

1888. *Belonostomus laniatus*, Smith Woodward, Rep. Brit. Assoc. p. 678.

The largest known specimen of this species would probably measure not less than 0·3 in length when complete. The head is remarkably large, this with the opercular apparatus being not less than two-thirds as long as the trunk. The maximum depth of the trunk immediately behind the head is contained about eight times in the total length; and the caudal region tapers rapidly to its hinder extremity.

*Head and Opercular Apparatus.*—The head (Plate LV. fig. 11) is

[1] F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. (1882), p. 198, pl. i. fig. 10.

[2] L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1843), p. 140, pl. xlvii. fig. 5; A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix. p. 690.

[3] Agassiz, *loc. cit.* p. 141, pl. xlvii. *a*, fig. 2; Wagner, *loc. cit.* p. 689.

[4] Agassiz, *loc. cit.* p. 143; Wagner, *loc. cit.* p. 689.

[5] Agassiz, *loc. cit.* p. 143; Wagner, *loc. cit.* p. 691.

[6] P. Z. S. 1887, p. 541.

extremely narrow and deep, the orbit (*orb.*) relatively large and posteriorly situated, and the surrounding membrane bones well developed. The jaws and facial bones seem to have been almost smooth, the mandible only being marked by a longitudinal series of perforations for a sensory canal; but the cranial roof is ornamented with numerous tuberculations, which are also visible upon the stout preopercular spine. The preoperculum (*p.op.*) is comparatively robust, triangular in shape, tapering to a point above, and abruptly truncated below; its postero-inferior spinous process (*s.*) exceeds in length the maximum width of the bone, is sharply pointed, and distinctly appears to have been hollow. The operculum (*op.*) and subopercular are comparatively thin, the former deeper than broad, and the latter broad in proportion to its depth; the only ornament exhibited consists in a few feeble radiating lines upon the operculum. The branchiostegal rays (*br.*) are very delicate and apparently numerous.

*Axial Skeleton of Trunk.*—The vertebræ are well ossified, apparently simple double cones, somewhat longer than deep, and about forty in number. The neural and hæmal spines are firmly united to their supporting arches, and the ribs in the abdominal region are very robust. There are also numerous short intermuscular bones, in their crushed state transversely overlapping the arches of the axial skeleton.

*Appendicular Skeleton.*—The fin-rays are robust, and in all, except the caudal fin, are undivided for a considerable space above their insertion, though apparently articulated and bifurcating distally. In the caudal fin the rays are closely articulated from a point close to the base. In the dorsal and anal fins each ray is borne by a separate interspinous element, but the arrangement of the fin-supports in the caudal is not distinctly shown. The pelvic fins are relatively small and remote, the space between these and the pectorals being three times as great as that between the same fins and the anal. The rays of the latter, about seventeen in number, scarcely exceed those of the pelvic fins in length, but the dorsal fin is relatively much elevated, with not less than twenty stout rays, and is situated completely in advance of the anal.

*Squamation.*—The scales are only distinctly shown in part in the type specimen, but it seems probable that they formed a continuous covering. They are all very thin, and their most conspicuous markings are the concentric lines of growth, along which a feeble ornament of fine rugæ and tuberculations is developed. A single series of deep narrow scales, at least half as deep as the trunk, occupies the flank; and above (probably also below) there are smaller, more nearly equilateral scales, likewise of quadrangular shape.

*Formation and Locality.*—Upper Cretaceous (Upper Senonian); Hakel, Mount Lebanon, Syria.

### Evolution of the Aspidorhynchidæ.

The Cretaceous species assigned to *Belonostomus* are so closely

similar to the typical members of the genus of late Jurassic age, that they may be regarded as proving the persistence of this somewhat specialized type during a long period and over wide areas of the earth's surface. That is a feature of some interest in the evolution of the group. But if *Apateopholis* be correctly interpreted in the foregoing description, this genus is still more noteworthy as presenting probably the latest phase in the specialization of the family-type. It would appear that in the Aspidorhynchidæ, as in most groups, the degeneration of the squamation is a character indicating high degree in development, and it is quite possible that further researches may prove some intimate connection between this family and the problematical Hoplopleuridæ, which are so characteristic of Upper Cretaceous formations, and are generally considered to include at least one genus (*Prionolepis* or *Aspidopleurus*) with a single series of deep flank-scales like those of *Belonostomus*. It is further of interest to note that the development of a preopercular spine is a feature hitherto unknown even in the most specialized of Physostomous fishes; *Apateopholis*, in this respect, being paralleled only by some of the highest Physoclysti.

With regard to the origin of the family, the typical genera, *Aspidorhynchus* and *Belonostomus*, so far as known, appear suddenly in the Lower Oolites[1]; and no intermediate stages occur between these rostrated forms and the more ordinary "ganoids" of earlier date. It is, however, worthy of note that, so low in the Mesozoic Series as the Upper Trias, there are *Pholidophorus*-shaped fishes (*Pholidopleurus*) with scales and fins almost identical with those of *Belonostomus*, and further discoveries elucidating the osteology of these early types will be awaited with interest in connection with the problem under consideration.

## EXPLANATION OF THE PLATES.

### Plate LIV.

Fig. 1. *Belonostomus comptoni*; remains of head and trunk, coiled up in nodule. Upper Cretaceous, Serra de Araripe, North Brazil. *c.o.*, circumorbitals; *op.*, operculum; *orb.*, orbit; *p.op.*, preoperculum; *pct.*, pectoral fin; *s.cl.*, supraclavicle; *s.o.*, suborbitals; *s.op.*, subopercular. [47892.]

### Plate LV.

Fig. 1. *Belonostomus comptoni*; superior aspect of rostrum. Upper Cretaceous, Serra de Araripe, North Brazil. [15495 *c*.]
2. Ditto; transverse section of rostrum. Ibid. [15495 *a*.]
3. Ditto; right hyomandibular, outer aspect. Ibid. *p.*, articular process for operculum. [15495 *b*.]
4. Ditto; upper portion of operculum, showing ornament. Ibid. [15495 *a*.]
5. Ditto; vertebral centra, (*a*) lateral aspect of caudals, (*b*) abdominal in longitudinal section. Ibid. [P. 975 *c*.]
6. Ditto; inferior lateral scale, restored. Ibid.
7. Ditto; dorso-lateral scale. Ibid. [P. 3809.]

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[1] Smith Woodward, "A Synopsis of the Fossil Fishes of the English Lower Oolites," Proc. Geol. Assoc. vol. xi. (1890), pp. 295, 296.

W.Purkiss lith. Hanhart imp.

HETEROMEROUS COLEOPTERA FROM THE ARUWIMI VALLEY.

Fig. 8. Ditto; dorsal scales. Ibid. *r.*, series of ridge-scales. [P. 3809.]
9, 10. Ditto; caudal region. Ibid. [47894, 47896.]
11. *Apateopholis lanistus*; head, lateral aspect. Upper Cretaceous, Hakel, Mt. Lebanon. *br.*, branchiostegal rays; *orb.*, orbit; *op.*, operculum; *p.op.*, preoperculum with spine (*s*). [P. 4869.]

All the specimens are preserved in the British Museum, and the numbers refer to the Register of the Geological Department. All the figures are of the natural size.

## 4. On the Heteromerous Coleoptera collected by Mr. W. Bonny in the Aruwimi Valley. By G. C. Champion, F.Z.S.

[Received November 13, 1890.]

(Plate LVI.)

The following is a list, with descriptions of new species, of the Heteromerous Coleoptera collected by Mr. Bonny at the Yambuya Camp. It forms a continuation of the paper contributed by Mr. Bates (*ante*, pp. 479–492), and has been undertaken at his request. Seventeen species only, representing the families Tenebrionidæ, Lagriidæ, and Meloidæ, are contained in the collection; of this number seven are described as new, and one new genus is added. Mr. Bates's remarks (*op. cit.* p. 480) as to the similarity of the fauna with that of the Cameroons and Old Calabar apply equally well to the Heteromera.

### Family Tenebrionidæ.

#### Taraxides, Waterh.

*Taraxides*, C. O. Waterhouse, Ann. & Mag. Nat. Hist. 4th ser. xvii. pp. 288, 289 (1876).
*Dischidus*, Kolbe, Ent. Nachr. xii. p. 297 (1886).

#### Taraxides sinuatus.

*Helops sinuatus*, Fabr. Syst. Eleuth. i. p. 160; Beauv. Ins. Afr. et Amer. p. 139, t. 30 *b*. figg. 9, *a*, *b*.
*Nyctobates confusus*, Westw. P. Z. S. 1842, p. 118; Trans. Z. S. iii. p. 224, t. 15. figg. 6, 7; Ann. & Mag. Nat. Hist. xi. p. 532 (1843).
Three examples of the dark form.

#### Taraxides gibbipennis, sp. n. (Plate LVI. fig. 1, ♂.)

Black, subopaque, the elytra with a greenish-æneous lustre. Head finely and thickly punctured, strongly longitudinally carinate on either side just within the eyes; antennæ (♂) short, not reaching the base of the prothorax, joint 8 about as broad as long, joints 9 and 10 transverse; prothorax transversely subquadrate, slightly narrowed in front, bisinuate at the sides behind (the anterior sinuation formed by an interruption of the sharp lateral carina), the

hind angles acutely rectangular, the base strongly bisinuate, the surface finely, sparsely, and very distinctly punctured; elytra wider than the prothorax, widest beyond the middle, very obliquely narrowing behind, the apices a little produced, the lateral margin grooved within from a little below the base to the apex, the disc transversely depressed below the base, transversely convex or gibbous beyond this, and flattened and somewhat abruptly declivous posteriorly, the surface finely striate-punctate, the punctures not very closely placed and becoming finer towards the apex, the interstices smooth and quite flat; beneath almost smooth, the ventral segments 1–3 punctured and wrinkled in the middle; the anterior tibiæ bent inwards at the apex in the male.

Length 18, breadth 7¾ millim. (♂.)

One male example. Allied to *T. sinuatus* (Fabr.), but easily known from that species (and from *T. mœrens*, Westw., also) by the gibbous, æneous elytra, the bisinuate lateral margins of the thorax, and the shorter antennæ. *T. æneipennis* (Kolbe), from the Congo valley, resembles *T. gibbipennis* in the colour and shape of the elytra, but is described as having the thorax and elytra more strongly punctured than in *T. sinuatus*, a definition certainly not applicable to the present insect.

Taraxides pictus, sp. n. (Plate LVI. fig. 2, ♂.)

Subopaque, black; the elytra each with a transverse flavous fascia some distance before the middle, curving forwards as it approaches the suture and narrowly extending along the side of it nearly to the base and also narrowly extending forwards along the lateral margin to the shoulder, and a shorter and narrower similarly-coloured transverse fascia considerably beyond the middle, this latter at some distance from the suture abruptly and obliquely branching off anteriorly to about the centre of the disc (forming a large V-shaped mark) and posteriorly connected near the suture and along the lateral margin with a large pale castaneous common apical patch, these markings enclosing a large spot of the ground-colour on each elytron. Head broadly flattened between, and obliquely carinate on either side near, the eyes, minutely punctured, the punctuation becoming closer in front and sparser behind; antennæ (♂) black, short, not nearly reaching the base of the prothorax, thickening outwardly, joint 7 about as long as broad, joints 8–10 transverse, 9 and 10 strongly so, 11 about twice as long as 10; prothorax transversely subquadrate, a little narrowed in front, very slightly narrowed and sinuate at the sides behind, the hind angles acutely rectangular, the base strongly bisinuate, the surface sparsely and minutely punctured, more shallowly so towards the sides, the disc with traces of an obsolete median groove behind; elytra wider than the prothorax, widest beyond the middle, very obliquely narrowing behind, the apices a little produced, the lateral margin from the base to the apex not grooved within, the disc transversely flattened just below the base, the surface very finely and obsoletely striate-punctate, the punctures not continued to the apex and a little more

distinct on either side of the suture at the base, the interstices smooth and quite flat; beneath black, the ventral segments finely and somewhat thickly punctured and longitudinally wrinkled along the middle; legs pitchy black, the femora dark castaneous at the extreme base; the anterior femora thickened to beyond the middle, and the anterior tibiæ somewhat strongly curved inwards, in the male.

Length 18, breadth 7¼ millim. (♂.)

One example in Mr. Bonny's collection; a second, from Old Calabar, is contained in the National Collection. This species is closely allied to *T. sinuatus* (Fabr.), for a colour-variety of which it might be taken at first sight, more especially as the latter varies in the colour of the thorax. It differs, however, from that insect not only in colour, but in the broadly flattened interocular space of the head, the much shorter antennæ in the male (not longer than in the female of *T. sinuatus*, with the penultimate joints more transverse and the apical joint relatively longer), the shorter legs, and the more finely and much more obsoletely striate-punctate elytra, the latter not grooved within the lateral margin (in *T. sinuatus* the margin is accompanied by a groove which becomes deeper and more distinct towards the apex). The species is interesting from the fact of there being a large Erotylid with similarly coloured elytra in the same region in which Mr. Bonny's collection was made; the peculiar markings are very distinct and sharply defined, the allied forms, *Nyctobates bifasciatus*, Quedenf., excepted, being all of very sombre colours.

### Chiroscelis, Lam.

#### Chiroscelis passaloides.

*Chiroscelis passaloides*, Westw. Trans. Z. S. iii. p. 210, t. 14. f. 3; Arcana Ent. ii. p. 160, t. 87. f. 4.

Three specimens.

### Odontopus, Silb.

#### Odontopus obsoletus.

*Odontopus obsoletus*, Thoms. Arch. Ent. ii. p. 90 (1858).

One female specimen. This nearly agrees with a male example in Mr. F. Bates's collection, except that it has the punctuation of the upper surface still more obsolete, the thorax being almost impunctate, and the elytra shallowly, finely, and sparsely punctate.

### Pycnocerus, Westw.

#### Pycnocerus costatus.

*Odontopus costatus*, Silb. Rev. Ent. i. pt. 2, no. 4 (1833); Casteln. Hist. Nat. Ins. Col. ii. p. 213.

Two specimens. *P. exaratus*, Harold, seems to be a closely allied species.

STERCES, gen. nov.

Mentum strongly transverse, flat; labial and maxillary palpi with their last joint ovate, obliquely truncate at the apex (that of the maxillary pair subtriangular in *S. violaceipennis*); ligula largely developed, triangularly raised in the middle between the point of insertion of the labial palpi, deeply emarginate in the centre at the apex; mandibles feebly emarginate at the tip; head short, feebly emarginate in front, not deeply sunk into the prothorax, distinctly narrowed behind the eyes, the antennary orbits not prominent, the epistoma short, limited behind by a faintly impressed groove; the eyes rather convex, coarsely granulated, moderately large; antennæ short, not or scarcely reaching the base of the prothorax, the six outer joints broadly dilated and punctured, 6–10 transverse, 11 much longer than 10, the five basal joints almost smooth; prothorax as long as broad, subquadrate, somewhat cylindrical, very acutely margined at the sides, the base bisinuate and distinctly margined; scutellum subtriangular; elytra about one half broader than and fully four times as long as the prothorax, parallel towards the base, a little dilated at the middle, and obliquely converging behind, very sharply margined at the sides (the margin deeply grooved within) from the base nearly to the apex, the epipleuræ reaching as far as the apex of the fourth ventral segment and strongly sinuous posteriorly; prosternum abruptly declivous behind the anterior coxæ and extending as far as the base of the prothorax, a little raised at the apex; mesosternum triangularly excavate in front, V-shaped; intercoxal process of the abdomen subtriangular; legs short; the femora not clavate; the tarsal joints (the apical one excepted) broad and compressed and clothed beneath with a dense brush of spongy hairs (this clothing being extended on to the apex of each of the tibiæ), the penultimate joint deeply excavate above, as broad as the preceding joint, and slightly emarginate at the apex, the first joint of the posterior pair about one third longer than the following joint; tibial spurs obsolete; claws furnished with a long sharp tooth at the middle within; body elongate and somewhat cylindrical, metallic, glabrous.

This new genus is proposed for an interesting species belonging to the group Cnodalonides; a closely allied form, from Lagos[1], also

[1] STERCES VIOLACEIPENNIS.

Less elongate than *S. resplendens*; the head not depressed in the middle between the eyes; the antennæ shorter, joints 6–10 shorter and much more strongly transverse; the prothorax more parallel at the sides behind, the hind angles more rectangular, the transverse basal depression deeper, the disc not canaliculate in front, the punctuation a little coarser (similar to that of the head); the elytra relatively shorter, bright violaceous, coppery in certain lights, a little more deeply punctate-striate; the legs shorter; the femora and tibiæ, except at the base and apex, reddish-testaceous, this colour occupying more of the basal portion of the femora than in *S. resplendens*; the rest as in *S. resplendens*.

Length 14, breadth 4¼ millim.

*Hab.* Lagos (*coll. F. Bates*).

One example, apparently a male.

belongs to it. The sharply margined subquadrate thorax, the dilated and excavate, broad penultimate joint of the tarsi, the sharply toothed claws, the posteriorly narrowed head, and the elongate, somewhat cylindrical shape distinguish *Sterces* from the other known genera of Cnodalonides. The genus is perhaps best placed between *Camarimena* and *Acropteron*.

STERCES RESPLENDENS, sp. n. (Plate LVI. figg. 3, ♂; 3 *a*, labium; 3 *b*, maxilla and maxillary palpus; 3 *c*, anterior tarsus.)

Head and prothorax black, the latter with a slight violaceous lustre; the scutellum black; the elytra bright metallic green, this colour (in certain lights) changing to violaceous towards the suture and along the lateral margins; shining. Head somewhat flattened, depressed in the middle between the eyes, finely, deeply, and rather closely punctured, the epistoma smoother; antennæ black, joints 6–10 broad, transverse, 6–8 subtriangular, 11 about one half longer than 10; prothorax as long as broad, subquadrate, narrowing a little in front and slightly sinuate at the sides behind, the hind angles acute and directed outwards, the disc broadly transversely depressed in the middle before the base and obsoletely canaliculate in front, the surface finely, irregularly, and rather sparsely punctured (the punctuation finer than that of the head), a longitudinal space down the middle impunctate; scutellum smooth; elytra very finely punctate-striate, the interstices quite flat and with very minute widely scattered punctures; beneath very shining, blackish-violaceous, very sparsely and minutely punctured, the first three ventral segments also with very fine shallow longitudinal rugæ; legs black, the femora broadly marked with reddish-testaceous beyond the middle (the apex and base alone black), the tibiæ and tarsi thickly, the femora very sparsely, punctured, all the tibiæ slightly dilated within at the apex and somewhet curved, the femora glabrous.

Length 16½, breadth 5 millim. (♂.)

One example.

NESIOTICUS, Westw.

NESIOTICUS FLAVOPICTUS. (Plate LVI. fig. 4, var.)

*Nesioticus flavopictus*, Westw. P. Z. S. 1842, p. 121; Trans. Z. S. iii. p. 227, t. 15. f. 13; Thoms. Arch. Ent. ii. p. 92, t. 3. f. 1.

Numerous examples. These differ from the type in the shape of the transverse flavous basal fascia of the elytra, and they form a well-marked variety: the fascia extends inwards to a little nearer the suture and usually has a short additional ramus extending forwards from its point of termination.

STRONGYLIUM, Kirby.

STRONGYLIUM ATROVIOLACEUM, sp. n. (Plate LVI. fig. 5.)

Elongate, parallel, opaque, bluish-black, the head in front and the elytra obscure violaceous. Head distinctly grooved between the

eyes, thickly and finely punctured, the interocular space more coarsely so in front but with a smooth space in the middle behind; the eyes moderately large, not prominent; antennæ (♀) blackish-violaceous, short, extending very little beyond the base of the prothorax, moderately stout, joint 3 twice as long as 2, 4 longer than 3, triangular, 5 very much shorter than 4, 5–10 gradually increasing in width, flattened, subtriangular, 10 transverse, 11 a little narrower but not longer than 10; prothorax transversely subquadrate, moderately convex, the sides almost straight, very little narrowed in front, with a fine but complete lateral carina, the anterior angles prominent but obtuse, the hind angles acute and outwardly directed, the base and apex strongly margined, the surface finely and thickly punctured, a very narrow space down the middle (slightly impressed at the base) smooth; scutellum very finely and sparsely punctured; elytra nearly one half broader than and fully four times as long as the prothorax, parallel, exceedingly finely and shallowly punctate-striate from the base to the apex, the punctures oblong in shape, the interstices smooth and perfectly flat, the shoulders swollen and prominent; beneath bronze-black, shining, the propleuræ, the sides of the meso- and metasternum, and the metasternal episterna rather coarsely punctured, the ventral segments sparsely, obsoletely punctured and aciculate (the fifth more coarsely and more closely punctured); prosternum broad, transversely depressed before and behind the anterior coxæ, and with the apex produced behind but very little raised; legs blackish-violaceous, the femora reddish-testaceous from near the base to far beyond the middle.

Length 18, breadth 5¼ millim. (♀.)

One example. This species is chiefly distinguished by its very smooth elytra, prominent humeri, parallel shape, and dull violaceous colour, the femora broadly marked with red. It does not seem to be at all closely allied to any of the described African members of the genus.

STRONGYLIUM AURONITENS, sp. n. (Plate LVI. fig. 6.)

Elongate, parallel, of a bright metallic golden-green colour, with golden-cupreous reflections. Head feebly longitudinally grooved between the eyes, sparsely and somewhat coarsely punctured behind, more finely so in front; the eyes large and prominent; antennæ moderately long, gradually thickening outwardly, joint 4 much longer than 3, 5 much shorter than 4, 5–8 flattened, but little widened towards their apex (9–11 missing), 1–3 metallic green, the rest bronze-black; prothorax transversely subquadrate, a little flattened on the disc, the sides almost straight behind, slightly converging and somewhat arcuate in front, with the lateral carina fine and only extending from the apex to a little beyond the middle, the hind angles acute and outwardly directed, the base sharply and the apex very distinctly margined, the disc transversely depressed in the middle in front and deeply and somewhat obliquely depressed on either side before the base, the surface coarsely, closely, and irregu-

larly punctured; scutellum with a few fine punctures; elytra about one third broader than and fully four times as long as the prothorax, parallel, a little flattened on the disc, coarsely striate-punctate from the base to the apex, the punctures oblong in shape and becoming finer towards the suture and larger and deeper towards the sides, the interstices very minutely and very sparsely punctured, flat on the disc, moderately convex towards the sides, the shoulders very little swollen and not prominent; beneath very shining, bright metallic green, with golden and cupreous tints, the propleuræ, the sides of the meso- and metasternum, and the metasternal episterna very coarsely punctured, the rest of the surface (the fifth ventral segment excepted) sparsely and minutely punctured, the ventral segments also longitudinally aciculate, the fifth thickly and rather coarsely punctured; prosternum horizontally produced behind, its posterior face vertical; legs moderately long, golden-cupreous, with greenish tints in certain lights.

Length 15, breadth 4½ millim. (♀.)

One example. Apparently closely allied to *S. quadraticolle* and *S. puncticolle*, Thoms., from the Gaboon, but not agreeing satisfactorily with the brief and very imperfect descriptions of either of these species.

### Xanthothopeia, Mäkl.

Xanthothopeia aruwimensis, sp. n. (Plate LVI. figg. 7; 7 *a*, antenna.)

Elongate, rather convex, subparallel; bronze-black, the head violaceous in front and greenish in the middle and at the sides anteriorly, the elytra greenish-æneous and opaque, the head, prothorax, and scutellum shining. Head distinctly foveate in the middle between the eyes, finely and sparsely punctured, a longitudinal space down the middle smooth; the eyes comparatively very large, not prominent; palpi bronze-black; antennæ dark violaceous, short, extending a little beyond the base of the prothorax, the joints from the fourth greatly dilated and flattened and becoming very much wider outwardly, 4–7 subtriangular, 6–10 strongly transverse, 9 and 10 each about twice as broad as long, 11 narrower and scarcely longer than 10; prothorax convex, transverse, the sides converging from the middle and slightly rounded anteriorly, feebly sinuate before the base, with the lateral carina very fine and extending only from the apex to about the middle and thence to the base replaced by a finely impressed line, the apex finely margined on either side, immarginate in the middle, the base sharply grooved within, the hind angles acute and outwardly directed, the anterior angles declivous, the disc very feebly transversely depressed on either side at the middle and with a deeper transverse impression lower down nearer the lateral margin, the surface finely, deeply, and closely punctured; scutellum very finely and sparsely punctured; elytra about one third wider than and fully four times as long as the prothorax, parallel to about the middle, crenate-striate from the base

to the apex, the punctures fine on the disc but becoming much coarser towards the sides anteriorly, the interstices sparsely and very minutely punctured and transversely wrinkled, almost flat towards the suture, convex at the sides, the epipleuræ transversely wrinkled; beneath dark violaceous, shining, the propleuræ coarsely and sparsely, the sides of the metasternum more finely punctured, the ventral segments finely and rather thickly punctured and aciculate; prosternum broadly, longitudinally depressed between the anterior coxæ, the apex broadly produced but very little raised; legs rather short, dark violaceous, thickly and rather coarsely punctured.

Length 16½, breadth 5½ millim.

