TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

VOLUME XIII.

LONDON:

PRINTED FOR THE SOCIETY:

SOLD AT THEIR HOUSE IN HANOVER-SQUARE:

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

1895.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

CONTENTS.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

I. *On the Genus* Urothoe *and a new Genus* Urothoides.

By the Rev. Thomas R. R. Stebbing, *M.A.*

Received July 16th, 1889, read November 5th, 1889.

[Plates I.–IV.]

Genus Urothoe, Dana, 1852.

1852. *Urothoe*[1], Dana, American Journ. Sci. and Arts, ser. 2, vol. xiv. p. 311.
1852. „ Dana, United-States Explor. Exped. vol. xiii. pt. 2, pp. 908, 920.
1853. *Egidia,* Costa, Rendiconto d. Soc. r. Borb. Acad. d. Scienze, p. 165.
1856. *Gammarus* (pars), Spence Bate, On the British Edriophthalma, Brit. Assoc. Report for 1855.
1857. *Egidia,* Costa, Ricerche sui Crost. Amfip. Nap. pp. 174, 190.
1857. *Sulcator* (pars), Spence Bate, Synopsis of British Edr. Crust., Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 140.
1857. „ (pars), White, Popular Hist. Brit. Crust. p. 175.
1857. *Urothoe,* Spence Bate, Synopsis of British Edr. Crust., Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 145.
1857. „ White, Popular Hist. Brit. Crust. p. 186.
1860. „ Boeck, Forhandlinger ved de Skand. Naturf. 8de Möde, p. 646.
1862. „ Spence Bate, Brit. Mus. Catal. Amph. Crust. p. 114.
1862. „ Bate & Westwood, British Sess. Crust. vol. i. p. 192.
1865. „ Lilljeborg, On *Lysianassa magellanica,* p. 18.
1869. „ Grube, Mitth. über St. Vaast-la-Hougue, Abhandlungen der schlesischen Gesellschaft für vaterländische Cultur, 1868–9, p. 119.
1869. „ Norman, Last Report on Dredging among the Shetland Isles, Brit. Assoc. Report for 1868, p. 279.

---

[1] The name is variously printed in different works as *Urothoe, Urothöe,* and *Urothoė.*

1870. *Urothoe*, Boeck, Crust. amph. bor. et arct. p. 57.
1876. „ Boeck, De Skand. og Arkt. Amph. p. 224[1].
1876. „ Giard, Comptes Rendus, Jan. 3, p. 76; Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 261.
1876. „ Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 344.
1877. „ Meinert, Crust. Isop. Amph. et Decap. Daniæ, p. 107.
1878. „ Spence Bate, the Crustacea in Couch's Cornish Fauna revised, Journ. Roy. Inst. Cornwall, no. xix. pt. ii. p. 48.
1879. „ Sars, Crust. et Pycn. nova, p. 446.
1879. „ Stebbing, Sessile-eyed Crustacea of Devonshire, Suppl. List, Trans. Devon. Assoc. vol. xi. p. 519.
1882. „ Haswell, Catal. Australian Stalk- and Sessile-eyed Crustacea, p. 240.
1882. „ Sars, Oversigt af Norges Crustaceer, p. 22.
1884. „ Chevreux, Assoc. pour l'av. des Sciences, Blois.
1885. *Egidia*, Carus, Prodromus Faunæ Mediterraneæ, pars ii. p. 419.
1885. *Urothoe*, Sars, Den norske Nordhavs-Exped. p. 164.
1886. „ Gerstaecker, Bronn's Klassen und Ordnungen, Bd. v. Abth. ii. p. 501.
1887. „ Barrois, Note sur Morph. des Orchesties et liste Amph. du Boulonnais, p. 16.
1887. „ Bonnier, Catal. Crust. Malac. Concarneau, p. 79.
1887. „ Chevreux, Crust. Amph. dragués par l'*Hirondelle*, Bull. Soc. Zool. de France, t. xii. extr. pp. 13, 15.
1887. „ Chevreux, Catal. Crust. Amph. Bretagne, Bull. Soc. Zool. de France, t. xii. extr. p. 10.
1888. „ Chevreux, Distr. géogr. Amph. sur les côtes de France, Bull. Soc. d'études Sci. de Paris, 11[e] année, 1[er] sem. 1888, extr. pp. 2, 7.
1888. „ Chevreux, Amph. du littoral des Açores, Bull. Soc. Zool. de France, t. xiii. p. 34.
1888. „ Chevreux, Dragage de l'*Hirondelle* au large de Lorient, Bull. Soc. Zool. de France, t. xiii. séance du 28 février.
1888. „ Chevreux, Amph. réc. aux environs de Cherchell, Assoc. pour l'av. des Sci. Oran, séance du 3 avril.
1888. „ Robertson, Catal. Amph. and Isop. Clyde, p. 29.
1888. „ Stebbing, Challenger Reports, vol. xxix. p. 824.

Upper lip distally rounded, strongly attached to the mandibles.

Mandibles having the cutting-edge scarcely denticulate, the secondary plate small, spine-row wanting, the molar tubercle strong, all three joints of the palp slender and rather elongate.

First maxillæ with inner plate slender, curved, the two joints of the palp subequal.

Maxillipeds with inner and outer plates of only moderate size, the second joint of the palp large and dilated, the third joint apically dilated, the fourth narrow.

Upper antennæ with a secondary flagellum; the three joints of the peduncle moderately elongate, not very unequal in length, together longer than the few-jointed flagellum.

[1] In the first part of this work (1872) at p. 56, Boeck refers to Costa's *Egidia* as *Aegidia*.

Lower antennæ. Peduncle spinous; the flagellum in the male very long, and multi-articulate, in the female very short, two-jointed; calceoli present in the adult male both on the flagellum and on the last joint of the peduncle.

First and second gnathopods similar, subchelate, the wrist larger than the hand; the finger of the *first gnathopod* longer than that of the *second*, each having a little transparent cap over the tip.

First and second peræopods having the third joint longer than the strongly spined fourth or fifth.

Third peræopods with the first, third, and fourth joints dilated, the third, fourth, and fifth strongly spined, and furnished with long plumose setæ; the fourth joint as wide as or wider than the third.

Fourth peræopods the longest, with long plumose setæ on the first and third joints. In all the *peræopods* the finger has the inner margin more or less nodulous or serrulate and has a cap over the tip.

Pleopods having the inner ramus conspicuously shorter than the outer, and in the female the peduncle distally widened.

Third uropods. The outer ramus furnished with a small second joint.

Telson in general cleft nearly to the base.

Body generally obese, not much either depressed or compressed; the side-plates not very large. Gland-cells are distributed in great numbers over different parts of the animal.

In this genus the *eyes* are very variable; in some, if not in all, species the eyes, though very large in the male, are of moderate size in the female, and very small in the young. In *Urothoe abbreviata*, Sars, no eyes were observed; but the specimen being very small and probably young, it cannot be inferred with certainty that this is a blind species. The second joint of the mandibular palp forms an angle or bend near its base, owing to which its full length is sometimes not perceived. The inner plate of the first maxillæ appears to be always slender and slightly curved; the first joint of the palp seems to vary in its proportion to the second, to which it is sometimes equal, while in other cases it may be longer or shorter than it. Boeck has remarked that, when Dana attributed to this genus long and narrow maxillipeds with very small inner lamellæ, he was thinking only of his *Urothoe rostratus*, which belongs elsewhere. Spence Bate was perhaps influenced by Dana's account when describing the outer plates as small, and the inner as rudimentary; they are, in fact, both of moderate size. In most, and perhaps in all, species the wrist of the *first gnathopod* is distinguished from that of the *second* by having a row of short feathered setæ planted just within the distal margin. As a rule, there is an oblique row of setæ on the outer surface of the third and fourth joints of the first and second peræopods; long feathered setæ are attached to the inner distal margin of the third and fourth joints and to the inner surface of the fifth joint in the *third peræopods*, also to the inner surface of the first joint and the hind margin of the third joint in the *fourth peræopods*, also to the inner surface on the lower part of the second pleon-segment, and to the rami of the *third uropods.*

There have been at various times assigned to this genus twelve named species, one unnamed species, and one named variety. Four of the species have their proper places in other genera. *Urothoe rostratus*, Dana, 1852, from the Sooloo Sea, was transferred by Boeck in 1876 to *Phoxus* (now *Phoxocephalus*); and whether it belongs to that genus or not, it is certainly excluded by the maxillipeds from *Urothoe.* In 1874 Professor S. I. Smith recorded "*Urothoë*, species," as "apparently belonging to this genus," from Vineyard Sound, N.E. America. This, however, proves to be a species of the genus *Harpinia*, Boeck. *Urothoë pinguis*, Haswell, 1880, from Bondi, New South Wales, also approaches the genus *Harpinia*, but is clearly removed from *Urothoe* by the upper antennæ, the maxillipeds, the gnathopods, and some other details. *Urothoe lachneëssa*, Stebbing, 1888, from Kerguelen, should be transferred to a new genus *Urothoides*, on account of the character of the fourth and fifth peræopods and the third uropods, as well as the absence of the plumose setæ, which are so conspicuous in the European species of *Urothoe.*

The type species, *Urothoe irrostratus*, Dana, 1852, had scarcely been published, when another species of the same genus appeared under the name *Egidia pulchella*, Costa, 1853, from the Bay of Naples. The fuller description of this species was given in 1857, and in 1872 Boeck pointed out that *Egidia* was a synonym of *Urothoe.* In the generic description Costa says that the lower antennæ have the first joint unarmed, doubtless meaning that there is no gland-cone; but this is a mistake, as the gland-cone, though inconspicuous, is present. It is clear both from the generic and specific characters that Costa confused some of the limbs, overlooking one of the first two pairs of peræopods altogether, and regarding the third pair as the second. In describing the third peræopods he also evidently overlooked the second joint, so that, although he gives a recognizable description and figure of the last four joints of the limb, he supposes the last of the four, the finger, to be entirely wanting. It is clear from the account of the lower antennæ that *Urothoe pulchella* was described from a male specimen. The eyes are stated to be large, rounded-triangular, nearly meeting on the back. The colour of the living animal was, according to Costa, pale green (*verdiccio pallido*). The prevailing colour in the genus is light buff, sometimes mottled with pink or rose-colour. Rose-coloured specimens procured from Naples by Dr. Norman must probably be assigned to *Urothoë elegans*, Bate. Other specimens from the same locality, not so coloured, agree well with Costa's species, though not having the hand of the second gnathopods produced into a tooth confronting the finger. This tooth may have been described and figured by Costa under a misapprehension owing to his having only had an oblique view of the little convex palm.

In 1856 Spence Bate published a third species of the genus under the name *Gammarus elegans*, which in 1857 he changed to *Urothoe elegans*. The type specimen from Plymouth was described in detail, and figured in the British-Museum Catalogue in 1862. Many of the characters given are common to other species. The long flagellum of the lower antennæ shows that the specimen was a male. The eyes are described as "nearly horizontal, long ovate," the palms of the gnathopods as "oblique, imperfectly defined, ciliated," the fingers of the peræopods as straight and sharp. In the fifth peræopods, it is said, "a few long plumose cilia mixed with short simple ones occur upon the posterior margins of the carpus and propodos." The first and second uropods are said to be short, with the "rami very short, shorter than their respective bases, subequal," while the third pair are, as usual, "long; rami longer than base, plumosely ciliated." In the figure the postero-lateral angles of the third pleon-segment are decidedly acute. In the 'British Sessile-eyed Crustacea' (1862) a figure of the species similar to that in the Catalogue is given, with a much shorter description. Here the authors think two "important points," the shape of the eyes and the size of the antennæ, sufficient to distinguish it from *Urothoe marinus*. "The rest of the animal," they say, "scarcely offers any specific variation from *U. marinus*." As the size of the antennæ is dependent on age and sex, the only character left for distinction is that of the eyes, which, the authors say, "are uniform." Since this has no meaning, it becomes a question whether the word intended may have been *reniform* or *oviform*. An explanation is given that the specific name was suggested by the extremely beautiful colouring,—whitish-buff, and parts mottled with pink,—but no stress is laid upon this as a specific character. The Scotch specimens of *Urothoe*, from the Clyde and the Shetland Isles, which make the nearest approach to this species, agree with Spence Bate's figure of it in not having the joints below the first in the third peræopods much dilated, and in having the corresponding joints in the two following pairs rather elongate; but no specimens that have come under my observation have the postero-lateral angles of the third pleon-segment acutely produced as in Spence Bate's figure of *Urothoe elegans*, or the second uropods with rami so very short. The discrepancies may be explained by the fact that no dissection of the specimen was made. This will account for the circumstance that the first and second peræopods are drawn with seven joints, the third only with five, and that no regard is paid to the long plumose setæ on the third and fourth peræopods.

In 1857, under the name of *Sulcator marinus*, Spence Bate published a species which in 1862 he figured and more fully described as *Urothoe marinus*, having received it from the Moray Firth, the Shetlands, and the Clyde. It was pointed out by Giard in 1876 that the brevity of the lower antennæ relied on as a specific character only indicated that the specimen examined was a female. In the description of these antennæ it is stated that the *first* joint of the peduncle is "furnished with three longitudinal rows of obtuse-pointed spines," and that the flagellum consists of a single joint; but that which by a slip of the pen is called the *first*, is in reality the *fourth* joint of the peduncle, and it is surmounted by two, not three, rows of spines, although sometimes the spines of one row by lying over in opposite directions give the appearance of a double row. The flagellum consists of two joints, a long and a short one. The first pair of gnathopods are said to be much smaller than the second; but, while this would be unusual in the genus, there is a fairly certain proof that the gnathopods have been interchanged in the description, since the larger gnathopods are figured as having on the distal margin of the wrist the little row of spines which is distinctive of the first pair. It is true that both in the Museum Catalogue and in the 'British Sessile-eyed Crustacea' these gnathopods are figured with the branchial vesicle attached, which of course cannot belong to the first pair, and no doubt it was this apparent attachment of the breathing-organ which led to the confusion. The segments carrying the two pairs of gnathopods are in this genus so closely tied together, that the accident might easily arise of the second gnathopod being detached, while leaving its branchial vesicle in apparent connection with the first gnathopod. Of the crooked finger ascribed to the fifth peræopods I can give no account, except that it appears to be abnormal or accidental. The character most easy to seize for this species is to be found in the uropods, of which the first pair have a short peduncle and short unequal rami, the inner ramus being the shorter and much curved. In Spence Bate's figure the tips of these rami do not reach to the end of the short peduncle of the second pair, but in their natural position they reach much further than this, since the fourth pleon-segment much overlaps the fifth at the sides. The telson is accurately defined as "subapically furnished with a short spine and several fine hairs," but in no specimen that I have seen is it cleft quite to the base as in the figure. The length of the animal is said in the Museum Catalogue to be "$\frac{4}{20}$ths of an inch;" but in the 'British Sessile-eyed Crustacea' we read "length $\frac{12}{20}$ths of an inch," without any explanation of the change. In the latter work a line presumably indicating the natural size measures $\frac{6}{20}$ of an inch, and there can in fact be no doubt that $\frac{12}{20}$ is a misprint. Nevertheless *Urothoe marinus* is a much larger and more robust species than *Urothoe elegans.*

Urothoë norvegica, Boeck, 1860, from Norway, was the species next established. Figures and detailed description of it did not appear till 1876, and even with these the species is still left in some obscurity. It may be presumed from the small size of the lower antennæ that the specimen examined was a female[1]; for, though Boeck states that the flagellum has four joints, an inspection of the figure makes it tolerably certain that there were actually no more than the usual two. Of the third pleon-segment Boeck makes two statements—one, that the postero-lateral angle is produced upwards, the other, that it is acute. His figure does not correspond with either particular. Of the third peræopods he remarks that the first joint is not much dilated. Specimens obtained by Canon Norman from "Sleat Sound, 1866," and "Shetland, 1867," agree with

[1] For a different opinion, see Chevreux on this species, 1887.

Boeck's description in having the angles of the third pleon-segment acute (though not produced upwards), and in having the first joint of the third peræopods rather less dilated than is usual in the genus, and with the lower hinder angle of the joint very much rounded. In Boeck's work, De Skand. og Arkt. Amphip. plate vii., fig. 4 *n* probably refers to these limbs, not, as the lettering would indicate, to the fifth peræopods. In describing the fifth peræopods he says that the fourth joint is longer and thicker than the *first*. *First* is obviously a misprint for *fifth*, a correction which brings the statement into agreement with Norman's specimens above referred to, and with Boeck's own figure of the limb, plate vi. fig. 9 *m*, where 9 *m* would indicate the third or the fourth peræopods, and is beyond doubt a mistake for 9 *n*. Plate vii. has two figures marked 4 *h*, as if representing the maxillipeds of *Urothoe norvegica*, but the upper one should probably be 5 *h*, referring to the species "*Phoxus Holbölli*;" in the lower one the first joint of the palp has been accidentally omitted. The figures 4 *g* and 4 *m* near the right-hand lower corner of the plate are most likely also wrongly numbered.

In 1862 Spence Bate described and figured under the title "*Urothoë Bairdii*, n. s.," a specimen obtained, like *Urothoe marinus*, from the Moray Firth. The lower antennæ show that the specimen was a male, but not a male which had attained its fullest development, so as to have calceoli and a very prolonged flagellum with very slender joints. Both in the Museum 'Catalogue' and in the 'British Sessile-eyed Crustacea' the maxillipeds are figured, evidently by mistake, without a finger; in the latter, but not in the former, work the lettering of the first and second pairs of uropods is transposed. The latter work affirms that the third peræopods "terminate in a knife-shaped finger, the anterior margin of which is entire," and the margin is so represented in both works, owing, I believe, to defective observation, since the denticulation of this margin may easily escape notice from some points of view, but has nevertheless proved to be present in all specimens of the genus that I have examined. It seems to me scarcely doubtful that *Urothoe Bairdii* is a synonym of *Urothoe marinus*. The peculiarity of having the outer ramus of the third uropods devoid of plumose setæ can scarcely be relied on of itself to constitute specific distinction. It can derive no validity from the sanction of a single, not fully developed, specimen. Boeck supposes *Urothoe Bairdii* to be a synonym of his own *Urothoe norvegica*; but in the former species the first joint of the third peræopods is very broad instead of being, as in Boeck's species, comparatively narrow, and the rami of the first uropods are very unequal, while in Boeck's species they are equal, so that there is really no question of uniting these two names.

In the same year (1862) Spence Bate established another species, upon a specimen one-tenth of an inch in length from Tenby, under the name *Urothoë brevicornis*, n. s. The specific name is unfortunate, since it is now known that the young and females in all species of the genus have the lower antennæ short, while they are long in the adult males. As in the case of *Urothoe marinus*, so here it is evident that the first and second gnathopods have been confused, the larger first gnathopods with the spines on the apex of the wrist being figured and described as the second.

Professor Grube in 1869 described and figured a specimen from St. Vaast-la-Hougue under the title "*Urothöe marinus*, Sp. Bate, ? var. *pectinatus*, Gr." (in the explanation of the plate "**Urothoe marinus**, Sp. B. (? var. **pectina**, Gr.)." The account of the lower antennæ shows that the specimen was a female. Grube says that these antennæ have five joints, the second much longer than the first, armed above with a subtriple row of spines, the third simple, and armed with an outer row of rather long setæ, the flagellum very short, equalling the length of the third joint. The so-called second joint with the *subtriple* row of spines is evidently the fourth joint of the peduncle, the so-called third being the fifth, and the remaining two joints constituting the flagellum. He notices that the finger of the second gnathopods is shorter than that of the first. He would have been well content to assign the specimen to *Urothoe marinus*, Bate & Westwood, but for certain differences in the peræopods, especially the third pair, and in the uropods and telson. The stripes and patches of yellow-ochre which he notices on the three hinder pairs of peræopods are not peculiar to any one species of *Urothoe*, being due to the gland-cells which are found in almost every part of the animal. The spines on the third, fourth, and fifth joints of the third peræopods are not fully represented in Spence Bate's figures, but such details often escape notice, or are only perfunctorily represented before their importance has been brought into special prominence, so that it is rash of Grube to infer that had they been present they could not have been neglected. In regard to the plumose setæ on these limbs Grube himself has fallen into some misapprehension. He says that Spence Bate speaks only of one row of simple hairs on the hind rim of the third peræopods, while in Grube's specimen they are as decidedly plumose as Spence Bate figures them on the fifth pair[1]; the first joint, too, appears in Spence Bate noticeably narrowed below, whereas he (Grube) found it equally broad above and below. But Spence Bate speaks only of the first joint as having the hind margin "fringed with a row of simple hairs," just as Grube himself figures it. "The rest of the leg is remarkable for long plumose cilia," according to the account in the 'British Sessile-eyed Crustacea.' In the full figure given in that work of *Urothoe marinus*, the first joint of the third peræopods answers to Grube's description of it; but in a full figure the limbs being seen at all sorts of angles often give but a very rough idea of their actual details, and in the separate figure of the limb in question it is at once seen that the first joint is, as is usual throughout the genus, broader below than above. The first uropods are omitted from Grube's figure of his specimen; but in the Latin description he says that the first and second uropods reach almost equally far back, rarely beyond the peduncle of the third pair, having their rami slightly curved. By this account the position of the species is left obscure. The

[1] It is in *Urothoe elegans*, not in *Urothoe marinus*, that Spence Bate figures the plumose setæ on the fifth peræopods.

telson is described in the Latin as "latius lanceolatum, usque ultra dimidium fissum," and in the German as "cleft only to the middle, much longer than broad, running out into two narrow points, each with a spinule and two setæ." In the species of *Urothoe* in general the telson is cleft much beyond the centre.