One example, probably a female. In the very broadly widened outer antennal joints (joints 7–10 being about twice as broad as long), the prosternum broad and depressed between the anterior coxæ, the comparatively short legs, &c., this insect agrees very much better with *Xanthothopeia* than with *Strongylium*; and as it does not differ in any important particular from the former I refer it to that genus. Three species only of *Xanthothopeia* have been described, all differing considerably from the present one. Mäklin has taken the colour of the palpi as one of the generic characters of *Xanthothopeia*; but the colour of these organs cannot possibly be regarded as of generic importance, though they are conspicuously flavo-testaceous in his typical species, *X. rufipennis*.

### Aspidosternum, Mäkl.

#### Aspidosternum physopterum.

*Aspidosternum physopterum*, Harold, Mittheil. Münch. ent. Ver. iv. p. 164.

One example apparently referable to this species, of which von Harold has only published a brief and very incomplete diagnosis. It has the elytra gradually widened from the base to very far beyond the middle, strongly convex behind, and distinctly costate; the upper surface greenish-æneous and shining; the thorax strongly transverse, rounded at the sides, and sparsely punctured. Several specimens of the same species, from the Cameroons, are contained in Mr. F. Bates's collection; in one or two of these the elytral costæ are almost or quite obsolete, thus agreeing better with von Harold's diagnosis.

### Praogena, Cast.

#### Praogena procera.

*Praogena procera*, Harold, Mittheil. Münch. ent. Ver. ii. p. 107; Col. Hefte, xvi. p. 131, t. 1. fig. 8.

A single mutilated example, 25 millim. in length, agrees well with von Harold's diagnosis of *P. procera*, "Aurato-viridis, nitidissima, corpore subtus rufo-piceo, pedibus rufo-testaceis, femorum apice, tibiis ultra medium tarsisque nigris," and also with his figure. This is one of the finest known species of the genus.

## Family Lagriidæ.

### Lagria, Fabr.

Examples of three species, one apparently *L. obscura*, Fabr., the others undeterminable. The specimens of these latter are insufficient for description, even if they should prove to belong to undescribed species.

## Family Meloidæ.

### Eletica, Lac.

Eletica bicolor, sp. n. (Plate LVI. fig. 8, ♂.)

Moderately elongate, parallel; above and beneath and the legs and antennæ black; the elytra from the base to beyond the middle bright red, immaculate, for the rest black; the head, the basal half of the prothorax, and the elytra almost glabrous, shining, the elytra duller towards the apex; the anterior half of the prothorax, the scutellum, the entire under surface, the basal joint of the antennæ, and the legs (the inner side of the femora excepted) densely clothed with long, fine, silky, appressed yellowish-grey pubescence. Head coarsely, irregularly, and somewhat closely punctured, the occiput a little smoother, longitudinally grooved down the middle, the groove much more deeply impressed between the eyes and on the forehead; (antennæ mutilated); prothorax broader than long, the sides almost parallel behind and obliquely converging in front, the base very sharply margined, the anterior half transversely depressed, densely and finely punctured, and pubescent, the posterior half glabrous and with only a few very widely scattered punctures in the middle and at the sides, the disc sharply canaliculate (the median channel ending in a deep impression before the base and replaced on the densely punctured portion of the surface by a smooth central line) and with a large shallow depression on either side behind the middle; scutellum densely punctured, the punctures confluent and much coarser in the middle; elytra nearly twice as wide as the prothorax, parallel, transversely and irregularly wrinkled, and with two distinct longitudinal ridges on the disc and a short sharp ridge near the suture at the base, the suture also raised towards the base, the ridges on the disc becoming sharper and more distinct towards the base and fainter towards the apex, the apices broadly rounded externally and truncate and a little retracted towards the sutural angle; beneath very densely and finely, the legs densely and more roughly, punctured.

Length 20½, breadth 8 millim. (♂.)

Allied to *E. rufa* (Fabr.), but differing from the corresponding sex of that variable species by the peculiar sculpture of the thorax and by the coarsely punctured upper portion of the head. The densely punctured, pubescent, and depressed anterior portion of the thorax is very sharply delimitated from the smooth and glabrous posterior portion; the entire under surface is very densely clothed with long, silky, appressed, yellowish-grey pubescence, the legs also being very

pubescent. Since the publication of Gemminger and Harold's Catalogue numerous species of *Eletica* have been described by Kolbe, von Harold, Ancey, Peringuey, and Fåhræus; but the present insect appears to be perfectly distinct from any of these.

It may not be out of place to add here a list of the more recent and more important papers dealing with the Heteromerous fauna of Tropical Africa. These are entirely German:—

1. "Bericht über die von den Herren A. v. Homeyer und P. Pogge in Angola und im Lunda-Reiche gesammelten Coleopteren," von E. v. Harold. [Col. Hefte, xvi. pp. 109–143 (1879).] (Diagnoses of some of the new species here described were published in the previous year, Mittheil. Münch. ent. Ver. ii. pp. 106–109.)
2. "Verzeichniss der von Herrn Major a. D. von Mechow in Angola und am Quango-Strom 1878–1881 gesammelten Tenebrioniden und Cisteliden," von G. Quedenfeldt. [Berl. ent. Zeitschr. xxix. pp. 1–38 (1885).]
3. "Neue afrikanische Coleoptera des Berliner zoologischen Museums," von H. J. Kolbe. [Ent. Nachr. xii. pp. 289–301 (1886).]
4. "Beiträge zur Kenntniss der Koleopteren-Fauna von Central-Afrika nach den Ergebnissen der Lieutenant Wissman'schen Kassai-Expedition 1883 bis 1886," von G. Quedenfeldt. [Berl. ent. Zeitschr. xxxii. pp. 183–189 (1888).]

EXPLANATION OF PLATE LVI.

Fig. 1. ♂ *Taraxides gibbipennis*, p. 637.
2. ♂ „ *pictus*, p. 638.
3. ♂ *Sterces resplendens*, p. 641.
3*a*. „ „ labium.
3*b*. „ „ maxilla and maxillary palpus.
3*c*. „ „ anterior tarsus.
4. *Neniotiens flavopictus*, var., p. 641.
5. *Strongylium atroviolaceum*, p. 641.
6. „ *auroviteus*, p. 642.
7. *Xanthothopeia arruwimensis*, p. 643.
7*a*. „ „ antenna.
8. ♂ *Eletica bicolor*, p. 645.

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December 2, 1890.

Prof. Flower, C.B., 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 1890:—

The registered additions to the Society's Menagerie during the month of November 1890 were 43 in number. Of these, 22 were acquired by presentation, 17 by purchase, 2 on deposit, and 2

were born in the Gardens. The total number of departures during the same period, by death and removals, was 67.

The most noticeable addition during the month was:—

A young example of the scarce carnivorous animal *Cryptoprocta ferox*, from Madagascar, new to the Collection, purchased November 12th.

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The following letter, addressed to the Secretary by M. A. Milne-Edwards, was read:—

"Muséum d'Histoire Naturelle,
28 Novembre, 1890.

"CHER MONSIEUR,

"Je viens de lire dans le dernier cahier des Proceedings (P. Z. S. 1890, p. 461) une note de Mr. Bolton relative au Zèbre de Grévy, dans laquelle il est dit que les proportions de l'exemplaire monté ne correspondent pas à celles de l'animal vivant, et que la peau a été beaucoup trop distendue. Je crois utile de ne pas laisser cette erreur s'accréditer, et je puis vous assurer que les dimensions de l'animal ont été minutieusement observées par les taxidermistes. Le Zèbre de Grévy est arrivé vivant à Marseilles, où on en a pris une photographie, sur laquelle les oreilles sont indistinctes et le museau disparaît dans le seau où un gardien fait boire l'animal. Il est donc impossible d'après cette photographie de se rendre un compte exact de la forme de la tête.

"Envoyé à Paris à l'époque la plus chaude de l'année, ce Zèbre est mort en arrivant d'une congestion pulmonaire. J'ai fait de suite mouler en plâtre la face, les épaules, les pattes et le bassin, afin que l'on puisse en reproduire exactement les formes. Ces montages existent encore dans mon laboratoire. Le crâne a ensuite été enlevé, et il est aujourd'hui placé dans la collection d'Anatomie Comparée; mais le squelette a été préparé, et il a été laissé, comme charpente, sous la peau de manière à assurer l'exactitude des proportions. Je vous envoie, d'ailleurs, un dessin sur lequel sont indiquées les dimensions de ce Zèbre, telles qu'elles ont été relevées sur le cadavre après la mort. Les taxidermistes se sont conformés à ces indications.

"J'insiste sur ce point parce que les proportions de l'*Equus grevyi* sont tout-à-fait différentes de celles de l'*E. zebra*. Le premier est beaucoup plus svelte et plus haut que le second. Il n'a pas la forme de l'espèce de l'Afrique australe. Son aspect est tout autre, et l'on peut considérer l'exemplaire monté de la collection du Muséum de Paris comme une reproduction aussi exacte que possible de ce qu'était l'animal vivant.

"Croyez, cher Monsieur, à l'expression de mes sentiments dévoués.

"A. MILNE-EDWARDS."

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A letter was read addressed to the Secretary by Dr. Emin Pasha, C.M.Z.S., dated "Tabora, East Africa, Aug. 16th, 1890," returning thanks to the Society for his election as Corresponding Member. Dr. Emin stated that a Striped Hyæna, similar to (and perhaps

identical with) the Egyptian form (*Hyæna striata*), but smaller and lighter in colour, occurred in that part of Africa. He was not aware that the occurrence of this species so far south in Africa had been previously registered.

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The following papers were read :—

## 1. On the Antelopes of Nyasa-land.

By Richard Crawshay [1].

[Received October 14, 1890.]

In the following notes I have endeavoured to embody and condense as far as possible my observations and experiences as regards Antelopes in the Lake Nyasa District, where I have travelled and resided at intervals during the last seven years, viz. from September 1883 till March 1890.

Being a sportsman, however, or rather, perhaps, what is termed a "hunter," and not an accomplished naturalist, I cannot pretend to be an authority on natural history; but, as most of my time in Africa has been spent in "hunting," mainly in pursuit of Elephants, I have been constantly in touch with both large and small game of all kinds, and thus have had ample opportunities of seeing for myself what animals there are and where, in addition to picking up a good deal of information from natives as to districts I have not visited; so that I ought to be in a position to throw some light on the game to be found in Nyasa-land, though at the same time I do not know if I shall be able to impart my knowledge satisfactorily on paper to others. Hitherto little or nothing has been said or written of Nyasa-land as a hunting resort; but this must be due to the fact that comparatively few whites have visited it, while of these few again only some half dozen have been sportsmen, or, to put it otherwise, "sportsmen-naturalists;" two who are, I believe, still alive, viz. Capt. Fairlie and Lieut. Pulley, R.N., standing out very prominently; and, in a lesser degree, of late years Messrs. Alfred Sharpe and H. H. Johnston, the last-named being perhaps the only true naturalist of all, though his stay in the country was only too short; while, though no longer living, Messrs. Stewart, Rhodes, and Capt. Elton were nearly as well known in their day. Unfortunately, one only of all these appears to have committed his experiences to print; and this is Capt. Elton, whose delightful book, 'Lakes and Mountains of Africa,' with its life-like illustrations, I would commend to all who have not read it and who are interested in Nyasa-land.

Space and time prevent my here entering on the subject of my own travels in this part of Africa: little short of a book could give any comprehensive idea of my movements. Suffice it to say, then, I have made in all four journeys from the sea-coast at Kilimane to

[1] Communicated by the Secretary.

Nyasa and back, and have visited the following districts between the following dates :—

Between September 1883 and February 1884, travelling by the usual route up the Kwa-kwa, Zambezi, and Shiré Rivers, I made my way through to the Awa-Nyakyusa country at the N.W. end of Nyasa. Here I formed one of a party of whites hunting Elephants, as did my companion, Capt. Berry, of Natal, who, poor fellow, was there taken by a Crocodile whilst bathing at Kapora's, in the Kiwira River, December 16th, 1883.

Between June and December 1885, after trying unsuccessfully for Elephants in the country to the S. and S.W. of Lake Chirwa, I went on to Nyasa, where on the west coast I took up my quarters at Cape Maclear. Making this my head depot, I travelled over and hunted a large tract of country to the N.W., visiting from time to time Mlomba, Mbapi, Amuwa, and Mpemba's, in which neighbourhood Elephants then proved rather plentiful. Subsequently, however, I became involved with trouble with a band of Achikunda, from Chifisi's (a big Angoni chief), who stole the tusks from one of my dead Elephants; and not being able to get another caravan from the Cape-Maclear men (a miserable lot of cowards), I proceeded N. by water to Bandawe. Here, almost immediately, I was stricken down with heavy fever, and, with a congested liver, had ultimately to return to the coast, where I embarked for Europe.

In May 1887 I again made my way out to East Africa, and this time visited the E. coast of Nyasa, residing some months with the Universities' Mission on Likoma Island; from this, I occasionally made short excursions to the mainland, visiting Mapunda's, Ngofi's Chiteji's, Mataka's Mbuzi's, Utaya's, and Malo, but did little or nothing anywhere in the way of hunting. Subsequently however, in December, on my way to the coast, I made a short shooting-trip to the S.W. of Cape Maclear, on the W. side of the Lake, and visited Lesumbwi and Chirombo's. I then, in March 1888, left Kilimane for a change to S. Africa. Returning to Nyasa again, in Oct. 1888, I travelled and resided in all the country between Chombi (Mt. Waller) and the Wa-kinga mountains on the N.W. of the Lake, and also to some extent in the Apoka Mountains,—a range which branches off inland from Mt. Waller, and skirts the vast plains which extend from it N. to the Wa-kinga Mountains. A great part of my time I lived at Karonga's, or Nkanga, which last-named place I left in Feb. 1890 to come to England.

Thus very briefly, and I fear unintelligibly, I have given my head-quarters in Nyasa-land during these years; but I have not been able to include many places which will come in for mention in the following notes.

And now, maybe, some description of the country will be looked for; but Nyasa, with its vast coast-line, embracing swamp and plain, mountain and low undulating highland in endless profusion, is far beyond me to depict in so small a space; and I must not attempt now anything more than a few very general remarks.

Everywhere, the scenery is magnificent, and its beauty is further-

more enhanced by never-ending variety: swamps green and luxuriant with papyrus and reeds give way to open sandy plains sparsely studded with borassus; dry arid flats, relieved only by a few grotesque baobabs or sprawling-limbed acacias are gradually changed for thickly wooded undulating highlands; and, in places, as for instance on the E. coast of the Lake in the neighbourhood of Kalowilis, and again for some 50 miles at the N.E. end, lofty mountains rise wall-like sheer out of the water shutting out all beyond, while in others they succeed one another, tier upon tier, till those in the background resemble only blue hazy clouds.

And yet the distinguished writer of 'Tropical Africa' has it that Nyasa scenery is not African, or, to use his own words, does not "remind you where you are." But from what I have seen of the country, I can only say no words could be more unhappily chosen. Neither are the sentences "once a week you will see a palm; once in three weeks the monkey will cross your path," any more appropriate, since palms are almost everywhere, while forest and swamp are alive with animals and birds.

But though to the human eye the country is surpassingly fair to look upon, yet no part of it can be termed healthy, or even moderately so, since everywhere malaria is prevalent in a greater or less degree, whether in sand, soil, swamp, or rock, though temperature is doubtless a powerful agent in generating it. Still, on the highland plateaux, where a height of from 2000 to 4000 feet or more can be attained, the climate must be much better adapted to whites, though the change there from the enervating lowlands would at first prove trying, as the malaria "works itself out." On the Lake itself the heat is never very oppressive, and it is not so great as in the low country inland from it, as there is almost always in the daytime a breeze which more often than not partakes of the nature of a gale. There are two prevailing winds: from sunrise till noon the "Mvuma" (east wind) blows; this, as the sun reaches the meridian, gradually dies, and is then almost immediately succeeded by the "Mwera" (south-easter), the most tearing wind on Nyasa, which lasts till sunset, when it drops. During the night, there is rarely any wind, and then, as the natives say, the Nyanja "sleeps." The greatest heat I have experienced in the Nyasa Country has been on the vast swampy plains round Kisako, in Mapweri's country, close in under the Wa-kinga Mountains. Here about the middle of November when the rains there commence, the temperature at noonday in the shade is seldom under 100°, often considerably more. This moist steamy heat it is that generates the worst type of malaria, and terribly cruelly unhealthy are these Awa-Nyakyusa plains.

Many other topics there are still pressing for mention: one of the foremost being that of the Nyasa tribes and their languages—a most interesting study; but the subject is too lengthy to deal with now in my limited space, and I must leave it untouched, as also zoology in general, ornithology, and entomology, all of which offer a new and practically unlimited field to the naturalist. The future will, no doubt, do much for Nyasa-land and all these sciences as well as open

up the country for whites; the past, however, except for Bandawe and possibly Mweniwanda's, has done practically nothing, while the loss of human life has been proportionately enormous.

I now proceed to give my notes on the Antelopes that I have met with in Nyasa-land:—

1. Cobus ellipsiprymnus.

The Water-buck is by far the commonest of those Antelopes which go in herds, and it would be hard to set foot anywhere in Nyasa-land—except, of course, in the immediate vicinity of large villages, or in the very precipitous country which in places rises sheer out of the Lake—where these animals are not to be seen in greater or less numbers. There is only the one species, I take it, *C. ellipsiprymnus*; but in this I have noticed variety, animals frequenting the open plains being rather lighter in colour than those of the wooded highlands where they are often found. The natives seemingly only recognize the one species, known as the "Nakodzwi" or "Nyakodzwi" of the Ajawa and of the Anyanja, the "Ipiva" of the Angoni, the "Chuzu" of the Achewa, Atonga, Atembuka, Ahenga, and Anyika (Apoka), and the "Lipuwa" of the Ankonde.

All over Nyasa-land, as I have said, Water-buck are plentiful, and it would be almost impossible to enumerate every locality where I have seen them: I can, however, note a few places where they have appeared to be most numerous.

On the *west* coast, to the north of Cape Maclear and about a day's journey west of Mpemba's, I saw great numbers in September and October, 1885. I was at that time hunting Elephants, and the Water-buck proved a positive nuisance, since they constantly ran in on the former and put them on the *qui-vive*. To the north of "Chombi" or "Piri Ngoma" (*Anglicè*, Mt. Waller), and between it and the Hara River, I saw immense herds, and from there again right away to the foot of the Wa-kinga Mountains to the north-west of the Lake, a distance of some 130 miles, I was scarcely ever out of sight of Water-buck or their spoor, when I made the journey in 1889.

In the vast swamps of Kisako and Kisali, at the foot of the Wa-kinga Mountains, I saw more Water-buck than I have seen anywhere, except on the plains of the Shiré river.

On the East Coast I came across a few in 1887, in the hills bordering the Lake, to the south of Chiteji's; here the country is rocky and precipitous right down to the water, but there is a small belt of reeds, if no swamp. Water-buck are always found in greatest numbers on large swampy plains overgrown with coarse grass, tall reeds, and papyrus, where in the wet season it is almost impossible to get at them: unlike other Antelopes, except the Reed-buck, they do not appear to leave the lowlands in the rains, but keep to the plains all the year round: apparently they revel in almost impassable swamps where only Elephants, Buffaloes, and Reed-bucks care to stay, and I have occasionally followed them in mud and water almost waist-

deep. In such places one has to undergo cruel torture from reed-cuts and mosquitoes, the latter of the fiercest type and even in broad noonday most vicious. Nature has provided the Water-buck with a tougher hide and coarser hair than any other of his kind, but even these are not proof against the rank tall "mabandi" grass and spear-like "matele" reeds, and I have noticed that the legs of some I have killed have suffered considerably, the skin on the fetlocks and pasterns being cut clean through.

I have seen more of Water-bucks than of any other Antelopes, and had ample opportunity for observing their habits at Nkanga and other places, where I have actually lived among them. They have a habit, after drinking, of wandering considerable distances along the sandy shore of the Lake; Elands, I have noticed, do the same; this I have seen on bright moonlight nights, when I have camped on the Lake shore. When alarmed and beating a retreat, they occasionally give vent to a low snorting bark, and move off at a smooth and, if I may use the expression, "wooden" trot; unless wounded or hard-pressed in pursuit, they seldom canter or gallop, and they do not bound or jump as do almost all their kind. Water-bucks have an extraordinarily powerful scent, like that from Sheep but stronger, and their haunts and paths retain it for weeks and even months after the animals have left them. Lions, it has occurred to me, seldom kill a Water-buck, and I can only attribute this either to their dislike to this scent, or to the habit Water-bucks have of lying in open places where Lions cannot easily get at them. Buffaloes appear to me the natural prey of the Lion, but compared with Koodoo, "Impala," and Bush-buck, it is seldom that Water-bucks fall victims. The meat of the Water-buck is quite the worst of all African venison that I have eaten, its grain being considerably coarser than that of an old bull Buffalo, while at the same time it has a very strong flavour, too strong by far for stomachs undermined by a malarial climate; natives, however, to a man eat it, and, so far as I know, they have no evil superstitions about the animal itself, such as they have with the Bush-buck, a small red-coloured Antelope, the "Insa," and the Red River-hog (*Potamochærus penicillatus*). I have heard it said by some that Water-bucks are unusually stupid; such, however, has not been my experience; no doubt they are at times confiding and offer an easy shot, but not more often, I should say, than any other Antelopes of the open plains. I think they possess greater vitality than any other of their kind, at least those I have met (though there is little to pick between a Water-buck and a Hartebeeste on the score of being hard-lived); and they are certainly more stoutly built, especially about the neck and legs, the latter being short, coarse, and even clumsy. Compared with other Antelopes they are by no means graceful, yet their beauty may be said to "consist in their ugliness;" and if not actually useful, they are certainly ornamental to the vast wastes of swamp, grass, and reeds where they are generally found.

2. Cervicapra arundinacea.

Quite as widely distributed as the Water-buck, though in fewer numbers, is the Reed-buck, "Mpoyo" of the Anyanja, "Ndopi" of the Ajawa, "Imzigi" of the Angoni, "Swye" of the Ahenga and Anyika, and "Iswera" of the Ankonde. All over Nyasa-land Reed-bucks are to be found, at least wherever there are open plains such as Water-buck frequent; I have not, however, come across them in the hills.

On the West Coast, on the plains to the north of Cape Maclear, especially between Amuwa and Mpemba's, I found the Reed-buck in considerable numbers in 1885.

I also saw a good number in 1889, scattered about the country between Chombi and Nkanga; here there are five small rivers, the Kapwekeri, Hara, Kambweri, Chonanga, and the Ngarawi, all close together, and the intervening country is particularly suited to the Reed-buck. I have found it perhaps in greatest numbers on the vast swampy plains at the foot of the Wa-kinga Mountains, between Kisali in Mankendya's country and Kisako in Mapweri's to the north-west of the Lake; south of that, again, in the Songwi and Insesi country, and indeed everywhere between that and the Rikuru River, some three miles north of Karonga's. But the Reed-buck are so generally met with throughout all Nyasa-land that really it seems needless to give any localities.

I should say that the Reed-buck is more wary than the Water-buck, at least they are certainly more difficult to stalk, and this is mainly due to their liking for bare open country; as a rule, they are found singly or in pairs, but I have occasionally come across as many as four or even six together in one place.

In their habits they are decidedly local, and day after day the same animals can be found in the same spot; they are particularly partial to clean bare sandy patches in open plains, well away from cover, and here, like the "Insa," a small reddish-coloured Antelope, they resort and stand about day after day for weeks together, as may be seen from the piles of droppings that accumulate. When alarmed they give vent to shrill screams—Whew! Whew!—and bound off kicking up their hind legs and tossing their tails like rabbits; their tails are thick and bushy and, being white on the underside, present a striking appearance when their owners are making off in the grey dusk of evening or very early morning. They have a strong scent, but their venison, to my thinking, is better than any except that of the "Impala" or Eland; as a rule, too, it carries more fat than any other, unless occasionally an Eland.

3. Oreotragus saltator.

The Klip-springer, "Chinkoma" of the Nyasa tribes, is commonly met with in rough mountainous country, and occasionally where there are no other Antelopes.

On the West Coast, on Chombi and all along the Apoka Mountains, I have found them plentiful, especially in the dry rocky hills

about Taowira, and behind Kaundi, to the N.W. of that region. I have, too, now and again come on them in the hills between Nkanga and Ncheweri.

At the foot of the Wa-kinga Mountains, in the Upper Lufira country, I have also seen them.

On the East Coast, I have occasionally come across them in the hills to the south of Chitezi's (Chiteji's), and between that and Malo.

I have never seen more than a pair together, though, in places where they are numerous, one occasionally sees as many as three or four on the move at the same time. When wounded, I have noticed Klip-springer cry piteously, bleating not unlike a young Goat. The venison is, to my thinking, excellent; and the skins are prized by hill tribes, who make bags of them for carrying grain, for which they are well suited, being unusually thick and durable. The hair is very curious, rather resembling soft bristles, and I have heard the term "minga" (thorns) applied to it by natives when describing the animal.

4. Nanotragus tragulus (Licht.).

The Steinbuck, I believe, will prove to be common in Nyasa-land, at any rate in those parts where Duiker are found; but for myself I have only succeeded in obtaining one specimen, a female, which I killed on the Chitimba River, a little to the north of Chombi (Mt. Waller). This the Ahenga with me pronounced to be "Yisya" (which is the name by which they know the Duiker); but I had no difficulty in distinguishing it from that animal, inasmuch as the dark brown mark on the forehead and down the nose was wanting, as was also that on the legs, which were in this case of an almost uniform red with the body, while the white belly in this Antelope was very much more conspicuous than in the Duiker, there being no gradual blending of the white and reddish brown, such as I have usually noticed in the Duiker.

I may, however, be wrong in assuming this Antelope to have been a Steinbuck, since, at the time I examined the specimen, I had had very little previous knowledge of the Steinbuck; but, at any rate, I am fully persuaded the animal in question was *not* a Duiker.

5. Æpyceros melampus.

The "Impala" of the Angoni, "Nswala" of the Anyanja, Ajawa, and I believe of all the Nyasa tribes, is not common to all Nyasa-land, but where met with these Antelopes are as a rule found in even larger numbers than Water-buck, and I have seen them, I daresay, in herds numbering one hundred or more. On Nyasa itself, I only remember having come across them in three districts, all on the West Coast.

In 1885 I saw some very large herds on a clean sandy plain, covered with mimosas, half a day's march beyond Mbapi, to the north of Cape Maclear; here there appeared to be little other game

than Buffalo, and from the numbers of "Impala" skulls lying about, it looked as if Lions had made these animals their special prey.

In 1887 and 1888 I constantly saw "Impala" on the plains to the S.W. of Cape Maclear, notably round Lesumbwi (Monkey Bay), which is only about nine miles from it; here the country bordering on the Lake is very hilly and covered with rough boulders, but there are intervening plains overgrown with short grass and beautifully wooded with sweet-smelling umbrella-shaped mimosas, and these were always a sure find for "Impala."

In 1889 I came across a small herd of about seven on the Wovu River, about 20 miles inland from Vuwa, but they were very wild and quite unapproachable; here, again, they were in clean sandy country, wooded with short mimosas and dwarf borassus palms, and I fancy they are not found in any other. To the S.W. of Nyasa, I have found "Impala" in very great numbers, and in 1888 I ran down and caught a young buck about four days old, but he did not live more than a day.

No Antelope I have seen can compare with the "Impala" in fleetness of foot, and certainly no other can display such wonderful leaping power; they go off like the proverbial "arrow from the bow," and, with most beautiful gliding bounds, cover the ground without apparently the least effort. When alarmed they often give utterance to a sharp bark. Once or twice I have noticed that "Impala" become panic-stricken if persistently followed or run after in the open: I have had a herd stop, look at me, and then double back past me when they had plenty of open ground to their front. Natives seem to know this, and when occasion offers take advantage of it.

6. Tragelaphus sylvaticus.

Commonest of all the Nyasa Antelopes, whether gregarious or otherwise, and better known perhaps than any other to the natives is the Bush-buck, "Babala" of the Anyanja, "Mbawala" of the Ajawa, "Imbabala" of the Angoni, and "Mpatu" of the Ahenga and Anyika.

From the great variety that exists in the colour and markings of Nyasa Bush-bucks, I have thought there must be more than one species, but after carefully examining a great many of both sexes, both young and old, I have come to the conclusion that I have only met with *T. sylvaticus*.

I now exhibit several skins and pairs of horns of specimens from different localities of the west coast of Nyasa, and a brief description of them may not be without interest.

*Young males* are of a bright reddish brown, deepening in colour about the back, belly, and legs. They are marked plentifully with white spots on the flanks and haunches, and have also some five or more transverse white stripes on either side, emanating from the ridge of the back, along which extends a short white mane intermixed with black.

*Old males* vary very much indeed, but the majority are of a dull

reddish brown, in places verging on coal-black, plainly marked with about forty or more large and small white spots on the flanks and haunches. In some the white stripes may be said to be imperceptible, in others only just discernible, but in a few they are even more clearly defined than in the young males. The mane on the back is white.

*Young females* are of a very rich red, especially the very young fawns, very beautifully spotted and clearly marked with a number of transverse white stripes; along the back there is a narrow stripe of short dark brown hair, tipped with white.

*Adult and old females* are of a darker red, but are not nearly so plainly spotted and striped as the younger animals.

In both male and female there is a broad band round the neck, on which there is only some very fine mouse-coloured hair, the coarser and longer hair having been rubbed off, presumably by contact with overhanging branches; outside this band, again, there is a broad white stripe.

A good average length for the horns of the Bush-buck is between 10 and 11 inches; the longest pair I have seen measured 11¾ inches on the straight, and the bearer of these stood 30 inches at the shoulder, with a neck at the "collar" 20½ inches in girth.

Bush-bucks are found everywhere on Nyasa, on the plains and in the hills, and I think I may say I have seen or heard them almost wherever I have set foot on the shores of the Lake.

I have, however, seen more than anywhere else between Chombi and Nkanga, in a long dense belt of small bush and undergrowth extending for some miles along the margin of the Lake; here in former years there were villages and the land was cleared for cultivation, but these in course of time moved, and, as usual, a heavy crop of small bush and tangled undergrowth quickly came up. In places such as these Bush-bucks are sure to lie, and indeed anywhere in thick clumps of bush, especially those surrounded by open grass-land.

It is curious how close to the haunts of men these animals will occasionally take up their quarters; if there is a thicket or a clump of grass or reeds at all undisturbed close to a village, one may be tolerably certain it harbours one or more Bush-bucks. But perhaps the best "find" of all for them is a native burial-place, and one that has been a burial-place for some generations; here the undergrowth and trees are let run riot, and except when a funeral takes place or an offering is made, no one dares go there for fear of the "masoka" (spirits-of-the-departed) and other "mizimu" (spirits), which are supposed to haunt it. From thus constantly frequenting burial-grounds, there is a superstition amongst Nyasa natives that Bush-bucks are evil spirits; they are said to have a habit of lying on graves, and are also credited with licking the pole on which the corpse has been carried to burial. Natives who believe this will not eat the meat of the animal; some even go so far as to refuse to touch it, and I have occasionally had difficulty in finding men to tan the skin!

It appears to me that the Bush-buck is monogamous; at least, I have never come across more than a pair together, male and female, unless there happens to be a fawn; but in places they are so numerous, and the families so closely located to one another, that it is not possible to say positively whether such is the case. Each family, at any rate, is strictly local, as may be ascertained by cautiously reconnoitring the domain of each for two or three days consecutively, when the same animals will almost certainly be seen or heard in the usual place. An extra big buck, conspicuous for his long horns or dark coat, will now and then serve to identify any particular family. Quicker of hearing than perhaps any other Antelope, at any rate those of the plains, it is almost impossible to approach Bush-bucks in thick covert in the mornings and evenings when they are on the move—the crackling of a dry leaf, the snapping of a twig, or the catching of a thorn or branch in one's person or clothing being quite sufficient to attract their attention. But if the wind is fair, it is not difficult to obtain a shot by posting one's self and lying in ambush before they start feeding or go to drink. In the heat of the day, when asleep in the shade of thick bush, they will occasionally lie close and allow a hasty shot, after being roused, before turning and bounding off; but it is a hasty shot, and one that can seldom be taken advantage of, especially in thick covert. When alarmed and looking at an object of suspicion, Bush-bucks as a rule stand broadside on, instead of facing round as do almost all their kind; and as often as not they contrive to have their bodies shielded by a bush or tree-trunk. For this reason they are difficult to see, and perhaps the first warning one has of the presence of these animals is a loud, hoarse, startling bark "Baugh!" often repeated in quick succession, as a dark red form dashes away from within, maybe, as little as 20 or 30 paces of you.

In so small an animal as the Bush-buck this loud, far-sounding bark is very remarkable, and I have wondered for what special object nature can have intended it. Often, when passing near thick bush at sunset or a little later, I have noticed Bush-bucks barking in quick succession, but knowing I was not myself the cause of it, and that no other human beings were in the neighbourhood, I have only been able to attribute it to the presence of their natural enemies, Lions or Leopards. At Nkanga, in the belt of bush already mentioned, I especially noticed this barking, and there Leopards are unusually plentiful, since in the space of a few months, in broad daylight, I came across three, at different times, and was fortunate enough to kill one. Leopards, I take it, are the natural enemies of the Bush-buck, and one has only to watch these Antelopes in their native haunts to see that they are ever on their guard against some such stealthy foe, for their every movement suggests instinctive fear of surprise. Take the Bush-buck as he moves through thick bush: picking his steps gingerly among dead leaves or over fallen timber, and creeping when need be under overhanging branches, he steals through the thickest covert almost as noiselessly as a cat. Nor will he trust his hearing altogether when on the move, for every now and

young animals, as in the Koodoo and Bush-buck, the stripes, I take it, would be most conspicuous; but this is merely a conjecture on my part, as I have never seen a very young specimen. In the horns, I have not been able to note any specific difference, though it is remarkable that in some districts they are wider or narrower apart as the case may be, as with other Antelopes.

Elands as a rule go in large herds numbering 50 or more, but it is not unusual to meet solitary bulls, or even small troops of bulls, which latter are generally very fat. It is a remarkable fact that "Rhinoceros" birds almost always accompany Elands: I have not, however, once noticed them with other Antelopes, though natives tell me they sometimes go with the Wart-Hog. Elands no doubt are naturally shy and timid, but these birds make them still more difficult to approach, since, on the slightest appearance of danger, they fly up from the backs of the animals and screech out a terrible tell-tale concert; they are, however, also useful in enabling one to find Elands, especially in wooded country.

The favourite haunts of Elands seem to be undulating, well-timbered country, where the grass is not too long, and where there are intervening open plains; as a rule, they visit the plains at night or in the early mornings to drink, and then wander back long distances into the forest, where they spend the hot hours of the day. I have often found Elands five or six miles from water, notably in the Nkanga and Fulirwa countries. Eland, I have noticed, consort freely with Zebras, taking the same paths and mixing with them when feeding; they also have a habit of rolling in the curious basin-shaped earth-holes which Zebras make and use for the same purpose; this I especially remarked at Nkanga.

8. Strepsiceros kudu.

The Koodoo, "Ngoma" of the Anyanja, "Ndandala" of the Ajawa, "Nganchla" of the Angoni, and "Chipurupuru" of the Ahenga and Anyika (Apoka), is tolerably well distributed throughout all Nyasa-land; I have myself, however, seen comparatively few—fewer indeed, than any other well-known species except the Sable Antelope, though this may be readily attributed to the excessive shyness and retiring habits of these animals, as well as to the rough out-of-the-way hilly country where they are generally found.

In 1885 I repeatedly came across the Koodoo in the hills at the back of Amuwa, north-west of Cape Maclear; here I saw some really magnificent bulls with splendid heads, but could not take advantage of the chances they afforded me, as I was anxious not to disturb the Elephants in whose pursuit I was then engaged. In the same year in the neighbourhood of Mbapi, I noticed the skull and horns of a fine bull, presumably killed by Lions, and I subsequently obtained a remarkably fine pair of horns from a native of Mbapi, who had killed the bearer of them not far from the outskirts of the village.

On the Cape Maclear promontory I know there are Koodoos, having constantly noticed their spoor on the path to and from Lesumbwi; but the animals themselves are incredibly shy there,

and only come down to the plains from their mountain fastnesses at night, returning again at the break of day.

There are Koodoos, I am told, in the hills at the back of Karali and Bana, and I saw a fine pair of horns, of which the bearer was killed by Mr. Alfred Sharpe, between the former place and Mwazi's.

In 1889 I passed a lot of spoor in the neighbourhood of Taowira (Kapyira's) and Kaundi, at the foot of the range of mountains which run inland about north-west from Mount Waller (Chombi); and in Kapyira's village, on the Chimbwiriri River, I saw a Koodoo bull's skull.

In the hills about Mweniwanda's (Chirenji), I have been told there are a good many Koodoos, but I have not visited that district.

However, as I have said, Koodoos are common practically to all Nyasa-land, especially in the rugged wooded highlands away from the haunts of men; occasionally they are met with on the plains, but never far from hills, which they leave at night for the low country, returning again at daybreak.

Like Elands, they are fond of browsing on the young and tender shoots of trees and shrubs, especially in the dry season, when the grass has been burnt off and has not had time to grow. When alarmed, Koodoos sometimes give vent to a low bark—best imitated by anyone inflating the lungs with air and then expelling it open-mouthed; but this bark—if bark it can be called—is only audible at close quarters.

The horns of this animal are very generally seen in the possession of Nyasa natives, who use them for hubble-bubble pipes and also as war-horns; but they furthermore are made to do duty, like most other Antelope horns, as receptacles for native "medicine" and are hung suspended in the houses or outside under the eaves of the thatch, according as the contents are expected to act.

### 9. Hippotragus niger.

The Sable Antelope or Harris-buck, "Mpala-mpala" of the Anyanja, "Mbarapi" of the Ajawa, "Mpala-mpala" of the Achewa, Angoni, Ahenga, and Anyika, is not by any means evenly distributed, but in parts appears to be plentiful, especially in forest highlands, its favourite haunts.

I have myself only once seen these animals in Nyasa-land, and that was in 1885, in the Yao hills, between the south-east corner of the Lake and Shirwa; there were just a pair standing watching me from the crest of a hill. In the Chirenji country (Mweniwanda's), I hear, they are plentiful, and Mr. Alfred Sharpe showed me the horns of a bull killed by himself in that district. In the "Ma-suku" forests of the Apoka Mountains they are also said to exist, but I was never lucky enough to come across any.

Sable Antelopes must be very plentiful in parts—judging from the number of horns in the possession of the natives, especially Ajawa and Machinga, who use them as powder-horns, and I think they

must obtain them along the caravan-routes through the Yao country between the east coast of the lake and the sea.

10. Cephalophus ocularis (?).

A species of Duiker which, following Sir J. Kirk (P. Z. S. 1864, p. 656), I call by this name is very generally met with throughout Nyasa-land, except on bare open plains or in very steep rocky country, and appears to be known as "Insa" of the Anyanja, "Gwapi" of the Ajawa, "Nyiska" of the Atonga, and "Yisya" of the Abenga and Anyika. As regards these native names, however, I may be open to correction, as nearly all the natives of the Lake with whom I have come in contact appear not to distinguish between the Duiker and another little Antelope (which I take to be the Steinbuck), but call both by the same name, so that I have never been able to determine which of these animals is actually entitled to any or all of the above names, though I have adopted what seems to be the opinion of the majority.

As I have said, Duikers are common practically to all Nyasa-land, and I have come across them almost everywhere; I can, however, note a few districts where they have appeared most numerous.

On the west coast of the Lake, between Mponda's and Cape Maclear, especially in the neighbourhood of Chuaro's, I came across a good many in 1888, and to the north of Cape Maclear I saw a few at the foot of the hills about Amuwa and between there and Mpemba's. At Bandawe, in the direction of Chintechi, in the low thickly wooded hills, between which are patches of long grass and reeds, I have occasionally met with them, and again to the north of that, between Chombi and Karonga's, in a broad belt of low scrubby bush bordering on the Lake. At Nkanga, in 1889, I caught a young male fawn, which lived over a month, and then came to an untimely death through accident.

Nyasa Duikers, I have noticed, vary very much in colour, ranging from a reddish brown, not unfrequently tinged with green, to almost a dark red, while in some the belly is more conspicuous for its whiteness than in others; in size, too, they are inferior to the Duikers of Natal and parts of the Transvaal, and I have never once come across a specimen of the decided grey which the Duikers of the south generally assume.

11. Cephalophus maxwelli (?).

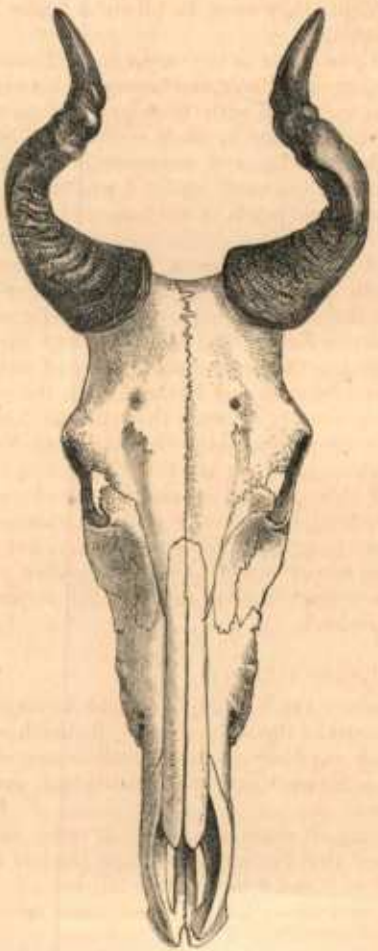
This little Antelope, or at any rate a species of Blue-buck very closely resembling it, appears to be common in parts of the Nyasa country, especially in the densely wooded slopes of mountains; and though I cannot claim to have come across any in life, I have yet seen a good number of their skins—notably among the Anyika of Chombi and the adjoining mountains, where they are said to be plentiful. On the thickly wooded mountainous slopes between Bandawe and Syiska they are also said to exist, and again in some of the hills about Cape Maclear; but everywhere natives speak of them

as being shy and very difficult to bring to bag in the thick covert where they are generally found.

I cannot just now recollect the Ahenga or Anyika names, and I never had an opportunity of finding out what the Anyanja and Ajawa call them; but a Chikunda from the Kwa-kwa, who happened to be with me when two skins of these animals were brought in from Chombi, at once recognized them as those of the "Lumza" or "Lumsa" of the Achikunda about Kilimane.

12. ALCELAPHUS LICHTENSTEINI.

Lichtenstein's Hartebeeste, "Ngondo" of the Anyanja and Ajawa,



Front view of skull of *Alcelaphus lichtensteini*, ♂ jr.

"Nkozi" of the Ahenga and Anyika, "Kangosa" of the Awanyakyusa, is very generally met with in the hills, if not too steep and rocky, and in the plains; but appears to prefer a flat or undulating country, well wooded and with intervening open glades.

In 1883 I first met with this Antelope on the plains between the Kiwira and Insesi Rivers, in Makyusa's country, at the north-west of the Lake; there were just three in the troop, and with the help of another gentleman I was lucky enough to kill one—a nearly full-grown bull, which was subsequently identified by Mr. Pulley, one of our party, as Lichtenstein's Hartebeeste, and of which I now exhibit the skull (Fig., p. 662). In 1885 I saw several herds of these animals to the south-east of Nyasa, and between it and Lake Shirwa, and from all accounts they must be plentiful in the Yao country, to the east of the Lake.

On the West Coast, later in the same year, I came across a good many on the Kanjamwana River, and between Amuwa and Mpemba's: here they usually consorted with Impalas; but on the same plains there were also to be seen in their company, from time to time, Water-bucks, Reed-bucks, and occasionally Koodoos or Elands. Inland from Bana to the north again, I was told there were Hartebeestes, and I saw some heads of animals said to have been killed there.

In 1889–90 I repeatedly saw a few in the low red-sandstone hills to the north of Chombi, between Makwawa's and Afunanchenga's, on the Hara River; here they generally went in company with Water-bucks or Zebras, and once I noticed three Hartebeestes herding and feeding in the midst of some thirty or forty Water-bucks, all cows. Between Nkanga and Karonga's, on the coast-line, and in all the intervening country between that and the Anyika Mountains, Hartebeestes are commonly met with, notably at Vuwa, Mrali, and Taowira. At Nkanga, during my stay there, a cow was killed in a game pit, and of this animal I secured the horns and frontal bone. As a rule, I have seen Hartebeestes in herds numbering from half a dozen or even less to perhaps fifteen or twenty, but I never remember having come across more than that number. This Antelope possesses extraordinary vitality, and in this respect is very little behind the Water-buck.

13. Connochætes taurina.

This Wildebeeste—the "Nyumbu" of the Anyanja and Ajawa, but apparently unknown to the natives round the northern half of Nyasa—is not met with anywhere in the immediate neighbourhood of the Lake, though it is found a little to the south-east, and also, I believe, to the south-west.

I have never myself come across any of these animals, though I have often noticed that the natives of Cape Maclear and other places north and south of it make use of their tail-hairs for stringing beads on their combs, and these, I fancy, must come from the country to the westward.

## 2. On the Presence of Pterygoid Teeth in a Tailless Batrachian (*Pelobates cultripes*), with Remarks on the Localization of Teeth on the Palate in Batrachians and Reptiles. By G. A. Boulenger.

[Received November 1, 1890.]

On recently examining some disarticulated bones of Batrachians, which I prepared in 1877, and which I had not looked at since, I was very much surprised to find a few small teeth on the left pterygoid bone (the right one had been lost) and on the parasphenoid in a skull of *Pelobates cultripes*. My attention once drawn to this point, which is of considerable importance from the fact that pterygoid teeth have not yet been recorded in any living Batrachian, I examined the various skulls of *Pelobates* in the British Museum, and also removed the mucous membrane from the palate of several specimens in spirit, with the result that, although I have failed to detect any teeth on the pterygoids or parasphenoid of *Pelobates fuscus*, I have succeeded in finding pterygoid teeth in two other specimens of *P. cultripes*, one from Nantes, the other from the south of France. I will designate the former specimen as *a*, the latter as *b*, and the imperfect skull (from Bordeaux), mentioned above, as *c*.

In all three these teeth are small, grain-like, resembling the same in various Stegocephala; the mucous membrane of the palate has to be removed to ascertain their presence; they are evidently in a rudimentary condition.

In specimen *a* there are about ten teeth on the parasphenoid, at the base of the longitudinal branch of the ⊥-shaped bone, and two pterygoid teeth close together on the left side. Specimen *b* has no teeth on the parasphenoid nor on the left pterygoid, but shows a group of eight distinct teeth on the right pterygoid. In specimen *c*, as in *a*, there are about ten teeth on the parasphenoid, and a series of four on the left pterygoid (the right being lost).

Our knowledge of the localization of the teeth on the various bones of the palate in Batrachians and Reptiles has so much increased of late[1] that it appears to me useful, on this occasion, to review and tabulate the data available at present in recent and fossil forms.

Whilst in not a few fishes all the bones of the palate are toothed, it is only among the lowly Stegocephala that we meet, higher up in the scale, with such a disposition. As evolution proceeds in both the Batrachian and Reptilian phylæ, we find the palatal dentition more and more localized and reduced. Thus, in the Urodeles or tailed Batrachians, we have frequent examples of a toothed parasphenoid, no form, however, showing teeth on the pterygoids, but all agreeing in having them on the vomers and palatines[2]. In the

[1] A table, very incomplete even at the time it was published, of the dentition of recent Batrachians is given by O. Hertwig in his admirable memoir "Ueber das Zahnsystem der Amphibien," Arch. mikr. Anat. xi. Suppl. (1874).

[2] In the *Proteidæ* the palatines are not yet separated from the pterygoids in most Urodeles they are fused with the vomers.

tailless Batrachians most forms are provided with teeth on the vomers, whilst but a few have any upon either the palatines or the parasphenoid. Among Reptiles, a distribution of the teeth on as many as three elements (pterygoids, palatines, vomers) is only known in two forms—a Rhynchocephalian and Lacertilian. It is a fact that the Batrachians generally agree with the Fishes in the sequence in which the teeth of the palate are usually lost, viz., in the following order:—(1) Pterygoid, (2) Parasphenoid, (3) Palatine, (4) Vomer; whilst in the Reptilia we find great

| Teeth on | Stegocephala. | Batrachia. | Reptilia. |
|---|---|---|---|
| Vomers, Palatines, Pterygoids, Parasphenoid. | *Dawsonia.*<br>*Secleya.*<br>*Acanthostoma.* | ..... .. | ..... |
| Vomers, Palatines, Pterygoids. | ..... | ..... | *Champsosaurus.*<br>*Ophisaurus.* * |
| Vomers, Palatines, Parasphenoid. | ..... | Caudata (*Plethodontinæ*, *Desmognathinæ*). | ..... |
| Vomers, Pterygoids, Parasphenoid. | ..... | *Pelobates.* * | ..... |
| Vomers, Palatines. | *Sparodus.*<br>*Hylerpeton.*<br>*Mastodonsaurus.*<br>*Capitosaurus.*<br>*Labyrinthodon.* | Caudata generally.<br>Apoda.<br>*Ceratohyla.*<br>*Hemiphractus.* | *Sphenodon.* *<br>*Hyperodapedon.*<br>*Palæohatteria.*<br>*Proterosaurus.* |
| Vomers, Pterygoids. | ..... | ..... | *Procolophon.* |
| Vomers, Parasphenoid. | ..... | *Triprion.* | ..... |
| Palatines, Pterygoids. | ..... | ..... | Placodontia.<br>*Chamæleolis.*<br>*Heloderma.* *<br>Ophidia generally. |
| Palatines, Parasphenoid. | ..... | *Amphodus.* | ..... |
| Vomers..... | *Branchiosaurus.*<br>*Nyrania.* | Ecaudata generally. | ..... |
| Palatines ..... | ..... | *Callula.* *<br>*Genyophryne.*<br>*Dyscophidæ.* | *Oligodon.* *<br>*Dasypeltis.*<br>*Atractaspis.* |
| Pterygoids ..... | ..... | ..... | Lacertilia generally.<br>Mosasauria. |

diversity. The Rhynchocephalians appear to lose the pterygoid teeth first, the vomerine next. In the Squamata, the predominating Reptilian type at the present period, vomerine teeth are known in but a single genus (*Ophisaurus*) of the family *Anguidæ*, which has in addition palatine and pterygoid teeth; and in these Squamata we see that the rule in the suborder Lacertilia is to lose the teeth from front to back, and in the suborder Ophidia from back to front. Thus, there are but two genera of Lizards with palatine teeth, and they are also armed with teeth on the pterygoids; and the few genera of Snakes in which the teeth are restricted to one of the two bones have them invariably on the palatines.