In 1879 Sars described, under the name *Urothoë abbreviata*, n. sp., a single specimen, 3 millim. in length, taken in the sea north-west of Finmark, lat. 71° 25′ N., long. 15° 40′·5 E., from a depth of 620 fathoms. Of this in 1885 he gave a somewhat fuller description and a figure. In the earlier account he distinguishes it from other species by the abbreviate form of the body, the absence of eyes, and the rudimentary accessory flagellum of the upper antennæ; in the later, "by its remarkably short and thickset body, the peculiar form distinguishing the first pair of antennæ, the absence of eyes, and by the short last pair of caudal stylets." In point of fact these characters are not of much service for the recognition of the species. The short and thickset body is not the exception but the rule in this genus. In the young the eyes are also, as a rule, very inconspicuous. "The first pair of antennæ," according to Sars, "are rather elongate, and unlike those in all other known species." Yet according to his description and figure of these organs they agree very well with the prevalent form, the smallness of the flagellum in all probability only indicating that the specimen was a very young one. Its diminutive size and the shortness of the last uropods are in accord with this supposition. In the earlier account Sars states that the flagellum of the lower antennæ has four joints, just as Boeck does for his *Urothoe norvegica*; but in the later account Sars omits all mention of this flagellum, only saying that these antennæ from their position are difficult to examine without dissection. The circumstance that the almost rectangular corners of the third pleon-segment are *not produced upwards* is probably mentioned as a point of distinction from Boeck's species, but, judging by Boeck's figure, the upward production is wrongly attributed to that species itself. On the whole, with our present information, it is difficult to avoid the conclusion that *Urothoe abbreviata* is the young of *Urothoe norvegica*, a deep-water form, of which fuller and more definite details are still to be desired.

In 1888 M. Chevreux described, under the name "*Urothoe Poucheti*, nov. sp.," a male specimen taken at the surface, off Ponta Delgada, at the island of San Miguel, in the Azores. "This species," he says, "while tolerably near to *Urothoe elegans*, Sp. Bate, differs from it by its less obese form, the size and peculiar appearance of the eyes, and above all by the first two pairs of uropods, which are more developed than in other species of the genus." "The eyes prominent, very large, rounded, meeting one another at the apex of the head," would naturally be a very distinctive character to any one judging only by the published figures of species in this genus. It is, however, common to the fully developed males in several species, and agrees closely with Costa's description of the eyes in *Egidia pulchella*. The uropods, of which M. Chevreux has kindly sent me a drawing, correspond in general shape and proportions with those of *Urothoe brevicornis*, Sp. Bate; but the peduncle of the first pair shows a series of twenty-four spines, and the outer ramus has four spines, the outer ramus of the second pair carrying three spines. *Urothoe brevicornis*, moreover, is not less, but more, bulky than *Urothoe elegans*.

I have been most kindly assisted with specimens for this paper by M. E. Chevreux, D. Robertson, Esq., and the Rev. Canon Norman. Dr. Norman had already taken up the subject himself, but as soon as he heard that my work was further advanced than his own he at once, *more suo*, placed at my disposal both his preliminary notes and his collection of species from numerous localities.

UROTHOE IRROSTRATUS, Dana.

1852. *Urothoe irrostratus*, Dana, United-States Explor. Exped. vol. xiii. pt. 2, p. 922, pl. 62. figs. 6 *a–f*.
1862. „ „ Spence Bate, Brit. Mus. Catal. Amph. Crust. p. 117, pl. xx. figs. 3, 3 *c*.
1876. „ „ Boeck, De Skand. og Arkt. Amph. p. 225.

This, which has become the type species of this genus, was only partially figured by Dana, under the impression that this and his *Urothoe rostratus* might be male and female of one species. His description of *Urothoe irrostratus* is:—"Near the *rostratus*. Front not rostrate. Flagellum of the superior antennæ six- or seven-jointed, shorter than the base; appendage very short, two- or three-jointed. Tarsi of feet of fourth and fifth pairs nodulose along inner side, this side somewhat arcuate." Spence Bate interprets the tarsi to mean the carpus; but in the special figures which Dana devotes to the extremities of the fourth and fifth pairs of feet, the carpus is not included, while the finger shows a nodulose convex inner margin in accordance with the description of the so-called tarsi. It is unfortunate that Dana gives neither figure nor description of the sixth and seventh pairs of feet (the fourth and fifth peræopods). In his notes on the genus he says "the six posterior legs [third, fourth, and fifth pairs of peræopods] are broad lamellar, especially the first, third, and fourth joints." But just as he evidently inferred without examination that the maxillipeds of *Urothoe irrostratus* were similar to those of *Urothoe rostratus*, so he may have inferred without observation that the fourth and fifth peræopods would be alike in the two species. In the European species the expression "broad lamellar" would not be especially appropriate to the third and fourth joints of the last two pairs of peræopods.

Dana figures the lower antennæ with a long, slender flagellum carrying calceoli, so that there can be no doubt that his specimen was a male. The three joints of the peduncle of the upper antennæ are figured as nearly equal in length.

The exact relationship of this species to its kindred in Europe cannot well be determined until fresh specimens have been obtained from the Sooloo Sea. Should there prove to be any very striking diversity in regard to the fourth and fifth peræopods, amounting to generic difference, it might be necessary to revive Costa's name *Egidia* for the European species; but it is not very probable that any such necessity will arise.

UROTHOE PULCHELLA (Costa). (Plate IV. A.)

1853. *Egidia pulchella,* Costa, Ricerche su' Crostacei Amfipodi del Regno di Napoli, Rend. d. Soc. r. Borbon. Acad. d. Sci. n. ser. 1853.
1857. „ „ Costa, Ricerche sui Crostacei Amfipodi del Regno di Napoli, Mem. d. R. Accad. d. Sci. di Napoli, vol. i. p. 190, tav. iv. fig. 3, *a–g*.
1876. *Urothoë pulchella,* Boeck, De Skand. og Arkt. Amph. p. 225.
1885. *Egidia pulchella,* Carus, Prodromus Faunæ Mediterraneæ, pars ii. p. 419.
1888. *Urothoë pulchella,* Stebbing, 'Challenger' Amphipoda, p. 297.

Rostrum little developed, lower front corners of the head fully rounded; third pleon-segment with the postero-lateral angles not acute.

Eyes reniform, except in the smaller stages, seemingly never very large.

Upper antennæ. First joint thicker but by no means longer than the second, each having two lines of setæ on the surface; third joint shorter than the first, and much more slender, nearly as long as the five- or six-jointed flagellum; secondary flagellum three- to four-jointed, longer than half the principal.

Lower antennæ. In the male specimen examined the fourth joint of the peduncle had twenty-one spines in the outer row, five in the inner, and several small setæ; the fifth joint had a row of five spines near the outer margin, and eight long serrate setæ near the inner; the flagellum consisted of twenty-three joints, and was more than twice as long as the peduncle. There being no brush of hairs on the fourth joint of the peduncle, and there being spines but no calceoli on the fifth joint, this specimen may not represent the fully adult male. In the female from Naples the fourth joint has twenty-one spines in one row, two in the other, about a dozen long setæ along one margin, and seven at one corner; the fifth joint shorter than the fourth, with a row of eleven spines, ten long setæ near the convex border, and six at the opposite distal corner; the flagellum scarcely as long as the fifth joint of the peduncle, the first joint carrying three rather slender spines, and the second six long setæ and three shorter ones; the second joint is about one third the length of the first, its two apical setæ long.

The triturating organs have on the confronting margins each twelve or fourteen stout spines toothed on two edges, the series being continued along the distal border by six-and-twenty slender serrulate spines or setæ.

Mandibles. The cutting-plate forming a strong blunt tooth; the secondary plate small, on the left mandible denticulate, on the right more slender, strap-like, slightly bifid; the molar tubercle powerful; the second joint of the palp carrying nine setæ, three or four of which are very small; the third joint about as long as the second, nearly acute at the apex, carrying eleven spines, four or five at the apex seta-like.

Lower lip. The outer and inner lobes have the margins well furred; the mandibular processes are divergent.

First maxillæ. The slender, slightly curved, inner plate has on the convex outer margin and apex six plumose setæ; the outer plate has eleven spines on the truncate distal margin, some straight, some curved, all, except perhaps the outermost, more or less serrate, or with a subapical tooth; the palp not reaching so far as the outer plate's apex, having at its base a little lobe of the trunk, the first joint rather broader and longer than the second, which on the truncate apex carries three setæ, the inner serrate, the other two plumose.

Second maxillæ. Inner plate rather shorter than the outer, tending to oval in shape, the apical end narrow, bordered with spines, plumose setæ fringing both it and the distal half of the inner margin; the outer plate with parallel sides, only the truncate distal margin occupied with spines.

Maxillipeds. The inner plates with three plumose setæ on the inner margin, two or three teeth and several plumose setæ or spines on the truncate distal margin; the outer plates bordered with seven stout spines and seventeen plumose setæ of various sizes; the second joint of the palp with the broad distal margin naked, the inner margin and adjacent surface thickly fringed with setæ; the third joint pear-shaped, with a very narrow neck, the broad distal half of the joint set about with groups of setæ, and having the short and narrow slightly furred terminal joint attached to the middle of its distal margin; at the narrowed apex of the fourth joint there are two setæ and three or four very small ones near the apex.

First gnathopods. Side-plates not very narrow, the lower hinder angle forming a well-produced rounded point, with a single spinule. Limb as in *Urothoe marinus*, but with only seven spines in the spine-row adjoining the broad distal margin of the wrist, and the hand oval.

Second gnathopods. The narrow hand is slightly distinguished from that of other species by the prominence of the small convex palm, and is about four fifths as long as the wrist.

First and *second peræopods* nearly as in *Urothoe marinus*, but the fourth joint has six or seven spines, the fifth has nine or ten, and the finger has six or seven small tubercles, which in the second pair are set very closely together. In the first pair the side-plates have eight or nine spinules at the lower hind corner. The marsupial plates of the female, here and apparently in the kindred species, long and slender, and when fully developed having the distal half fringed with moderately long setæ.

Third peræopods. The hind rim of the side-plates almost completely smooth. The limb distinguished from that of *Urothoe brevicornis* by having the fourth joint very much broader than the third, this joint (although belonging to a smaller species) having more numerous spines in the spine-rows, and also on its distal margin a great number of very long densely plumose setæ; the fifth joint is broad, and the finger not gently tapering as in *Urothoe brevicornis*, but narrowing rather abruptly as in *Urothoe marinus*, from which, however, it differs in having on the front margin many little sharp denticles rather closely set, even that nearest the tip being of no great size, nor does the tapering part form a concave margin as in the last-named species.

Fourth peræopods nearly as in *Urothoe brevicornis*, the third joint not shorter than the fourth, the fourth with four or five groups of spines on the front and two on the hind margin; the finger more than half the length of the fifth joint, very narrowly tapering, with numerous little teeth or tubercles along the front margin.

Fifth peræopods nearly as in *Urothoe marinus*, but the side-plates less crenate, the first joint scarcely at all more widened above than below, the fourth joint with four or five groups of spines on the front and two on the hind margin, the slender tapering finger more than half the length of the fifth joint, with from twenty to thirty little tubercles along its front margin; the first joint in the female having the front margin slightly more convex than in the male.

Pleopods nearly as in *Urothoe marinus*, but none of the peduncles elongate, and the joints of the inner ramus not exceeding thirteen, those of the outer not exceeding nineteen in number.

Uropods nearly as in *Urothoe marinus*, but outer branch of first pair with only two spines, branches of second pair without armature, the branches of the third pair with fewer setæ, and the inner branch only reaching the base of the second joint of the outer.

Telson short, with very convex sides, otherwise nearly as in *Urothoe brevicornis*.

Length about a fifth of an inch.

Localities. Naples (specimens obtained by Canon Norman) and off the west coast of France (specimens obtained by M. E. Chevreux).

UROTHOE ELEGANS, Sp. Bate. (Plate I.)

1856. *Gammarus elegans*, Sp. Bate, On the British Edriophthalma, Brit. Assoc. Report for 1855.
1857. *Urothoë elegans*, Sp. Bate, Synopsis of Brit. Edr. Crust., Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 145.
1857. ,, ,, White, Popular History of British Crustacea, p. 186.
1862. ,, ,, Sp. Bate, Brit. Mus. Catal. Amph. Crust. p. 117, pl. xx. fig. 2.
1862. ,, ,, Bate & Westwood, British Sess. Crust. vol. i. p. 200, woodcut.
1869. ,, ,, Norman, Last Report on Dredging among the Shetland Isles, Brit. Assoc. Report for 1868, p. 279.
1876. ,, ,, Giard, Comptes Rendus, Jan. 3, p. 76; Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 261.
1876. ,, ,, Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 344.
1879. ,, ,, Sp. Bate, The Crustacea in Couch's Cornish Fauna revised and added to Journ. Roy. Inst. Cornwall, no. xix. pt. ii. p. 48 (sep. copy).

1884. *Urothoe elegans,* Chevreux, Assoc. pour l'av. des Sciences, Congrès de Blois, Amph. du Croisic, p. 2 (sep. copy).
1887. „ „ Chevreux, Crust. Amph. Bretagne, Bull. Soc. Zool. de France, t. xii. extr. p. 11.
1888. „ „ Chevreux, Amph. du litt. des Açores, p. 5.

Rostral point obtuse, very slightly produced. Postero-lateral angles of the first pleon-segment having a minutely produced point, those of the second more sharply produced, those of the third slightly rounded.

Eyes moderately large in the adult male.

Upper antennæ. Peduncle as in *Urothoe marinus*; flagellum six-jointed; secondary flagellum slender, three-jointed, decidedly less than half as long as the principal.

Lower antennæ. In the adult male peduncle very nearly as in *Urothoe marinus,* the fourth joint, however, having sixteen or eighteen spines in one row, and two or three in the other, the fifth joint carrying a row of nine calceoli on one edge, and four or five rather small setæ on the other; the flagellum between two and three times as long as the peduncle, consisting of forty joints. In one specimen on one antenna each of the first five joints, on the other each of the first three had a calceolus, the remaining joints being alternately without and with these appendages. In the female the fourth joint longer than the fifth, carrying fourteen spines in one row and two in the other, with a few setæ, the fifth joint having six spines and four of the long setæ; the flagellum full as long as the fifth joint of the peduncle, with one spine and four setæ on the first joint, the slender second joint being half as long as the first, the two setæ at its tip not very elongate.

Mandibles. Cutting-plate like a broad tooth; the little secondary plate on the left mandible (when unworn) cut into five little unequal teeth, on the right strap-shaped; the third joint of the palp longer than the second, with five setæ in a series beginning low down on the front margin, and two accompanied by two spines at the apex.

Lower lip. Mandibular processes well developed.

First maxillæ. Inner plate slender, curved, with two plumose setæ on the rounded apex; outer plate as in *Urothoe pulchella*; second joint of the palp about equal in length and thickness to the first, fully reaching the apex of the outer plate, having three setæ on its distal margin.

Second maxillæ as in *Urothoe pulchella,* but with the plumose setæ not fringing all the distal half of the inner margin of the inner plate.

Maxillipeds differing but little from those of *Urothoe pulchella*; the outer plate with five spines; the second and third joints of the palp not so much distally widened.

First gnathopods. Side-plates distally widened, with two spinules at the lower hind corner. The wrist with seven or eight spines in the row on the very sloping distal margin; the hand narrowly oval.

Second gnathopods as well as the *first*, in general character, like those of *Urothoe marinus*, but with narrower wrists and hands.

First and second peræopods as in *Urothoe marinus*, but comparatively slender, with only four stout spines on the fourth joint, eight on the fifth, the finger with three or four small and distant pointed tubercles. The side-plates of the first pair have five spinules at the indented hind corner.

Third peræopods. The side-plates with the hind margin only slightly indented. The limb strikingly distinguished from that of *Urothoe pulchella* by having the fourth joint not broader than the third, with about seven spines in each of its spine-rows; the finger is comparatively narrow, the distal half slenderly tapering, with about seven small tubercles on the front margin.

Fourth peræopods differing little from those of *Urothoe marinus* and other species, but having the third joint shorter than the fourth, with five or six plumose setæ on the hind margin, the fourth joint shorter or not longer than the fifth, with three groups of spines in front and two behind, the finger very slender and tapering, with about seven denticles on the front margin.

Fifth peræopods in general character like those of *Urothoe marinus*, but the first joint not widened above, and with no conspicuous row of spinules on the upper part of the hind margin; the third joint with two groups of spinules on each margin, the fourth and fifth joints each with three groups on the front and two on the hind margin; the finger very slender, more than half as long as the fifth joint, with some seven or eight little nodules on the front margin. The female has the front margin of the first joint convex instead of nearly straight.

Pleopods as in *Urothoe marinus*, but with fewer joints to the rami, the inner having eleven or twelve, the outer thirteen or fourteen.

Uropods similar to those of *Urothoe brevicornis*, but the rami of the two first pairs smooth, the peduncle of the second pair having only one spine on the inner margin; the inner ramus of the third pair is sometimes very decidedly shorter than the outer; the number of plumose setæ on the rami of the third pair appears to be too variable to afford a character.

Telson not very broad, nearly as in *Urothoe brevicornis.*

Length less than a fifth of an inch.

Localities. The specimens figured were dredged in February 1889 from a depth of 20 fathoms, off Fairlie Perch, in the Clyde, near Cumbrae, by Mr. David Robertson. Other specimens examined were taken by Canon Norman in dredging among the Shetland Isles. The original specimen, to which the name was given by Mr. Spence Bate, came from the neighbourhood of the Eddystone Lighthouse.

UROTHOE MARINUS, Sp. Bate. (Plate II.)

1857. *Sulcator marinus,* Sp. Bate, Synopsis of Brit. Edr. Crust., Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 140.
1857. ,, ,, White, Popular History of British Crustacea, p. 175.
1862. *Urothoë marinus,* Sp. Bate, Brit. Mus. Catal. Amph. Crust. p. 115, pl. xix. fig. 2.
1862. ,, ,, Bate & Westwood, British Sess. Crust. vol. i. p. 195, woodcuts.
1869. ,, ,, ? var. *pectinatus,* Grube, Mitth. über St. Vaast-la-Hougue, Abh. der schles. Gesellsch. für vaterl. Cultur, 1868–9, p. 119.
1869. ,, ,, Norman, Last Report on Dredging among the Shetland Isles, p. 279.
1876. ,, *marina,* Giard, Comptes Rendus, Jan. 3, p. 76; Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 261.
1876. ,, *marinus,* Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 344.
1877. ,, *marina,* Meinert, Crust. Isop. Amph. et Decap. Daniæ, p. 107.
1884. ,, *marinus,* Chevreux. Assoc. pour l'av. des Sciences, Congrès de Blois, Amph. du Croisic, p. 313.
1887. ,, ,, Barrois, Morph. des Orchesties et liste Amph. du Boulonnais, p. 16.
1887. ,, *marina,* Bonnier, Catal. Crust. Malac. Concarneau, p. 79.
1887. ,, ,, Chevreux, Crust. Amph. Bretagne, Bull. Soc. Zool. de France, t. xii. extr. pp. 10, 34, 36.
1888. ,, ,, Chevreux, Dragage de l'*Hirondelle* au large de Lorient, p. 1.
1888. ,, ,, Chevreux, Amph. réc. aux env. de Cherchell, extr. p. 5.
1888. ,, *marinus,* Robertson, Catal. Amph. and Isop. of Clyde, p. 30.

The sides of the rostrum not forming an obtuse angle, but the apex not acute. The postero-lateral angles of the second pleon-segment acutely produced, but not those of the first or the third segment.

Eyes very large in the adult male, nearly meeting on the top of the head.

Upper antennæ. First joint thicker, but scarcely longer, than the second, each with an elongate group of setæ on the upper or outer side, and (in the adult male) a brush-like fringe of hairs on the lower or inner; the third joint thinner than the second, two thirds as long, with a few hairs; flagellum nine-jointed; secondary flagellum, little more than half as long as the principal, five-jointed.

Lower antennæ. In the adult male first three joints short, gland-cone very inconspicuous, the third joint having a tuft of hairs near the inner distal angle; the fourth joint longer than the three preceding united, closely fringed on one side with a brush of hairs, which also pass round the distal margin, on the other side carrying numerous unequal spines, eighteen in one row, four in the other, and also some setæ; the fifth joint nearly as long as the fourth, carrying twelve setæ on one edge, and eight calceoli, each with an accompanying tuft of hairs, on the other; the flagellum very long and slender, with fifty joints, each of the first six having a calceolus, and of the next forty-two each alternate one, the calceoli being smaller towards the end of the flagellum. In a specimen with no fringe of hairs and no calceoli the fifth joint of the peduncle has a row of ten unequal spines, and the flagellum consists of twenty-five joints. In a female specimen from the same locality the fourth joint has seventeen spines in one row and three in the other; the fifth joint is decidedly shorter than the fourth, and has nine or ten spines, the long setæ of this and the preceding joint being fewer than in the female specimen described of *Urothoe brevicornis.* The flagellum is as long as the last joint of the peduncle, the first joint carrying two spines near the distal end, and eight long setæ round it; the little terminal joint is scarcely more than a third of the breadth of the preceding.

Mandibles as in *Urothoe elegans*, but the long setæ on the second joint of the palp more numerous, and the long narrow third joint having ten spines along the front margin, and two at the apex, together with four others that are long and more or less setiform.

Lower lip. Mandibular processes strongly developed.

First maxillæ. The curved inner plate with four or five setæ on and near the apex; outer plate and palp as in *Urothoe elegans.*

Second maxillæ with plumose setæ passing round the apex and the distal half of the inner margin of the inner plate, which also has a row of plumose spines on the apical margin, these maxillæ not sensibly differing from those of *Urothoe pulchella.*

Maxillipeds nearly as in *Urothoe pulchella*, the inner plates rather broader, the outer with six stout spines and twenty setæ, thus arranged—a short seta, three rather large ones, a group of three small ones, of which the middle is the longest, such a group followed by a stout spine occurring four times in succession, then a single seta, two stout spines, and (on the apical margin) three plumose setæ. The number of spines and setæ, however, cannot be depended on as constant in this species, or probably in any of the others. Here the third joint of the palp is more elongate than in *Urothoe pulchella.*

First gnathopods. Side-plates narrow, with a group of three spinules at the lower hind corner. The first joint slender, with a few spinules on the front margin, many long pectinate setæ on the hind margin, and four groups of them on the inner surface; the second joint short, with one group of setæ on the hind margin; the third joint with one or two setæ on the hind margin, its apex acute; the wrist almost as long as the first joint and much broader, the convex hind margin or breast closely fringed with unequal setiform spines, the inner surface carrying five or six groups, the row of pectinate spines at the distal margin twelve in number; overlapping this row and running to the front margin is a row of microscopic spinules, such a series being found in all the species examined; the hand about three quarters as long as the wrist, much narrower, with setiform spines in two rows on the inner surface, in one row on the outer, and fringing more than the distal half of the hind margin; the palm oblique, microscopically pectinate, fringed with various setules, and defined by a stout spine, beyond which the capped tip of the finger reaches; the finger carries two or three setules.