I have attempted to record in the table (see p. 665) what is at present known of the distribution of the teeth on the palates of the Reptiles and Batrachians. An asterisk after a generic name indicates that the character is not constant throughout the genus.

## 3. On the Fijian Species of the Genus *Merula*.

By Henry Seebohm.

[Received November 29, 1890.]

The four largest islands of the Fiji group each contain a species of *Merula*, which appears to be distinct from those found on the other three. Of these four species three are well known, but the fourth appears to be undescribed. The distribution of the four species is as follows:—

*Merula vanuensis*. Vanua-Levu.
*Merula layardi*. Viti-Levu.
*Merula ruficeps*. Kandavu.
*Merula tempesti*. Taviuni.

These four species differ from each other in many characters, of which the following are the most useful for diagnostic purposes:—(*a*) In some species the under tail-coverts are uniform in colour, in others each under tail-covert has a conspicuous pale shaft-streak, widest at the tip. (*b*) The upper parts below the nape are nearly black in some species, and olive or brown in others. (*c*) The throat in one species is orange-buff, and in the others grey. These three characters serve to diagnose the four species as follows:—

Under tail-coverts uniform.
- *vanuensis*. — Throat grey.
- *layardi*. — Throat grey.
- *tempesti*. — Back nearly black.
- *ruficeps*. — Back nearly black.

The male differs somewhat from the female in all the species, but the characters given above are common to both sexes.

MERULA VANUENSIS, nom. nov.

*Merula vanicorensis* (Quoy et Gaimard), *apud* Layard, Ibis, 1876, p. 151.

*Merula vitiensis*, Layard, Ann. Mag. Nat. Hist. 4th ser. xvii. p. 305 (1876).

The Vanua-Levu Ouzel was discovered by Mr. Tempest at Kandi, a small village 600 feet above the level of the sea, near Bua in Sandalwood Bay, on the west coast of Vanua-Levu. It was recorded as *Merula vanicorensis* under the erroneous impression that it was identical with the species said to have been obtained on the island of Vanikoro (Quoy et Gaimard, Voyage de l'Astrolabe, 1826–1829, Zool. i. p. 188).

Shortly afterwards Mr. Layard discovered his error and described the species as new, but unfortunately adopted a name which must be abandoned as misleading. When Mr. Layard described the species it was the only *Merula* known from the Fiji Islands, and the name *vitiensis* was applied in a collective sense as denoting an inhabitant of the Fiji Islands. When it was found that two of the Fiji Islands were inhabited by other species the name became somewhat objectionable, but now that we discover that Viti-Levu is inhabited by a fourth species, which everybody has taken for granted to be *Merula vitiensis*, it is obvious that this name must be no longer used for the Vanua-Levu species, and I have accordingly proposed *Merula vanuensis* as a substitute.

There are two examples (male and female) in the Layard Collection, which are the types both of *Merula vitiensis* and of *Merula vanuensis*. The British Museum does not possess a specimen of this species, but there is a female in the Tristram Collection.

The Vanua-Levu Ouzel differs from its ally on Viti-Levu in the following particulars:—(*a*) The under tail-coverts of both sexes are uniform dark grey without pale shaft-streaks or pale tips. (*b*) The general colour of the upper parts of both sexes is darker and browner, much less olive. (*c*) It is a rather smaller bird, wing 4·2 to 4·4 inches instead of 4·3 to 4·5 inches. (*d*) The lower breast and flanks of the male and the lower breast of the female are of a duller chestnut colour, whilst the flanks of the female are brownish grey instead of dull orange-chestnut.

MERULA LAYARDI, sp. nov.

*Merula vitiensis*, Layard, *apud* Seebohm, Cat. Birds Brit. Mus. v. p. 278 (1881).

The Viti-Levu Ouzel was probably discovered by Mr. Kleinschmidt in the interior of Viti-Levu, whence examples were sent to the Godeffroy Museum in Hamburg, but for want of an opportunity of comparing them with examples from Vanua-Levu they have been hitherto confounded with the allied species. I have two examples in my collection, and there are two examples in the Tristram Collection; but I prefer to make the two examples (male and female) in the British Museum the types of my *Merula layardi*. It is much

to be regretted that so absolutely appropriate a name as *Merula vitiensis* cannot be applied to the Viti-Levu species, but as it has been previously applied to the Vanua-Levu species it cannot be used for any other.

The differences between the two species have been already pointed out.

There is less difference between the sexes in the Viti-Levu Ouzel than there is in the Vanua-Levu species; but in the male the tail is longer than it is in the female (3·1 inches instead of 2·8 inches), the chestnut on the breast and flanks is paler and duller in the female than in the male; the colour of the upper tail-coverts and tail of the male is darker and more rufous (less olive) than in the female; and the grey on the upper breast is more sharply divided from the chestnut of the lower breast in the male than it is in the female.

MERULA TEMPESTI.

*Turdus tempesti*, Layard, Proc. Zool. Soc. 1876, p. 420.

The Taviuni Ouzel was discovered by Mr. Tempest on the island of Taviuni, and the type is in the Layard Collection.

It is most nearly allied to *Merula poliocephala* from Norfolk Island (more than a thousand miles from Taviuni), so nearly indeed that it requires a very accurate knowledge of the species to discriminate between them. So far as is known, *Merula tempesti* always has uniform dark brown or black under tail-coverts, but this seems also to be the case with adult males and very old females of its Norfolk-Island ally. In both species males have the grey of the throat and upper breast sharply divided from the black of the lower breast and belly, whilst in the females the two colours gradually blend into each other. In both sexes the Taviuni species has a much darker head than the same sex of its Norfolk-Island ally. The crown of *Merula tempesti* male, and that of *Merula poliocephala* female, may be described as greyish brown, several shades darker and browner than the brownish grey of *Merula poliocephala* male; whilst the crown of *Merula tempesti* female is brownish black, almost as dark as the back.

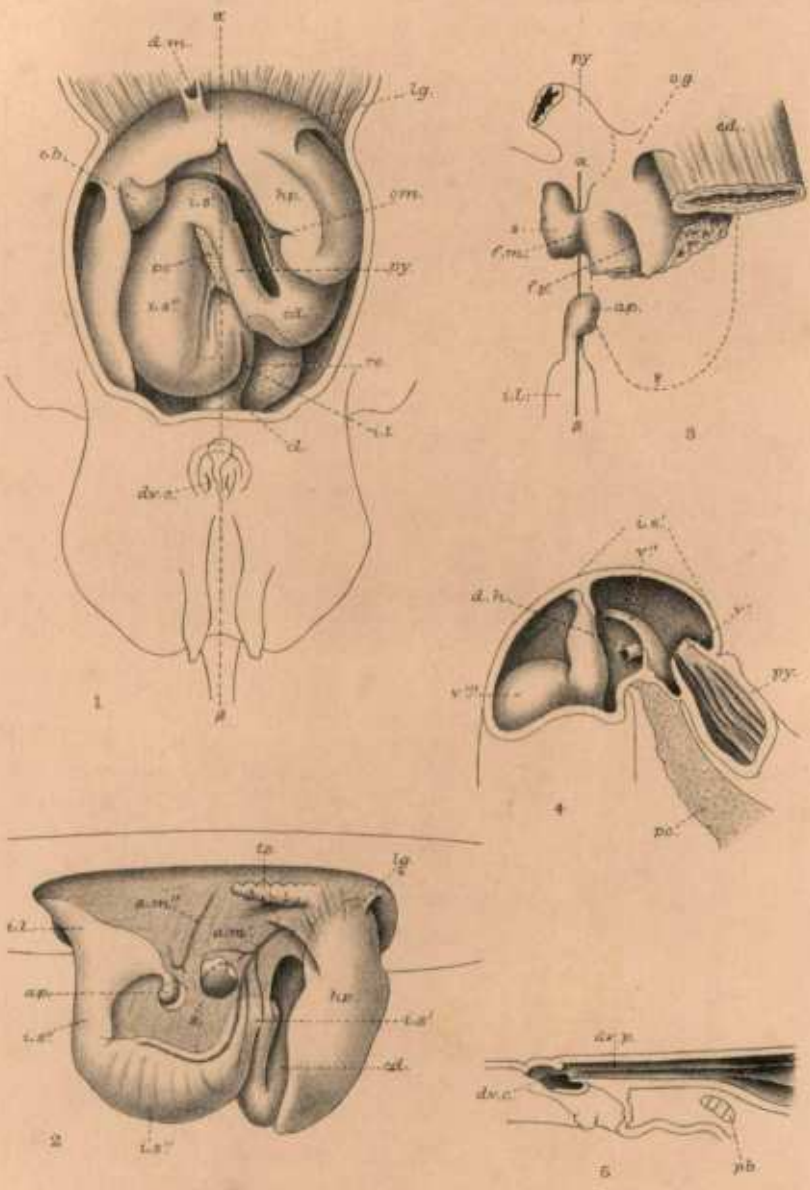
MERULA RUFICEPS.

*Merula ruficeps*, Ramsay, Proc. Linn. Soc. New South Wales, i. p. 43 (read 29th November, 1875).

*Merula bicolor*, Layard, Ibis, 1876, p. 153.

The Kandavu Ouzel was discovered on the island of Kandavu by Mr. Pearce, who seems to have sent skins to Mr. Ramsay and to Mr. Layard, so that the species was almost simultaneously described by each of these ornithologists.

It is a very handsome species, and appears to be nearest allied to *Merula pritzbueri* from the Loyalty Islands and the New Hebrides, and more distantly to *Merula tempesti* from Taviuni. It differs from these two species in having the entire head and neck of a rich (almost orange) buff.




G.B.H. ad nat. M.P.P. lith.

West, Newman & imp.

Visceral Anatomy of Hypnos subnigrum.

# 4. On the Visceral Anatomy of the Australian Torpedo (*Hypnos subnigrum*), with especial reference to the Suspension of the Vertebrate Alimentary Canal.

By G. B. Howes, F.Z.S., F.L.S., Assist. Professor of Zoology, R. College of Science, S. Kensington.

(From the Huxley Research Laboratory.)

[Received December 2, 1890.]

(Plate LVII.)

The Australian Torpedo, *Hypnos subnigrum*, was first described by A. Duméril [1] from two specimens, deposited in the Paris Museum by Mons. J. Verreaux. Its skeleton has been dealt with by Haswell [2], and has been shown to be in some respects exceptional and peculiar, while its electrical organs have recently been written about by G. Fritsch, in the second volume of his 'Die elektrischen Fische' [3]. During the Fisheries Exhibition held at South Kensington in 1883, Mr. Ramsay, Curator of the Sydney Museum, brought some specimens of this fish to Europe; three of them are now in the Museum of Natural History, two (a ♂ and a ♀) in my teaching collection at South Kensington. For the gift of these animals, zoologists at home owe Mr. Ramsay and the authorities of his Museum a debt of gratitude.

On laying open the post-pericardiac body-cavity of this fish, the alimentary tract is seen to be disposed in the manner of an inverted S, as is the case in all the Ichthyopsida and the lower Amniota. That is to say—a line ($\alpha$, $\beta$ of Plate LVII. fig. 1) drawn parallel with the long axis of the body would bisect the œsophagus and cloaca, together with a more or less considerable portion of the large intestine, and leave the stomach (*cd.*, *py.*) to the left and the small intestine (*i.s.*) to the right of the animal.

The liver (*hp.*), which is two-lobed [4], lies, as usual, ventrad of the stomach on the left side, and to the right and dorsad of the small (valved) intestine (*i.s.*') on the opposite one. Its gall-cyst (*c.b.*, so called gall-bladder) is exceptionally spacious and lies disposed in a notch of the right lobe. This right liver-lobe is much the larger of the two, and it extends inwards in this fish to an unusual degree, reaching almost to the middle line and forming (as seen from beneath) a kind of bed upon which the valved intestine lies. The latter, which, unlike that of most *Chondrichthyes*, bears no well-marked external furrows denoting the course of its contained valve, has the customary proportions and relationships, but that its duodenal segment (or Bursa Entiana, *i.s.*') is more tubular than is usually the case, *Læmargus* excepted [5], and is marked off from the stomach

[1] Rev. et Mag. de Zoologie, 1852, no. 5, p. 277.
[2] Proc. Linn. Soc. N. S. W. vol. ix. part 1.
[3] Leipzig, 1890.
[4] As in *Trygon*, *Urolophus*, and *Myliobatis*, Haswell, Proc. Linn. Soc. N.S.W. vol. iii. (ser. 2), p. 1716.
[5] *Cf.* Turner, Journ. Anat. & Phys. vol. vii. p. 233 (1873).

by a deep constriction (Plate LVII. figs. 1 & 4) which coincides with the point of origin of a very efficient pyloric valve (*v'*, fig. 4).

I have elsewhere shown[1] that in the Thornback (*Raia clavata*) the left kidney may be restricted to the posterior third of the body-cavity, and that the conditions of its displacement show the same to have resulted either from atrophy or concentration in accommodation to the enlarged stomach and spleen. That which may be thus true of the individual Thornback is true of certain other species of the genus *Raia*, and of the fish now under consideration; so completely so in the latter that the entire kidney may be seen from beneath (*re*, fig. 1) while the stomach is still in its natural position.

Between the liver and stomach of this fish there passes a well-defined lesser omentum (*om.*, fig. 1); the suspensory ligament of the liver (*lg.*) is very extensive and asymmetrical, passing on the left side to the dorso-lateral wall of the cardiac gastric sac (*cd.*), and on the right to the adjacent body-wall and head of the testis (*ts.* of fig. 2). Buried up in this ligament there lies the customary vestige of the coalesced ostia of the Müllerian ducts (*d.m.*, fig. 1), and that here assumes the form of a short but spacious tube, disposed obliquely on the right side, and closely bound down to the ventral body-wall. There is no trace of median ventral mesentery.

The pyloric chamber of the stomach of this fish is long and tubular (*py.*, figs. 1 & 4), and, as already stated, marked off from the head of the small intestine by a deep constriction. That portion of it which lies to the right of the axial line is skirted posteriorly by a pancreas, which, contrary to the general rule among these fishes, is lozenge-shaped (*pc.*, fig. 4). The Bursa Entiana (*i.s.'*) is remarkable for its subdivision internally into two chambers, the posterior of which receives the bile-duct (*d.h.*)[2]; this subdivision is effected by a crescentic infolding of the postero-lateral wall to form a well-defined *intra-duodenal valve* (*v.''*). That which is most noteworthy in the general disposition of the viscera of this fish is the non-appearance of the processus digitiformis and spleen, when the parts are viewed from the ventral aspect. The appendix digitiformis of all other Elasmobranchs lies conspicuously disposed at or towards the left side of the valved intestine[3]. The spleen of the Plagiostome fishes is very variable in its extent and relationships; it lies either (most Batoids) in the bay formed by the cardiac and pyloric gastric sacs, or in a more or less close relationship to the base of the entire stomach. The relations of these organs are, in *Hypnos*, remarkable and exceptional, as the sequel will show.

The alimentary viscera of the *Plagiostomi* are well known to be suspended by two folds of mesentery—an anterior one, which is continuous in front with the suspensory ligament of the liver; and a posterior one, which serves to attach the processus digitiformis

[1] Journ. Anat. & Phys. vol. xxiv. (N. S. vol. iv.) p. 407 (1890).

[2] The bursa was injured at the point of termination of the pancreas anteriorly, wherefore it was not possible to determine the course of the pancreatic duct.

[3] *Cf.* Blanchard, Mittheilung. a. d. Embryol. Instit. Wien, Heft iii. p. 190 (1878–79).

(*ap.* of figs. 2 & 3) and that portion of the gut which lies behind it, as also to carry the post-superior (so-called inferior) mesenteric artery (*a.m.''*, fig. 2). These folds have been termed "mesogaster" and "mesorectum"[1]. The first named extends backwards to the posterior limit of the so-called superior mesenteric artery (*a.m.'*); it ensheaths this vessel and its cœliac ally, and, while frequently continuous as a simple sheet, it is more generally fenestrated and broken up[2]. Inasmuch, however, as it suspends the duodenal segment of the gut together with the stomach and pancreas, the term mesogaster would be well withdrawn. I have elsewhere attempted to show[3] that that portion of the Plagiostome's gut which is suspended by mesentery posteriorly, represents the entire large intestine of the higher Vertebrata; whether I am right or not, the term "mesorectum" might be preferably restricted to that mesentery of those higher Vertebrata possessed of a recognizable rectum, and withdrawn here in preference to a more general one. I would propose to substitute for "mesogaster" the term *ante-mesorœum*, and for "mesorectum" that of *post-mesorœum*.

The foregoing description applies to both the Plagiostomes and Chimæroids, allowance being made for the absence of the processus digitiformis in the latter; in them, and in some Selachii, the fenestration of the ante-mesorœum is so complete that the superior mesenteric arteries, be there one or more present, are set free within the folds of cord-like sheaths, and the assumption of this condition is associated with the origin of the arteries named at a point remote from the cœliac axis.

From the known facts of development of the dorsal mesentery, the fenestrated condition of the same may, with tolerable certainty, be regarded as due to absorption; and the description of it as "interrupted by one or more large fenestræ"[4] is as satisfactory as could be wished. In *Hypnos* the conditions are otherwise, for this fish is, among the *Chondrichthyes*, the sole known possessor of a continuous mesentery. The fact that in it the spleen and processus digitiformis are not seen on opening the body-cavity from the ventral aspect, has been already alluded to. It is due to these organs being hidden beneath the continuous mesentery named. More than this however! for, on turning the alimentary viscera to the left side as indicated in fig. 2, the mesentery in question is seen to be perforated by two large round holes. The anterior of these lies immediately behind the anterior (superior) mesenteric artery (*a.m.'*), in juxtaposition to the head of the small intestine, and gives passage to the spleen (*s.*); the posterior occurs lineally below the posterior (inferior) mesenteric artery (*a.m.''*), and similarly gives passage to the appendix digitiformis (*ap.*). There here arises the question whether the spleen and digitiform process, which alike perforate the mesentery,

[1] Parker, T. J., 'Zootomy,' p. 47. The descriptions of Haswell for *Trygon* and *Urolophus* (Proc. Linn. Soc. N. S. W. vol. iii. (ser. 2) p. 1716) are more nearly correct.

[2] *Cf.* Stannius, 'Handbuch d. Anat. d. Wirbelth.' p. 193.

[3] Journ. Linn. Soc., Zool. vol. xxiii. pp. 393 *et seqq.* (1890).

[4] Marshall & Hurt, Junior Course in Practical Zoology, ed. 2, 1888, p. 218.

may have actually caused the absorption of its substance; or whether the latter may have not been induced by other means, the glands named having merely accommodated themselves to the exigencies of the case. The spleen had been unfortunately removed, to a large extent, in my specimen before it reached my hands (*cf.* Plate LVII. fig. 3, *s.*); sufficient, however, remains to show the presence of a couple of well-marked furrows. One of these (*f.p.*) indicates the point of apposition with the head of the pyloric gastric sac (*py.*); the other (*f.m.*) that of strangulation or embrace by the mesentery. That portion of the spleen which lay to the right of the latter (= that marked *s.* in figs. 2 & 3) had grown out into a veritable hernia. In view of the very variable extent to which this organ may force its way between the folds of the mesentery among *Plagiostomi* in general, I am inclined to adopt the second of the two alternatives postulated above, and to regard the absorption as perhaps not primarily due to this hernia-like extension of the glandular structures named.

The spleen of the *Batoidei* is remarkable among that of all vertebrates for its enormous development. It lies in the bay formed between the cardiac and pyloric sacs of the stomach, and projects freely to the right side. It either extends under cover of the stomach and intestine, giving rise to a solid mass which lies immediately beneath the backbone, and not unfrequently fills the interspace between the genital glands; or it embraces the left side of the valved segment of the gut (ex. *Rhinobatus* and *Trygonorhina*), in a manner somewhat resembling that in which the embryonic supra-renal body of mammals "caps" its corresponding kidney. It will be observed that in *Hypnos* the spleen (*s.*, fig. 2) passes behind the main trunk of the (anterior) superior mesenteric artery (*a.m.'*). In many Plagiostomes, it shows a marked tendency to extend either in front of the same or between its branches; consequently, while the facts seen in the absorption of the mesentery of *Hypnos* beyond doubt furnish the clue to the rationale of this process as it applies to the living *Chondrichthyes* generally, they would appear to denote the initial phase in one of a possible series of variations in the same.

The absorption of the mesentery is a phenomenon which has long been recognized among other vertebrated animals, and consideration of the facts concerning it yields an interesting result. Rathke has long ago described it[1] in the Turbot and Gar-Pike, Owen in the Pipe-fish[2], while both these observers have recorded it for the Cyprinidæ.

While in the Myxinoids the mesentery is continuous, in the Petromyzontidæ it is absorbed to the maximum degree—persisting, as is well known, at the extreme anterior and posterior ends of that portion of the gut which lies within the post-pericardiac cœlom,

[1] 'Ueb. den Damkanalen und Zeugungsorgane d. Fische.' Halle, 1824, pp. 104–105.

[2] Comp. Anat. & Phys. vol. i. p. 424.
*Cf.* also Cuvier and Valenciennes, Hist. Nat. des Poissons, vol. i. p. 507.

as a series of insignificant investments for the blood-vessels of the former[1].

On turning to the *Amphibia*, we find that in the Anura the mesentery is, like that of the Amniota, continuous, except for an occasional feeble splitting and overgrowth in relation to the gathering up of the blood-vessels within the folds of the gastro-duodenal omentum (ex. *Ceratophrys*). In the Urodeles, however, the mesentery is either continuous and unabsorbed (*Ichthyophis*, *Siphonops*, *Siren*, *Proteus*, *Amphiuma*, *Menopoma*), or widely interrupted (*Salamandra*[2], *Siredon*, *Menobranchus*), in a manner such as is never realized in any known Anuran.

The presence of a continuous mesentery can only mark the retention of a lowly character; wherefore it follows that the Batoid *Hypnos subnigrum*, although admittedly one of the most specialized living members of the order *Plagiostomi*, retains at least one character more lowly than that of all its allies. It is interesting to note the parallelism to this which is seen in the other orders of Vertebrata cited, the dorsal mesentery being complete in the specialized Hags among Marsipobranchs, and in the Gymnophiona and Anura among Amphibians.

Finally, as to the rationale of the process of absorption of the mesentery among the Ichthyopsida in general. The Dipnoi and Amphibia are well known to possess a median ventral mesentery, which, in the last-named order, lodges the median epigastric (anterior abdominal) vein. This mesentery, like its fellow on the dorsal side of the gut, is well known to be subject to absorption; and if a Frog and a Salamander be compared, it will be readily seen that in its most completely absorbed state it forms but a cover for the vein named. In the Amniota it becomes still more abbreviated, and finally persists in relation to the median epigastric vein (or its homologue the umbilical vein [afterwards the round ligament][3] of the liver) as the broad, or falciform ligament.

The relationships of the dorsal mesentery of the cartilaginous fishes to the dorsal intestinal vein[4] repeat those of the ventral mesentery of the Amphibia and Amniota to the median epigastric vein. Again: between the relationship of the first named to the intestinal arteries, in those Plagiostomes in which it is most completely absorbed and in the *Petromyzontidæ*, there is a striking

[1] I think it not unlikely that its disappearance in these fishes has to do with the immense development of the genital glands, they having apparently fused in the middle line.

[2] On examination of a numerous series of individuals I find this interruption to be variable, and at times uneffected.

[3] Beddard has briefly described (P. Z. S. 1884, p. 553) a median epigastric vein in the adult *Echidna*. It is most desirable that the relationships of this vessel should be more fully worked out.

I cannot reconcile with this the belief (Balfour, Comp. Embryology, vol. ii. p. 623) "that the falciform ligament is not a remnant of a primitive ventral mesentery." Beddard's discovery would appear to me fatal to this consideration, and it calls for a reinvestigation of the matter.

[4] *Cf.* T. J. Parker, Phil. Trans. vol. clxxvii. (pt. ii. 1886), p. 707.

similarity to that of the ventral mesentery of some Teleostei (ex. *Salmo*) to venous trunks which pass between the intestinal and ventral body walls[1]. On the whole, and on consideration of the facts referred to in dealing with the Anurous Amphibia, I am disposed to regard the disposition of the great vessels named as the primary agent in originating the absorption under consideration.

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The so-called abdominal pores of the cartilaginous fishes have been shown by Bridge[2] to arise in relation either to peritoneal pouches (*dv.p.*, fig. 5) resulting from outward extension of the peritoneum, or to cloacal pits (*dv.c.*) formed by inward extension of the ventral body-wall. In the specimen of *Hypnos* here figured, the two were in wide communication on the left side, sufficient to pass a crow-quill; on the right side the base of the peritoneal pouch (*cf.* fig.) was constricted, whereby it communicated with the cloacal pit by a minute aperture in its dorsal wall. This is of interest, as Bridge's researches have shown the parts in question to be variable specifically and individually to an unexpected degree.

## DESCRIPTION OF PLATE LVII.

Fig. 1. *Hypnos subnigrum*, ♂. General disposition of the viscera, as seen on reflecting the ventral post-pericardiac body-wall. *One third nat. size.*

2. *The same.* The alimentary viscera, dorsal mesentery, and testis, as seen from the right side. *One third nat. size.*

3. *The same.* The spleen and appendix digitiformis, represented in relation to the dorsal mesentery (indicated by a black line $\alpha, \beta$). *Two thirds nat. size.*

4. *The same.* The Bursa Entiana, together with the head of the small (valve-bearing) intestine and the pyloric chamber of the stomach; laid open from the left side, to show their contained valves. *Two thirds nat. size.*

5. *The same.* Peritoneal pouch and cloacal pit of the right side, lateral view from within. *Nat. size.*

*Reference letters.*

*a.m'*. Anterior superior mesenteric artery.
*a.m''*. Posterior superior mesenteric artery.
*ap.* Appendix digitiformis.
*cd.* Stomach (cardiac sac).
*c.b.* Gall-cyst.
*cl.* Cloaca.
*d.h.* Bile-duct.
*d.m.* Müllerian ducts (coalesced ostia of).
*dv.c.* Cloacal pit.
*dv.p.* Peritoneal pouch.
*f.m.* Mesenteric furrow.
*f.p.* Gastric furrow.
*hp.* Liver.

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[1] *Cf.* Stannius, *op. cit.* pp. 250, 251.
[2] Journ. Anat. & Phys. vol. xiv. p. 81 (1879).

*i.l.* Large intestine.
*i.s'.* Small intestine (Bursa Entiana or duodenal segment).
*i.s''.* Small intestine (ileal or valve-bearing segment).
*lg.* Suspensory ligament of liver.
*o.g.* Gastro-hepatic omentum.
*om.* Lesser omentum.
*pc.* Pancreas.
*py.* Stomach (pyloric sac).
*re.* Left kidney.
*s.* Spleen.
*ts.* Testis.
*v'.* Pyloric valve.
*v''.* Intra-duodenal valve.
*v'''.* Spiral valve.

## 5. Observations on the Pectoral Fin-Skeleton of the Living Batoid Fishes and of the Extinct Genus *Squaloraja*, with especial reference to the Affinities of the same. By G. B. Howes, F.Z.S., F.L.S., Assist. Professor of Zoology, R. College of Science, S. Kensington.

(From the Huxley Research Laboratory.)

[Received December 2, 1890.]

### I.—*The Pectoral Fin-Skeleton of the Trygonid* Pteroplatea hirundo.

The pectoral fin-skeleton of this fish is supported for the most part upon large pro- and meta-pterygia (*pp.*, *mt.*, figs. 1 & 2), and the first-named cartilage is in articulation with the shoulder-girdle and the mesopterygium, one or both, by means of well-defined synovial joints. Intercalated between the pro- and meta-pterygia (*pp.*,*mt.*) are two well-defined cartilages (*ms.*,*np.*), each resulting from the fusion of the bases of a number of parallel rays of the fin-axis. These cartilages are plate-like and expanded in the manner of the mesopterygium of the Selachoidei, and with that they might appear at first sight to be jointly homologous.

The mesopterygium of the Selachii is well known to be variable in its degree of extension outwards, in proportion to which it forms a more or less efficient support for the axis of the fin; great as is this variation, there is no known Selachoid fish in which the articular base of the mesopterygium is furnished by more than four rays. In *Pteroplatea* some 18–23 or more of the 21–26 rays which support the fin-axis are in direct apposition with the limb-girdle. The detailed characters and variations in fusion of these are sufficiently represented in the accompanying figures (figs. 1 & 2); but, concerning their fundamental relationships, there are one or two noteworthy features. In the younger of the two examples (fig. 1) the anterior of the two supposed mesopterygia (*ms.*) is in mere fibrous connection with the shoulder-girdle; and the propterygium (*pp.*), which bears postero-internally a facet for synovial articulation with the latter, furnishes a condyle for articulation

(also synovial) upon the excavated anterior border of the mesopterygium (*ms.*).

The posterior plate (*np.*) is, for the most part, in well-defined articulation, by means of an efficient synovial capsule, with the postero-lateral moiety ("glenoid commissure" of Parker[1]) of the

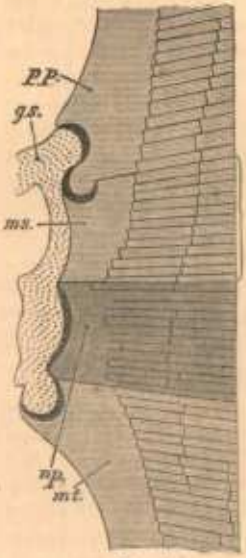


Fig. 1.

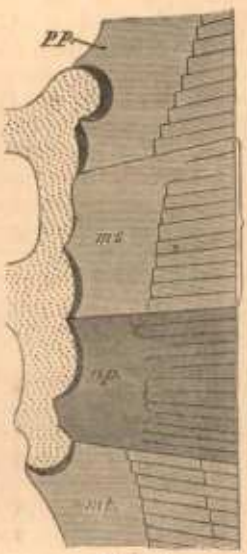


Fig. 2.

Fig. 3.

Fig. 1. Horizontal section[2] through the left pectoral fin of *Pteroplatea kirundo*, ♂.

Fig. 2. A similar section of the corresponding fin of a second specimen (also ♂), older than fig. 1.

Fig. 3. A similar section of the corresponding fin of a *Myliobatis aquila*.

All natural size.

*References.*—*g.s.*, shoulder-girdle; *ms.*, mesopterygium; *mt.*, metapterygium; *np.*, neopterygium; *pp.* propterygium.

The black areas denote synovial cavities.

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[1] Ray Soc. Monograph on Shoulder-girdle and Sternum, p. 8.

[2] I have found from experience that sections, such as those here figured, give more satisfactory results than do mere macerated preparations. In the latter, as in ordinary dissections, the presence of occasional superficial furrows, at the points of fusion of rays or segments or of the disposition of nerves, tendons, &c., and the appearances produced by the remains or cut edges of inter-muscular septa, are apt to be seriously misleading.

Haswell speaks (Proc. Linn. Soc. N. S. W. vol. ix. part. i. p. 35) of the propterygium of *Trygon pastinaca* as having in articulation with its distal extremity "a stout ray with which are connected a number of fin-rays." Gegenbaur makes no mention of this, and, as I have looked for it carefully, but in vain, in the five individuals of the species which I have dissected, I think it probable that Haswell may have been misled in the manner indicated, or that his "stout ray" was but a fusion of rays such as may occur at any point in any fin.

girdle, its two posterior rays being alone in fibrous connection therewith. In the older of the two specimens which I have examined, the two basal plates of the fin-axis bear (*ms.*, *np.*, fig. 2) essentially the same relationships to the girdle. The propterygium is in a merely fibrous connection with the anterior mesopterygial plate (*ms.*), and the synovial articulation between the two is here unrecognizable. The former (*pp.*) bears postero-internally a shallow facet for the reception of a corresponding condyle of the adjacent limb-girdle; the supposed mesopterygial plate (*ms.*), apparently the more free to move upon its base, takes on a synovial articulation with the limb-girdle, in common with its fellow (*np.*) of the same side. The differences between these two pairs of fins are not a little remarkable and unexpected, and that they are not sexual is clear from both specimens having been males (*cf.* Table on p. 685). I know of no parallel for them elsewhere; and that, as effecting the pro- and meso-pterygia, they are a corollary of each other, it seems to me in the highest degree probable.

### II.—*The Pectoral Fin-Skeleton of* Pteroplatea, *compared with that of the* Raiidæ *and of the* Selachoidei.

The pectoral fin-skeleton of *Pteroplatea* differs most markedly from that of any known Plagiostome thus far described. On superficial examination, its two supposed mesopterygial plates might appear to correspond to the well-known single one of the *Selachoidei*, and to represent therefore a subdivision of that structure as it exists in the genus *Rhina* (*Squatina*). The entire mesopterygium of *Rhina* bears, however, but some 10–12 rays, whereas more than double that number are present in *Pteroplatea*; in *Rhina* but 2–3 of these rays reach the shoulder-girdle [1], while in *Pteroplatea* they either all, or all but two or three, do so. From this it is clear that the conditions of the supposed mesopterygium in *Pteroplatea* are such as the known facts of anatomy of the Selachoid fin, in even its most expanded form, are inadequate to explain.

On turning to the *Batoidei*, it is seen that the posterior moiety of the axis of the fin is supported by a greater or smaller number of free rays (figs. 6, 7, *r.*) disposed serially with those forming the mesopterygium (*ms.*) and intercalated between it and the head of the metapterygium (*mt.*). These *intercalary rays* were first described by Gegenbaur (*l. c.* p. 144) in "*Raia*? *sp.*" as four or five in number. I find them to be more numerous and usually from six to seven in number in the commoner species, *R. radiata* excepted (*cf.* Table on p. 685, and fig. 7), and I think it tolerably certain that Gegenbaur's specimen (*l. c.* pl. ix. fig. 13) was of the latter species.

A careful comparison of the mesopterygium of *Raia* and *Rhina* brings into prominence some considerations of importance in the present enquiry. In *Raia*, the rays of the mesopterygium which reach the shoulder-girdle and furnish the articular facet are usually 4 or 5 in number, but they may be reduced to 3 (*cf.* fig. 7 and

[1] *Cf.* Gegenbaur, 'Untersuchung. z. vergleich. Anat. d. Wirbelth.' Heft 2, pl. ix. fig. 10 (1865).

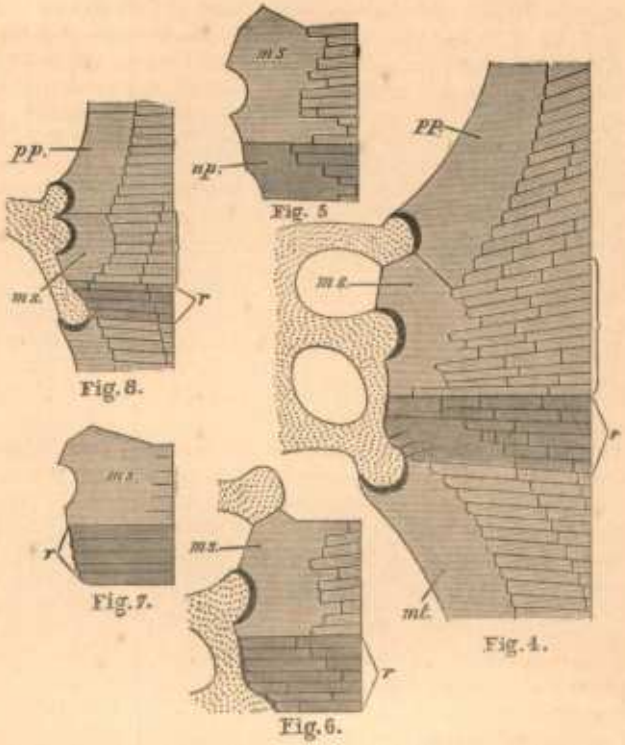


Fig. 4. Horizontal section of the left pectoral fin-skeleton, with girdle, of an exceptional individual of *Raia maculata*, ventral aspect.
Fig. 5. A similar section of the base of the fin-axis of the opposite side of the same specimen, reversed, for comparison with its fellow.
Fig. 6. A similar section of the normal base of the fin-axis in *Raia clavata*.
Fig. 7. The same, in *Raia radiata*.
Fig. 8. The same, in *Rhinobatus granulatus*. ♂.
All natural size.
*References* as for figs. 1 to 3 except *r*, neopterygial (intercalary) rays.

Table); in *Rhina* they are never more than 3 in number, and they may be reduced to 2 (*cf.* Gegenbaur, pl. ix. fig. 10). While in *Raia* the mesopterygium bears peripherally from 6 to 12 rays, in *Rhina* it never bears more than 13. The rays of the axis of the Plagiostome's pectoral fin are well known to be exceedingly variable in the extent to which they coalesce with the mesopterygium, or—to put the same facts into other words—the degree of outward extension of the mesopterygium is one of the most inconstant characters of the fin in question. It is obvious from this that the number of rays borne upon that cartilage must, to a large extent, increase in proportion to the extension named; but the latter although variable, is not without its constant features, inasmuch

as in the region of the metapterygium it is always proportionate to the variation in depth of the anterior face of that cartilage. In *Raia*, the metapterygium is elongated and rod-like, in *Rhina* it is expanded and plate-like. Both the meso- and metapterygia of the Plagiostome's fin are known to be identical in origin, and to arise by the coalescence of the bases of originally distinct and parallel rays[1]; if, in knowledge of this fact, the rays which unite to form that portion of the mesopterygium of *Rhina* which represents the free border of that of *Raia* be counted, it will be found that the number is greatest in the last-named species, instead of fewest as might have been supposed[2]. Thus it is seen that the mesopterygium of *Raia*, so far as it goes, more than embraces that of the *Selachoidei*, *Rhina* not excepted; and, as the anterior of the two supposed mesopterygial plates of *Pteroplatea* similarly embraces the characters of them both, in respect to the points at issue, the clue to the morphology of the posterior plate of that fish (*np.* of figs.) must be sought in something else.

The facts which I have described for the fin-skeleton of *Pteroplatea* first arrested my attention in 1887, while preparing a paper which this Society has done me the honour of printing[3]; homology between the apparent post-mesopterygial cartilage (*np.*) and the intercalary rays (*r.*) of Gegenbaur not unnaturally suggested itself at the time, and it occurred to me that if such be the truth, the intercalary rays of *Raia* might be expected to show signs of fusion to form a basal plate. During the 3–4 years which have elapsed since first I entertained these ideas I have examined some scores of Skate, without having observed any traces of the fusion anticipated. Quite recently, however, there has come into my hands[4] an individual of *Raia maculata* in which it was realized to an unexpected degree. The mesopterygium of the left side of this fish (fig. 4, *ms.*) was in relationship peripherally to 11 rays; and the intercalary rays which followed it (*r.*) were united to form a single plate, except for the lingering traces of the demarcation lines between their bases and between the bodies of the second and third of the series. On the right side (fig. 5) there was present a mesopterygium bearing 12 free rays; the six intercalary rays had, by the union of their bases, given rise to a single expanded plate, with a smooth inner border and destitute of all traces of demarcation lines. There was thus realized a condition of the basal cartilages of the fin-axis essentially similar to that seen in *Pteroplatea* (figs. 1 & 2), except for the numerical disparity in the number of rays involved and for the differences in the mode of articulation upon the shoulder-girdle. That these differences are of secondary and non-morphological significance will, I think, be admitted, on a knowledge of the numerical variation in the rays of the fin-axis for species of the

[1] *Cf.* P. Z. S. 1887, p. 15, and Dohrn in Mittheilung. a. d. Zoolog. Stat. zu Neapel, vol. v. p. 174 (1884).

[2] Compare for ex. my figs. 4 or 5 with Gegenbaur's pl. ix. fig. 10.

[3] P. Z. S. 1887, pp. 3–26.

[4] Thanks to my pupil Mr. J. Harrison.

genus *Raia* (*cf.* Table), and of the variations with age in the articular surfaces of *Pteroplatea* already alluded to (*ante* p. 677, figs. 1 & 2).

The post-mesopterygial plate of the Trygonid and the free intercalary rays of the *Raiidæ* having been now proved to be homologous, the question arises, which of them is to be regarded as the more primitive representative of the other? That the Batoid type of fin has been derived from a shorter Selachoid one by forward rotation and general enlargement is sufficiently clear, from known facts of development; and, on comparison of the two types, it might at first sight appear that the post-mesopterygial plate and free rays named above both represent, together with the mesopterygium, the mesopterygium of the *Selachoidei*, and that the free rays of the *Raiidæ* may have arisen by dismemberment and segmentation of the posterior half of that. Such a possibility is, however, irreconcilable with the fact, already demonstrated, that all the distinguishing features of the mesopterygium of the *Selachoidei* are realized by that of the *Raiidæ*, apart from the intercalary rays. The last named are related to Parker's "glenoid commissure" (*cf. ante*, p. 676), and Gegenbaur has sought to correlate (*l. c.* p. 144) their origin with what he terms the "stretching of the articular region" of the shoulder-girdle. Be their original significance what it may, the facts above described show them to be at present active in the production of a fourth basal cartilage, phylogenetically the youngest of the series. The now well-known fact already cited (p. 679) that the basal pterygia of Gegenbaur arise by fusion of the bases of parallel and originally distinct rays, shows the cartilage in question to be serially homologous with the former. I have thus far alluded to it as the post-mesopterygial plate; as it can no longer be referred to the mesopterygium, I propose to term it, as is consistent with its mode of origin and with Gegenbaur's expressive nomenclature, the *neopterygium*.

### III.—*The Pectoral Fin-Skeleton of* Trygon, Urolophus, *and* Myliobatis, *compared with that of* Raia *and* Pteroplatea.

The pectoral fin-skeleton of *Trygon pastinaca* has been already described by Gegenbaur (*l. c.* p. 144) and Haswell (*l. c.* p. 35). Both observers agree in regarding that basal cartilage which occupies "all the interval between the propterygium and the metapterygium" as the mesopterygium. Gegenbaur figures in relation to it 13 rays of the axis, five of which reached the pectoral girdle. I have dissected, in all, five individuals of this species, three of *Triton varnak*, and two of *Urolophus testaceus*; and in all but three of the series the number of these rays exceeds that of Gegenbaur's specimen. In all of them the mesopterygium is comparatively short and plate-like. Both Gegenbaur and Haswell regard it as the homologue of the Selachoid mesopterygium. If, however, the two things be compared under the conditions which I have laid down (*ante*, p. 679) in dealing with *Rhina* and *Raia*, it will be seen that the supposed mesopterygial rays of the Trygons are much more

numerous than are those of the Sharks, and that the would-be mesopterygium of the *Trygon* furnishes, like that of *Raia*, more than is demanded of it (*cf.* Table, and especially *Trygon uarnak*).

Fig. 9

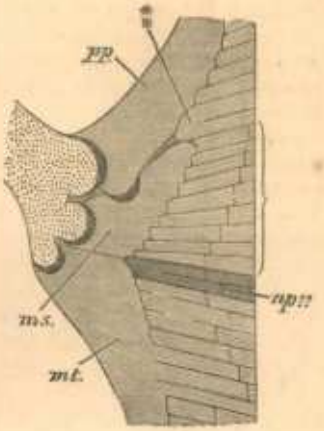


Fig. 10

Fig. 9. Horizontal section through the left pectoral fin-base, with its related girdle, in *Trygon pastinaca*, ♀. One half nat. size.
Fig. 10. A similar section through corresponding parts of *Torpedo narce*, ♂. Nat. size.

References and other details as for figs. 1–8.

In one of my specimens the basal cartilages are in an altogether exceptional and highly interesting condition. The case referred to is that of an adult female of *Trygon pastinaca*, by far the largest of the individuals examined (see Table). The supposed mesopterygial rays instead of being from 12 to 13 in number, reached, in it, the total of 19; and of these 8–9 were in articulation with the shoulder-girdle, instead of from 3–5. The base of one of these fins is represented in fig. 9, and that which is most remarkable concerning it is the subdivision of the so-called mesopterygium into two plates (*ms.*, *mp.*), each independent of the other, and both in synovial articulation with the middle glenoid facet. Both fins were similarly modified, except for the fact that whereas on the right side the demarcation line between the two plates lay between rays 9 and 10, on the left it lay between those numbering 11 and 12.

Comparison of this pair of fins (fig. 9) with those of *Pteroplatea* figs. 1 & 2) reveals a striking similarity in structure, and it must be admitted that the characters of the basal cartilages of the individual *Trygon pastinaca* in question depart from those of its species, as hitherto described, exactly as they approximate towards those of *Pteroplatea*. In other words, what then is the nature of the relationship between these two? as we have once more to face the correlation of the existence of an apparently duplicated meso-

pterygium with that of supernumerary rays. The shoulder-girdle of *Trygon* (fig. 9) is, like that of *Raia* (figs. 4, 6), discontinuous laterally, between the anterior and middle glenoid condyles. It will be observed that the base of the propterygium in *Trygon*, unlike that of *Pteroplatea* (figs. 1, 2), is simple and destitute of a second articulation; and this fact, which might readily account for the differences in the limb-girdles, would appear to be of no morphological significance, on analogy to the behaviour of the propterygium in the younger and older stages of *Pteroplatea*, described at the outset (*ante*, p. 677). The structural plan of the pectoral fin of the individual *Trygon* before alluded to (fig. 9) is, on the whole, somewhat a simplification of that of *Pteroplatea* (figs. 1, 2); and, in view of the condition of its mesopterygial area, I regard the posterior of the two plates there present as homologous with the neopterygium herein described. And I submit that, with this, the basal fin-skeleton of *Trygon* and *Urolophus* is brought into complete harmony with that of their ally *Pteroplatea*, and that its axial portion represents a confluence of those parts which, in the latter and in the *Raiidæ*, are differentiated to form the mesopterygium and neopterygium as I have sought to define them.

Examination of the Table which I append will show that in *Trygon pastinaca* there are indications of a numerical increase of the rays of the fin-axis, with age; and, as the neopterygium is present as a distinct plate only in the oldest example, the possibility that that may be formed late, in connection with the said numerical increase, must not be overlooked. Proof that such is the case is not forthcoming; but on the whole, and on comparison of *Trygon uarnak*[1], I am inclined to regard the numerical differences alluded to as of the nature of individual variations.

## IV.—*The Pectoral Fin-Skeleton of* Myliobatis *and of the* Torpedinidæ.

*Myliobatis*.—Gegenbaur originally described the mesopterygium of *Myliobatis aquila* (*l. c.* p. 144) as succeeded by first a single fin-ray and then by a couple of plates carrying respectively four and five to six rays each. Concerning the relationships of these to the limb-girdle he does not furnish details. I have examined three individuals of this species, and, in all, the rays of the fin-axis were almost entirely confluent with the girdle adjacent (fig. 3), so much so that I was at first inclined to doubt the existence of basal pterygia in that region. On closer examination, however, distinct traces of a line of fusion between the latter and their girdle were found to be perceptible[2], and fragments of the pterygia were encountered, in the form of isolated plates such as that shown at * in the fig. In three of the fins dissected there was present a well-defined demarcation line, at about the

[1] Three specimens examined.
[2] Indicated as a dotted line in fig. 3.

middle (axis), and this, which occupies the position of Gegenbaur's intercalary ray (*l. c.* pl. ix. fig. 14), appears to me to indicate the apposition point of parts representative of the meso- and neo-pterygia of the *Trygonidæ* and *Raiidæ*. Viewed from this standpoint, the pectoral fin of *Myliobatis* is in complete structural harmony with that of the *Trygonidæ*, as represented by *Pteroplatea*. Its propterygium is in articulation with both the girdle and the mesopterygium, and the whole differs chiefly from the Trygonid fin in the fusion of its parts—a dominating peculiarity which extends even to its metapterygium in a varying degree. It is interesting here to recall my belief in the fusion of the meso- and neo-pterygia of *Trygon*, and to remark that the specimens of *Tr. uarnak* under my hands show signs of fusion between the axial basal plate and the pro- and meta-pterygia. A belief in affinity between the *Trygonidæ* and *Myliobatidæ* thus becomes justifiable; and, so far as the pectoral fin-skeleton goes, the latter family would appear to realize a culminating term in the series.

*Torpedinidæ*.—The basal skeleton of the pectoral fin of the Torpedoes is one of the most perplexing with which I have had to deal, not because of its structure but rather of its affinities, as the sequel will show. It has been described by Gegenbaur for *Torpedo*, and by Haswell for *Hypnos*. I have been able to examine it in both genera and in *Astrape*; and to the general descriptions of the authors named I have nothing to add, except that neither seems to have sufficiently recognized the presence of an articulation of the propon the meso-pterygium as in *Pteroplatea* and *Myliobatis* (*cf.* figs. 1, 3, and 10).

The mesopterygium of the *Torpedinidæ* is a remarkable structure. Both in the number of its rays and in its general relationships, as in the composition of its articular facet, it suggests the mesopterygium of the *Raiidæ* and of the *Selachoidei*, hypertrophied and vertically enlarged to form a stay for the massive propterygium. There can be no question that rays answering to the intercalary series of the *Raiidæ*, *Trygonidæ*, and *Myliobatis* (with their products) do not enter into its composition; and, in the absence of these, the Torpedo's fin differs from that of all other Batoids. In one specimen (fig. 10) I observed a fusion of the bases of two rays next in order behind the mesopterygium; and the resulting minute plate (*np.??*) showed signs of intercalation between the meso- and meta-pterygia, suggestive of its being the vanishing vestige of a neopterygium. The marked abbreviation of the metapterygium so characteristic of these *Torpedinidæ* appeared at first glance to favour the suggestion, but I have been unable to find further support for it; and, indeed, similar and more marked fusions had affected the two posterior rays of the propterygium (⁂ of fig.), in common with other parts of the same fin.