Second gnathopods. Side-plates distally widened, the lower distal angle not having, as in the first pair, a produced point, carrying a group of seven setules. The sack-like branchial vesicle as long as or longer than the first joint. The limb differs from that of the first pair in having the first joint more elongate, with two instead of four groups of setæ on the inner surface; the long setæ on the second and third joints are more numerous; the wrist is narrower and without the special armature of the distal margin; the hand has less of the hind margin furnished with setæ, and the palm a little less oblique; the finger is decidedly shorter, its tip reaching very little beyond the palmar spine.

First peræopods. Side-plates widened below, with six or seven spinules on the upward curved hinder part of the lower margin. Branchial vesicle longer than the first joint, nearly uniform in breadth, except at the point of attachment. First joint straight, with setæ at the apex of the hind margin, and near that of the front; second joint with a group of setæ about the apex of the hind margin; third joint as long as the fourth and fifth joints together, having groups of setæ along the hind margin, and near it a transverse group high up on the outer surface, which also carries an oblique series near the apex of the convex front margin; the fourth joint nearly as broad as the third, with an oblique group of setæ approaching the distal end of the front margin, several bent plumose setæ and four graduated stout spines along the undulating hind margin, one stout spine and four setæ on the distal border, which projects strongly behind the fifth joint; the fifth joint a little shorter than the preceding, and scarcely half its width, carrying seven or eight unequal short spines directed towards the finger, the distal part of the hind margin undulating; the finger straight, except at the tip, with five tubercles along the hind margin, which, with the spines of the fourth and fifth joints, must give it a prehensile character; the slightly bent tip has a transparent cap.

Second peræopods. Side-plates broader than in the preceding pair, with the spinules not grouped at the corner, but spread along the lower margin. Branchial vesicle much dilated below the long neck. Limb scarcely differing from that of first pair, except that the first and third joints are longer, and the first is a little sinuous.

Third peræopods. Side-plates with the hind lobe deeper than the front, its margin crenulate with spinules in the indents. Branchial vesicles narrowed at the two extremities. The first joint very broad, distally widened, the wing often darkened by the crowd of gland-cells, the upper corners rounded, the lower hinder angle not very acute, sometimes rounded, the front margin rather sinuous, with two or three spinules above, two groups of setæ below, and a few spines at the apex, the hind margin crenulate, and having about a dozen setæ, the straight lower margin of the wing carrying two or three setules; the second joint not half the width of the first, but broader than long, with a group of setæ and a spine at the apex of the front; the third joint rather longer, scarcely broader, with a group of setæ and a spine at the indent of the front margin, the apex of which has five spines: a row of seven spines arms the lower margin of the outer surface and the rounded hinder apex, the corresponding margin of the inner surface being fringed with some sixteen immensely long and densely plumose setæ, some of which reach to the extremity of the limb; there are sometimes short plumose setæ along the hind margin; the fourth joint is nearly as long as the two preceding joints together, and decidedly, yet not very greatly, wider than either; on the outer surface there is a series of eight unequal spines reaching the indent of the front margin, and another reaching that of the hind margin; below these there are two distal series, respectively of six and eight spines, and on the hinder part of the distal margin there are also on the inner surface some long plumose setæ; the fifth joint is longer, but very much narrower than the fourth, having at the middle of the hind margin a group of five unequal spines, and of three at the apex, on the strongly indented front margin three groups of seven, six, and five respectively, and on the inner surface below the middle a row of five long densely plumose setæ; the finger is not much shorter than the fifth joint, comparatively broad, except near the cap-bearing tip, containing, like almost all other parts of the animal, numerous gland-cells with their ducts and minute circular openings; the hind margin almost straight, carrying near the base a small plumose cilium, the front margin at first smooth, but for two thirds of its length armed with nodules, about thirteen in number, the first eight or nine successively larger, the next one, two, or three small and sharper than the rest, followed by one near the tip longer than any of the others.

Fourth peræopods. Side-plates narrower than in the preceding pair, the hind margin crenate and fringed with spinules. The branchial vesicle smaller than in the preceding pair. The first joint large and oval, rather broader below than above, the front margin a little sinuous, with two or three spinules above, and three or four groups of pectinate setiform spines below; the convex hind margin very shallowly crenulate, with spinules in the indents; the wing has numerous gland-cells, and sometimes as many as sixteen long and very plumose setæ, planted in a slight curve a great way from the margin on the inner surface; the short second joint has a group of pectinate spines at the apex of the front margin; the third joint, which is more than twice as long as broad, has three groups of spines along the front, nine long, much flattened, setæ along the hind margin, and a spine at its apex; the fourth joint is longer than the third, and has four groups of rather stout spines along the front, and three mixed groups along the hind margin; the fifth joint is narrower than the fourth, scarcely longer than the third, with three groups of stout spines along the front, one at the sharply produced apex of the hind margin, and a little higher up a slender group; the finger is half the length of the fifth joint, straight, very slender, with a plumose cilium on the hind margin near the base, several little nodules along the front, of these that near the curved tip of the finger being as usual the largest.

Fifth peræopods. Side-plates small, with the hind margin crenulate. The branchial vesicle directed forward, not much longer than broad, very much shorter and narrower than the first joint of the limb. The first joint broader than in the preceding pair and as long, the widest part not far from the base, the broad wing containing numerous gland-cells, its irregularly convex border shallowly indented and fringed with spinules, of which, as in the preceding pair, those at the upper part are much larger than those below; the front margin nearly straight or a little convex, with three or four groups of spines; the short second joint having a group of spines at the apex of the front; the third joint decidedly shorter than the fourth, with three groups of spines in front and two or three behind; the fourth joint with four or five groups of spines on the front, and three or four on the hind margin; the fifth joint subequal in length to the fourth, but narrower, with three or four groups of spines in front and two behind; the finger straight, slender, tapering, about half the length of the fifth joint, with seven or eight little nodules along the front margin, and the usual plumose cilium near the base. The whole limb is a little shorter than that of the fourth pair, the difference being chiefly owing to the shorter third joint.

Pleopods. The peduncles of the first pair the longest, in all the pairs carrying one or two groups of setæ on the lower margin. The coupling-spines (*retinacula*[1]) long and slender, with five or six teeth, besides the strongly bent apex; in general there are two only of these organs on the peduncle, but in one instance four were counted; there is always a plumose spine with them; the cleft spines on the first joint of the inner ramus two or three in number; the spoon-shaped arm much shorter than the serrate one; the inner ramus sometimes with sixteen, the longer outer one with twenty joints.

Uropods. The stout peduncle of the first pair subequal in length to the outer ramus, having on the outer margin one or two groups of setiform spines and a row of about seven small spines, and a row of three on the inner margin; the rami are not very long, smooth, the inner much smaller than the outer, both strongly curved, although in some positions the curvature may not be very distinctly seen; peduncles of the second pair rather shorter and narrower than those of the first, similarly armed, but with rather stronger spines; the rami subequal, the outer almost imperceptibly the longer, both smooth, slightly curved, a little longer than the peduncle; peduncles of the third pair stouter than the preceding pairs, not longer than broad, having groups of spines about the distal margin; the rami long and moderately broad, extending for nearly their whole length beyond the telson and the other uropods, subequal, fringed with numerous long plumose setæ; in one specimen the outer ramus had on its outer margin twenty, two at the apex of the little second joint, and eight on the inner margin; the inner ramus had

[1] In regard to the occurrence of the *retinacula* in various groups of Crustacea, and their phylogenetic importance, see the interesting footnote in 'Carcinologische Mittheilungen,' ix. p. 220, by Paul Mayer, 1880. By Carl Bovallius they had been recognized in his account of "*Pterygocera arenaria.*" Dr. Boas calls them in German "Hefthaken." When I wrote my 'Challenger' report these notices had escaped my attention.

nine on the outer margin, two at the apex, and fourteen on the inner margin. In another specimen, also a male, and from the same locality, there were only fifteen setæ on the outer and seven on the inner margin of the outer ramus, while in this specimen the second joint was more elongate than in the other. Very little constancy is to be expected in the number of these ornaments, which undoubtedly varies with the age of the animal, as well as probably between individuals of the same age.

Telson. Cleft nearly to the base on the upper side and quite to the base on the under side, the cleft gaping a little distally, the convex outer margins having each two cilia near the centre, and a spinule not far from the apex, the distal margin of each half oblique, carrying a feathered cilium, a short stout spine, and three setæ.

Length of a good-sized specimen one third of an inch.

Localities. The specimen figured was taken at a low tide in February 1889, at Cumbrae, in the Clyde, by Mr. David Robertson. Other specimens examined and considered to belong to this species were obtained by M. E. Chevreux, of le Croisic, Loire-Inférieure, off the French coast, and in Balta Sound, Shetland, by Canon Norman. M. Chevreux in recording *Urothoe marinus* from "les environs de Cherchell," says, "le genre *Urothoe* n'était pas représenté jusqu'ici en Méditerranée," but this is overlooking *Urothoe pulchella* (Costa).

UROTHOE NORVEGICA, Boeck. (Plate IV. B.)

1860. *Urothoë norvegica,* Boeck, Forhandl. ved de Skand. Naturf. 8de Möde, p. 647.
1870. ,, ,, Boeck, Crust. Amph. bor. et arct. p. 58.
1876. ,, ,, Boeck, De Skand. og Arkt. Amph. p. 226, pl. vi. fig. 9, pl. vii. fig. 4.
1882. ,, ,, Sars, Oversigt af Norges Crustaceer, p. 22.
1887. ,, ,, Chevreux, Crust. Amph. dragués par l'*Hirondelle,* Bull. Soc. Zool. de France, extr. pp. 13, 15.
1887. ,, ,, Chevreux, Crust. Amph. Bretagne, Bull. Soc. Zool. de France, t. vii. extr. p. 10.
1888. ,, ,, Robertson, Catal. Amph. and Isop. of Clyde, p. 29.

Postero-lateral angles of the first three pleon-segments acute, those of the first two only minutely produced.

Upper antennæ. The first joint of the peduncle stout, the third joint decidedly shorter than the first or second; the flagellum of five joints, together little longer than the first or second joint of the peduncle; the secondary flagellum three-jointed, about half the length of the principal.

Lower antennæ. Fourth joint of the peduncle longer and much stouter than the fifth, carrying a single row of about sixteen unequal stout spines near the convex margin, and a row of setæ apparently unmixed with stout spines; the fifth joint carrying five stout spines and some setæ; the flagellum consisting of eighteen naked joints, the structure being indicative of a male not fully adult.

Mouth-organs as in *Urothoe elegans.* The palp of the *first maxillæ* consists of two equal joints, and has three setæ on the apex.

First gnathopods. The side-plates with a row of six setæ on the truncate distal margin. The limb nearly as in *Urothoe elegans*, the spine-row at the apex of the wrist consisting of only three or four spines.

Second gnathopods nearly as in *Urothoe elegans.*

First and second peræopods scarcely to be distinguished from those of *Urothoe elegans*, except that the inner margin of the finger, which in that species has very few nodules, is here closely serrate, of the series of projecting points only the large one nearest the tip of the finger being blunt enough to deserve the name of a nodule.

Third peræopods distinguished from those of *Urothoe elegans* by the much rounded lower hind corner of the first joint, fewer plumose setæ on the third and fourth joints, and by the close serration of the distal half of the slender tapering finger.

Fourth peræopods. The front margin of the first joint has some spinules at four points of the upper part, and at intervals on the lower part four long plumose setæ; the third joint is longer than the fourth, the plumose setæ on the hind margin missing, but not originally more than three or, at most, four in number; the finger slender, closely serrate for two-thirds of its length.

Fifth peræopods nearly as in the female of *Urothoe elegans*, but here the third and fifth joints are nearly equal in length, the fourth joint being decidedly longer than either, with spines at four points of the front and at three of the hind margin.

Pleopods. The peduncles short; the cleft spines two or three; the inner ramus with ten or eleven joints, the outer with thirteen to fifteen.

Uropods. Peduncles of the first pair a little longer than the straight slender rami, the outer ramus with one spinule just above the middle, the inner equal in length, smooth; the peduncle of the second pair not longer than the rami, which are slender, straight, subequal to one another, but shorter than those of the first pair; they are smooth, or possibly there is a spinule on the outer ramus; the peduncles of the third pair are shorter than the rami; the inner ramus is considerably shorter than the outer, with a single seta near the extremity of its outer margin, five or six plumose setæ on the inner margin; the outer ramus has a spinule and seta at three points on the lower half of each margin; the second joint is a third the length of the first.

Telson cleft nearly to the base so as to form two halves almost oval, but straight at the base, and with the adjoining margins slightly compressed along the upper part; below the centre of each outer margin there are two cilia, and from an incision in each rounded and rather narrow apex projects a moderately long spine, with a minute cilium adjoining on the outer side.

Length about one fifth of an inch or less.

Locality. The Shetland Isles, taken by the Rev. A. M. Norman in 1867.

UROTHOE BREVICORNIS, Sp. Bate. (Plate III.; Plate IV. C.)

1862. *Urothoë brevicornis,* Sp. Bate, Brit. Mus. Catal. Amph. Crust. p. 116, pl. xx. fig. 1.
1862. „ „ Bate & Westwood, British Sess. Crust. vol. i. p. 198, woodcuts.
1879. „ *marinus,* Stebbing, Sess. Crust. Devon., Trans. Devon. Assoc. vol. xi. p. 519.

Rostrum forming an obtuse angle, but with a little acute point between the upper antennæ. Second pleon-segment with the plumose setæ large and numerous, the produced point of the postero-lateral angles minute.

Eyes very conspicuous in the male, approaching one another very closely.

Upper antennæ nearly as in *Urothoe marinus.* In the adult male specimen the first joint of the peduncle was decidedly longer than the second, and the principal flagellum had seven joints, the accessory flagellum being more than half its length, with six joints, of which the last was minute.

Lower antennæ. In the adult male peduncle nearly as in *Urothoe marinus,* but in the fourth joint the brush of hairs not passing round the distal margin; the spines twenty-two in one row, five in the other, the setæ more numerous; the fifth joint rather longer than the fourth, with nine calceoli on one side, and eight long plumose setæ on the other; the flagellum not once and a half as long as the peduncle, having twenty-three or twenty-four joints, with a calceolus to each of the first three or four, and then on alternate joints for some distance along. In the female the fourth joint is longer than the fifth, and has twenty-five spines in one row, seven in the other, with numerous long serrate setæ near the straight inner border, and a group of about a dozen near the produced distal corner of the convex side; the fifth joint has thirteen spines along the convex border, with a group of eight long setæ near its distal end, and along the other border some fifteen long setæ; the two-jointed flagellum is shorter than the last joint of the peduncle; the first joint has ten long setæ round the distal half, and three spines on one margin; the little second joint is about a quarter the length and not half the breadth of the first, and is tipped with two slender setæ several times its own length. Both in male and female the fourth and fifth joints of the peduncle have some little stiff setæ or cilia, which are strongly plumose, and appear as if twisted at the centre.

Upper lip with a smoothly rounded margin to the principal plate, except that in the centre a little space is marked off by a small notch on either side, the tract so marked off being distally smooth, but furry on the sides. The inner plate appears to have a quite smooth margin not reaching quite to the distal margin of the outer plate. The structure of this lip seems to be tolerably uniform in all the species.

Mandibles as in *Urothoe marinus,* except that the third joint of the palp has nearly two thirds of the inner margin clear of spines.

Lower lip as in *Urothoe marinus.*

First maxillæ. The inner plate with three plumose setæ on the apex; outer plate as in the other species; palp with the first joint rather longer than the second, the second with the usual three setæ on the apex.

Second maxillæ. The plumose setæ occupying two thirds of the inner margin of the inner plate.

Maxillipeds, probably not to be distinguished from those of *Urothoe marinus* by any constant character; thus in one specimen one of the outer plates had six, and the other seven, stout spines, while in another specimen each of these plates had eight stout spines.

First and second gnathopods not distinguishable from those of *Urothoe marinus.* In a male specimen from North Wales there were eight spines in the distal spine-row of the wrist, in a female from the same locality ten, and in another female from South Devon fourteen.

First and second peræopods scarcely, if at all, distinguishable from those of *Urothoe marinus.* In the specimens examined the fourth joint had six spines instead of five, and the fifth joint eight spines instead of seven, while the tubercles on the finger were fewer and less pronounced.

Third peræopods closely resembling those of *Urothoe marinus,* but the large first joint with fewer indents on the hind margin, and its apex rather more acute; the third joint has nine or ten spines in each group of its distal margin; the fourth joint ten or eleven in each of its four groups; the fifth joint also has larger groups of spines, and is rather more widened, whereas the distal narrowing of the finger is much less abrupt than in the species compared, and the marginal nodules are smaller.

Fourth peræopods nearly resembling those of *Urothoe marinus,* but the third joint is here rather longer than the fourth, having almost the whole of the hind margin fringed with the long plumose setæ.

Fifth peræopods closely resembling those of *Urothoe marinus,* but with the first joint of the limb not wider above than below. In the female the first joint appears to have the front margin more convex than in the male.

Pleopods as in *Urothoe marinus,* but with no more than two cleft spines observed on the ramus of any specimen.

Uropods. Peduncle of the first pair much more elongate than in *Urothoe marinus,* with two groups of setiform spines and five stouter spines on the outer and four spines on the inner margin; the rami slender, subequal in length to one another and to the peduncle, nearly straight, reaching beyond the second pair, the outer having three spines upon it, the inner having a little seta on its inner margin; the peduncle of the second pair much shorter than that of the preceding pair, shorter than the rami, with four spines on the outer and two on the inner margin; the rami subequal, shorter than the preceding pair, straight, the outer with two spines, the inner with a little seta; the peduncle of the third pair rather longer than broad, but otherwise this pair is scarcely, if at all, to be distinguished from the corresponding pair in *Urothoe marinus.*

Telson differing very little from that of *Urothoe marinus,* the convex margins unbroken by the insertion of a spinule, the distal margin less broad, carrying a feathered cilium, a spine, and one or two setules.

Length. A quarter to a third of an inch.

Localities. The specimen figured was taken with others of both sexes at Llanfairfechan in North Wales, from the banks of little streams or pools left in the sands at low tide. The species has also been obtained at Goodrington, near Torquay, from the sand left bare at low tide. The specimen to which Spence Bate gave the name *brevicornis* was taken at Tenby, a locality intermediate between the two just named, and presents such differences from the description of the adult here given as might be expected in an example only a tenth of an inch long. Recently the species has been met with in North Devon.

[UROTHOE POUCHETI, Chevreux.

1888. *Urothoe Poucheti,* Chevreux, Crust. Amph. du littoral des Açores, Bull. Soc. Zool. de France, t. xiii. janvier 1888, p. 34.

When this paper was sent to the Zoological Society, the type specimen of *Urothoe poucheti*, which is at present unique, was being exhibited in the Pavillon de Monaco at the Paris Exhibition. It has since been lent me through the kind instrumentality of M. Chevreux, naturally, however, without being available for dissection, which is almost essential for a full and accurate account of a species in this genus. Under this restriction the following brief notes were made upon it:—

Eyes strikingly large and black, the specimen being a male.

First gnathopods. The finger longer than in the second pair.

Third peræopods. The lower hinder angle of the first joint well rounded. The third joint not broader than the second, and not strongly spined, but with long plumose setæ; the fourth joint not broader than the third; the finger long and slender, the distal half serrate.

Fourth peræopods. The first joint having slender spines on the lower part of the front margin, and seven plumose setæ within the wing; the third joint longer than the fourth, instead of shorter as in *Urothoe elegans.*

Fifth peræopods. Front margin of the first joint straight.

Uropods. The first pair with the rami equal, slender, not quite so long as the peduncle; the second pair considerably smaller than the first, the rami equal, slender, shorter than the peduncle; the third pair with long rami reaching back beyond those of the first pair.

The postero-lateral corners of the third pleon-segment are slightly rounded, almost rectangular.

The species approaches *Urothoe elegans*, Spence Bate, and in regard to the third peræopods it much resembles *Urothoe norvegica*, Boeck; but taking all the characters together (see page 9), it must be regarded as distinct from all the earlier known members of the genus.—T. R. R. S., Sept. 1890.]

UROTHOIDES, nov. gen.

1888. *Urothoe*, Stebbing, 'Challenger' Amphipoda, Zool. Reports, vol. xxix. p. 824.

Nearly resembling *Urothoe*, Dana, in regard to the antennæ, mouth-organs, gnathopods, first and second peræopods, and the pleon.

Third and fourth peræopods having the first, third, and fourth joints much expanded, the third joint more widely than the fourth; these limbs not armed with long plumose setæ as in *Urothoe*.

Fifth peræopods having the much expanded first joint strongly produced downwards behind, and with a strongly serrate hind margin.

The fingers of the *peræopods* not nodulous on the inner margin.

The name is derived from *Urothoe*, a closely related genus, and εἶδος, likeness.

UROTHOIDES LACHNEËSSA.

1888. *Urothoë lachneëssa*, Stebbing, 'Challenger' Amphipoda, Zool. Reports, vol. xxix. p. 825, pl. lvii.

It is with some hesitation that I now propose a new genus for this recently published species. When originally including it in the genus *Urothoe* I was not aware how singularly compact a group the existing species of that genus formed, and how intimately connected with one another they were in many minute details.

Since the 'Challenger' Report was published I have examined an additional specimen of this species, in which the upper antennæ proved to be abnormal. The entire peduncle is stout, the second joint not longer than broad, the third longer than either the first or second, conically produced along two thirds of the first joint of the secondary flagellum. The principal flagellum consists of four joints, the secondary flagellum of three, the first of which is as long as the other two together, and the three together are as long as the principal flagellum. It may be assumed that the malformation results from a coalescence of the third joint of the peduncle with the first one or two joints of the principal flagellum, or it might be more correct to say that the articulations have not been developed so as to produce the usual distinction of these joints.

The second segment of the pleon is not armed with long plumose setæ as in the genus *Urothoe*, and the rami of the third uropods are also devoid of these ornaments. In the species of *Urothoe* the outer of these rami is perhaps invariably longer than the inner, but sometimes the difference is scarcely perceptible, whereas in the present species the difference between the two rami is very great.

SUMMARY AND INDEX.

The history of the genus may be shown in brief by the following list:—

The genus *Urothoe* is therefore at present composed of the following eight species:—

Urothoe abbreviata, Sars.	*Urothoe marinus,* Bate.
„ *brevicornis,* Bate.	„ *norvegica,* Boeck.
„ *elegans,* Bate.	„ *poucheti,* Chevreux.
„ *irrostratus,* Dana.	„ *pulchella* (Costa).

Should any reader object to finding some of the specific names masculine and others feminine, he is respectfully reminded that among the specimens examined some were males and others females.

Of the eight species enumerated, it must be observed that they are more remarkable for their likeness to one another than for any differences that can be discerned. The magnitude of the eyes and the structure of the lower antennæ vary greatly with the age and sex of the animal, the most constant feature being that the lower antennæ in the female have a two-jointed flagellum. Among the details that appear to prevail throughout the genus may be noticed the vast number of gland-cells over all parts of the body, the transparent caps to the tips of all the fingers, a peculiar spine-row on the wrist of the first gnathopods, and the long plumose setæ on the third, fourth, and fifth joints of the third peræopods, on the first joint of the fourth peræopods, and on the second segment of the pleon. The species for the most part are to be distinguished from one another only by groups of small differences. Among these, however, a single feature may here and there make itself moderately conspicuous: thus, only *Urothoe abbreviata,* Sars, is said to be blind; only *Urothoe elegans,* Sp. Bate, is described as ornamented with rose-coloured markings[1]. *Urothoe pulchella* (Costa) has the fourth joint of the third peræopods wider than in any other species. *Urothoe marinus*, Sp. Bate, alone has the rami of the first and second uropods strongly curved. *Urothoe poucheti*, Chevreux, appears to be distinguished from all other species by the greater length and stronger armature of the first uropods. *Urothoe norvegica*, Boeck, shows no very salient difference from *Urothoe elegans*, unless it may do so in colouring. *Urothoe brevicornis*, Sp. Bate, makes a near approach to *Urothoe marinus*, except in regard to its longer and straighter uropods. Dana's *Urothoe irrostratus* is the only species at present known from the Pacific. As Spence Bate has pointed out, it makes a near approach to *Urothoe elegans*; but as the figures and description are incomplete, it is not at present possible to decide whether it is identical with any European species or otherwise. The exact position of Grube's *Urothoe marinus*, var. *pectinatus*, is also doubtful.

EXPLANATION OF THE PLATES.

PLATE I.

Urothoe elegans.

The full figure is given in lateral view, the three lines above it indicating the natural size of a female, a male, and a young specimen, respectively.

a.s. Upper antenna of the male; *a.s*, ↄ, of the young.
a.i. Lower antenna of the male; *a.i*, ♀, of the female; *a.i*, ↄ, of the young.
l.i, ♀. Lower lip of the female.
gn. 1. First gnathopod of the male.
gn. 2. Second gnathopod of the male.
prp. 1, 2, 3, 4, 5. The first, second, third, fourth, and fifth peræopods respectively, of the male.
prp. 2, ↄ. Second peræopod of the young.
prp. 5, ♀. Fifth peræopod of a female; *prp.* 5, ↄ, of the young.
ur. 1, 2, 3. The first, second, and third uropods respectively, of the male.
ur. 2, *ur.* 3, ♀. Second and third uropods of the female.
T. Telson of the male.

[1] Yet such markings are still visible in a specimen from Balta Sound, Shetlands, taken by the Rev. A. M. Norman in 1866, and labelled (probably for that very reason) as *Urothoe elegans*, though otherwise it does not seem to be distinguishable from *Urothoe marinus*. Hence it is doubtful whether reliance can be placed upon colouring as a distinguishing mark of *Urothoe elegans*.

PLATE II.

Urothoe marinus.

The full figure is given in lateral view, with a line above it indicating the natural size.

a.s. Upper antenna.
a.i. Lower antenna; only a part of the flagellum drawn.
m.m. The pair of mandibles.
mx. 1. First maxilla.
mx. 2. Second maxilla.
mxp. One half of the maxillipeds, and on a larger scale the inner and outer plates of the other half.
gn. 1. First gnathopod.
gn. 2. Second gnathopod.
prp. 1, 2, 3, 4, 5. The first, second, third, fourth, and fifth peræopods respectively; the figure *prp.* 3 to the left showing the outer side, and the figure *prp.* 3 to the right showing the inner side of the limb.
plp, sp. Coupling-spines and a cleft spine of the pleopods.
ur. 1, 2, 3. First, second, and third uropods respectively.
T. Telson.

PLATE III.

Urothoe brevicornis.

The full figure is given in lateral view from a small specimen, the line above it to the right indicating the natural size, the line above it to the left showing the length of a female specimen. The figures of the separate parts were all taken from the male.

a.s. Upper antenna.
a.i. Lower antenna.
m. Left mandible.
l.i. Lower lip.
mx. 1. First maxilla.
gn. 1. First gnathopod.
gn. 2. Second gnathopod.
prp. 1, 2, 3, 4, 5. First, second, third, fourth, and fifth peræopods respectively, both sides of the third peræopod being shown.
Pl.s. 2, *Pl.s.* 3. The lower portions respectively of the second and third segments of the pleon.
ur. 1, 2, 3. First, second, and third uropods respectively.
T. Telson.

PLATE IV.

A. *Urothoe pulchella*, ♀.

or. tr. Triturating organs *in situ* in the stomach.

gn. 1. First gnathopod. *prp.* 3. Third peræopod.

gn. 2. Second gnathopod. *plp.* A pair of pleopods.

ur. 1, 2, 3. First, second, and third uropods respectively.

T. Telson upturned, and consequently viewed from the underside.

B. *Urothoe norvegica*.

gn. 1. First gnathopod. *prp.* 3. Third peræopod.

gn. 2. Second gnathopod. *plp.* A pair of pleopods.

ur. 1, 2, 3. First, second, and third uropods respectively.

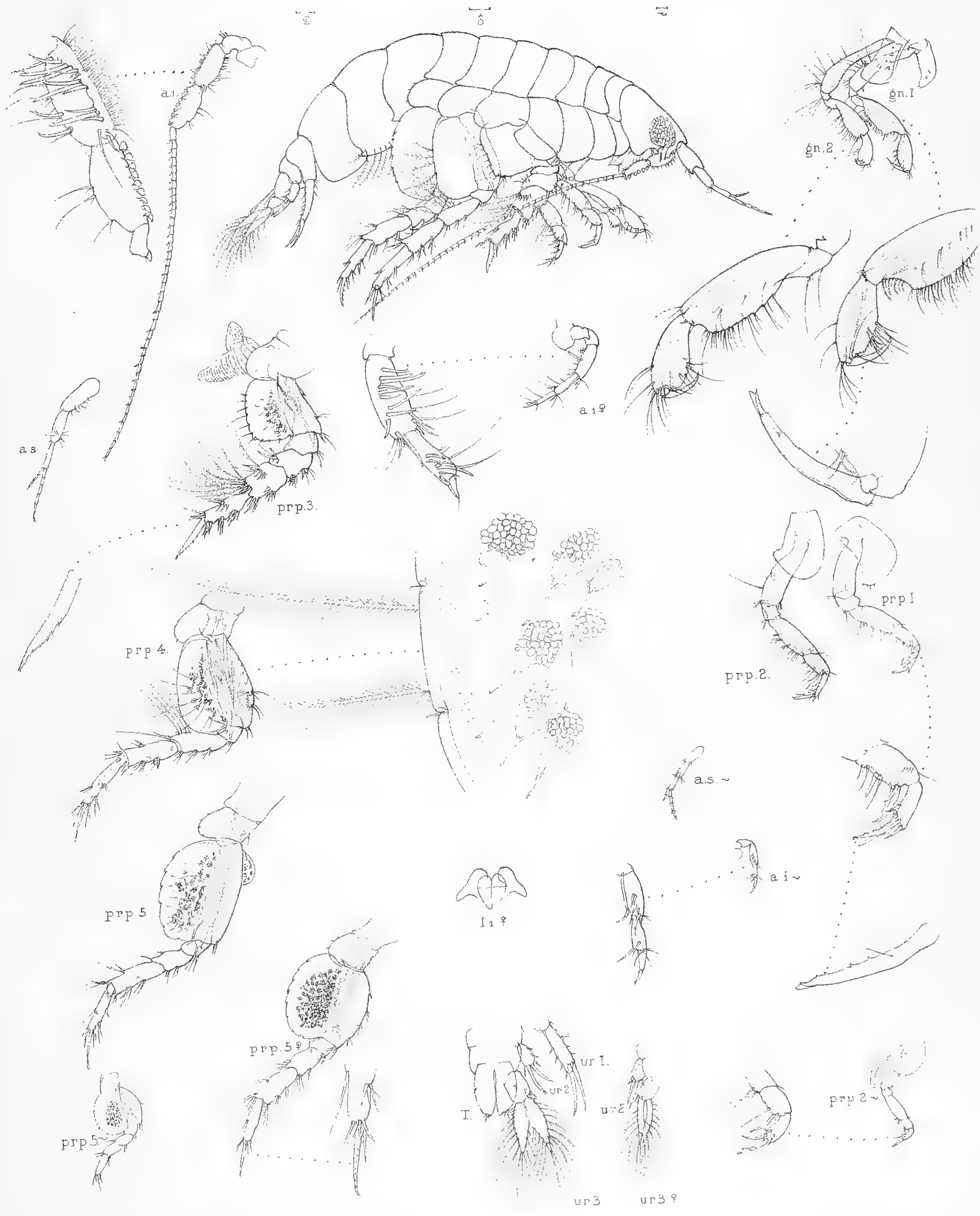
T. Telson.

C. *Urothoe brevicornis*, ♀.

a.i. Lower antenna. *l.s.* Upper lip.

ur. 1, 2, 3. First, second, and third uropods respectively.

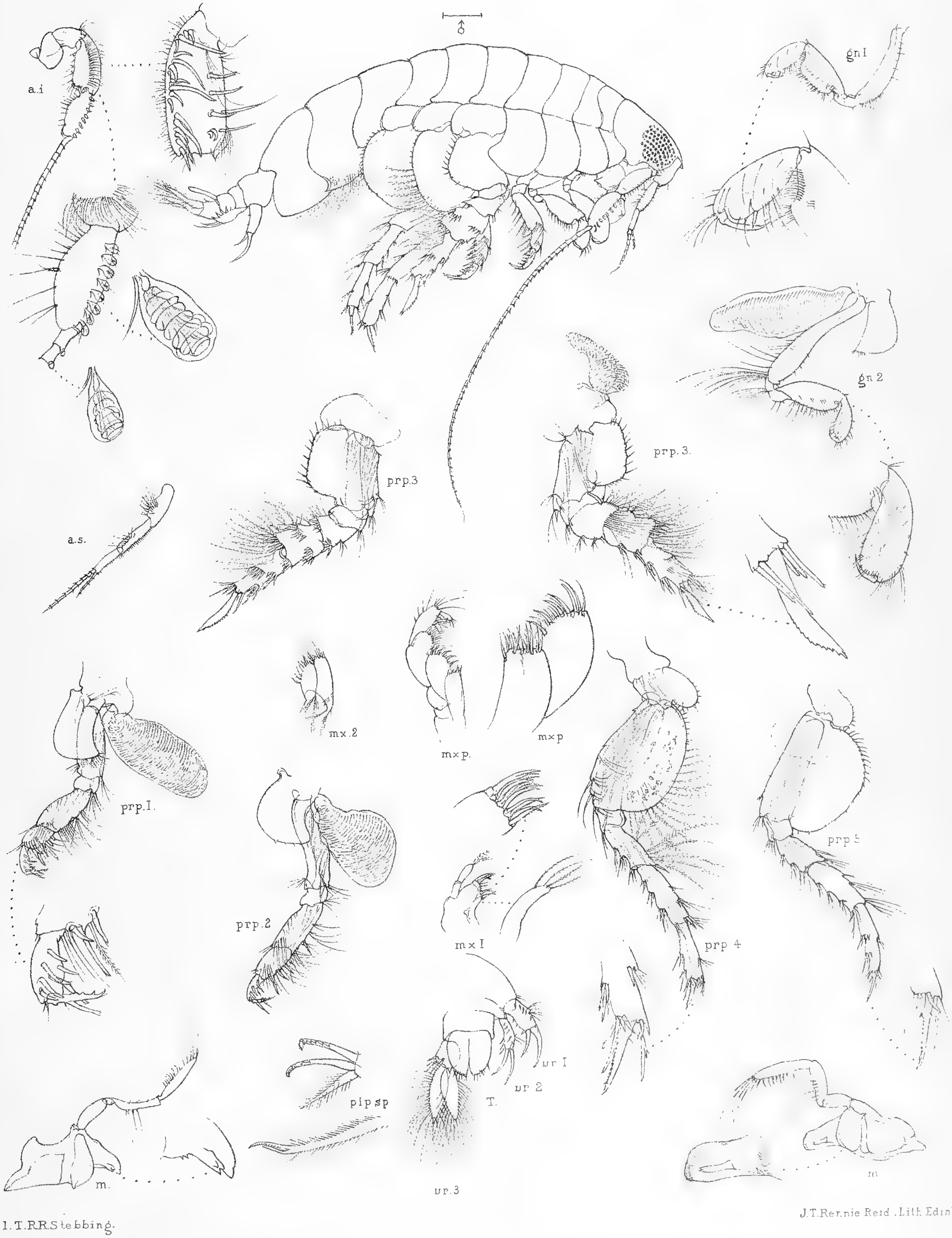
T. Telson.



Del. T.R.R. Stebbing.

J.T. Rennie Reid. Lith. Edinr.

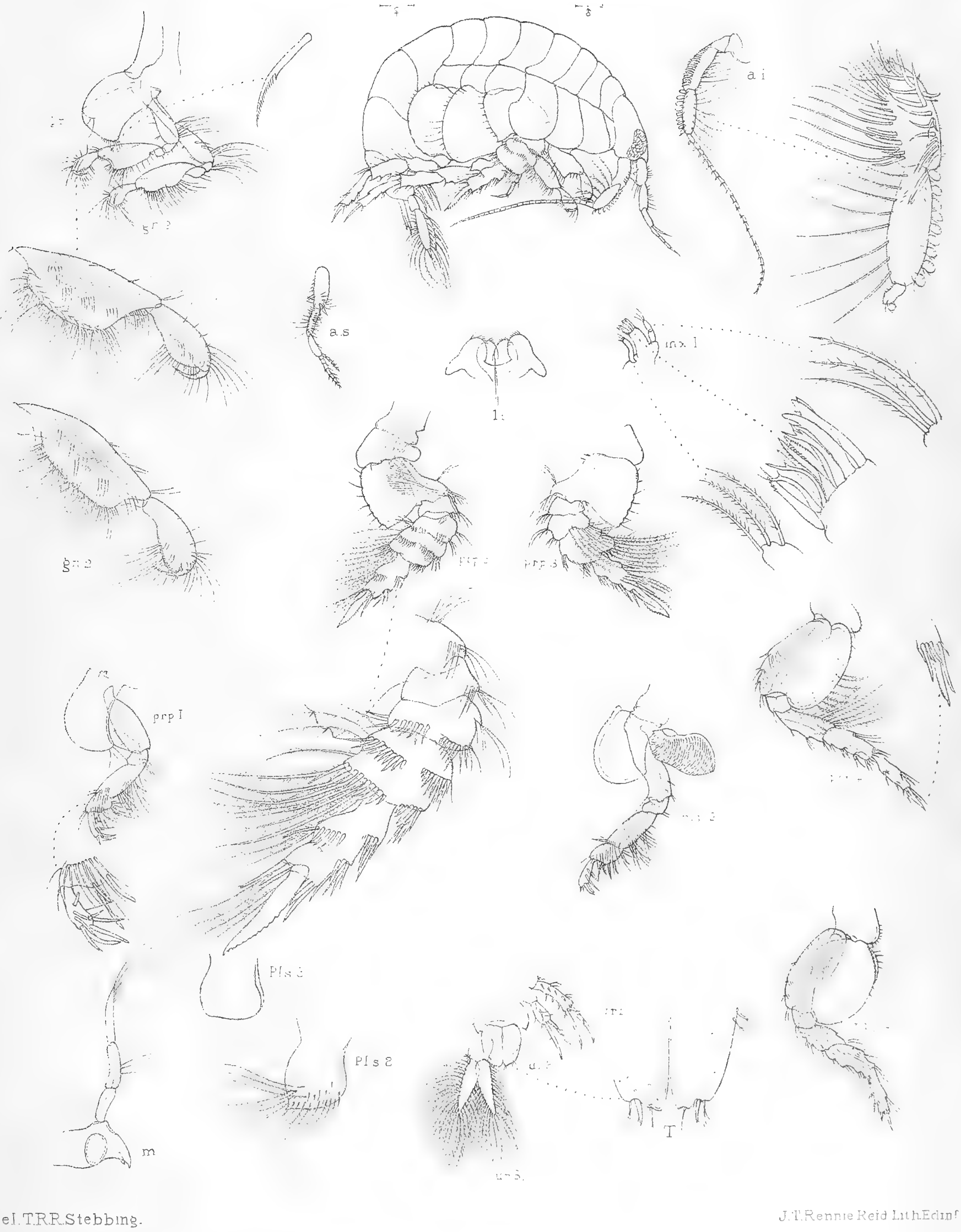
UROTHOE ELEGANS. SP. BATE.



Del. T.R.R.Stebbing.

J.T. Rennie Reid. Lith. Edin[r]

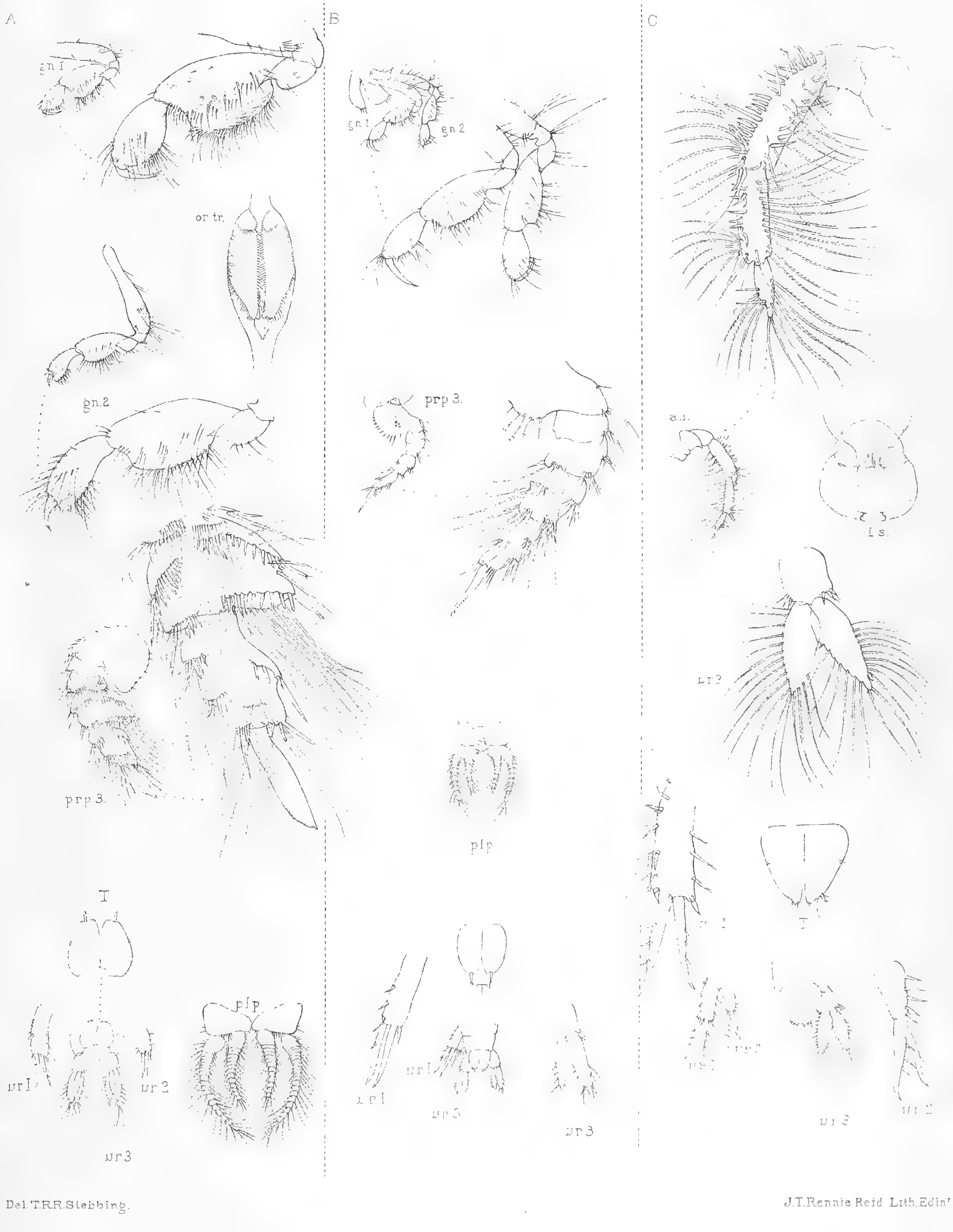
UROTHOE MARINUS. SP. BATE.



Del. T.R.R.Stebbing.

J.T.Rennie Reid Lith. Edinr

UROTHOE BREVICORNIS. SP. BATE.



Del. T.R.R. Stebbing. J.T. Rennie Reid Lith. Edin[r]

UROTHOE PULCHELLA ♀ (COSTA). UROTHOE NORVEGICA, BOECK. UROTHOE BREVICORNIS ♀ SP. BATE.

II. *On four new British Amphipoda. By the Rev.* THOMAS R. R. STEBBING, *M.A., and* DAVID ROBERTSON, *F.L.S., F.G.S.*

Received September 19th, 1889, read November 19th, 1889.