There is something in the above at complete variance with that seen in all other Batoids; and, except for its rotation forwards and fusion with the head, the pectoral fin of the *Torpedinidæ* is that of a Shark. Gegenbaur has insisted (*l. c.* p. 84) upon the marked dif-

ferences between the shoulder-girdle of the *Torpedinidæ* and the other *Batoidei*; and, among those characters which I have recounted, the mere articulation of the propterygium upon the mesopterygium is, in itself, insufficient to warrant the relegation of their fin-skeleton to the Trygonid category. The articulation named is absent in *Hypnos*; and, in view of the inconstancy of the pro- meso-pterygial articulation of *Pteroplatea* (*ante*, p. 677), it may justly be looked upon as of independent origin, probably in association with the demands of the electrical apparatus. The facts appear to me to strongly suggest the possibility of an independent origin for the *Torpedinidæ*, as distinguished from other Batoids, and to warrant a suspicion that the suborder *Batoidei* as defined by Dr. Günther [1] may be at least diphyletic. In this connection it is noteworthy that Smith Woodward has lately referred *Pristis*, through *Sclerorhynchus*, to a near kinship with the *Pristiophoridæ* [2], and that examination of the pectoral fin-skeleton of that fish fully justifies his action [3]. Comparison of *Rhina squatina* with the *Batoidei Ceratopterina*, in which the pectoral fin is free of the head [3], would seem to point in the same direction, and to indicate the independent association of these forms. The study of the fin-skeleton of *Dicerobatis* is, at this juncture, very desirable, but I regret to say that I have been unable to pursue it, for want of material.

### V.—*The Pectoral Fin-Skeleton of the* Rhinobatidæ.

The fin-skeleton of this family has been described by Gegenbaur for *Rhinobatus*, and more recently dealt with by Haswell for *Trygonorhina* (*l. c.* pp. 39 *et seq.*). My own observations have extended to *Rhynchobatus* also (*cf.* Table). Taking the three genera collectively, the mesopterygium (*ms.*, fig. 8) may be regarded as a small plate, most nearly resembling that of the *Raiidæ* but for its more regular and constant proportions (*cf.* figs. 4, 7, and 8). The rays which unite to form it are least numerous (from 4 to 5) in *Rhynchobatus*, most numerous in the two remaining genera; and the same holds good for the numerical variation observable in the intercalary rays. Examination of the Table which I append will show that the pectoral fin-skeleton of *Raia radiata* furnishes a very satisfactory connecting-link, between that of the other *Raiidæ* and of the *Rhinobatidæ*, and I conceive of that fish as much more lowly than the allied *R. batis*, *R. clavata*, and *R. maculata*. And, whatever is to be said for the surmised diphyletic origin of the *Batoidei* taken as a suborder, the two families above named would appear to be more intimately related to each other than to any remaining family of the Batoids as ordinarily understood.

The embryological data at our disposal warrant the belief that the forward rotation of the propterygium is a secondarily acquired

[1] Catalogue of the Fishes in the British Museum, vol. viii. (1870) p. 434.
[2] P. Z. S. 1889, p. 449. For a description and fig. of the *Pristiophorus* fin see Mivart, P. Z. S. pt. iv. 1879, p. 453, pl. lxxviii.
[3] *Cf.* Günther, Cat. cit. p. 496.

TABLE OF FORMULÆ OF THE FIN-RAYS FOR THE SPECIMENS DISSECTED.

| Forms examined, with total length in centims. | Mesopterygial rays | | Neo-pterygial rays. | Total. |
|---|---|---|---|---|
| | fused to form meso-pterygium. | in apposition with limb-girdle. | | |
| **RHINOBATIDÆ.** | | | | |
| *Rhinobatus columnæ*, ♂, 43·5 | 7–8 | 4 | 3–4 | 10–12 |
| *Rhinobatus granulatus*, ♂, 23·5 (fig. 8, p. 678) | 6–7 | 4 | 4–5 | 10–12 |
| *Rhynchobatus djeddensis*, ♀, 52 | 4–5 | 3–4 | 3–4 | 7–9 |
| *Rhynchobatus djeddensis*, ♂, 66 | 5–6 | 3–4 | 3–4 | 8–10 |
| *Trygonorhina fasciata*, ♂, 26 | 7–8 | 4 | 5–6 | 12–14 |
| **RAIIDÆ.** | | | | |
| *Raia batis*, *Raia clavata*, *Raia maculata*, var. adults | 9–11 | 3–5 | 3–7 | 12–18 |
| *Raia clavata*: | | | | |
| juv., 12·5 | 9–11 | 3 | 7 | 16–18 |
| juv., 13·5 | 8–9 | 3–4 | 6 | 14–15 |
| *Raia radiata*, ♂ ♀ (fig. 7, p. 678) | 6 | 4 | 4–5 | 10–11 |
| **TRYGONIDÆ.** (Measured to end of pelvic fins.) | | | | |
| *Pteroplatea hirundo*: | | | | |
| ♂, 23·5 (fig. 1, p. 676) | 10–12 | 8–10 | 11–13 | 21–25 |
| ♂, 40 (fig. 2, p. 676) | 11–13 | all | 12–13 | 23–26 |
| *Trygon pastinaca* | | | | |
| ♂, 39[1] | ..... | 5 | ..... | 14–16 |
| ♀, 71 | ..... | 5 | ..... | 12–14 |
| ♀, 74 | ..... | 3–4 | ..... | 11–13 |
| ♀, 108 | ..... | 3 | ..... | 10–11 |
| ♀, 160 (fig. 9, p. 681) | 8–11 | 4–5 | 9–12 | 20 |
| *Trygon varnak*: | | | | |
| ♀, 27 | ..... | 4–5 | ..... | 24 |
| ♂, 34 | ..... | 4–5 | ..... | 23–24 |
| ♀, 36 | ..... | 5 | ..... | 18–21 |
| *Urolophus testaceus*: | | | | |
| ♂, 38 | ..... | 5 | ..... | 14 |
| ♀, 41[2] | ..... | 5 | ..... | 15 |
| **MYLIOBATIDÆ.** | | | | |
| *Myliobatis aquila*: | | | | |
| ♀, 23 | 8? | ..... | 14–16? | 22–24 |
| ♂, 27·5 | 8? | ..... | 14–15? | 22–23 |
| ♀, 29·5 (fig. 3, p. 676) | 7–9 | ..... | 12 | 19–21 |
| **TORPEDINIDÆ.** | | | | |
| *Astrape dipterygia*, ♂, 17 | 10–11 | 2–3 | ..... | 10–11 |
| *Hypnos subnigrum*: | | | | |
| ♀, 32 | 6 | 3 | ..... | 6 |
| ♀, 42 | 5–6 | 2–3 | ..... | 5–6 |
| *Torpedo marmorata*, ♂, 22 | 11 | 2–3 | ..... | 11 |
| *Torpedo narce*, ♂, 37 (fig. 10, p. 681) | 8–9 | 3 | 2?? | 10–11 |

[1] Pterygia all united on one side.
[2] Mesopterygium fused posteriorly with metapterygium.

character; they also show the basal pterygia to have arisen independently (*cf. ante*, p. 680) by the fusion of parallel rays. This being so, the fin of the *Rhinobatidæ*, while clearly specialized as regards the first proposition, is less modified than that of all other Batoid fishes in respect to its feeble expansion.

Until we know more than at present concerning the manner of multiplication of fin-rays with bodily elongation and growth, we must regard the presence of free rays in the position of those intercalated between the meso- and meta-pterygia of these fishes as none other than a primitive character; and, in respect to this, the *Rhinobatidæ* would appear to exhibit a more lowly structural feature than the, for the most part, less modified *Selachoidei*. Whether they may not have reverted to it, it is at present impossible to say; but I regard the matter as the more interesting in that Edinger has attempted to show[1] the prosencephalon of the Skates to be more lowly than that of the Sharks, and that I have found[2] the primitively continuous dorsal mesentery of the alimentary viscera to be alone retained by the Torpedo *Hypnos subnigrum* among living Plagiostomes. It raises, among other things, the question whether this type of fin-skeleton, which Huxley[3] would apparently associate with his "multibasal" one, may not represent the (admittedly modified) survivor of a type more primitive than that of the living *Selachoidei*, rather than a culminating term in a series of changes which he has pictured (*l. c.* p. 52) as of the nature of an expansion with interpolation of postaxial rays, under a shortening up of the supposed "archipterygium."

For the greater part of the material upon which this investigation is based, I stand indebted to the late Dr. F. Day, and, through my honoured master Prof. Huxley, to Mr. Ramsay (of the Sydney Museum), to whom we owe the possession of the Australian forms. My thanks are also due to my friend Mr. G. A. Boulenger for a continuance of that assistance and advice extended to me on former occasions, and to my friend and former pupil Dr. J. Beard for the reference to Edinger's work cited.

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P.S.—Since this paper was written Mr. Boulenger has directed my attention to a short paper recently published by O. Jaekel[4], in which the author arrives at the conclusion that the *Batoidei* are of polyphyletic origin. He bases this upon the study of the disposition of the gill-slits, of the translocation of the pectoral fin in relation thereto, among living forms, and of certain facts of palæontology. I am, on the whole, disposed to accept the spirit of his conclusions; but my own researches suggest that, setting aside the *Ceratopterina* (which may possibly be related to the *Rhinidæ*) and *Pristis* (which

[1] Abhandl. d. Senckenbergsche Gesellsch. nat. Frankfurt, Bd. xv. 1888, p. 102.
[2] This vol., p. 671.
[3] P. Z. S. 1876, *cf.* pp. 52, 58, 59.
[4] Sitzungsb. d. Gesellsch. naturf. Freunde, Jhrg. 1890 (no. 3), p. 47.

has gone already), those Batoids which remain would fall into two great series—one including the *Rhinobatidæ*, *Raiidæ*, *Trygonidæ*, and most probably the *Myliobatidæ*, which might be provisionally termed the *Batoidei veri*, as distinguished from the *Torpedinidæ* or *Batoidei non veri*.

Jaekel has failed to recognize one character of especial interest at the present juncture, viz. the presence in many Batoids of a vestigial (sixth) pair of gill-slits. These are disposed lineally with the functional ones and immediately below (ventrad of) the coracoid cartilage. Parker refers to them in *Raia nasuta* as "looking like an obliterated sixth pair of gill-slits." I fail to see that any other interpretation is possible, and their position and relationships appear to me to warrant the conclusion that the pectoral girdle of the *Plagiostomi* has, with its related fins, undergone a translocation forwards proportionate to the shortening up of the branchial apparatus by suppression from behind.

## *VI.—*The Pectoral Fin-Skeleton and Affinities of the Liassic* Squaloraja polyspondyla.

My friend Mr. Smith Woodward, in his excellent paper on this fish[1], seeks to associate it with the Sharks and Rays (p. 537), and he would create for its reception the family *Squaloraiidæ* of the *Selachii Tectospondyli*. He figures and describes the pectoral fin-skeleton with perfect accuracy, and he regards the anterior of the two basal cartilages which support it as (*l. c.* p. 536) either "the coalesced pro- and mesopterygium" or "mesopterygial, with a minute indistinguishable propterygium at its proximal angle." In this I believe him to be mistaken. He bases his conclusions, as need hardly be said, upon analogy to the living forms; but on appeal to them another, and to my mind more forcible, comparison may be instituted. I have previously attempted to show[2] that the paired fins of the Chimæroids are destitute of a mesopterygium, and that Mivart was right in regarding the two-jointed ray of the anterior border of their pectoral fin as a propterygium. Very shortly after the reading of Mr. Smith Woodward's paper, I had the good fortune to examine his specimens; the conclusion that the pectoral fin of his fish was that of a Chimæroid forced itself upon me at the time; and as all subsequent consideration has the more fully persuaded me that this is so, I avail myself of the present opportunity of recording my belief.

It is, unfortunately, impossible to say whether the propterygium of *Squaloraja* was or was not segmented; its posterior border appears to have been thickened and keel-like throughout its proximal region, and examination under a lens reveals the presence of an interspace between the ridge in question and the base of the metapterygium. The Chimæroid metapterygium differs from that of all known Sharks in its gradual increase in depth from behind forwards, and

[1] P. Z. S. 1886, pp. 527-538.

[2] P. Z. S. 1887, p. 23.

in the forward and downward slope of its anterior border. Whereas in the Sharks the vertical diameter of this cartilage is greatest at its middle, or near its posterior extremity, in the Chimæroids it is greatest at its anterior end; and in some respects the anterior border of the Chimæroid metapterygium repeats, in its relationships to the propterygium, the conditions of the mesopterygium of the Selachii. In its realization of these characters, and in the simple constitution of its cartilaginous rays, the pectoral metapterygium of *Squaloraja* closely resembles that of the living Holocephali; and, on careful comparison of the two, I am convinced that, with respect to the skeleton of its paired fins, that fish is indubitably, and as Dr. Günther at first suggested[1], a Chimæroid.

In talking this matter over with Dr. Traquair during the autumn of 1889, I was much rejoiced to find that he had independently arrived at the same conclusion on a study of the skull, which he asserts[2] is "of the autostylic structure." It is to be hoped that he will give us, with as little delay as possible, fuller details of this important discovery.

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My best thanks are due to my friend Mr. Smith Woodward, for his courtesy in having allowed me to examine his matchless specimen.

[1] Geol. Mag. vol. ix. (p. 148). Curiously enough he altered his mind later, in doubtfully referring it ('Introduction to the Study of Fishes,' p. 335) to the *Pristiophoridæ*.

[2] Nicholson & Lydekker's Manual of Palæontology, vol. ii. p. 950 (1889).

# APPENDIX.

## LIST OF ADDITIONS TO THE SOCIETY'S MENAGERIE

### DURING THE YEAR

### 1890.

Jan. 2. 1 Common Barn-Owl (*Strix flammea*). Presented by Mr. H. Craig.

4. 2 Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*). Deposited.

6. 4 Leopard Tortoises (*Testudo pardalis*). 2 ad., 2 jr. Presented by the Rev. G. H. R. Fisk, C.M.Z.S.

3 Well-marked Tortoises (*Homopus signatus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S. From Namaqualand, S. Africa.

1 Rufous Snake (*Ablabes rufulus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.

6 Gray's Frogs (*Rana grayi*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.

8 Smooth Clawed Frogs (*Xenopus lævis*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.

7. 1 Koala (*Phascolarctus cinereus*). Received in Exchange.

2 Indian Cobras (*Naia tripudians*). Received in Exchange.

1 Indian Python (*Python molurus*). Received in Exchange.

2 Spur-winged Geese (*Plectropterus gambensis*). Presented by C. B. Mitford, Esq.

4 Tufted Umbres (*Scopus umbretta*). Purchased.

8. 3 Yellow-winged Sugar-birds (*Cæreba cyanea*). Presented by H. E. Blanford, Esq.

2 Broad-billed Tanagers (*Euphonia laniirostris*). Presented by H. E. Blanford, Esq.

1 Green Turtle (*Chelone viridis*). Presented by Mrs. Harris.

9. 1 Bluish Finch (*Spermophila cærulescens*), ♂. Presented by Mrs. Mayne.

1 Geoffroy's Terrapin (*Hydraspis hilarii*). Purchased.

10. 6 Red-bellied Waxbills (*Estrelda rubriventris*). Presented by T. W. Bacon, Esq.

5 Blue-breasted Waxbills (*Estrelda cyanogastra*). Presented by T. W. Bacon, Esq.

Jan. 10. 7 Grenadier Waxbills (*Uraeginthus granatinus*), 6 ♂, 1 ♀. Presented by T. W. Bacon, Esq.
3 Paradise Whydah-birds (*Vidua paradisea*), 3 ♂. Presented by T. W. Bacon, Esq.
2 Golden-backed Weaver-birds (*Pyromelana aurea*). Presented by T. W. Bacon, Esq.
1 Chattering Lory (*Lorius garrulus*). Presented by Capt. Bason, P. & O. s.s. 'Bombay.'
11. 2 Dufresne's Waxbills (*Estrelda dufresnii*), ♂ ♀. Purchased.
15. 1 Black-headed Gull (*Larus ridibundus*). Presented by E. Hart, Esq., F.Z.S.
1 Antarctic Skua (*Stercorarius antarcticus*). Purchased.
3 Green Tree-Frogs (*Hyla arborea*). Presented by Mrs. F. Aronson.
16. 2 Cardinal Grosbeaks (*Cardinalis virginianus*), 2 ♂. Purchased.
1 Indigo-bird (*Cyanospiza cyanea*), ♂. Purchased.
2 Shining Weaver-birds (*Hypochera nitens*). Purchased.
4 Grenadier Weaver-birds (*Euplectes oryx*), 2 ♂, 2 ♀. Purchased.
2 Black-bellied Weaver-birds (*Euplectes afer*). Purchased.
4 Red-beaked Weaver-birds (*Quelea sanguinirostris*), 2 ♂, 2 ♀. Purchased.
4 Cut-throat Finches (*Amadina fasciata*), 2 ♂, 2 ♀. Purchased.
4 Chestnut-eared Finches (*Amadina castanotis*). Purchased.
1 Paradise Whydah-bird (*Vidua paradisea*), ♂. Purchased.
1 Indian Silverbill (*Munia malabarica*). Purchased.
4 Barred Doves (*Geopelea striata*). Purchased.
1 Chinese Jay-Thrush (*Garrulax chinensis*). Presented by Sir Harry B. Lumsden, K.C.S.I., C.B., F.Z.S.
17. 1 King Parrakeet (*Aprosmictus scapulatus*), ♂. Presented by the Count Povoleri, F.Z.S.
1 White-necked Raven (*Corvultur albicollis*). Presented by — Marshall, Esq.
1 Vulturine Eagle (*Aquila verreauxi*). Presented by — Marshall, Esq.
1 Jackal Buzzard (*Buteo jacal*). Presented by — Marshall, Esq.
18. 1 Pigmy Cormorant (*Phalacrocorax africanus*). Purchased.
1 Moorhen (*Gallinula chloropus*). Purchased.
21. 1 Bonnet-Monkey (*Macacus sinicus*), ♀. Deposited.
22. 2 Brown Capuchins (*Cebus fatuellus*), 2 ♂. Presented by Mr. E. Malatesta.
23. 1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♂. Deposited.
1 Bonnet-Monkey (*Macacus sinicus*), ♀. Presented by Miss Alice Booth.
1 Macaque Monkey (*Macacus cynomolgus*), ♂. Presented by Mr. C. Harris.
24. 1 Green Monkey (*Cercopithecus callitrichus*), ♂. Presented by Quart.-Master Sergeant Mathison, W.I.R.
1 Silver Pheasant (*Euplocamus nycthemerus*), ♂. Presented by W. R. Rootes, Esq.
28. 12 Cuming's Octodons (*Octodon cumingi*). Presented by W. H. Newman, Esq.
1 Larger Hill-Mynah (*Gracula intermedia*). Deposited.
31 5 Common Dormice (*Muscardinus avellanarius*). Presented by F. Wyndham, Esq.

Feb. 2. 1 Dingo (*Canis dingo*). Born in the Menagerie.
3. 1 Hoffmann's Sloth (*Cholopus hoffmanni*). Purchased.
1 Ring-tailed Lemur (*Lemur catta*). Presented by the Executors of the late Dr. Allan.
7. 1 Vulpine Phalanger (*Phalangista vulpina*), ♀. Presented by W. H. Seward, Esq.
1 Alligator (*Alligator mississippiensis*). Presented by A. B. Archer, Esq.
9. 1 Hamster (*Cricetus frumentarius*). Presented by H. Hanauer, Esq., F.Z.S.
18. 1 Panama Amazon (*Chrysotis panamensis*). Received in Exchange.
1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
2 Barbary Turtle-Doves (*Turtur risorius*). Presented by Miss Teil.
22. 1 Bonnet-Monkey (*Macacus sinicus*), ♀. Presented by Mr. W. Bell.
1 Green Monkey (*Cercopithecus callitrichus*). Born in the Menagerie.
1 Esquimaux Dog (*Canis familiaris*), ♀. Presented by Wm. Tourney, Esq.
1 Common Raccoon (*Procyon lotor*). Deposited.
24. 2 Cereopsis Geese (*Cereopsis novæ-hollandiæ*). Bred in the Menagerie.

Mar. 3. 1 Grey Hypocolius (*Hypocolius ampelinus*), ♂. Presented by W. D. Cumming, Esq. From Scinde. See P.Z.S. 1890, p. 147, Plate XV.
4. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Deposited.
6. 1 Spotted Ichneumon (*Herpestes nepalensis*). Deposited.
2 Badgers (*Meles taxus*). Presented by P. Bicknell, Esq.
8. 1 Axis Deer (*Cervus axis*), ♀. Born in the Menagerie.
12. 2 Red-headed Tiger-cats (*Felis planiceps*). Purchased.
1 Plumbeous Fish-Eagle (*Polioaëtus plumbeus*). Purchased.
16. 1 Gayal (*Bibos frontalis*), ♀. Born in the Menagerie.
24. 3 Red-footed Ground-Squirrels (*Xerus erythropus*). Received in Exchange.
25. 2 Ring-necked Pheasants (*Phasianus torquatus*), ♂ ♀. Presented by H.R.H. the Prince of Wales, K.G.
26. 2 Himalayan Monauls (*Lophophorus impeyanus*), 2 ♀. Purchased.
2 Indian Pythons (*Python molurus*). Purchased.
2 Diuca Finches (*Diuca grisea*). Purchased.
1 Black-chinned Siskin (*Chrysomitris barbata*), ♂. Purchased.
2 Field Saffron Finches (*Sycalis arvensis*). Purchased.
1 Alaudine Finch (*Phrygilus alaudinus*). Purchased.
27. 1 Chacma Baboon (*Cynocephalus porcarius*), ♀. Deposited.
5 Common Boas (*Boa constrictor*). Purchased.
1 Hog-Deer (*Cervus porcinus*), ♂. Born in the Menagerie.
31. 1 Egyptian Cat (*Felis chaus*). Presented by Mrs. Florence J. Waghorn.
1 Rhesus Monkey (*Macacus rhesus*). Born in the Menagerie.
2 Mantchurian Cranes (*Grus viridirostris*). Presented by C. W. Campbell, Esq. From Corea. See P.Z.S. 1890, p. 147.

Apr. 1. 1 Diana Monkey (*Cercopithecus diana*), ♀. Purchased.
3 Long-eared Owls (*Asio otus*). Presented by W. Geoffrey N. Powell, Esq.

Apr. 2. 1 Stoat (*Mustela erminea*), ♂. Presented by Cuthbert Johnson, Esq.
2 Hybrid Deer (Bred between *Cervus elaphus* ♂ and *Cervus sika* ♀), 2 ♀. Deposited.
3. 8 Undulated Grass Parrakeets (*Melopsittacus undulatus*), 4 ♂, 4 ♀. Purchased.
5. 1 Short-winged Weaver-bird (*Hyphantornis brachyptera*). Presented by Commander W. M. Latham, R.N., F.Z.S.
1 Three-toed Sand-Skink (*Seps tridactylus*). Presented by J. A. C. Warburg, Esq.
8. 1 Black-eared Marmoset (*Hapale penicillata*). Presented by J. A. Watson, Esq., F.Z.S.
3 European Flamingos (*Phœnicopterus antiquorum*). Purchased.
1 Australian Crane (*Grus australasiana*). Purchased.
2 Simony's Lizards (*Lacerta simonyi*). Presented by the Lord Lilford, F.Z.S. From the Rock of Zalmo, Canaries. See P. Z. S. 1890, p. 354.
1 Simony's Lizard (*Lacerta simonyi*). Deposited. From the Rock of Zalmo, Canaries.
1 Delalande's Gecko (*Tarentola delalandii*). Deposited.
9. 1 Jackdaw (*Corvus monedula*). Presented by Mrs. Bowden.
4 Undulated Grass-Parrakeets (*Melopsittacus undulatus*), 2 ♂, 2 ♀. Deposited.
11. 1 Lesser White-nosed Monkey (*Cercopithecus petaurista*), ♀. Presented by E. B. Parfitt, Esq., M.R.C.S.
1 Macaque Monkey (*Macacus cynomolgus*), ♀. Presented by Mrs. H. F. Batt.
1 Common Badger (*Meles taxus*, white variety). Presented by the Hon. Morton North.
1 Sambur Deer (*Cervus aristotelis*), ♂. Presented by Capt. George Janes.
4 Great Bustards (*Otis tarda*), 4 ♂. Purchased.
2 Chestnut-eared Finches (*Amadina castanotis*), ♂ ♀. Purchased.
12. 1 Blesbok (*Alcelaphus albifrons*), ♂. Deposited.
1 Delalande's Gecko (*Tarentola delalandii*). Presented by Bertram B. Hagen, Esq.
14. 1 Indian White Crane (*Grus leucogeranos*). Purchased.
2 Black-gorgeted Jay Thrushes (*Garrulax pectoralis*). Purchased.
1 Pacific Fruit-Pigeon (*Carpophaga pacifica*). Purchased.
15. 4 Madagascar Weaver-birds (*Foudia madagascariensis*), 2 ♂, 2 ♀. Purchased.
2 Lataste's Frogs (*Rana latasti*). Presented by G. A. Boulenger, Esq., F.Z.S.
16. 1 Common Moorhen (*Gallinula chloropus*). Presented by Cuthbert Johnson, Esq.
2 Moorish Toads (*Bufo mauritanicus*). Presented by Cuthbert Johnson, Esq.
17. 1 Indian Muntjac (*Cervulus muntjac*), ♂. Deposited.
1 Puma (*Felis concolor*). Born in the Menagerie.
2 Indrance Owls (*Syrnium indrance*). Presented by A. R. Lewis, Esq.
6 Common Cormorants (*Phalacrocorax carbo*). Purchased.
19. 2 Adelaide Parrakeets (*Platycercus adelaidæ*). Received in Exchange.
22. 1 Musk-Deer (*Moschus moschiferus*), ♂. Received in Exchange.