[PLATES V., VI.]

1. SOPHROSYNE ROBERTSONI, n. sp. (Plate V. A.)

Rostrum minute; the body moderately compressed, with rounded back; the hinder angles of the first pleon-segment slightly rounded, those of the second squared, those of the third strongly produced upwards, so that a deep cavity is formed on either side between these and the arched dorsal surface of the segment; the much shallower fourth segment forms dorsally three little humps, two median and one distal; the fifth and sixth segments are very small. The integument is closely speckled.

Eyes not perceived.

Upper antennæ. First joint shorter than the head, once and a half as long as broad, as long as the six-jointed flagellum, the second joint not half as long as the first, and about twice as long as the third; the flagellum tapering, the first joint narrower but a little longer than the last of the peduncle, each joint with one or two filaments; the secondary flagellum slender, three-jointed, the last joint minute.

Lower antennæ. Gland-cone very prominent; third joint longer than broad, fourth joint longer than the fifth; the flagellum eight-jointed, slender, tapering, the first six joints together being about as long as the fourth joint of the peduncle.

Mandibles. The trunk slender, the cutting-edge narrow, apparently with a denticle at either end; molar tubercle wanting; palp set far forward, much longer than the trunk, first joint short, second elongate, slightly curved near the base, with one spine near the distal end, the third joint as long as the second, distally truncate, with four unequal spines on the extremity and one a little below it.

First maxillæ. The inner plate small and low down; the outer plate forming a single apical tooth, with a little denticle on its side; the palp was broken in dissection.

Second maxillæ. The inner plate much shorter and narrower than the outer, with three minute setules near or at the rounded apex, the much larger outer plate having four setules similarly situated.

Maxillipeds. The inner plate very small, not reaching to the base of the outer plate, carrying a single spinule on the apex; one of the pair of plates was in the specimen much smaller than the other; the outer plate longer but narrower than the first joint of the peduncle, having two or three spinules on the inner margin, and four somewhat larger on the apex; the first joint of the peduncle rather longer than broad, the second much longer, with two groups of spines on the inner margin and one at the outer apex;

the third joint rather shorter and narrower than the second, with several spines about the distal two thirds; the curved finger nearly as long as the third joint, with the dorsal setule not very near the base.

Triturating organ. One margin fringed with ten graduated spines, which are short and moderately stout, not serrate.

First gnathopods. The side-plates broad above, so as to project much beyond the upper part of the segment. The first joint broad, not very long, deeply channelled, with some spinules on the front margins, and a group of spines at the hinder apex; the second joint as broad as long, channelled, with spines along the hind margin; the third joint much longer than broad, with about a dozen spines and half a dozen setæ along the serrate hind margin, which is pointed at the apex; the wrist triangular, distally broader than the length, the front margin convex, with an apical spine, the hinder apex having a graduated series of five spines with several setæ; the hand much longer than the wrist and broad, but much longer than broad, with the front margin convex, the hinder concave, armed with two spines, and ending in a long slender tooth, the palm smooth, sinuous, the surface of the hand and the apex of the hind margin having a few setæ or spines; the finger closely fits the palm, except that its tip overlaps the apical tooth. One of this pair of gnathopods was in the specimen rather smaller than the other.

Second gnathopods. Side-plates longer but narrower than those of the first pair. Branchial vesicles broader but a little shorter than the side-plates, apically almost pointed. Marsupial plates very narrow, with three setæ at the apex. First joint of the limb elongate, narrow, a little widened distally; second joint longer than the third or hand; the third joint having much of the convex hind margin furred with setules; the wrist narrow, elongate, about half the length of the first joint, the front and hind margins furred with setules; the hand less than two thirds the length of the wrist, the margins nearly parallel, except near the base, both furred with setules, the hind margin distally carrying scale-like spinules, the apical margin having the usual spines; the finger minute, broad at the base, apically narrow and hooked, the dorsal setule median.

First peræopods. The side-plates like the preceding pair, but larger. The first joint not reaching below the side-plate, with setules along the front margin, and a spine or two at the hinder apex; the second joint is armed at three points of the hind margin; the third joint at eight points of the hind margin and the produced apex of the front; the fourth joint, much narrower and shorter than the third, has setæ at four points of the hind margin; the fifth joint is longer but narrower than the fourth, with setæ at two or three points; the finger is slightly curved, a little shorter than the fifth joint.

Second peræopods. The side-plates excavate behind to more than half the depth of the plate. The limb similar to the preceding pair, but with the third joint a little shorter.

Third peræopods. Side-plates of equal breadth and length, the front margin convex, the hinder nearly straight. The first joint a little longer than the side-plates, but not so broad, pear-shaped, with spines at eleven points of the convex front margin, and with a little serration at the top of the hind margin; the second joint almost embedded in the first; the third much shorter than in the two preceding pairs, with spines at two points of the hinder and four of the front margin; the fourth joint shorter and narrower than the third, with spines at three points of the front margin; the fifth joint narrower but longer than the fourth, with spines at two or three points of the front; the finger slightly curved, nearly as long as the fifth joint.

Fourth peræopods. The side-plates narrower and a little shorter than the preceding pair, more strongly bilobed below. The first joint much longer than in the preceding pair, elongate oval, the front margin with spines at eleven points, the hind margin slightly serrate; the second joint rather longer than broad; the third joint similar to that in the preceding pair, but larger; the fourth nearly as long, with spines at four points in front; the fifth narrower, but as long, with spines at four points; the finger a little shorter than the fifth joint.

Fifth peræopods. Side-plates much smaller than the preceding pair, not bilobed, the hind margin very convex, the front straight. The first joint a little longer than broad, as long as in the preceding pair and much wider, almost all the front margin fringed with spines, the hind margin roughly serrate; the other joints nearly as in the third pair, but the third and fourth joints smaller, and the finger as long as the smooth fifth joint.

Pleopods. The coupling-spines small, two in number, with two lateral teeth near the reflexed apex; the cleft spines two in number, the arms nearly equal; the joints of the inner ramus seven or eight, those of the outer eight or nine in number.

Uropods. The peduncles of the first pair longer than the rami, with several spines on the margins, the rami slender, tapering, subequal, the outer carrying three spines, the inner a single one; the peduncles of the second pair shorter than the rami, which are nearly as long as those of the first pair, the outer a little the longer, armed with two spines, the inner being unarmed; the peduncles of the third pair scarcely longer than broad, the rami smooth, slender, subequal, smaller than those of the preceding pair.

Telson flanked for more than half its length by the produced sides of the sixth segment, divided for more than a third of the length, the slightly indented apices not quite reaching the distal end of the peduncles of the third uropods.

Length one quarter of an inch.

Locality. The Clyde. One specimen, female, containing eight or nine rather large eggs in a forward state of development.

From *Sophrosyne murrayi*, taken at Kerguelen Island, the new species[1] differs in

[1] It is proper to mention that Mr. David Robertson, my colleague in this paper, by whom this and the other specimens described were captured, only assented to the adoption of the specific name *robertsoni* at my particular request.—T. R. R. S.

several small details; the second joint of the upper antennæ is less elongate, the armature of the first gnathopods is slighter, the hand of the second gnathopods is differently shaped, the third segment of the pleon is dorsally curved downwards instead of being posteriorly squared, the telson is longer than broad and less deeply cleft. In general features the two species are remarkably alike, and now that this rather striking genus is found to have a representative in one of our own estuaries, it seems singular that it should have first been made known to us from Antarctic waters.

2. SYRRHOË FIMBRIATUS, n. sp. (Plate V. B.)

The third segment of the pleon with the lower hinder angles produced into an acute upturned point, the two preceding segments having these angles acute, but only slightly produced. The dorsal denticles apparently present on some or all of these segments were not clearly made out. The sixth segment of the pleon fringed behind with a close-set row of spinules.

Upper antennæ. First joint stout, longer and much broader than the second, which is nearly twice as long as the third; the flagellum longer than the peduncle, the first joint as long as the first of the peduncle, and as long as the six following joints united, armed with a brush of long filaments; the secondary flagellum three-jointed, the small third joint not quite reaching the end of the second joint of the principal flagellum.

Lower antennæ. The first joint broader than long, overlapping the little acute gland-cone of the second joint, the third joint a little longer than broad, the fourth longer than the three preceding united, rather shorter than the fifth, each of these two carrying tufts of setules; the flagellum very slender, longer than the peduncle, consisting probably of ten or twelve joints, of which eight were present.

Upper lip. The central part of the distal margin forms an almost semicircular lobe, which in the dissection was folded back, but whether this may be its natural position or only accidental, could not be determined.

Mandibles. Cutting-edge having two teeth and a smooth border on the left mandible, on the right having only the two teeth; the secondary plate small with four teeth, which are blunt on the left, and delicately sharp on the right mandible; the molar tubercle broad and strong; the first joint of the palp longer than broad, the second joint elongate, slightly curved, with four groups of setæ, the third joint broken, probably very short.

First maxillæ. The palp has on the apex five spines and one spine on the outer margin below the apex.

Second maxillæ. The inner plate appears to be broader than the outer, both plates carrying numerous long spines.

Maxillipeds. Inner plates broad, reaching a little beyond the first joint of the palp, the inner margin produced into a small distal tooth, the distal part of the plate bordered with nine plumose setæ; the outer plates not quite reaching the end of the second joint of the palp, fringed with eight or nine spine-teeth; the second joint of the palp the longest, not very strongly spined.

First gnathopods. The side-plates, like the somewhat larger second pair, oblong, directed forwards. The first joint of the limb a little widened distally, carrying a few slender spines; the second joint having some slender spines at the apex of the hind margin; the third joint more or less oblong, with five spines on the lower part of the hind margin; the wrist not twice as long as the hand, furry on both margins, the hind margin being also fringed with spines; the hand broadest near the base, the front regularly convex, with spines at the apex, the hind margin convexly angled, carrying a few partially pectinate spines, the surface of the hand furry; the finger about half the length of the hand, broadest at the base, with spines at the centre, where at the inner margin it abruptly narrows.

Second gnathopods. The first joint longer than in the first pair, with a few feathered spines or setæ on the hind margin; the wrist and hand longer than in the first pair; the wrist twice as long as the hand, slender, furry, and carrying a few spines; the hand also slender, furry, with an oblique row of spines on the distal part; the finger much curved, about a third the length of the hand.

First peræopods. Side-plates longer than the preceding pair, distally widened. Branchial vesicles about equal in length and breadth to the side-plates, but with curved margins. The limb slender, the first joint reaching a little below the side-plate, the third joint with convex front margin, shorter than the fourth, which is straight and armed on the hind margin with a few spinules; the fifth joint rather longer than the third, shorter than the fourth, with spinules at four points of the hind margin; the finger curved, about half the length of the preceding joint.

Second peræopods. The side-plates with convex front and lower margin, the hinder excavate. Branchial vesicles and limb as in the preceding pair, but the fourth joint more elongate.

Third peræopods. The side-plates longer than deep, only slightly bilobed. The first joint narrowly oval, slightly serrate, the third wider but shorter than the fourth, the fourth than the fifth, each of the three having small spines at three or four points of each margin; the finger slender, nearly straight, more than half the length of the fifth joint.

Fourth peræopods. The side-plates with the length and depth equal. The limb similar to the preceding pair, but with the third, fourth, and fifth joints much longer; and the finger about half the length of the preceding joint.

Fifth peræopods. The side-plates very shallow, longer than deep. The broadly oval first joint longer and much wider than in the two preceding pairs, the third joint larger than in the preceding pair and more produced downwards behind, the remainder of the limb similar to that of the fourth pair.

Pleopods. The two coupling-spines long and slender, serrate on each side, with two, three, or four teeth near the apex; the cleft spines three in number; the joints of the inner ramus nine, of the outer ten.

Uropods. In the first pair the peduncle is scarcely so long as the longer ramus, which is straight, almost smooth, except for the group of spines on the truncate apex; the smaller ramus is similar to the larger, but not quite half as long; in the second pair the peduncle is longer than the short ramus, and a little more than half the length of the longer one, which is acutely lanceolate, carrying six spinules on one border and three on the other; the smaller ramus is less than half as long or as broad as its companion, but a little longer than the similar ramus of the first pair; in the third pair the peduncle is shorter than the rami, more than twice as long as broad, the rami acute, the inner rather the longer, with six or seven plumose setæ on the inner margin, the outer ramus having five spines and one plumose seta on the inner margin, nearly a third of the length of the ramus forming a second joint.

Telson elongate, cleft for more than half its length, reaching considerably beyond the peduncles of the third uropods, the acute apices having each a setule in a notch on the inner side; there are also three or four setules arranged near each lateral margin.

Length. This small and delicate species was dissected before the measurement of the body had been taken.

Locality. Clyde.

Remarks. The specific name alludes to the distinguishing fringe of spinules upon the sixth segment of the pleon.

3. Podoceropsis palmatus, n. sp. (Plate VI. a.)

Lateral angles of the head rather acutely produced between the upper and lower antennæ.

Eyes nearly round, situated on the lateral lobes of the head, in the preserved specimen showing a light rim round a black centre.

Upper antennæ. The first joint twice as long as broad, channelled; second joint once and a half as long as the first, much narrower, slightly curved, with setæ at four points of the lower margin; third joint a little longer than the first, with setæ at three points; flagellum of five or more rather elongate joints carrying filaments; the secondary flagellum very slender, two-jointed, shorter than the first joint of the principal flagellum, the second joint minute, tipped with setules.

Lower antennæ. The third joint as long as the first and second united, distally a little widened. The remainder of the antennæ missing.

Mandibles. Cutting-edge divided into five unequal teeth; the secondary plate on the left mandible has four teeth, that on the right about six denticles; the spine-row on the left consists of five spines, denticulate between the widest part and the apex; on the right mandible there are only four spines; the molar tubercle has an almost circular denticulate crown with a seta at the hind corner; the palp is much longer than the trunk, set far forward, the first joint rather longer than broad, the second about three times as long as broad, with several setæ along the front, and one or two on the hind margin; the rather shorter third joint has four or five setæ or spines near the hind margin, and several on the truncate apex and distal part of the front margin.

First maxillæ. The long second joint of the palp has four spine-teeth on the truncate apex.

Maxillipeds. Inner plates not reaching the middle of the outer, and these not reaching the middle of the second joint of the palp, the spine-teeth on the inner margin passing into curved spines on the apical border, the series about nine in number; the long second joint of the palp fringed, but not closely, with setæ; the third joint scarcely so long as the first, the fourth much shorter; the blunt apex tipped with spines.

First gnathopods. Side-plates distally widened. First joint slightly curved, reaching beyond the side-plates, the third joint almost oblong, with spines on the convex front and along the apical margin; the wrist fully as long as the hand, not very much shorter than the first joint, with slender spines on the surface, round the distal border, and in two groups on the hind margin; the convex front border of the hand carrying four groups of very slender spines, of which the much shorter hind margin has two groups, the deeply excavate palm being bordered with spinules and a group of spines; the finger slender, curved, reaching beyond the extremity of the palm and its palmar spine, and having some minute setules and microscopic furring along its inner margin, which has also a very small tooth far from the apex.

Second gnathopods. The side-plates larger and of more uniform width than the first pair. The first joint reaching beyond the side-plates, not longer and very much narrower than the hand, the third joint rather longer than in the first pair, but with fewer spines; the wrist triangular, cup-shaped, about half the length of the hand, which is much wider, broadly oblong, with several groups of slender spines along the hind margin, and one or two on the smoothly convex palm, which is left partly exposed by the slender curved finger, as this bends almost abruptly from the hinge on to the inner surface of the hand, its acute tip reaching beyond the middle of that surface, the concave margin having setules at three or four points. The general resemblance of this limb to the corresponding one in *Melita palmata* (Montagu) may be noted.

First peræopods. Side-plates rather larger than the preceding pair. Branchial vesicles small. The first joint reaching below the side-plate, both margins convex, the hinder carrying two or three very slender spines; the third joint about once and a half as long as broad, slightly armed at two points of each margin; the fourth joint narrower and shorter than the third, with very convex front margin; the fifth joint subequal in length to the third, with spinules at three points of the straight hind margin; the finger curved, not much shorter than the fifth joint.

Second peræopods closely resembling the first.

Third peræopods. Side-plates with the front lobe nearly as deep as the preceding pair, the hinder lobe much shallower. Branchial vesicles small. The first joint somewhat broadly pear-shaped, almost entirely unarmed; the third joint longer than the fourth, shorter than the fifth, the two latter having straight parallel margins, with rather long spines at the hinder apex; the finger curved, not half the length of the fifth joint.

Fourth peræopods. Side-plates small, bilobed. The first joint a little longer but narrower than in the preceding pair; the rest of the limb similar to the preceding pair, but with the joints longer and more strongly armed.

Fifth peræopods similar to the preceding pair, but on a larger scale, and the first joint fringed with spinules on both margins.

Pleopods. The two coupling-spines short and small, each with two pairs of reverted teeth; cleft spines two in number, joints of the rami about seven.

Uropods. Peduncles of the first pair rather longer than the inner ramus, carrying spines of various sizes at three or four points of the upper margin and a long one at the apex of the lower; each ramus has spines at two points of the upper margin and a large group at the rather blunt apex; the outer ramus is a good deal shorter than the inner; the peduncles of the second pair have a length intermediate between the lengths of the two rami, which resemble those of the first pair, but are a little smaller; the peduncles of the third pair are nearly as long as those of the second, longer and much stouter than the rami, which are equal, slender, acute, with spines at two points of the upper margin.

Telson. The breadth at the base equal to the length, the apical margin slightly concave, equal to more than half the greatest breadth of the telson; on either side a couple of spinules are planted on a raised ridge that runs obliquely incurved from each corner of the apical margin.

Length scarcely a sixth of an inch.

Locality. Cumbrae, in the Clyde. A single specimen.

Remarks. The specific name has been chosen because of the likeness presented by the second gnathopods to those of Montagu's species, *Melita palmata.* The secondary flagellum of the upper antennæ is a little less rudimentary than in most species of *Podoceropsis.*

4. PODOCERUS CUMBRENSIS, n. sp. (Plate VI. B.)

Rostrum small and blunt, lateral lobes of the head produced into a blunt point just in front of the eye. Hinder angle of the third pleon-segment bluntly produced.

Eyes round, composed of fifty or sixty ocelli.

Upper antennæ. The first joint rather longer than broad, the lower margin carrying spinules at three points; second joint considerably longer than the first, with slender slightly feathered spines at five points of the lower margin; the third joint shorter than the second, with spines at five or six points; the flagellum of three joints, together not so long as the first two of the peduncle; the secondary flagellum consisting of a single joint less than a half or sometimes a third of the first joint of the principal flagellum.

Lower antennæ. Gland-cone small, the third joint with a lobe at the distal margin on either side, the fourth joint not longer than the fifth, distally widened, the fifth joint rather longer than the three-jointed flagellum. In general appearance the lower antennæ from the third joint onwards greatly resemble the upper, but they are stouter and a little longer.

Mandibles. The cutting-edge has four teeth; the secondary plate on the left mandible has also four teeth, but on the right an irregularly serrate edge; the spine-row consists of three serrate spines; the molar tubercle is strong, with a little denticulate plate in a recess of the forward margin; the first joint of the palp is short, distally widened, the second joint is broad, with nine plumose spines on the convex margin; the third joint is also broad, but shorter than the second, with a transverse row of four spines on the surface, and about fourteen on the apex and adjoining border.

Lower lip. The outer lobes rather broad, lightly furred.

First and second maxillæ, so far as observed, differing little from those of *Podocerus falcatus* (Montagu).

Maxillipeds. The inner plates having two spine-teeth on the apical margin and one on the inner, and four curved spines about the apical margin; the outer plates reaching beyond the middle of the second joint of the palp, carrying three spine-teeth on the inner and four on the distal margin; the third joint of the palp a little more than half the length of the second; the fourth joint short and blunt, tipped with spines longer than itself.

First gnathopods. The side-plates very small, almost concealed under the following pair, the lower margin a little indented. The limb small, the first joint curved, having a long seta or slender spine below the middle of the convex hind margin; the wrist triangular, scarcely longer than the oblong third joint, each having some spines about the distal margin and a few on the inner surface; the hand oval, about twice as long as the wrist, with several slender spines along the hind margin and about the inner surface; the palm ill-defined, except by the set of three palmar spines, among which the tip of the curved finger closes, reaching a little beyond them.

Second gnathopods. The side-plates very much longer than the first pair, with convex front margin directed forwards. The branchial vesicles remarkably small. In the male the first joint channelled, shorter than the hand; the second joint channelled, distally widened; the third joint scarcely longer than the second, with a couple of setules at the apex; the wrist absorbed into the hand, which is very large, when full-grown two and a half times as long as broad, the front margin convex, the hind margin having near the base a projecting tooth, which attains to a length equalling the breadth of the hand, near to the distal extremity of which this margin forms a much smaller tooth; the varied relations of size between these two teeth are illustrated in the figures *gn.* 2, *gn.* 2 A, and *gn.* 2 B; a very long, much curved finger arches over the small cavity formed between the hinge and the distal tooth and the large cavity between the two teeth; in some cases the inner margin of the finger has a small prominence approaching the distal tooth of the hand; there are several slender setæ about the hinder margin and teeth of the hand, and setules along the inner edge of the finger. In the female the marsupial plates are longer and broader than the first joint and are fringed with setæ. The first joint of the limb is longer than the hand, which is here distinct from the wrist, the whole limb being very similar to that of the first pair, but a little larger.

First peræopods. The side-plates much broader than the preceding pair, with the front margin convex, the lower and the hind margin straight. The branchial vesicles very small. The first joint with convex front and hind margins, the latter having three setæ planted near the middle; the third joint armed at two points on each margin, much widened distally; the fourth joint only a little longer than the second, armed at two or three points of the hind margin and at the apex of the convex front; the fifth joint as long as the third, armed at three points of each margin; the finger curved, rather stout, more than half the length of the fifth joint.

Second peræopods. The side-plates large, almost square, with convex front margin, and the hinder a little excavated. The limb as in the preceding pair.

Third peræopods. The side-plates small. The first joint pear-shaped, the convex hind margin very slightly indented, the remainder of the limb nearly as in the two preceding pairs, but rather more slightly constructed.

Fourth peræopods resembling the third, but with the hind margin of the first joint more strongly indented, and all the joints more elongate.

Fifth peræopods. The first joint broadest at the centre, the hind margin very convex, the front only slightly; the limb in general resembling that of the preceding pair, but with the joints more elongate.

Pleopods. The two coupling-spines very short, with two or three teeth; the peduncles have also here and there a plumose seta; the cleft spines are two or three in number, where there are three the third being much longer than the first; the joints of the inner ramus from five to seven, of the outer from six to eight.

Uropods. Peduncles of the first pair longer than the rami, of which the inner has small spines at four points, the outer at three, the outer being rather the shorter; in the second pair the peduncle is longer than the outer, but rather shorter than the inner ramus; the peduncles of the third pair are stout, longer than those of the second pair, with a spine at two points of the upper margin; the shorter outer ramus is fringed above on the distal half with a graduated series of about nine minute denticles, the larger ones near the apex; the rather longer straight inner ramus has a little spine at the extremity.

Telson triangular, as broad at the base as the length, the upper angles and the apex rounded, each margin carrying a setule near the apex; the telson reaches about halfway along the peduncles of the third uropods.

Length an eighth of an inch.

Locality. Clyde. Obtained in some numbers at a depth of 20 fathoms, off Fairlie Perch, in February 1889.

Remarks. The specific name is derived from Cumbrae, an island in the Clyde. This species makes some approach to *Podocerus minutus*, Sars, but is clearly distinguished from it by the three-jointed flagella in both pairs of antennæ, by the small concealed first pair of side-plates, the hand of the second gnathopods in the female not excavate, and the large tooth of that hand in the male being simple instead of double-ended

EXPLANATION OF THE PLATES.

PLATE V.

A. *Sophrosyne robertsoni*, n. sp.

The full figure is given in lateral view, with a line above it indicating the natural size.

a.s. Upper antenna.
a.i. Lower antenna.
m. Mandible.
mx. 1. First maxilla, the palp imperfect.
mx. 2. Second maxilla.
mxp. Maxillipeds.
o.t. Triturating organ, from the stomach.
gn. 1. First gnathopod.
gn. 2. Second gnathopod.
prp. 2, 3, 4, 5. Second, third, fourth, and fifth peræopods respectively.
sp. of plp. Coupling-spines and a cleft spine of a pleopod.
ur. 1, 2, 3. First, second, and third uropods respectively, the telson being shown in combination with the second and third uropods.

B. *Syrrhoë fimbriatus*, n. sp.

a.s. Upper antenna.
a.i. Lower antenna.
m.m. The right mandible, with the palp imperfect, and a portion of the left mandible.
gn. 1. First gnathopod.
gn. 2. Second gnathopod.
prp. 1, 2, 3, 4, 5. First, second, third, fourth, and fifth peræopods respectively.
plp. 1. First pleopod.
Pl.s. 3. Lower lateral portion of third segment of the pleon.
ur. 1, 2, 3. First, second, and third uropods respectively.
T. Telson.

PLATE VI.

A. *Podoceropsis palmatus*, n. sp.

The full figure is given in lateral view, with a line above it indicating the natural size.

a.s. Upper antenna.

m.m. Right and left mandibles at the right and left corners of the Plate respectively.

mxp. Maxilliped.

gn. 1. First gnathopod. *gn.* 2. Second gnathopod.

prp. 1, 3, 4, 5. First, third, fourth, and fifth peræopods respectively.

ur. 1, 2, 3. First, second, and third uropods respectively.

T. Telson.

B. *Podocerus cumbrensis*, n. sp.

The full figure is given in lateral view, with a line above it indicating the natural size.

oc. One of the eyes adjoining the lower angle of the head.

a.s. Upper antenna. *a.i.* Lower antenna.

m.m. The left mandible and the anterior portion of the right mandible.

l.i. B. Lower lip. This and the other parts marked B were figured from another specimen, not from that drawn at the top of the Plate.

mx. 1 B. First maxilla. *mx.* 2 B. Second maxilla.

mxp. Maxillipeds, seen from the outer surface, but with outer plate and palp removed from the half to the right so as to expose the inner plate.

gn. 1, *gn.* 1, ♀. First gnathopod of male and female respectively.

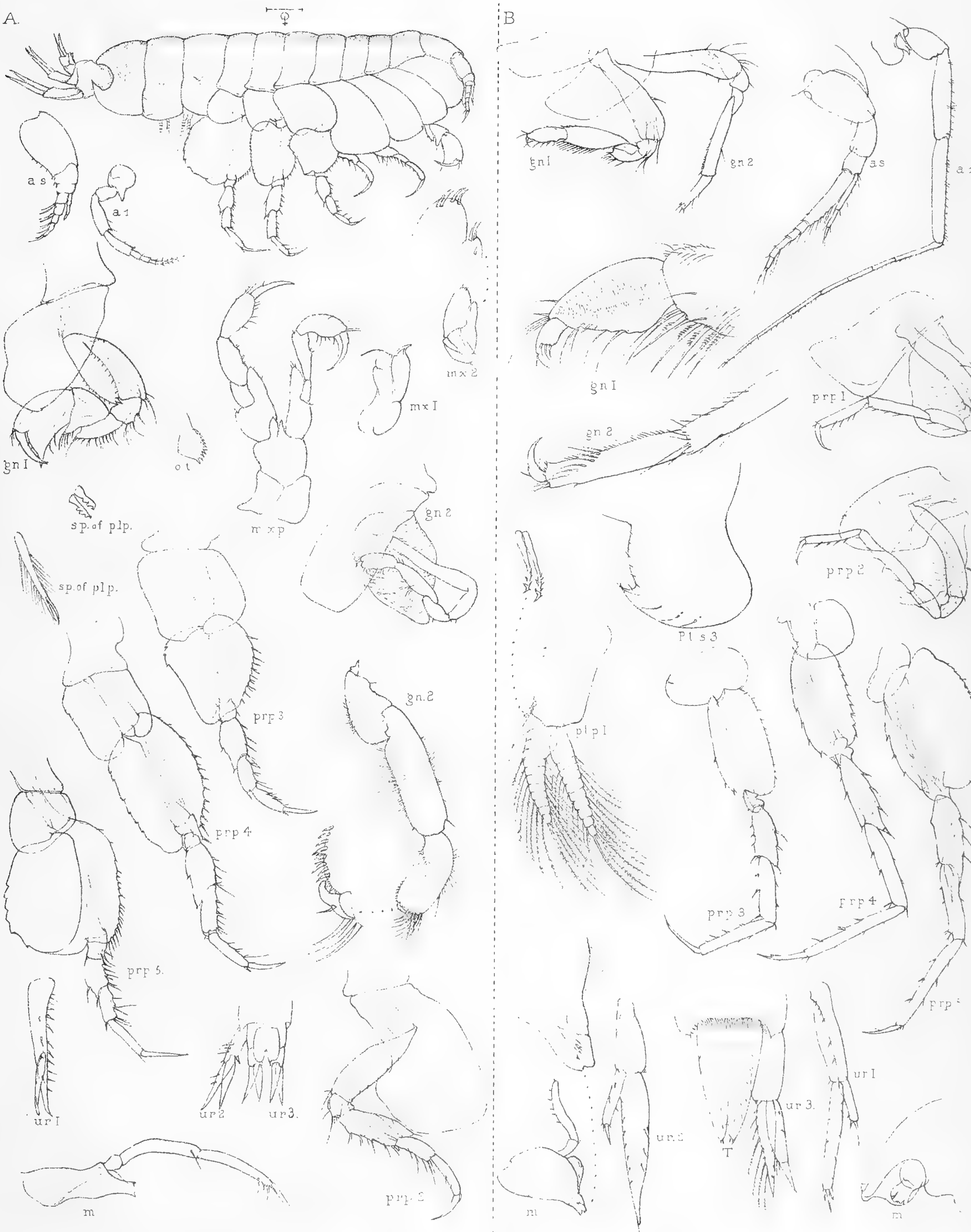
gn. 2, *gn.* 2 A, *gn.* 2 B. Second gnathopod of the male, three different specimens.

gn. 2, ♀. Second gnathopod of female.

prp. 1, 2, 3, 4, 5. First, second, third, fourth, and fifth peræopods respectively.

ur. 1, 2, 3. First, second, and third uropods respectively.

T, T. B. Telson.

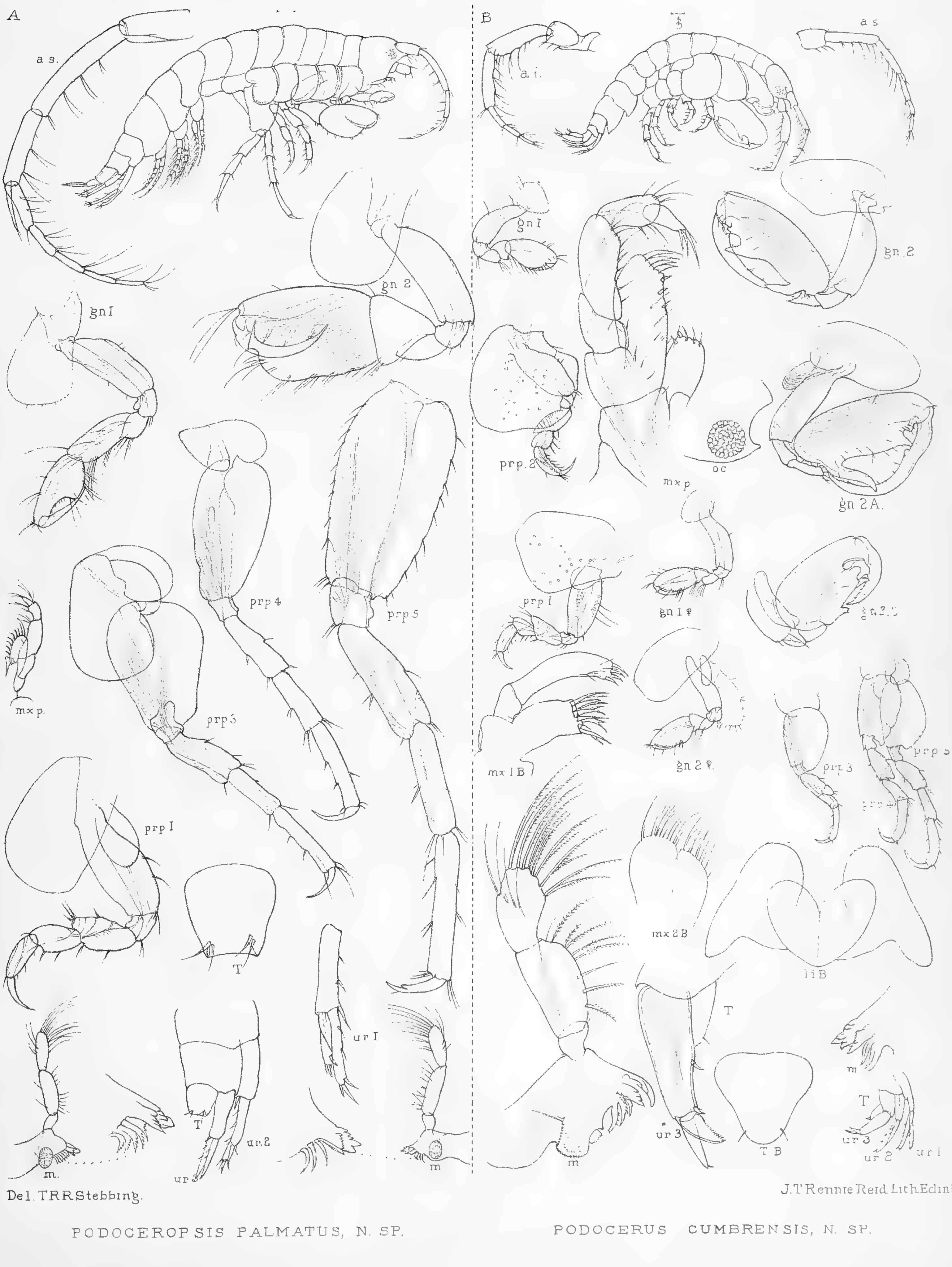


Del' T.R.R.Stebbing.

J.T.Rennie Reid, Lith. Edin^r.

SOPHROSYNE ROBERTSONI, N. SP.

SYRRHOË FIMBRIATUS, N. SP.



Del. T.R.R.Stebbing.

J.T. Rennie Reid Lith. Edin.

PODOCEROPSIS PALMATUS, N. SP.

PODOCERUS CUMBRENSIS, N. SP.

III. *On the Morphology of a Reptilian Bird*, Opisthocomus cristatus. *By* W. K. Parker, *F.R.S.*

Received January 4th, 1890, read February 4th, 1890.

[Plates VII.–X.]

Contents.

Early last year Mr. Sclater received from Mr. John J. Quelch, C.M.Z.S., of the Museum, Georgetown, British Guiana, a series of embryos of the Hoatzin (*Opisthocomus cristatus*). Some of these, after due examination by Mr. F. E. Beddard[1], were sent to me by Mr. Sclater. My study of the adult has been from the two skeletons in the Museum of the Royal College of Surgeons, kindly lent me by the President, Sir W. Savory, and the Curator, Prof. Charles Stewart. I take this opportunity of thanking all these friends for their kindness.

Hitherto my knowledge of the structure of the skeleton of this bird has been derived from Prof. Huxley's masterly description, given partly in his paper "On the Classification of Birds," and more completely in his paper "On the Classification and Distribution of the Alectoromorphæ and Heteromorphæ" (Proc. Zool. Soc. 1867, pp. 415–472; and ibid. 1868, pp. 294–319).

[1] See Mr. Beddard's paper, 'Ibis,' 1889, p. 283.

I had also made my own observations on the skeleton of an old male bird of this species in the Hunterian Museum. Judging from the figures given by Prof. Huxley in his second paper, I am of opinion that the specimens there figured were from skeletons of female birds.

What struck me at first in the Hunterian specimen was that it is much more like the skeleton of a strong Curassow (*Crax*) than those from which Prof. Huxley's illustrations were taken; these latter have a very *Musophagine* appearance; they suggest an evident relation to the Plaintain-Eaters. Thus, while I am glad to refer to those figures, and the excellent descriptions given of them, and the accompanying remarks on the affinities of this bird, my own notions of the structure of the adult, here given, will be from observations on the Hunterian specimen.

I. *Introductory Remarks on the Present Existence of Birds closely related to Reptiles.*

Two or three facts must be noticed at the outset of these remarks: namely, first, that the known extinct forms are very few in proportion to the multitudes of those that are still alive; secondly, that the Tertiary forms are closely related to existing types, and throw but little light on their origin; and, thirdly, that the very few most precious relics of the Secondary Rocks startle us at once by being tooth-bearers—not like our familiar forms with their horny beaks. Leaving out of consideration the mysterious and apparently quite isolated *Archæopteryx*, the types described by Dr. Marsh in his magnificent work on the "Odontornithes, or Extinct Toothed Birds of N. America," 1880, teach some very remarkable facts. If there is one modification of the skeleton of a bird which, more than any other, is peculiar and typical, it is the mode in which the presacral vertebræ, in the majority of cases, are articulated together; I refer to the cylindroidal or heterocœlous condition of the centra. I lately showed (Proc. Roy. Soc. 1888, pp. 465–482) that a much greater number of modern or existing birds than was hitherto supposed retain the old Reptilian or Opisthocœlous condition in several of their presacral vertebræ, namely, in the dorsal region; and that this condition is seen in arboreal Altrices, as well as in aquatic and semiaquatic Præcoces. If that is not a reptilian character I know of no one that can be described as such; it is equal in value, in my opinion, to anything that can be found in the skull, the shoulder-girdle, or in any other part of the skeleton.

For practical ornithological purposes the existing birds may be fenced off into two groups, namely, the Ratitæ and the Carinatæ. We thus get some two dozen archaic forms, mostly from the Southern Hemisphere, and twelve thousand modern forms with the Old World at their feet. Now all the existing Ratitæ have their presacral vertebræ cylindroidal; whilst some of the most highly specialized and largebrained forms, for instance the Parrot family, have opisthocœlous dorsals. Moreover, classifying the Toothed Birds of Marsh by their sternum, the type that is one of the Carinatæ has a still lower kind of vertebral articulation than the opisthocœlous; *Ichthyornis* has nearly all its presacrals amphicœlous; whilst *Hesperornis*, which is one of the Ratitæ, has its presacrals cylindroidal. Nor is this all; if *Hesperornis* has any living descendants, or even representatives, these are the existing Loons (Colymbidæ) and Grebes (Podicipedidæ).

But the Carinate *Ichthyornis* appears to me to be an ancient toothed Sea-Gull, one of the Laridæ; and yet the existing Gulls are far more intelligent birds, birds of a higher order than the Loons and the Grebes. Now the Gulls have not only opisthocœlous dorsals, but the last presacral joint is nearly amphicœlous, as in their Cretaceous quasi-ancestral relative the *Ichthyornis*. With regard to that character by which the Struthious birds are most definitely marked off from the ordinary flying birds, namely the flat breast-bone, correlated with almost useless wings, quite useless as organs of flight, it is not too much to say that this is a modern and an acquired character.

The fact that the vertebral chain in these low birds is longer than what is the average in the Carinatæ is a noticeable and important fact; but they all fail in the caudal region; their free caudals are always fewer than in the Carinatæ. Amongst the Carinatæ, however, there are some birds, namely the Swans, which have a longer vertebral chain than the large Struthious birds.

This abortive development of the tail is also manifestly an acquired character, like the starving of the wings and sternal keel. But this is part of the same specialization of these types in which all the strength goes to the hinder limbs, making them so perfectly adapted for terrestrial life—in the case of the Ostrich especially, which is a bird as exquisitely fitted for swift running as its desert companion the Wild Ass.

As for what is most archaic and quasi-reptilian in the Ostrich tribe, that is to be looked for in the skull and its contents. Those Carinatæ that come nearest to these birds, the Tinamous, have also an extremely small brain and low intelligence; and in some things, namely in the retention of cranial sutures and in the development of one or even two rows of superorbital dermal bones, they are more reptilian than the Ratitæ themselves. But these birds, and the one treated of in this paper, *Opisthocomus*, have retained good functional wings, and in the former, the Tinamous, a very large sternal keel, although only the most Gallinaceous species has the sense to fly [1].

The Hoatzin (*Opisthocomus*) rather flits than flies; its flying power is about equal to that of the heavier Fowls (Turkey, Peacock, &c.); but it is an arboreal type, like its nearest relatives the "Peristeropodous" Cracidæ; the Tinamous are the sub-struthious relations of the Grouse, which are "Alectoropodous"—have a high hallux, and are mainly terrestrial birds.

It comes to this, namely, that birds, like men, must be classified by their brain power

[1] See Frederic A. Lucas, Proc. U. S. Nat. Mus. 1886, pp. 157, 158.

and intelligence: a Rook has a lesser body than an average Tinamou, but it has three times its bulk of brain; the Raven and the Ostrich stand at the extremities of the bird series. *Opisthocomus* is not the only Neotropical type that belongs to the region round about the Ostrich territory; I have just mentioned the Tinamous, and there are several other rare, unclassifiable, and manifestly archaic types in the rich Avifauna of the American Tropics. It is in the Neotropical Region that we find the most archaic forms of every family. It is there also that we meet with the low harsh-voiced Passerines, aberrant in various ways; Cuculine forms that are so torpid that they become a mass of fat (*Steatornis*); and true Cuckoos (*Geococcyx*, &c.) that walk the ground firm, like Fowls, and have a pelvis that is strongly Ornithoscelidan. In this region, also, there are birds related to Geese that have the face of a Hen (Palamedeidæ); and a genus of the Crane family (*Psophia*) with a Pea-fowl's head and the bony brows of a Tinamou. These and various others characterize the rich and unique Avifauna of this region. Nor are these all the rare and isolated types to be found there; we have, also, *Eurypyga*, *Dicholophus*, *Attagis*, *Thinocorus*, *Chionis*, *Phaëthon*, and *Tachypetes*. Of course the Eastern Region south of "Wallace's Line" yields many important and rare forms, especially among the Ratitæ; but for archaic Carinatæ it is far inferior to the Western Tropics.

The type now under consideration, being the only one of its family, and considered by Prof. Huxley to represent, not a Family merely, but a Suborder or a bundle of Families (the Heteromorphæ), must of necessity be archaic, for all its near relations have been weeded out in the past. This is as self-evident on one hand, as, on the other, it is a sure induction that the wise Raven is a modern type; for he has not only acquired all the highest accomplishments of which a bird is capable, but, as the head of a long list of Families, he has an ornithological following of more than six thousand species, or half the number of existing birds.

Anticipating somewhat the descriptions now to follow, I may remark that, besides its isolation as a type, *Opisthocomus* is aberrant as a Carinate bird in the Struthious character of its palate; its temporary basipterygoids are Tinamine; its scapula is Batrachian; its three clavicles are more Lacertian than those of any other bird; whilst its sternal keel is permanently rudimentary. Its wing also has the largest claws in it of any known kind, with a rudiment of a third claw and two rudiments of a fourth digit; and to crown all, for a time, it has, before hatching, eight distinct carpals; and the intermedium of the tarsus is one of the longest and best developed ever yet seen by me in any bird. Of course, the existence in these days of a bird like this is not merely a "foreign wonder" to the ornithologist; its great importance lies in the light it sheds on the uprise of the feathered types during time. A comparison of the ankle-joint of the bird, in its early state, with what is extinct in the Ornithoscelidan Reptiles was a great stroke in this enquiry; but it is only in the hips and hind limbs that those Reptiles resemble immature birds. In the length of the neck, and in the shortness of the tail, birds are like Plesiosaurs; but in the structure of their skull, and I believe, also, that I may state in the development in their fore limbs of intercalary digits, they resemble the Ichthyosaurs.