Apr. 23. 7 Bearded Lizards (*Amphibolurus barbatus*). Received in Exchange.
3 Muricated Lizards (*Amphibolurus muricatus*). Received in Exchange.
1 Gould's Monitor (*Varanus gouldi*). Received in Exchange.
1 Brown Bear (*Ursus arctos*), ♂. Presented by Miss Evelyn Muir.
24. 1 Egyptian Ichneumon (*Herpestes ichneumon*). Deposited.
1 Bateleur Eagle (*Helotarsus ecaudatus*). Presented by Dr. E. J. Baxter.
1 Elliot's Pheasant (*Phasianus ellioti*), ♀. Presented by Wilfred G. Marshall, Esq.
1 Cape Weaver-bird (*Hyphantornis capensis*), ♂. Presented by Wilfred G. Marshall, Esq.
1 Red-eyed Ground-Finch (*Pipilo erythrophthalmus*). Presented by Wilfred G. Marshall, Esq.
25. 1 Rhesus Monkey (*Macacus rhesus*). Presented by Mrs. Pendry.
1 Indian Muntjac (*Cervulus muntjac*), ♀. Born in the Menagerie.
2 White Pelicans (*Pelecanus onocrotalus*). Deposited.
26. 1 Barnard's Parrakeet (*Platycercus barnardi*). Received in Exchange.
2 Alexandrine Parrakeets (*Palæornis alexandri*). Deposited.
2 Grey Ichneumons (*Herpestes griseus*), 2 ♂. Deposited.
1 Tuatera Lizard (*Sphenodon punctatus*). Presented by J. Catheson-Smith, Esq.
28. 1 Rhomb-marked Snake (*Psammophilus rhombeatus*). Presented by Miss Harris.
1 Black-headed Lemur (*Lemur brunneus*). Born in the Menagerie.
1 Sooty Phalanger (*Phalangista fuliginosa*). Deposited.
29. 3 Wild Boars (young) (*Sus scrofa*). Presented by Lord Herbrand Russell.
30. 3 Common Vipers (*Vipera berus*). Presented by Dr. W. C. Cousens.

May 1. 1 Louisianian Meadow-Starling (*Sturnella ludiviciana*), ♀. Presented by W. H. St. Quintin, Esq.
1 Black-bellied Sand-Grouse (*Pterocles arenarius*), ♀. Presented by W. H. St. Quintin, Esq.
4 Variegated Sheldrakes (*Tadorna variegata*), 4 ♂. Presented by Capt. C. A. Findlay, R.N.R.
2. 1 Ring-tailed Coati (*Nasua rufa*), ♂. Presented by R. E. Moore, Esq.
2 Yellow-rumped Seed-eaters (*Crithagra chrysopyga*), 2 ♂. Purchased.
3. 1 Green Lizard (*Lacerta viridis*). Presented by J. C. Warburg, Esq.
1 Three-toed Sand-Skink (*Seps tridactylus*). Presented by J. C. Warburg, Esq.
5. 2 Hartebeests (*Alcelaphus caama*), ♂ ♀. Purchased. See P. Z. S. 1890, p. 411.
1 Redwing (*Turdus iliacus*). Presented by J. Newton Hayley, Esq.
1 Common Viper (*Vipera berus*). Presented by Dr. W. K. Sibley.

May 5. 1 Slowworm (*Anguis fragilis*). Presented by Dr. W. K. Sibley.
6. 1 Bennett's Wallaby (*Halmaturus bennetti*), ♂. Deposited.
1 Black Wallaby (*Halmaturus ualabatus*), ♀. Deposited.
2 Brush-tailed Wallabies (*Petrogale penicillata*), 2 ♂. Deposited.
4 Common Quails (*Coturnix communis*). Deposited.
1 Blossom-headed Parrakeet (*Palæornis cyanocephalus*), ♂. Presented by Dr. Seton.
1 Ring-necked Parrakeet (*Palæornis torquatus*), ♂. Presented by Dr. Seton.
1 Red-sided Eclectus (*Eclectus pectoralis*), ♀. Presented by Dr. Seton.
2 King Parrakeets (*Aprosmictus scapulatus*), ♂ ♀. Presented by Dr. Seton.
1 Ceylonese Hanging Parrakeet (*Loriculus asiaticus*). Presented by Dr. Seton.
1 Pennant's Parrakeet (*Platycercus pennanti*). Presented by Dr. Seton.
1 Mealy Amazon (*Chrysotis farinosa*). Presented by Dr. Seton.
2 Yellow-shouldered Amazons (*Chrysotis ochroptera*). Presented by Dr. Seton.
1 Levaillant's Amazon (*Chrysotis levaillanti*). Presented by Dr. Seton.
2 Panama Amazons (*Chrysotis panamensis*). Presented by Dr. Seton.
1 Blue-fronted Amazon (*Chrysotis æstiva*). Presented by Dr. Seton.
1 Yellow-vented Bulbul (*Pycnonotus crocorrhous*). Presented by Dr. Seton.
2 Red-eared Bulbuls (*Pycnonotus jocosus*). Presented by Dr. Seton.
2 Red-vented Bulbuls (*Pycnonotus hæmorrhous*). Presented by Dr. Seton.
2 Orange-cheeked Waxbills (*Estrelda melpoda*). Presented by Dr. Seton.
1 Red-bellied Waxbill (*Estrelda rubriventris*). Presented by Dr. Seton.
1 Common Waxbill (*Estrelda cinerea*). Presented by Dr. Seton.
1 Cut-throat Finch (*Amadina fasciata*), ♂. Presented by Dr. Seton.
1 Shining Weaver-bird (*Hypochera nitens*). Presented by Dr. Seton.
1 Chestnut-eared Finch (*Amadina castanotis*), ♀. Presented by Dr. Seton.
1 Crimson-crowned Weaver-bird (*Euplectes flammiceps*). Presented by Dr. Seton.
1 Grenadier Weaver-bird (*Euplectes oryx*). Presented by Dr. Seton.
2 Madagascar Weaver-birds (*Foudia madagascariensis*), ♂ ♀. Presented by Dr. Seton.
1 Olive Weaver-bird (*Hyphantornis olivaceus*). Presented by Dr. Seton.
1 Red-headed Cardinal (*Paroaria larvata*). Presented by Dr. Seton.
1 Red-crested Cardinal (*Paroaria cucullata*). Presented by Dr. Seton.
1 Cardinal Grosbeak (*Cardinalis virginianus*), ♀. Presented by Dr. Seton.

May 6. 1 Cartagenian Motmot (*Momotus subrufescens*). Presented by Dr. Seton.
1 Large Hill-Mynah (*Gracula intermedia*). Presented by Dr. Seton.
1 Green Glossy Starling (*Lamprocolius chalybeus*). Presented by Dr. Seton.
7. 10 Cuming's Octodons (*Octodon cumingi*). Born in the Menagerie.
8. 1 Ring-necked Parrakeet (*Palæornis torquatus*), ♀. Presented by Mrs. O. Harvey.
2 Demoiselle Cranes (*Grus virgo*). Purchased.
9. 3 Green Tree-Frogs (*Hyla arborea*). Presented by Mrs. Humphreys.
10. 2 Red-eared Bulbuls (*Pycnonotus jocosus*). Presented by Lieut.-Gen. Sir H. B. Lumsden, K.C.S.I., F.Z.S.
1 Red-vented Bulbul (*Pycnonotus hæmorrhous*). Presented by Lieut.-Gen. Sir H. B. Lumsden, K.C.S.I., F.Z.S.
1 Japanese Deer (*Cervus sika*), ♂. Born in the Menagerie.
1 Hog Deer (*Cervus porcinus*), ♀. Born in the Menagerie.
12. 1 Wanderoo Monkey (*Macacus silenus*), ♀. Presented by Miss Eileen Martin.
2 Leopards (*Felis pardus*). Presented by — Egerton, Esq.
2 Bengal Foxes (*Canis bengalensis*). Presented by W. L. Sclater, Esq., F.Z.S.
2 Large-eared Hares (*Lepus macrotis*). Presented by W. L. Sclater, Esq., F.Z.S.
1 Himalayan Bear (*Ursus tibetanus*), ♂. Deposited.
13. 2 Black-headed Conures (*Conurus nanday*). Purchased.
1 Amherst Pheasant (*Thaumalea amherstiæ*), ♂. Purchased.
1 Variegated Sheldrake (*Tadorna variegata*), ♀. Purchased.
2 Yellow-wing Sugar-birds (*Cæreba cyanea*). Presented by H. E. Blanford, Esq.
1 Common Viper (*Vipera berus*). Presented by W. H. B. Pain, Esq.
14. 1 Ruffed Lemur (*Lemur varius*). Deposited.
1 Australian Peewit (*Lobivanellus lobatus*). Presented by Capt. Shepherd.
1 Common Viper (*Vipera berus*). Presented by Mrs. Mowatt.
15. 2 Mandarin Ducks (*Æx galericulata*), ♂ ♀. Presented by C. J. Kingzett, Esq.
1 Crested Porcupine (*Hystrix cristata*). Born in the Menagerie.
17. 2 Senegal Touracous (*Corythaix persa*). Presented by C. W. Burnett, Esq.
2 Undulated Grass-Parrakeets (*Melopsittacus undulatus*). Presented by A. Golden, Esq.
2 Bar-tailed Pheasants (*Phasianus reevesi*), 2 ♀. Purchased.
19. 2 Persian Gazelles (*Gazella subgutturosa*), 2 ♂. Born in the Menagerie.
2 Beatrix Antelopes (*Oryx beatrix*), ♂ ♀. From Arabia. Presented by Col. Ross. See P. Z. S. 1890, p. 411.
21. 1 Vociferous Sea-Eagle (*Haliaetus vocifer*). Presented by J. B. Elliot, Esq.
1 White-crested Tiger Bittern (*Tigrisoma leucolophum*). Presented by J. B. Elliot, Esq.
1 Wood-Owl (*Syrnium aluco*). Presented by the Hon. C. Parker.

May 22. 2 All-green Tree-Snakes (*Philodryas viridissimus*). Presented by A. E. Derrett, Esq.
2 Natterer's Snakes (*Thamnodynastes natterері*). Presented by A. E. Derrett, Esq.
2 Merrem's Snakes (*Liophis merremi*). Presented by A. E. Derrett, Esq.
1 Chequered Elaps (*Elaps lemniscatus*). Presented by A. E. Derrett, Esq.
1 Anomalous Snake (*Coronella anomala*). Presented by A. E. Derrett, Esq.
1 Mexican Guan (*Penelope purpurascens*). Presented by J. W. Dawe, Esq.
1 Barraband's Parrakeet (*Polytelis barrabandi*). Deposited.
23. 1 North-African Jackal (*Canis anthus*). Presented by Capt. Hay.
2 Common Kingfishers (*Alcedo ispida*). Presented by Mr. T. E. Gunn.
1 Common Paradoxure (*Paradoxurus typus*). Presented by E. Armstrong King, Esq.
24. 1 Eland (*Oreas canna*), ♂. Purchased.
2 Crowned Jays (*Cyanocitta coronata*). Purchased.
2 Swainson's Long-tailed Jays (*Calocitta formosa*). Purchased. See P. Z. S. 1890, p. 412.
2 Temminck's Tragopans (*Ceriornis temminckі*), ♂ ♀. Purchased.
1 Brush-Turkey (*Talegalla lathami*), ♂. Received in Exchange.
26. 1 Japanese Deer (*Cervus sika*), ♂. Born in the Menagerie.
27. 1 Masked Parrakeet (*Pyrrhulopsis personata*). Presented by George Lawson, Esq.
28. 2 Barbary Wild Sheep (*Ovis tragelaphus*), ♂ ♀. Born in the Menagerie.
1 Japanese Deer (*Cervus sika*), ♂. Born in the Menagerie.
2 Andaman Starlings (*Sturnia andamanensis*). Purchased.
3 Ceylonese Fish-Owls (*Ketupa ceylonensis*). Purchased.
1 Lanner Falcon (*Falco lanarius*). Presented by Miss Marjorie Barnard.
30. 1 Great Bustard (*Otis tarda*), ♀. Received in Exchange.
3 Common Vipers (*Vipera berus*). Presented by T. A. Cotton, Esq., F.Z.S.

June 1. 1 Burrhel Wild Sheep (*Ovis burrhel*), ♂. Born in the Menagerie.
2. 2 Oak Dormice (*Myoxus dryas*), 2♀. Presented by Lieut.-Col. G. M. Cardew.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Presented by Mrs. Waterson.
2 Bennett's Wallabies (*Halmaturus bennetti*), 2♂. Born in the Menagerie.
1 Hawk-headed Parrot (*Deroptyus accipitrinus*). Deposited.
1 Loggerhead Turtle (*Thalassochelys caouana*). Presented by Miss Beatrice Fort.
3. 1 Peacock Pheasant (*Polyplectron chinquis*). Bred in the Menagerie.
1 Swinhoe's Pheasant (*Euplocamus swinhoii*). Bred in the Menagerie.
1 Ring-necked Parrakeet (*Palæornis torquatus*), ♂. Presented by Arthur O. Cooke, Esq.

June 3. 1 Vociferous Sea-Eagle (*Haliaetus vocifer*). Purchased.
1 Red-crowned Pigeon (*Erythrœnas pulcherrima*). Purchased.
4. 1 Silver-backed Fox (*Canis chama*), ♂. Presented by Capt. H. D. Travers, R.M.S. 'Tartar.'
1 West-African Love-bird (*Agapornis pullaria*). Presented by Mrs. Fell.
1 Chinese Bulbul (*Pycnonotus sinensis*). Presented by Lieut.-Gen. Sir H. B. Lumsden, K.C.S.I., F.Z.S.
1 Grey Monitor (*Varanus griseus*). Presented by John Murray, Esq. From the Algerian Sahara.
1 Common Viper (*Vipera berus*). Presented by Mr. T. E. Gunn.
5. 3 Common Peafowl (*Pavo cristatus*), ♂ ♀ et jr. Presented by Mrs. Francis Leighton.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Born in the Menagerie.
6. 1 Great Kangaroo (*Macropus giganteus*), ♀. Presented by Henry Irving, Esq., F.Z.S.
1 Common Kestrel (*Tinnunculus alaudarius*). Presented by C. Ashdown, Esq., F.Z.S.
7. 4 Spanish Blue Magpies (*Cyanopolius cooki*). Bred in the Menagerie.
8. 1 Japanese Deer (*Cervus sika*), ♂. Born in the Menagerie.
9. 1 Common Marmoset (*Hapale jacchus*). Presented by Percy Standish, Esq.
1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♂. Presented by John W. Moir, Esq. From the Upper Shiré.
2 Grand Galagos (*Galago crassicaudata*). Presented by John W. Moir, Esq. From Mandala, Shiré Highlands, E. Africa.
1 Philippine Paradoxure (*Paradoxurus philippinensis*). Purchased.
18 Young Green Turtles (*Chelone viridis*). Presented by Capt. Robinson, R.M.S. 'Roslin Castle.'
2 Yellow-legged Herring-Gulls (*Larus cachinnans*). Bred in the Menagerie.
10. 1 Common Fox (*Canis vulpes*), ♂. Presented by Mr. Atkins.
2 Green Lizards (*Lacerta viridis*). Presented by the Rev. F. W. Haines.
3 Wall-Lizards (*Lacerta muralis*). Presented by the Rev. F. W. Haines.
1 Dark Green Snake (*Zamenis atrovirens*). Presented by the Rev. F. W. Haines.
4 Common Snakes (*Tropidonotus natrix*). Presented by the Rev. F. W. Haines.
4 Viperine Snakes (*Tropidonotus viperinus*). Presented by the Rev. F. W. Haines.
2 Smooth Snakes (*Coronella lævis*). Presented by the Rev. F. W. Haines.
4 Marbled Newts (*Molge marmorata*). Presented by the Rev. F. W. Haines.
1 Edible Frog (*Rana esculenta*). Presented by the Rev. F. W. Haines.
11. 1 Silvery Gibbon (*Hylobates leuciscus*). Deposited.
1 Angora Goat (*Capra hircus*, var.), ♂. Born in the Menagerie.
13. 3 Japanese Teal (*Querquedula formosa*), 1 ♂, 2 ♀. Purchased.
14. 1 Great Crested Grebe (*Podiceps cristatus*). Presented by Mr. T. E. Gunn.

June 14. 2 Common Marmosets (*Hapale jacchus*). Presented by W. Norbury, Esq.
16. 2 Bennett's Wallabies (*Halmaturus bennetti*), 2♀. Born in the Menagerie.
1 Spur-winged Goose (*Plectropterus gambensis*). Presented by Mrs. W. H. Quayle Jones.
1 American Box-Tortoise (*Terrapene carinata*). Presented by John Petit, Esq.
1 Horned Lizard (*Phrynosoma cornutum*). Presented by John Petit, Esq.
17. 1 Grey Ichneumon (*Herpestes griseus*), ♂. Presented by Mrs. H. F. Pollock.
1 Common Badger (*Meles taxus*). Presented by W. H. B. Pain, Esq.
2 Four-horned Antelopes (*Tetraceros quadricornis*), 2♀. Born in the Menagerie.
2 Common Rheas (*Rhea americana*). Presented by A. W. Neeld, Esq.
1 ¾-bred Bison (*Bison americanus* × *Bibos frontalis* × *Bos indicus*), ♂. Born in the Menagerie.
18. 2 Lions (*Felis leo*, jr.), ♂♀. Presented by H.R.H. the Duke of Clarence and Avondale, K.G.
1 Burrhel Wild Sheep (*Ovis burrhel*), ♀. Born in the Menagerie.
1 Derbian Wallaby (*Halmaturus derbianus*), ♀. Born in the Menagerie.
3 Grey-headed Sparrows (*Passer simplex*). Presented by Edm. G. Meade-Waldo, Esq.
2 Yellow-throated Rock-Sparrows (*Petronia petronella*). Presented by Edm. G. Meade-Waldo, Esq.
1 Tintillon Chaffinch (*Fringilla tintillon*), ♂. Presented by Edm. G. Meade-Waldo, Esq.
1 Rosy Bullfinch (*Erythrospiza githaginea*), ♂. Presented by Edm. G. Meade-Waldo, Esq.
4 Houbara Bustards (*Houbara undulata*). Deposited.
6 Spiegel Carp (*Cyprinus carpio*, var.). Purchased.
19. 1 Roseate Cockatoo (*Cacatua roseicapilla*). Presented by F. C. S. Roper, Esq., F.Z.S.
1 Leadbeater's Cockatoo (*Cacatua leadbeateri*). Presented by Mrs. Obbard.
20. 1 Bonnet-Monkey (*Macacus sinicus*), ♂. Presented by E. Wroughton, Esq., F.Z.S.
1 Grand Galago (*Galago crassicaudata*), ♂. Presented by Walter Carlile, Esq.
1 Alligator (*Alligator mississippiensis*). Presented by C. S. Morris, Esq.
21. 1 Thar (*Capra jemlaica*). Born in the Menagerie.
1 Common Barn-Owl (*Strix flammea*). Presented by Mrs. Frederick Tibbs.
1 Common Barn-Owl (*Strix flammea*). Presented by Chas. Faulkner, Esq.
23. 1 Harnessed Antelope (*Tragelaphus scriptus*), ♂. From the Gambia. Presented by Dr. Percy Rendall.
1 Nagor Antelope (*Cervicapra redunca*), ♂. From the Gambia. Presented by Dr. Percy Rendall.
1 Marabou Stork (*Leptoptilus crumeniferus*). From the Gambia. Presented by Dr. Percy Rendall.

June 24. 2 Vinaceous Turtle-Doves (*Turtur vinaceus*). Bred in the Menagerie.
1 Bosman's Potto (*Perodicticus potto*). Presented by P. S. S. Radcliffe, Esq.
25. 1 Ring-tailed Coati (*Nasua rufa*), ♀. Presented by C. W. Blacklock, Esq.
1 English Wild Bull (*Bos taurus*, var.). Presented by the Earl Ferrers. From Chartley, Staffordshire.
2 Nightingales (*Daulias luscinia*), ♂ ♀. Presented by J. Young, Esq., F.Z.S.
27. 2 Tigers (*Felis tigris*), ♂ ♀. Presented by H.R.H. the Duke of Clarence and Avondale, K.G.
1 Wedge-tailed Eagle (*Aquila audax*). Presented by Capt. Salvin.
28. 1 Alligator (*Alligator mississippiensis*). Presented by Alex. Finlay, Esq.
30. 1 Water-buck (*Cobus ellipsiprymnus*), ♂. Presented by George S. Mackenzie, Esq., F.Z.S. From Somali Land, E. Africa. See P. Z. S. 1890, p. 589.
1 Serval (*Felis serval*). Presented by George S. Mackenzie, Esq., F.Z.S. From Mombasa, E. Africa.
6 Vulturine Guinea-fowls (*Numida vulturina*). Presented by George S. Mackenzie, Esq., F.Z.S. From Somali Land.
3 Mitred Guinea-fowls (*Numida mitrata*). Presented by George S. Mackenzie, Esq., F.Z.S.
6 Vulturine Guinea-fowls (*Numida vulturina*). Deposited.
1 Tawny Owl (*Syrnium aluco*). Presented by G. Gurney, Esq.

July 1. 1 Yak (*Poëphagus grunniens*), ♂. Born in the Menagerie.
1 Viscacha (*Lagostomus trichodactylus*). Born in the Menagerie.
1 Feathery-footed Owl (*Athene plumipes*). Presented by Mons. J. de la Touche. From Newchang, S. Manchuria.
1 Black-and-white Jackdaw (*Corvus dauricus*). Presented by Mons. J. de la Touche. From Newchang, S. Manchuria.
1 Plumbeous Fish-Eagle (*Polioaëtus plumbeus*). Purchased.
1 Bonelli's Eagle (*Nisaetus fasciatus*). Purchased.
2 Emus (*Dromæus novæ-hollandiæ*), ♂ ♀. Received in Exchange.
2. 1 Long-eared Owl (*Asio otus*). Presented by Miss Muriel Hele.
2 Indian White-eyes (*Zosterops palpebrosus*). Deposited.
1 Yellow-winged Sugar-bird (*Cæreba cyanea*), ♂. Deposited.
1 Dufresne's Waxbill (*Estrelda dufresnii*), ♂. Deposited.
1 Green-winged Dove (*Chalcophaps indica*), ♀. Purchased.
2 Golden-headed Parrakeets (*Cyanorhamphus auriceps*), ♂ ♀. Purchased.
7. 1 Australian Crow (*Corvus australis*). Presented by Major C. Lett.
2 Chinchillas (*Chinchilla lanigera*). Purchased.
1 Elate Hornbill (*Ceratogymna elata*). Purchased.
1 White-necked Crow (*Corvus scapulatus*). Purchased.
1 Large Grieved Tortoise (*Podocnemis expansa*). Purchased.
8. 1 Indian Chevrotain (*Tragulus meminna*), ♂. Purchased.
1 Cambayan Turtle-Dove (*Turtur senegalensis*). Born in the Menagerie.
10. 2 Mule Deer (*Cariacus macrotis*), 2 ♂. Born in the Menagerie.