Like the Chelonia, Tertiary and existing birds have lost all traces of teeth and have horny jaws; and like the Crocodile's embryo, and the adult *Hatteria* (*Sphenodon*), the hyoid arch and the columella auris become continuous. The superficial parts of the shoulder-girdle of a bird, its parostoses, are like those of an *Ichthyosaurus*, an ordinary Lacertian, and of the Monotrematous Mammalia; but, as a rule, these are fused together. Moreover, these parts do not remain in their primitive distinctness; as a rule they graft themselves upon proximal remnants of the antero-inferior fork of the shoulder-plate (precoracoid). I have lately shown (Proc. Roy. Soc. 1888, pp. 397–402) that the skull of a bird is rich with the remains of truly Amphibian structures; indeed, it is far more Amphibian in its very foundations than any existing Reptile; the parasphenoid of a Frog and of a Bird closely correspond. Then there are the remnants of the ethmo-palatines and certain superficial structures that, as a rule, have been got rid of even in Reptiles. The one or even two rows of supra-orbital bones are remarkable; but still more so is the fact that the long jugo-maxillary chain of ganoid bones seen in *Lepidosteus* is represented in some birds (Emu, Owl, Heron, Cormorant) by a chain of four bones behind the premaxillary, namely, the maxillary, postmaxillary, jugal, and quadrato-jugal. In the palate, also, besides the endoskeletal postpalatines of the Passerine birds and the medio-palatine of the Woodpeckers (preformed in cartilage), we have in the latter birds especially, and also in others, a literal crop of vomers, such as we see also in the Marsupials among the Mammalia. Even these parosteal remnants are too valuable to be lost sight of or left as unrelated; they at once remind the Morphologist of what is seen in the generalized pavement of bones under the rostrum of a Sturgeon.

It is quite certain that not the least patch of bone-cells is ever differentiated and isolated accidentally; as a matter of observation in birds, the smallest of such patches is very uniform in its appearance in various genera and families. One more fact in evidence of what I am anxious to express—namely, that birds did not appear during time, as a sort of feathered sport in a truly reptilian type, but from some low, generalized Amphibian or Dipnoan, is to be seen in a character now to be described. The earliest embryo I have examined of this type has a dilated suprascapula, separated from the scapula by an arched line of smaller cells, and overlapping the scapula proper at its edges. This upper element is, for a short time, quite as distinct as in the Frogs and Toads; lower down, in the Rays, among the Elasmobranchs, the suprascapula is perfectly segmented off from the scapula (see 'Shoulder-girdle and Sternum,' 1868, pls. i. and v.). I have one more preliminary remark to make which bears directly upon the relation of Birds and Reptiles, and that is in the clear evidence we have of secular shortening of certain parts. In some birds, for instance the Humming-birds and the long-billed Shore-birds (Limicolæ), the bill rapidly elongates and takes on special curves, up or down, after hatching; these are comparatively recent specializations. But in some other kinds, *e. g.* the Guillemot (*Uria troile*), the bill tends to become as long as it is in the toothed birds of the Cretaceous Epoch. By the middle of incubation, the parosteal tracts first dominate, and then largely take the place of the endoskeletal elements, clasping them and stopping their growth. For a time, the cartilaginous rods struggle to grow to the ancestral length, but in this effort they become bent and deformed; this is all put right by the time of hatching; they cease to grow, overmastered by the enveloping splint-bones. But this twisting, and then arrest, of the cartilaginous rods appears also where there are no splint-bones, but merely the nerves, muscles, and ligaments to which these parts are related. This curious quasi-deformity is seen, not only in *Uria troile*, but I shall soon show and describe it here, in *Opisthocomus*; it appears in the pubic rods and in the columella auris. Of all existing birds, the African Ostrich comes nearest the Iguanodon and its kindred in the size of the rotated pubes [1].

There has evidently been, first, a secular rotation and elongation of the pubis and ischium, and then a re-shortening of these parts in the higher kinds of birds. A similar phenomenon is seen in the length of the sacrum, and correlatively of the extent of the ilium, behind and before. The African Ostrich and the Swan have each twice, or nearly twice, as many sacral vertebræ as the lesser birds of the higher kinds, both Passerine and Cuculine; and these lesser forms constitute about half the known existing birds. Even in the Rook (*Corvus frugilegus*), one of the chief of the Coracomorphæ, and in that Order a large bird, there are only eleven sacrals in the adult; whilst there are twenty-one, and sometimes twenty-two, in the common Swan and in the African Ostrich.

The young Rook, after it is fledged, has a longer sacrum than the adult; there is, for a time, a twelfth vertebra in that part of the spine; the ancestral Crows had, probably, a longer sacrum than the existing forms. At present, with a large number of unclassifiable facts in hand, it is safer for us to confess our ignorance as to how Birds and Mammals arose, than to invent crude hypotheses that will only be mocked at by those who enter into our labours in the time to come. Of one thing I feel certain, even now, and that is that no feathered or hairy form ever arose from a true gill-less Amniotic Reptile. A very large proportion of the Reptiles that have arisen during the geological ages have died out; these all came short, as the existing reptiles now come short, of the high excellences of the hot-blooded types, feathered or hairy.

II. *The Early Stages of* Opisthocomus cristatus.

There were three different stages in the four specimens sent to me; these, being measured, gave the following lengths from the end of the beak to the end of the tail:—

[1] See Dollo, on *Iguanodon bernissartensis*, Blgr. Bull. Mus. Roy. Hist. Nat. Belg. t. ii. pl. v.

Stage A. $2\frac{2}{3}$ inches long; about half ripe.
Stage B. $3\frac{1}{3}$ inches long; about two-thirds ripe.
Stage C. $4\frac{1}{2}$ inches long; about three-fourths ripe.

The largest embryo was evidently not quite ripe for hatching, and the smallest was at any rate half ripe; I come to this conclusion by comparison of these embryos with those of the Common Fowl. I am in a position now to compare the developing skeleton of this rare type with that of its familiar relative, for the descriptions and figures of the skull, shoulder-girdle, and wings of the latter are already published (see Phil. Trans. 1869, pls. 81–87, Proc. Roy. Soc. 1868, and Phil. Trans. 1888, B, pl. 62); and the rest of the skeleton of the chick has been worked out by me and will soon be published.

III. *The Skull of* Opisthocomus cristatus *in the Embryos and Adult.*

The chondrocranium in the first stage is at its fullest development, and is beginning to undergo ossification in certain parts (Pls. VII., VIII.); it is now in the best state for comparison with the cartilaginous, or osseo-cartilaginous, skull of the Ichthyopsida, and with the early condition of the skull in Reptiles and Mammals. The solid fore part of the premaxillaries (*px.*), where the right and left bony tracts are already fused together, is as long as the vestibular region of the nasal labyrinth (Pl. VII.). In this short-headed bird the brain-cavity extends only along the hinder two fifths of the whole chondrocranium; but its axial is only part of its real length, as it is tilted upwards very much, whilst the auditory capsules are tilted downwards and backwards so as to be almost horizontal (see 3rd stage, Pl. VIII. fig. 2). The whole structure, when deprived of the investing bones, is a short and rather shallow basin behind, with a long high wall in front. The foremost part of the face in front of the wall, and one-fourth of its length, is the free, rounded, somewhat flat, prenasal rostrum of the inter-trabecula [1].

The nasal labyrinth is like that of the Common Fowl, but the inferior turbinals (Pl. VIII. fig. 4, *i.tb.*) are simpler; they make scarcely more than one turn of a coil. In the normal ornithic skull we have repeated the high type of cranium seen in so many osseous fishes; whilst in Mammals the low type of cranium, seen in the Skate and the Frog, is once more adopted. This is the more important to notice because of the fact that of all the Ichthyopsida the high-skulled Teleostei are the most instructive types with which we can compare the Carinatæ, with their marvellously elastic and mobile jaws and palate. In these high skulls the posterior sphenoid, only, is fully

[1] In the Apteryx on the one hand, and in the Ibis on the other, the notochordal region of the skull is extremely short as compared with the prochordal; in *Opisthocomus* the latter, in this stage, is more than half as long as the notochordal, even allowing for the upward tilting of the notochord between the moieties of the post-pituitary or clinoid walls.

developed in front of the large, hollow occipital arch; the alisphenoids (Pls. VII., VIII. fig. 2, *al.s.*) are large and simply postorbital in position; whilst the basisphenoid, dominated by the auditory organs, and underfloored by the huge parasphenoid, is one of the largest and most complex structures to be seen in the whole skull. The anterior sphenoid (*p.s.*) is the hinder half of the interorbital partition; it is partly segmented from the meso-ethmoid, even in the earliest of my stages, by an oval fenestra (Pl. VII., *i.o.f.*). The upper part, which overhangs the large optic passage (II.), as a rule, has scarcely any development of cartilaginous lips representing the orbito-sphenoids (*o.s.*). The only bird in which these are at all well developed, even in the early embryo, is the African Ostrich (Phil. Trans. 1866, pl. vii. figs. 1–3, *o.s.*). In *Opisthocomus* they are well developed for a bird (Pl. VII., *o.s.*, and Pl. VIII. fig. 2, *o.s.*), and come nearest the Ostriches of any I have yet seen (see in the chick of the Common Fowl, Phil. Trans. 1869, pl. lxxxiii. figs. 2 & 4). In the 3rd stage the peculiarity of the ethmoidal region of a bird is well shown; the pars perpendicularis (*p.e.*) has already a large reniform osseous centre (Pl. VIII. fig. 2, *p.e.*) which will ultimately reach twice as far back to ossify the cartilaginous crista galli (*cr.g.*), and also, below the interorbital fenestra, will grow some distance backwards to meet the feeble presphenoid (*p.s.*) and the enormous basisphenoid (*b.s.*). This chondrocranium, so different from that of a Mammal, on the one hand, and from a Batrachian, on the other, already, in the 3rd stage, shows the beginning of that character which separates the skull of the Carinatæ, not only from that of other Vertebrata, but also from that of the Ratitæ themselves. This is the secondary segmentation of the vertical trabecular wall, so that the septum nasi in front is quite, or nearly, separated from the perpendicular ethmoid behind. In this modification, *Opisthocomus* agrees with the Carinatæ generally; and in the 3rd stage (Pl. VIII. fig. 2) the separation has taken place to an extent equal to what I have found it in an adult Tinamou (see Phil. Trans. 1866, pl. xv. fig. 8, *c.f.c.*)[1].

In the earlier stage the whole prochordal tract is continuous and only loses its vertical crest where that part is not wanted, namely, in front of the nasal labyrinth; thus the intertrabecula runs on as a free bar in front of its crested part. But in the 3rd stage (Pl. VIII. fig. 2, *i.tr.*), under the notch just mentioned, the fore part of the intertrabecula is already separated from that which thickens the dividing wall at its base; it is even now undergoing degeneration, and will disappear entirely after a time. This is only one of the many prenatal transformations to be seen in the embryo bird, all

[1] I have spoken before of the remarkable isomorphism existing between the culminating Fishes (Teleostei) and the culminating forms of the Sauropsida, seen in the extreme mobility of the jaws and palate. This mechanism is obtained in the former by the hyostylic condition of the pier of the mandibular arch, the palato-quadrate being swung on the hyo-mandibular and symplectic. But there is no segmentation of the cranial axis in front; that part is extremely short; and the large dominating premaxillaries ride over it, and in most cases throw the maxillaries back, as the edentulous "ossa mystacea." I may state that in such a bird as the Cock of the Woods (*Tetrao urogallus*) those bones are extremely like their counterparts in the Teleostei.

showing how high even the lower kinds of Carinatæ are, as compared with the cold-blooded Sauropsida [1].

In these high skulls there is a partial secondary segmentation of the ethmoid from the anterior sphenoid by a pyriform interorbital fenestra (*i.o.f.*); above this the ethmoid ends as a blunt cartilaginous crista galli, under which the olfactory crura (I.) run forwards to the simply infolded upper and middle turbinal regions. Below this groove we see the narrow orbito-sphenoidal alæ (*o.s.*). In all these stages the anterior sphenoid is wholly unossified: in Stage 1 the only part of the posterior sphenoid that has any bony matter is the rim of the pituitary hole; the trabeculæ do not form a floor to this part; and that bony substance is borrowed from the parasphenoid, a mere parostosis. The large leafy postorbital alisphenoids are still thin upgrowths of cartilage (Pl. VII., *al.s.*); but in Stage 3 these are largely ossified (Pl. VIII. fig. 2, *al.s.*), and although turning in behind the eyeballs, do also form the foremost third of the lateral wall of the skull, the rest being made by the superficial low-lying parietals (Pl. VIII. fig. 2, *p.*). Under these two bones, and wedged in between them and the large occipital arch, we see the large, long auditory capsules, which are so much tilted back as to have their top nearly as low as their base. These cartilaginous capsules were fused very early with the parachordals, and with their lateral upgrowths, alisphenoidal and exoccipital tracts.

A considerable osseous centre is already seen in Stage 3 (Pl. VIII. fig. 2) between the meatus internus (VII., VIII.) and the elegant anterior semicircular canal (*a.s.c.*); this is the prootic (*pr.o.*). Below, also, over the edge of the exoccipital (*e.o.*), a lanceolate bone is seen hardening the postero-inferior edge of the capsule; this is the opisthotic (*op.*); the epiotic is rarely seen in birds, and then only as a small tract of bone. Even in Stage 1 the double supraoccipital (*s.o.*) has become a single tract of bone; the exoccipitals are growing well at the sides of the arch, leaving, however, the large tympanic wings (Pl. VII., *t.eo.*) in a soft state; the basioccipital is still largely hidden in the cartilage (Pl. VIII. fig. 1, *b.o.*); it is forming, however, round the sheath of the notochord (*nc.*); the occipital condyle (*oc.c.*) is slightly bilobate. In Stage 3 (Pl. VIII. fig. 2, *nc.*) the notochord has retreated into the basioccipital region, although at first it reached, at least, the top of the post-pituitary wall. Under that wall, in this advanced stage, much absorption of the basal cartilage has taken place, to form the middle part of the cavities in front of the cavum tympani—the pre-tympanic recesses of the basisphenoid. These parts will be described with the parasphenoids; but before leaving the chondrocranium I must refer to the foramina of the cranial nerves.

The first nerve (Pl. VIII. fig. 2, I.) has already been mentioned; it is a single crus, and does not need a lamina cribrosa. The optic nerves (II.) have a large common passage

[1] It seems to me that the primary Dipnoan Bird-stock had a face as *long* as in the Skate; not *short*, as in the existing Dipnoi and Amphibia.

in a semicircular notch on the back of the interorbital wall, a little in front of and above the deep pituitary space (*py.*). The lesser nerves, 3rd, 4th, and 6th, pass out to their destinations through the membranous interspace that is now seen between the foramen opticum and the f. ovale; the latter is very large for the transmission of the 5th nerve (Pl. VIII. fig. 2, v.). It lies over the meatus internus for the 7th and 8th nerves (VII., VIII.). The passages for the vagus, glossopharyngeal, and hypoglossal nerves (Pl. VIII. fig. 1, X., XII.) are figured in the least and largest of these embryos. The glossopharyngeal and vagus pass out under the opisthotic bone, and the hypoglossal pierces the exoccipital. In the Sauropsida there is a small passage in front of it which makes it seem to be the "posterior condyloid foramen;" in Mammals a notable vascular passage is found behind that for the 12th nerve. That nerve in the bird (see Pl. VIII. fig. 2, XII.) is shown as escaping opposite the occipital condyle, with its notochordal dimple (*nc.*), and having directly in front of it a small vascular passage. The large internal carotids find their way into the skull over the parasphenoid and pass through the pituitary hole; they ultimately have a bony tube formed accurately round them. The rest of the cranium proper is formed of membrane and membrane-bones, or parostoses.

But besides the inner skull, or chondrocranium, there are the cartilaginous visceral arches that are formed in segments in that tract of the head of the embryo which corresponds with the splanchnopleura in the postcephalic region. These cartilages begin to solidify before the head-cavities are closed; they are indeed the first three branchial arches; for, as is well known, in the Elasmobranchs the quadrato-mandibular and hyoid arches both carry gills [1].

Whatever the prochordal tracts of the chondrocranium may turn out to be, whether visceral or cranial, the post-oral arches are determinable [2].

In this type, as in most of the Sauropsida, the palato-pterygoid arcade in front of the quadrate pier is merely developed as membrane-bone, although secondary tracts of

[1] If this fact had been attended to, the strange misconceptions which have arisen as to the nature of these parts would have been avoided. In the study of the Morphology of the Skull, before all things, it is necessary that the fundamental embryological development of this part should be mastered. Anything more hopeless than the confusion produced by want of this knowledge in some Memoirs on this subject cannot be conceived. The most remarkable instance of this is to be seen in Dr. Gadow's paper "On the Modifications of the First and Second Visceral Arches" (Phil. Trans. 1888, pls. 71–74, pp. 451–485). If our modern Morphology can do no more for us than this, we had better return to "Transcendentalism" and blindly follow OKEN.

[2] Prof. Huxley (see his paper on *Petromyzon*, Journ. Anat. & Phys. vol. x. pp. 412–429) classifies the trabeculæ with the visceral arches; my own view at present is that they do belong to the same original cranio-facial basket-work, such as is seen in the Myxinoids (Phil. Trans. 1883, pls. viii.–xxvi.); but that the whole of that continuous skeletal tract is, I feel certain, a prochordal skeleton formed in time before any vertebral rudiments appeared, and even before there were any skeletal elements in the occiput. This basket-work was developed for the support of the enlarging brain and increasingly complex oral apparatus long before any paired vertebral rudiments grow for the support of the notochord.

cartilage crop up wherever they are needed in the mobile upper face. The quadrate or upper segment of the mandibular arch (an epibranchial element) is, in this bird, all we have above the gape. In the early stage (Pls. VII., VIII. fig. 1, *q.*) this is a large segment of cartilage, the body of which has a bony shaft. The true apex or free pedicle (orbital process) is flat and rounded; the secondary apex or otic process is rounded, and fits in between the squamosal and the anterior margin of the auditory capsule, close in front of the anterior ampulla. As in birds generally, but not as, as a rule, in the Ratitæ, nor in the Tinamidæ, the lower articular facet is bilobate; the outer lobe is somewhat in front of the inner; inside the latter there is a knob for the pterygoid, and outside the former there is a cup for end of the quadrato-jugal. The endoskeletal part of the lower segment, or primary mandible, is in a very instructive condition in these chicks. In the youngest embryo (Pl. VII., *mk.*) Meckel's cartilage is exposed on the inner side up to its fore end; but in the largest (Pl. VIII. fig. 2) it is enclosed by the dentary (*d.*) and has what the other has not yet, namely, an ectosteal plate, the outer ossification of the articulare (*ar.*); this is a thin, deep, lanceolate tract of ossified perichondrium; the endosteal part of the articulare has not yet appeared. As bearing upon the order in time of the appearance of these bony deposits, I may remark that in the half-grown Green Turtle (*Chelone viridis*) the endosteal centre is not present; in old Turtles it is large. The Anura have only a dentary and a large ectosteal articulare as a rule; but in the skull of one of the most feebly ossified types, *Bombinator igneus*, I find, contrary to rule, the endosteal part of the articulare. The thick *malleal* part of the primary mandible in *Opisthocomus* is generalized; it is more like that of a Plover than that of a Fowl, for the posterior angular process (*p.ag.*) is a very small hook; the internal angular process (*i.ag.*) is large, thick, and normal. The development of the posterior angular process is greatest in that gigantic Fowl, the Cock of the Woods (*Tetrao urogallus*), but it is large in all the true Fowls; in the Anatidæ, which in some things are marvellously like the Gallinaceæ, and also in the Flamingo and anserine Ibis, it is large. Thus in this part of its structure *Opisthocomus* is seen to have fallen short of the Fowl type; it is a *pregallinaceous* bird, like the Tinamou [1].

The hyoid arch (Pls. VII., VIII. fig. 3) is quite normal and similar to that of the Common Chick; the distal part of the second arch is merely the lower half of a ceratobranchial rod, with no terminal or hypobranchial segment. The median element (*b.hy.*) is formed in the usual way by the fusion and partial separation from the ends of the ceratohyals (*c.hy.*). The rest of the basal tract behind is a single rod

[1] The first visceral arch in the Amphibia and Sauropsida generally is chondrified at first as two tracts, an epibranchial and ceratobranchial. In the Salmon (Phil. Trans. 1873, pls. 1–3) all the visceral arches are developed as continuous bands of cartilage, and are segmented afterwards. The same thing takes place in the mandibular arch in Marsupials (e. g. *Macropus major*); thus the incus and malleus are continuous at first and become separate after birth.

(*b.h.br.*), and really belongs to the third postoral arch, and to arches that have been suppressed behind that. That third arch is developed as the "cornu major"; it is merely divided into a ceratobranchial and epibranchial (*c.br.*, *e.br.*), the lower pieces ossifying. The upper part of the second arch repeats the old Amphibian specialization; it is now the skeleton of the middle ear—the stapes or columella. Morphologically this part (Pl. VIII. figs. 5, 6) is a pharyngobranchial, an epibranchial, and the beginning of the ceratobranchial region; this is followed by a membranous tract of considerable and, during growth, of relatively increasing extent. Below, the ceratohyal = ceratobranchial just described, breaks out again. In these arrested and specialized pharyngohyal and epihyal cartilages we have the archaic character seen in *Hatteria*, and in the Crocodilia for a time, namely, the fusion of these two cartilages, the intermediate and secondary element, the "interhyal," so well known in Ganoids and Teleosteans, binding together the two tracts. The interhyal (=infrastapedial) is present in the ordinary Lacertilia, but it is free below; it does not catch the top of their long epihyal; it does not exist in the Amphibia.

All birds are therefore Hatterian in this respect; but the embryos of *Opisthocomus* show this better than any birds I have yet worked out. This specialized hyomandibular is at first of the full relative size; its growth, however, soon becomes arrested: it has the usual dilated opercular plate; a short thick shaft, the mediostapedial (*m.st.*); a tongue-shaped extrastapedial (*e.st.*); and a forked suprastapedial (*s.st.*), finished above by a ligamentous tract. The infrastapedial (*i.st.*), (=interhyal of Fishes and Mammals) is developed directly from the columella and ends in a bulbous form; it is half the length of the extrastapedial, and one-third of its width. Articulated to this is a tract of cartilage as long as the whole columella proper; this is sharp above, and then, after articulating with the infrastapedial, which it exceeds in size, it turns suddenly backwards, and then makes a second sudden turn forwards, and ends in a large tongue-shaped lobe, which lies on the edge of the basitemporal bone. This cartilage is the epihyal, with a continuous but enlarged rudiment of the top of the ceratohyal [1].