July 10. 1 Cape Ratel (*Mellivora capensis*), ♀. Presented by Capt. J. F. M. Prinsep. From Suakim.
11. 1 Egyptian Gazelle (*Gazella dorcas*). Presented by Commander W. Crofton, R.N.
12. 1 Great Ant-eater (*Myrmecophaga jubata*), ♀. Presented by the Directors of the Botanic Gardens, Demerara.
1 Jackal Buzzard (*Buteo jacal*). Presented by W. H. Wormald, Esq. From East London, Cape Colony.
1 African Hawk-Eagle (*Nisaetus spilogaster*). Presented by W. H. Wormald, Esq. From East London, Cape Colony.
1 Guillemot (*Lomvia troile*). Presented by T. H. Nelson, Esq.
13. 1 Greater Spotted Woodpecker (*Dendrocopus major*). Presented by W. H. B. Pain, Esq.
14. 1 Arctic Fox (*Canis lagopus*), ♀. Purchased.
1 Hawfinch (*Coccothraustes vulgaris*), ♂. Presented by L. C. Wharton, Esq.
4 Australian Wild Ducks (*Anas superciliosa*). Bred in the Menagerie.
2 Slender Ducks (*Anas gibberifrons*). Bred in the Menagerie.
8 Chilian Pintail (*Dafila spinicauda*). Bred in the Menagerie.
6 Summer Ducks (*Æx sponsa*). Bred in the Menagerie.
4 Mandarin Ducks (*Æx galericulata*). Bred in the Menagerie.
2 Red-crested Pochards (*Fuligula rufina*). Bred in the Menagerie.
15. 1 Short-toed Lark (*Calandrella brachydactyla*), ♂. Purchased.
1 White-thighed Colobus (*Colobus vellerosus*), ♂. Purchased.
1 Cape Ratel (*Mellivora capensis*), ♂. Purchased.
18. 1 Snow-Bunting (*Plectrophanes nivalis*). Presented by J. Young, Esq., F.Z.S.
4 Spoonbills (*Platalea leucorodia*). Purchased.
3 Rough-scaled Lizards (*Zonurus cordylus*). Presented by H. A. Spencer, Esq.
1 Hispid Lizard (*Agama hispida*). Presented by H. A. Spencer, Esq.
1 Delalande's Lizard (*Nucras delalandii*). Presented by H. A. Spencer, Esq.
1 Common Boa (*Boa constrictor*). Presented by R. J. Money, Esq.
19. 2 Macaque Monkeys (*Macacus cynomolgus*), 2♀. Presented by Capt. C. Taylor.
21. 2 Ravens (*Corvus corax*). Presented by Walter Chamberlain, Esq., F.Z.S.
22. 1 Dwarf Chameleon (*Chamæleon pumilus*). Presented by Mr. H. Tholen.
1 Black Tortoise (*Testudo carbonaria*). Presented by Master Morris Blake.
1 Cuckoo (*Cuculus canorus*). Presented by Valentine Marks, Esq.
5 Cuming's Octodon (*Octodon cumingi*). Born in the Menagerie.
23. 1 Thar (*Capra jemlaica*), ♀. Born in the Menagerie.
1 Brazilian Hangnest (*Icterus jamaicai*). Deposited.
1 Saffron Finch (*Sycalis flaveola*). Deposited.
2 Bluish Finches (*Spermophila cærulescens*). Deposited.
1 Tropical Seed-Finch (*Oryzoborus torridus*). Deposited.
1 Thick-billed Seed-Finch (*Oryzoborus crassirostris*). Deposited.

July 24. 2 Mule Deer (*Cariacus macrotis*), 2 ♀. Born in the Menagerie.
2 Wheatears (*Saxicola œnanthe*). Presented by J. Young, Esq., F.Z.S.
2 Whinchats (*Pratincola rubetra*). Presented by J. Young, Esq., F.Z.S.
2 Great Tits (*Parus major*). Presented by J. Young, Esq., F.Z.S.
26. 1 Black-faced Kangaroo (*Macropus melanops*), ♂. Deposited.
28. 1 Vulpine Phalanger (*Phalangista vulpina*), ♀. Born in the Menagerie.
29. 1 Common Otter (*Lutra vulgaris*). Presented by the Hon. J. S. Gathorne-Hardy, M.P., F.Z.S.
1 Greater Sulphur-crested Cockatoo (*Cacatua galerita*). Deposited.
2 Cape Doves (*Œna capensis*), ♂ ♀. Presented by Miss Grace Debenham.
2 Smooth Snakes (*Coronella lævis*). Presented by E. Penton, Esq., F.Z.S.
30. 2 Golden Eagles (*Aquila chrysaetus*). Presented by Walter J. Buck, Esq.
5 Common Peafowl (*Pavo cristatus*). Bred in the Menagerie.
7 Californian Quails (*Callipepla californica*). Bred in the Menagerie.
6 Ring-necked Pheasants (*Phasianus torquatus*). Bred in the Menagerie.
5 Silver Pheasants (*Euplocamus nycthemerus*). Bred in the Menagerie.
5 Gold Pheasants (*Thaumalea picta*). Bred in the Menagerie.
31. 1 Malbrouck Monkey (*Cercopithecus cynosurus*), ♂. Presented by Miss Florence Schuler.

Aug. 1. 1 American Black Bear (*Ursus americanus*). Presented by John Sands, Esq.
2. 1 Hairy Armadillo (*Dasypus villosus*), ♂. Deposited.
4. 1 Barbary Wild Sheep (*Ovis tragelaphus*), ♀. Born in the Menagerie.
5. 2 Patagonian Conures (*Conurus patagonus*). Purchased.
2 Ariel Toucans (*Rhamphastos ariel*). Received in Exchange.
1 Yellowish Monitor (*Varanus flavescens*). Presented by Capt. W. J. Rule.
1 Ashy-black Macaque (*Macacus ocreatus*). Presented by W. J. Bosworth, Esq.
9. 1 Wapiti Deer (*Cervus canadensis*), ♀. Purchased.
1 Aard Wolf (*Proteles cristatus*). Purchased.
11. 1 Brown Bear (*Ursus arctos*), ♂. Presented by A. C. de Lafontaine, Esq.
1 Brown Bear (*Ursus arctos*), ♀. Presented by D. B. Gellibrand, Esq.
10 Common Chameleons (*Chamæleon vulgaris*). Presented by W. Manger, Esq.
13. 7 Oyster-catchers (*Hæmatopus ostralegus*). Purchased.
14. 1 Axis Deer (*Cervus axis*). Born in the Menagerie.
16. 1 Panolia Deer (*Cervus eldi*), ♂. Presented by Chas. C. Galbraith, Esq.
1 Common Goat (*Capra hircus*), ♂. Presented by Chas. C. Galbraith, Esq.

Aug. 17. 1 Water-Pipit (*Anthus spipoletta*). Presented by Commander W. M. Latham, R.N., F.Z.S.
18. 1 Common Fox (*Canis vulpes*), ♀. Presented by H. Fane Gladwin, Esq.
3 Cambayan Turtle-Doves (*Turtur senegalensis*). Bred in the Menagerie.
6 Prussian Carp (*Carassius vulgaris*). Presented by G. S. Godden, Esq.
19. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by Miss White.
20. 2 European Scops Owls (*Scops giu*). Presented by E. R. Divett, Esq., F.Z.S. From Roveredo, Italian Tyrol (Austria).
3 Pochards (*Fuligula ferina*), 2 ♂, 1 ♀. Purchased.
21. 1 Punjab Wild Sheep (*Ovis cycloceros*), ♂. Presented by Dr. W. King.
1 Yellow-footed Rock-Kangaroo (*Petrogale xanthopus*), ♂. Born in the Menagerie.
1 Yak (*Poëphagus grunniens*), ♀. Born in the Menagerie.
22. 1 Common Otter (*Lutra vulgaris*). Presented by W. Corbet, Esq.
23. 1 Azara's Fox (*Canis azaræ*). Presented by J. W. Bell, Esq.
25. 1 Madagascar Love-bird (*Agapornis cana*), ♂. Purchased.
26. 1 Wonga-Wonga Pigeon (*Leucosarcia picata*). Purchased.
2 Chinese Alligators (*Alligator sinensis*). Presented by D. C. Jansen, Esq.
28. 1 Great-billed Touracou (*Corythaix macrorhyncha*). Purchased.
29. 1 Squirrel-Monkey (*Chrysothrix sciurea*), ♀. Presented by Mrs. Osgood.

Sept. 1. 1 Banksian Cockatoo (*Calyptorhynchus banksi*). Deposited.
2. 1 Brown Capuchin Monkey (*Cebus fatuellus*), ♂. Deposited.
1 Squirrel Monkey (*Chrysothrix sciurea*), ♀. Deposited.
2 Red-vented Bulbuls (*Pycnonotus hæmorrhous*). Bred in the Menagerie.
3. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by E. Jesser Coope, Esq., F.Z.S.
2 Short-tailed Wallabies (*Halmaturus brachyurus*) Received in Exchange.
1 Nightingale (*Daulius luscinia*). Presented by J. Young, Esq., F.Z.S.
1 Common Chameleon (*Chamæleon vulgaris*). Presented by Master C. S. Forwood.
4. 2 Green-winged Doves (*Chalcophaps indica*). Presented by Mrs. Thompson.
5. 2 Common Marmosets (*Hapale jacchus*). Presented by the Misses Crocker.
1 Hairy Armadillo (*Dasypus villosus*), ♂. Purchased.
8. 1 Green Monkey (*Cercopithecus callitrichus*), ♀. Presented by Mrs. Roupell.
1 Common Viper (*Vipera berus*). Presented by W. H. B. Pain, Esq.
9. 1 Pig-tailed Monkey (*Macacus nemestrinus*), ♂. Deposited.
2 Vinaceous Turtle-Doves (*Turtur vinaceus*). Bred in the Menagerie.
10. 1 Sykes's Monkey (*Cercopithecus albigularis*), ♀. Presented by Mrs. M. Tanner.
2 Bonnet-Monkeys (*Macacus sinicus*), ♂ ♀. Presented by Mrs. Julie Rule.

Sept. 10. 1 Toque Monkey (*Macacus pileatus*), ♀. Presented by Mrs. Julie Rule.
2 Ring-necked Parrakeets (*Palæornis torquatus*). Presented by Mrs. Julie Rule.
1 Grey Ichneumon (*Herpestes griseus*), ♂. Presented by Master Stanley Kerfoot.
13. 1 Brush-tailed Porcupine (*Atherura africana*). Presented by the Liberian Government Concessions and Exploration Co., Ld.
1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by Mr. W. Dodson.
15. 1 Lion (*Felis leo*), ♂. Deposited by H.M. The Queen. From Sokoto, West Central Africa.
1 Common Bee-eater (*Merops apiaster*). Purchased. See P. Z. S. 1890, p. 589.
1 Green-headed Tanager (*Calliste tricolor*). Purchased.
16. 2 Viscachas (*Lagostomus trichodactylus*). Born in the Menagerie.
2 Pucheran's Guinea-fowls (*Numida pucherani*). Presented by Keith Anstruther, Esq.
1 Silver Pheasant (*Euplocamus nycthemerus*), ♀. Presented by E. W. H. Blagg, Esq.
2 Wheatears (*Saxicola œnanthe*). Presented by J. Young, Esq., F.Z.S.
1 Whinchat (*Pratincola rubetra*). Presented by J. Young, Esq., F.Z.S.
1 Whitethroat (*Sylvia cinerea*). Presented by J. Young, Esq., F.Z.S.
17. 1 Brazilian Tree-Porcupine (*Sphingurus prehensilis*). Presented by J. N. Kilner, Esq.
1 Owen's Apteryx (*Apteryx owenî*). Presented by Capt. E. A. Findlay, R.N.R., R.M.S. 'Ruapehu.'
18. 2 Vulturine Guinea-fowls (*Numida vulturina*), ♂ ♀. Received in Exchange.
1 Blue-and-Yellow Macaw (*Ara ararauna*). Presented by Luxmoore Marshall, Esq.
1 Blue-eyed Cockatoo (*Cacatua ophthalmica*). Presented by Mrs. R. E. Anson.
1 Guillemot (*Lomvia troile*). Presented by Mrs. Forbes.
19. 3 Garden Dormice (*Myoxus quercinus*). Received in Exchange.
2 Vulpine Phalanges (*Phalangista vulpina*), ♂ ♀. Presented by J. G. Mackie, Esq.
20. 2 Common Gulls (*Larus canus*). Presented by A. C. Howard, Esq.
1 Black-headed Gull (*Larus ridibundus*). Presented by A. C. Howard, Esq.
21. 1 Rhesus Monkey (*Macacus rhesus*), ♂. Presented by A. I. Keys, Esq.
24. 1 Brown Bear (*Ursus arctos*), ♂. Presented by G. W. Robinson, Esq.
1 Golden Eagle (*Aquila chrysaëtus*), ♀. Presented by Percy Cooper, Esq. From the Rocky Mountains, Wyoming, U.S.A.
25. 1 Reticulated Python (*Python reticulatus*, jr.). Purchased.
5 Viperine Snakes (*Tropidonotus viperinus*). Born in the Menagerie.
27. 2 Common Squirrels (*Sciurus vulgaris*). Purchased.

Sept. 29. 1 White-fronted Lemur (*Lemur albifrons*), ♂. Purchased.
2 Brown Ichneumons (*Herpestes fulvescens*). Purchased.
3 Violet Tanagers (*Euphonia violacea*). Purchased.
1 Horned Screamer (*Palamedea cornuta*, jr.). Purchased. See P. Z. S. 1890, p. 589.
1 Ocellated Sand-Skink (*Seps ocellatus*). Purchased.
1 Chestnut-breasted Duck (*Anas castanea*). Received in Exchange.
1 Great Kangaroo (*Macropus giganteus*). Deposited.

Oct. 2. 2 Mississippi Alligators (*Alligator mississippiensis*). Presented by Miss Edith Baker.
3. 1 Crested Pigeon (*Ocyphaps lophotes*). Bred in the Menagerie.
1 Common Tern (*Sterna hirundo*). Presented by A. C. Howard, Esq.
4. 2 Grizzly Bears (*Ursus horribilis*), 2 ♀. Presented by Ewen Somerled Cameron, Esq., F.Z.S. From the Missouri Brakes, Montana, U.S.A.
1 Raccoon (*Procyon lotor*). Presented by Mr. James H. Frodsham.
1 Macaque Monkey (*Macacus cynomolgus*), ♂. Deposited.
1 Greater Black-backed Gull (*Larus marinus*). Presented by A. M. Bailey, Esq.
1 Herring-Gull (*Larus argentatus*). Presented by A. M. Bailey, Esq.
6. 2 Blackcaps (*Sylvia atricapilla*). Presented by J. Young, Esq., F.Z.S.
1 Garden-Warbler (*Sylvia hortensis*). Presented by J. Young, Esq., F.Z.S.
7. 2 Black-eared Marmosets (*Hapale penicillata*). Presented by Capt. C. Crawford-Caffier, R.N.
1 African Civet Cat (*Viverra civetta*). Presented by Lieut.-Col. W. Gordon-Patchett, W.I.R.
1 Two-spotted Paradoxure (*Nandinia binotata*). Presented by Lieut.-Col. W. Gordon-Patchett, W.I.R.
2 North-African Jackals (*Canis anthus*). Deposited.
3 Passerine Parrots (*Psittacula passerina*). Presented by Arthur Robottom, Esq.
8. 2 Long-fronted Gerbilles (*Gerbillus longifrons*), ♂ ♀. Presented by Miss F. A. Kitchener.
1 Bauer's Parrakeet (*Platycercus zonarius*). Presented by Mrs. E. M. Temple.
2 Philantomba Antelopes (*Cephalophus maxwelli*), ♂ ♀. Purchased.
1 Toco Toucan (*Rhamphastos toco*). Purchased.
9. 1 Golden Eagle (*Aquila chrysaëtus*). Presented by Chas. Alfred Payton, Esq.
1 Snowy Egret (*Ardea candidissima*). Presented by H. H. Sharland, Esq., F.Z.S.
1 Herring-Gull (*Larus argentatus*). Presented by the Hon. J. S. Gathorne-Hardy, M.P., F.Z.S.
3 Lesser Black-backed Gulls (*Larus fuscus*). Presented by the Hon. J. S. Gathorne-Hardy, M.P., F.Z.S.
6 Esquimaux Dogs (*Canis familiaris*, var.), 4♂, 2♀. Born in the Menagerie.
10. 1 Serval (*Felis serval*). Presented by J. H. Cheetham, Esq., F.Z.S.

Oct. 10. 2 Purple Porphyrios (*Porphyrio cæruleus*). Presented by J. I. S. Whitaker, Esq., F.Z.S. From Sicily. See P. Z. S. 1890, p. 590.
1 Malaccan Parrakeet (*Palæornis longicauda*), ♂. Purchased.
11. 1 Common Chameleon (*Chamæleon vulgaris*). Presented by Mrs. E. Wanklyn.
13. 1 Common Chameleon (*Chamæleon vulgaris*). Presented by Mr. V. H. Dudmesh.
14. 1 Speke's Antelope (*Tragelaphus spekii*), ♀. Presented by James A. Nicolls, Esq., F.Z.S. From Lake Ngami, S. Africa. See P. Z. S. 1890, p. 590, Plate XLVII.
1 White Pelican (*Pelecanus onocrotalus*). Deposited.
16. 1 Larger Hill-Mynah (*Gracula intermedia*). Received in Exchange.
1 Bay Colobus (*Colobus ferrugineus*), ♀. Purchased. See P. Z. S. 1890, p. 590, Plate XLVIII.
2 Herring-Gulls (*Larus argentatus*). Presented by Mr. Joseph White.
1 Beech-Marten (*Mustela foina*). Presented by H. H. Sharland, Esq., F.Z.S.
18. 2 Reindeer (*Rangifer tarandus*), ♂ ♀. Presented by Col. W. B. Thomson, F.Z.S.
20. 1 Angora Goat (*Capra hircus*, var.), ♀. Received in Exchange.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Born in the Menagerie.
2 Pomatorhine Skuas (*Stercorarius pomatorhinus*). Presented by Mr. T. E. Gunn.
22. 1 Cashmere Monkey (*Macacus pelops*), ♀. Deposited.
2 Reed-Buntings (*Emberiza schæniclus*). Purchased.
2 Redpolls (*Linota rufescens*). Purchased.
23. 2 Laughing Kingfishers (*Dacelo gigantea*). Presented by W. B. Phillips, Esq.
2 Vinaceous Turtle-Doves (*Turtur vinaceus*). Born in the Menagerie.
24. 1 Polecat (*Mustela putorius*). Presented by F. D. Lea Smith, Esq.
2 Common Squirrels (*Sciurus vulgaris*). Purchased.
1 Spotted Ichneumon (*Herpestes nepalensis*). Presented by J. Percy Leith, Esq., F.Z.S.
25. 1 Diana Monkey (*Cercopithecus diana*), ♀. Presented by Howard V. Henry, Esq.
28. 1 Alligator (*Alligator mississippiensis*). Presented by A. Schafer, Esq.
29. 2 Black-faced Spider-Monkeys (*Ateles ater*). Deposited.
1 Azara's Fox (*Canis azaræ*), ♂. Presented by R. M. Dodington, Esq.
30. 1 Rhesus Monkey (*Macacus rhesus*), ♀. Presented by Chas. E. Flower, Esq.

Nov. 3. 2 Masked Weaver-birds (*Hyphantornis personata*), ♂ ♀. Presented by Commander W. M. Latham, F.Z.S.
1 Short-winged Weaver-bird (*Hyphantornis brachyptera*), ♀. Presented by Commander W. M. Latham, F.Z.S.
1 Indian Grey Shrike (*Lanius lahtora*). Purchased.
1 English Wild Cow (*Bos taurus*, var.). Presented by G. W Duff Assheton-Smith, Esq. From Vaynol Park, Bangor.
4. 1 Viverrine Cat (*Felis viverrina*), ♀. Presented by Capt. H. Fortescue, 17th Lancers.

Nov. 4. 1 Azara's Fox (*Canis azaræ*). From Chili. Presented by Thos. S. Fisher, Esq.
5. 1 Brown Bear (*Ursus arctos*). Presented by W. H. Stuart, Esq.
2 Squirrel-Monkeys (*Chrysothrix sciurea*). Presented by E. Leech, Esq.
8. 1 White-crested Touracou (*Corythaix albocristata*). Purchased.
10. 1 Globose Curassow (*Crax globicera*), ♂. Presented by R. M. Pryor, Esq., F.Z.S.
11. 2 Long-eared Owls (*Asio otus*). Presented by Mrs. Twickline.
1 Indian Chevrotain (*Tragulus meminna*), ♂. Presented by Mr. Greenberg.
12. 1 Bennett's Cryptoprocta (*Cryptoprocta ferox*), ♂. Purchased. See P. Z. S. 1890, p. 647.
1 Alligator (*Alligator mississippiensis*). Presented by C. J. Owen, Esq.
2 Crested Porcupines (*Hystrix cristata*). Born in the Menagerie.
1 Eyed Lizard (*Lacerta ocellata*, var.). Presented by Francis Napier, Esq.
15. 1 Kittiwake Gull (*Rissa tridactyla*). Presented by Miss Lauze.
20. 1 Toque Monkey (*Macacus pileatus*), ♀. Presented by A. S. Rose, Esq.
22. 1 Virginian Opossum (*Didelphys virginiana*), ♂. Presented by N. Hammond, Esq.
25. 1 Ocelot (*Felis pardalis*), ♀. Presented by J. H. Bennett, Esq.
2 Cape Zorillas (*Ictonyx zorilla*), 2 ♀. Presented by Miss Reinette Dumings.
10 Thunder-Fish (*Misgurnus fossilis*). Purchased.
5 Golden Orfes (*Leuciscus orfus*). Purchased.
27. 1 Common Fox (*Canis vulpes*), ♀. Presented by R. Myddelton Biddulph, Esq.
1 Ring-necked Parrakeet (*Palæornis torquatus*), ♀. Presented by Miss S. L. Hands.

Dec. 1. 1 Common Raccoon (*Procyon lotor*). Presented by C. E. Brewerton, Esq.
2. 1 Himalayan Bear (*Ursus tibetanus*), ♀. Presented by B. T. Ffinch, Esq., C.M.Z.S. From Beloochistan.
1 Greater White-crested Cockatoo (*Cacatua cristata*). Presented by Mrs. C. J. Cassirer.
1 Water-Rail (*Rallus aquaticus*). Presented by Mr. T. E. Gunn.
2 Alligators (*Alligator mississippiensis*). Presented by Henry Birkbeck, Esq.
3. 2 Snow-Buntings (*Plectrophanes nivalis*). Purchased.
4. 1 Barbary Ape (*Macacus inuus*), ♂. Presented by Mdm. Ruoy.
1 Pinche Monkey (*Midas œdipus*), ♀. Presented by J. Barry O'Callaghan, Esq.
1 Pennant's Parrakeet (*Platycercus pennanti*). Presented by Mrs. Moon.
5. 1 White-fronted Capuchin (*Cebus albifrons*), ♂. Presented by Mrs. Akers-Douglas.
1 Blue-and-Yellow Macaw (*Ara ararauna*). Presented by A. Cohen, Esq.
1 Vulpine Phalanger (*Phalangista vulpina*), ♂. Born in the Menagerie.
7. 2 Pied Snakes (*Pituophis melanoleucus*). Presented by R. Morton Middleton, jr., Esq., F.Z.S. From New Jersey, U.S.A.

Dec. 8. 1 Cape Hyrax (*Hyrax capensis*). 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.
1 Galeated Pentonyx (*Pelomedusa galeata*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Rough-scaled Lizards (*Zonurus cordylus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
6 Dwarf Chameleons (*Chamæleon pumilus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Smooth-headed Lizard (*Mabuia homalocephala*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Rufescent Snakes (*Leptodira rufescens*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
3 Smooth-bellied Snakes (*Homalosoma lutrix*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Rufous Snake (*Ablabes rufulus*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
1 Ring-hals Snake (*Sepedon hæmachates*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Robben-Island Snakes (*Coronella phocarum*). Presented by the Rev. G. H. R. Fisk, C.M.Z.S.
2 Snow-Buntings (*Plectrophanes nivalis*). Presented by J. L. Baldwin, Esq.
3 Bramblings (*Fringilla montifringilla*). Presented by J. L. Baldwin, Esq.
9. 1 Common Fox (*Canis vulpes*), ♂. Presented by C. T. Stanhope Bilbrough, Esq.
10. 1 Broad-fronted Crocodile (*Crocodilus frontatus*). Received in Exchange.
13. 2 Common Mynahs (*Acridotheres tristis*). Presented by G. W. Blathwayt, Esq.
2 St. Thomas's Conures (*Conurus pertinax*). Presented by H. C. Martin, Esq.
1 Demoiselle Crane (*Grus virgo*). Presented by Mrs. Wright.
17. 1 Wild Cat (*Felis catus*), ♂. Presented by Osgood H. Mackenzie, Esq.
1 African Civet Cat (*Viverra civetta*), ♀. Presented by John J. Pitcairn, Esq., M.R.C.S., F.Z.S.
2 Weka Rails (*Ocydromus australis*). Presented by Edward T. Dixon, Esq.
18. 1 Himalayan Bear (*Ursus tibetanus*, jr.). Deposited. From E. Tibet.
19. 1 Common Teguexin (*Tupinambis teguexin*). Presented by Mr. Edward Sloane. From Rio de Janeiro.
1 Molucca Deer (*Cervus moluccensis*), ♀. Born in the Menagerie.
22. 1 Macaque Monkey (*Macacus cynomolgus*), ♀. Presented by P. Boulton, Esq.
1 Tuatera Lizard (*Sphenodon punctatus*). Presented by Capt. Worster.
26. 2 Common Marmosets (*Hapale jacchus*). Presented by F. J. Biggs, Esq.
31. 2 Brown Bears (*Ursus arctos*). Deposited.

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