[1] Let this structure be compared with what is seen in *Hatteria*, and also for a time in the Crocodile (see T. Z. S. vol. xi. pls. 68 & 69). The ectocranium of *Opisthocomus* conforms very closely to that of Carinate birds generally, but it comes nearest to that of the Gallinaceous tribes. It is a "holorhinal" skull with a strongly curved rostrum and highly ossified endocranium. The cranial and rostral parts are of nearly equal length. The hinge of the rostrum on the cranium is, however, much more perfect than in the Common Fowl; and this agrees with the *normal* Cracidæ, which are very Cuculine in this respect. The splints of the rostrum or upper face are well formed already (Pls. VII. & VIII.), but in the first stage the premaxillaries (*px.*) do not cover the prenasal rod (*pn.*) in front. The nasals (*n.*) have a round notch behind the alinasal wall; this skull is therefore holorhinal. The frontals and parietals (*f.*, *p.*) are quite normal; the large squamosal (*sq.*) lacks the special jugal spur so well seen in Gallinaceous birds generally. In this respect this bird is generalized; so it is also as to the lachrymal (*l.*), which is very small and attached to the back of the nasal. In the palate (Pl. VIII. fig. 1) the parostoses are slender and feeble, much like those of the Gallinaceæ generally. This is especially seen in the feeble state and hidden position of the maxillaries (*mx.*), which, as in

The pterygoids (*pg.*) are also simple, with scarcely any epipterygoid process, and with the articular plate for the basipterygoid spur far back as in the Tinamou and Ostrich. That this bird is not a special Gallinaceous form is also seen in the fact that the front part of the pterygoid does not remain on that bone and become specialized as a particular peg as in all true Fowls, but becomes segmented off, as in Tinamous and most Carinatæ, to form a mesopterygoid, which, however, as in the Carinatæ generally, soon fuses with the palatine. These bones meet right and left, and hide the rostrum of the sphenoid as in most birds. As we pass from the most special kinds of modern Fowl to the older types the vomer is seen to become larger, as in the *Talegalla*; but it is always azygous. The vomer (*v.*) in this bird is large; in the 1st stage it reaches halfway from the ascending plates of the palatines to the end of the intertrabecula (Pl. VIII. fig. 1); the hinder pointed end just wedges in between these two plates; its fore end is thick and bifid. The enlarged split fore end in all three stages is such as to suggest that this was formed at first, for a day or so, of two club-shaped centres of bone, and not of a single thread, as in the Gallinaceous types generally. This is another generalized character, for in most birds that have a large or a wide vomer it is double at first; but it is single in those in which it is a mere vertical plate or a narrow median needle; when double, the fusion takes place very early as a rule. Behind the palate, but on a higher plane, we see the triple bony tract that forms the parosteal support of the endocranium. This tract, the parasphenoid, was, as the early stage of the Fowl shows (Phil. Trans. 1869, pl. 80. fig. 2, *b.t.*), composed of a pair of centres under the skull-bowl—these are the basitemporals; and of a median bar, the rostral part, which supports the thick trabecular base of the interorbital septum. These parts are so generalized that they come in character exactly between those of the Carinatæ and of the Ratitæ. The rostrum is nearly Struthious in respect of the backward position of the basipterygoids, and the temporary cartilaginous core of each process was evidently a direct outgrowth from the basis cranii, and not a mere articular tablet of cartilage developed afterwards, as in the Common Chick (Phil. Trans. 1869, pl. 83. figs. 1, 13, 14). The basitemporals (*b.t*) are larger than in the Struthionidæ, and smaller by far than in Fowls and Geese; they are, indeed, very similar to what we find in birds generally; they are generalized, and not specially Gallinaceous.

osseous fishes, are mere ossa mystacea. Indeed, the palatine part or maxillo-palatine process (*mx.p.*) is less developed than even in typical Fowls and Hemipods, scarcely more than in the Picidæ, quite unlike what is seen in the Musophagidæ, or even in the large Cracidæ, for these latter have secondary Desmognathism. This bird is as Schizognathous as a Lizard; it is "Saurognathous." The cheek-splints, jugal and quadrato-jugal (*j.*, *q.j.*), are rather feeble, but normal; the submedial bars, the palatines (*pa.*), and the pterygoids (*pg.*) are of the simplest kind; the former have no postero-external angle, scarcely any groove in the hind part, but have an extensive ascending plate.

The superficial or somatopleural elements of the mandible are very stout, but quite normal; the largest is the dentary (Pl. VII. & Pl. VIII. fig. 2, *d.*); it is closing in upon Meckel's cartilage in the 3rd stage, and that rod is beginning to shrink; the splenial (Pl. VIII. fig. 2, *sp.*, deflected in the figure) is long and thin; the coronoid, as in the Fowl tribe and some others, is absent; and the supra-angulare (*s.ag.*) and the angulare (*ag.*) are normal, and are at present quite distinct from, and superficial to, the articulare (*ar.*). The skull of the adult is very solid and strong[1], and does not suggest a Musophagine relationship so much as the younger and feebler specimens; both in the skull and general skeleton it will be necessary for me to give some account of the parts in the adult, notwithstanding the excellent descriptions already given by Prof. Huxley, for I wish to make my own monograph complete; moreover my observations have been made from a somewhat different standpoint. The skull of *Opisthocomus* is remarkably short, stout, and broad; the bill, when the mouth is closed, is almost conical; it is much unlike that of the Peafowl, which is more arched and is very lightly built. The likeness to that of the Musophagidæ (e. g. *Corythaix buffoni*) is much less in the old male than in the feebler specimens; but the skull of those Ethiopian Cuculines resembles that of the Cracidæ, and they seem to have something Gallinaceous in their nature; they might be called Cracine Cuckoos. The true Cuckoos of the Neotropical Region (*Saurothera*, *Geococcyx*, and *Piaya*) are the proper isomorphs, not relatives of the Cracidæ. In *Opisthocomus* the rostrum is, measured in a straight line, two-thirds the length of the cranium proper; the lower edge is 24 millim. in extent, and the culmen, measured along its curve, 30 millim. This part is hinged on to the cranium at a considerable angle, so that if a line be drawn from the base of the quadrate to the point of the rostrum, the fore end of the jugal bar would be 8 millim. above that line. This general deflection of the rostrum and the arched form of the mandibles, whose lower edge rises 5 millim. above a basal line, gives a stunted and strong appearance to the face of this bird; it is short-faced even for a Fowl. The likeness of this skull to that of a Touraco (*Corythaix*) will be illustrated by the following measurements:—

	Width of Hinge. millim.	Least frontal Width. millim.	Width across Postorbitals. millim.
Opisthocomus	19	19	26
Corythaix	12	12·5	23

In the large *Crax globicera* the skull is twice as long as in the two birds just compared together; its hinge is 20 millim. across, but it is all ankylosed except the

[1] In the Hunterian Museum there are two skeletons of this bird; these will be referred to here as A & B. The mounted specimen (A) is evidently that of an old male bird; the other is an injured specimen, and is not mounted. Prof. Huxley's figures (P. Z. S. 1868, pp. 310, 311, figs. 13–16) show feebler birds, and were probably younger specimens or females.

narrow nasal processes of the premaxillaries; in the other two birds the hinge is perfect. In *Crax globicera* the narrowest frontal width is 33 millim., so that relatively, although broad, it is a much narrower skull than that of *Corythaix* or *Opisthocomus.* Yet, with the exception of *Opisthocomus*, the skull of this bird is the most Musophagine of all the Gallinaceæ. These three types of skull are all holorhinal, but the ossification of the upper face in the strong skull of *Crax* is much less than in the light skull of *Corythaix*, or in that of *Opisthocomus*, which is intermediate in this respect [1].

In *Crax globicera* the external nostrils in the macerated skull are large, obliquely oval spaces, 22 millim. by 12 millim. in size; for the alinasal cartilages that so largely fill this space are lost in such preparations. In *Corythaix* this space is largely closed by the ossification of those cartilages; this osseous change takes place in a large number of the Coccygomorphæ, in very few Coracomorphæ (for instance *Gymnorhina*), and in no normal member of the Alectoromorphæ. In *Opisthocomus* this ossification is as complete as in *Corythaix*; this is very remarkable, and helps to stamp this bird as aberrant. The actual nasal opening in this bird is obliquely reniform, with the "hilus" below. In *Corythaix* it is horizontal, and the hilus of the kidney-shaped hole is above, the opening being modified by the protrusion of an ossified valvular process from the inside. In *Opisthocomus* the hilus is caused by a process of the alinasal laminæ, where it rests on the descending crus of the nasal. In this bird the septum nasi is ossified, but its vertical extent is small, and it is fenestrate; it is like that of *Corythaix*, but feebler. In *Crax globicera*, with an unusually solid skull, even for a Curassow, the lower part only of the septum nasi is ossified, and, as in Accipitrine birds and Owls, is ankylosed to the swollen maxillo-palatine; so that, contrary to rule, this Fowl is desmognathous in a secondary manner (see Huxley, P. Z. S. 1867, p. 433, fig. 15).

The use of such a taxonomic character as Desmognathism or Schizognathism is very extensive in some groups and very limited in others; and there is no sharp line of distinction between the two. The most Lacertian palate for openness is that of the Woodpecker; the most modified by intense ossification is that of the Toucan; yet these two types, each specialized to the uttermost, have a postcephalic skeleton, not indeed identical, but extremely similar. *Corythaix* also, and its relatives, have an intensely ossified fore palate; but this abnormal Curassow—*Opisthocomus*—which looks at first sight as if it might be a member of the Musophagidæ, is as schizognathous as the Woodpecker. The structure of the rest of the palatal part of the face of this aberrant bird will show how far it is removed, not merely from the Musophagidæ, but even from the Cracidæ. But the Cracidæ in the New, and the Megapodidæ in the Old Tropics, are the most archaic forms of the Fowl tribe; the latter are very reptilian in

[1] My meaning as to *light*, in contrast with coarsely strong skulls, will be seen at once by anyone who will compare the skull of a Toucan with that of the Cock of the Woods (*Tetrao urogallus*) or that of a domestic Goose.

their habits, and in both families the foot is flat. They are Peristeropodous, not high-heeled as the other true Gallinaceæ, which are Alectoropodous (see Huxley, P. Z. S. 1868, pp. 294–319). The palatal region of *Opisthocomus* as a whole would have been a very difficult study if the Tinamou had not come in for our enlightenment. It is only by tracing the relation of the latter type as well as of *Opisthocomus* to the Struthious forms that we shall find the real clue.

When we come to the organs of flight it will appear evident that both these low Neotropical Families show good proof that they are much less modified from the ideal archaic bird than the Ratitæ, which have manifestly undergone a large amount of degradation on the one hand and specialization on the other.

In the general palatal view (Huxley, *op. cit.* p. 311, fig. 16)[1] the skull of the adult is more Struthious than in the embryo (Pl. VIII. fig. 1), for the long ascending processes of the palatines meet at no part, and behind the sharp vomerine wedge the rostrum of the parasphenoid is exposed. The pterygoids behave in this type as they do in the Tinamou, in both of which the mesopterygoid is segmented off and unites with the palatine, as in the majority of birds; in the Ratitæ there is no segmentation, and no special modification of the fore part of the pterygoid. In Fowls proper, as in the Goose tribe, that part becomes a neat peg which rolls in a groove on the upper and hinder face of the palatine. The slight development of the hinder part of the palatines, and the extreme feebleness of the fore part, are essentially general or Struthious; so also is the imperfect development of the maxillo-palatines, and the length and breadth of the vomer. That bone is not so Struthious as it is in the Tinamou, but is intermediate in size between the vomer of that bird and that of the Fowls proper, in which it is, as a rule, a slender azygous style. Its breadth and forked form suggest a primary division of the bone in *Opisthocomus*, although, as I have shown, my earliest embryos have it already in one piece. In my earliest embryo of *Struthio camelus* (Phil. Trans. 1866, pl. vii. fig. 4, *v.*) it was, although very large for a bird, in one piece. The proper pterygoid segment of the adult is remarkable for its dilatation in front; it wants the neatness seen in the higher kinds of birds, and the dilatation, which is great and reptilian in the Ratitæ, is nearly equal in this bird to what is seen in the Penguins. The quadrate is not like that of a typical Fowl, or of a Tinamou, or of a struthious bird; in these latter, as a rule, and in the Tinamou, the otic process is oblong and undivided; in the Fowl there is a round main condyle and a small secondary head on its inside. But in the Cracidæ and Megapodidæ the head is divided into two condyles, the outer larger than the inner in *Crax*, but the two are subequal in *Talegalla*; in *Opisthocomus* they are subequal as in the latter bird[2].

[1] In this figure the basitemporal is shown as abortively developed, or it was injured on one side; it is perfectly symmetrical in the Hunterian specimen (A), in which both of the Eustachian tubes are well floored.

[2] In working out the *Apteryx*, my son, Prof. T. Jeffery Parker, finds that its quadrate has its otic process undivided, as in the Carinatæ generally. This is a remarkable fact, as the whole upper face of that bird is perhaps more immobile than in any other type in the Class.

The occipital condyles are not so bilobate as in the Cracidæ. The occipital plane is rounded and complete, not fenestrate as in many water-birds; in this it agrees with the Fowl tribe. A comparison of Prof. Huxley's figures with those given by me of an old Fowl (Phil. Trans. 1869, pl. lxxvii. figs. 4–6) will show how much this bird comes short of the typical Fowl. This is seen also in the postorbital region, where the post-orbital process of the frontal, the zygomatic process of the squamosal, and the sphenotic process of the alisphenoid are all aborted in *Opisthocomus*, but, together, form a bridge over the temporal muscle in the Common Fowl. The Fowl, like the Goose, has the posterior angular process of the mandible very long; in *Opisthocomus* it is almost suppressed; it is best seen in the embryo (Pls. VII. & VIII. fig. 2, *p.ag.*). The figure of the hyoid arch in the 3rd stage (Pl. VIII. fig. 3) shows how near this part comes to that of a typical Fowl.

IV. *The Vertebral Chain of* Opisthocomus cristatus.

In the 1st stage the vertebræ are all formed but not ossified, and the number of the caudal series can be determined accurately; this part has generally six in the adult, and the last of these is composed of four (Pl. VII., *cd.v.*) very rudimentary segments; therefore *nine* may be given as the number in this region. I have met with no species of bird in which the individual variability in the number of the vertebræ is so great as in this, as though the tendency to produce races and species had gone no further than to give rise to unuseful individual modifications. I suspect that this bird bears the same relation to the early Tertiary types as the Tapir does to the Mammals of that period—the *Palæotherium* and its congeners. Where the number of vertebræ is greatest, for instance in the Swans, I have found the number of presacrals vary in different species, but not in different individuals; and, as a rule, the Carinatæ vary more in asymmetry of the vertebræ that are developed than in the number in the chain. A very large proportion of the Passerine Order have 14 cervicals, or exactly twice as many as Mammals. The larger the type the greater the number of vertebræ; and the largest of the *sifting* birds—the Swans—have as many as the largest Ratitæ, notwithstanding their extremely high position among the aquatic birds. *Opisthocomus*, like the Gallinaceæ generally, takes a middle place in this respect, halfway between the Swan and the Humming-bird. In giving a vertebral formula I shall, in this case, break up the avian sacrum into four secondary regions; namely, the dorso-sacral, lumbo-sacral, sacral proper, and uro-sacral. The dorsals proper are those that have perfect rib-cinctures, are in front of the pre-ilia, and as a rule are distinct from the first that is overlapped by those plates. The following table will show the variability of this chain of bones in this bird.

	C.[1]	D.	D.S.	L.S.	S.	U.S.	Cd.
1st stage	18	4	2	3	3	6	6+3
2nd stage	18	4	1	3	3	6	6+3
3rd stage	18	4	1	3	3	6	6+3
Hunterian adult........	19	3	2	3	4	6	6+3
Huxley's adult	19	3	2	3	4	6	5+4

So that in the 1st stage the total number in the chain is 45; in the 2nd and 3rd stages 44; in the Hunterian and Huxley's adult specimens 46. But this does not exhaust the variability of the axial skeleton with its inferior arches arrested or developed. In the 1st stage (Pl. VII.) the last two cervicals have considerable styloid ribs; it has four complete rib-cinctures; and the second dorso-sacral has ribs with a half-developed sternal piece. Only those ribs that are complete below have the appendage (*c.a.*), an oblongo-oval cartilage, not diverging backwards from the rib, but parallel with it. The eight more or less developed ribs are ossifying rapidly; these are the only axial parts that are not entirely cartilaginous at present. Behind the developed ribs of the second dorso-sacral there is, in this first stage, a pair of small rudiments (Pl. IX. fig. 4, $s.r^3$.) which are losing their individuality already, and will only appear as part of the transverse processes later on.

There are two pairs of similar riblets in the fore part of the uro-sacral series (Pl. IX. fig. 4, *s.r.*); behind these, again, there are only upper transverse processes (diapophyses); these parts are very uniform, the two pairs of uro-sacral riblets being constant in this species.

In the 2nd stage the last two cervicals have elongated or styloid ribs, and in two specimens at this stage the second dorso-sacral had only small rudiments of ribs; but there were five perfect thoracic cinctures. It is seen at once that there is a vertebra wanting in the dorso-sacral region in the 3rd stage as compared with the 1st (Pl. IX. figs. 4 & 6): the 2nd agrees with the 3rd stage in this respect; in both specimens of the 2nd stage there is a small rib right and left on the first lumbo-sacral vertebra, and also in the 3rd stage (Pl. IX. fig. 6, $s.r^2$.); this shows how arbitrary is our classification of the regions of the chain. The cervical vertebræ in the 1st (Pl. VII.) are largest and strongest in front; behind the atlas (*at.*) four of these have more or less development of the upper and lower spines; there is some downward development also of the atlas. The cartilage, quite unossified, is very solid, and, examined in horizontal sections, it is seen that the notochord (Pl. VIII. fig. 7, *nc.*) is submoniliform, so that

[1] C. Cervical; D. Dorsal; D.S. Dorso-sacral; L.S. Lumbo-sacral; S. Sacral; U.S. Uro-sacral; Cd. Caudal.

there is a tendency to produce three times as many vertebræ as are needed. There are two constrictions in each centrum in all the presacral vertebræ, besides that which afterwards is formed at each intervertebral space. Originally the constriction was, as in fishes, in the middle of each rudimentary centrum (see my paper on the Vertebral Chain in Birds, Proc. Roy. Soc. March 8, 1888, pp. 465–482). This bird agrees with the Fowls and the majority of the Carinatæ in having no rudimentary rib on the atlas and axis (Pl. VII., *at.*, *ax.*): the rest of the cervicals down to the last two have a rudiment, right and left: the distinctness of these riblets as cartilage is very temporary; they complete the canal for the vertebral artery so far as it extends. These riblets have but a small styloid process in this bird, and in the hinder part of the neck this is lost; but the ribs break out suddenly in the seventeenth vertebra (Pl. VII., $c.r.^{17}$). Those hinder cervicals begin to have an upper spine, and these spines are like those of the dorsals from the fifteenth to the eighteenth. There is scarcely any development of the infero-lateral edge of the cervicals in this bird, tending to protect the carotid artery below.

The centra of all this series, and of all the dorsals also, are very broad, and all these vertebræ are cylindroidal. The interarticular ligament is normal, being perforated in the middle, the notochord passing through as the "suspensory ligament." Ossification is advancing fast in the 3rd stage, but the centres are not all present; when complete there is a pair for the neural arch, one for the centrum, and a pair for the riblets. In the axis there are two axial centres, for the centrum of the atlas is fused with it; the so-called centrum of the atlas is an intercentrum belonging to the junction of the first vertebra to the occipital condyle. Behind this another intercentrum appears belonging to the junction of the atlas with the axis, so that the atlas has three azygous osseous centres. The dorsal vertebræ, with their large quadrate upper spines, show scarcely any outgrowth below, but are unusually broad at that part; their transverse processes are large; the elevated cup for the capitulum of the rib is normal. Seen from below (Pl. IX. fig. 4) the sacral series is spindle-shaped; in the middle the centra are developed to a great width, for these contain the dilated, hollow sacral part of the myelon. There is a synovial cavity, with an interarticular ligament, between the first of the series and the last dorsal; for the rest, the cartilaginous centra are fused together, fibrous tissue only appearing between these parts and the hinder half of the uro-sacral region. The transverse lines marking the junction of the centra are curved backwards; the notochord (*nc.*) is obscurely moniliform, and there is only one constriction in each centrum. In Stage 1 (Pl. IX. fig. 5) the spines are confluent, and die out on the last lumbo-sacral, to reappear in the middle of the uro-sacral series.

The ribs, developed on the first and second, the dorso-sacrals, appear as small remnants on the first lumbo-sacral and the first and second uro-sacrals. The diapophyses are present throughout the series; they form strong buttresses to the pre-ilia, become very small in the last sacral proper, and then gradually approximate to the condition seen in the free caudal series. The first of that series (Pl. IX. fig. 4, *cd.v.*[1], *ic.*) sends an intercentrum under the fourteenth or last sacral; the rest up to the fore-part of the uropygial tract have increasingly large intercentra traced from before backwards; in the Common Fowl these parts are suppressed. Above (Pl. VII. & Pl. IX. fig. 5) the neural arches are seen to be narrow, and the spines low and blunt, in these free vertebræ. The short uropygial series of four imperfect segments formed on the end of the notochord is pinched in between the third and fourth, and the last segment expands a little. The ossification of the sacral series, as seen in the 3rd stage, is by a pair of centres for each arch and one for each centrum (Pl. IX. fig. 6); there is in many young birds the appearance of a double bony centre in this part; it is really single, the osseous matter which is first formed round the notochord growing out as a right and left lobe into the surrounding cartilage. The ossification of the caudal series is like that of the uro-sacrals in front, but becomes simpler behind; the intercentra are separately ossified. The vertebral chain of the adult may be profitably compared with that of some other types; in the following formulæ the avian sacrum is taken as one region:—

Corythaix buffoni.

C. 14, the two last with free ribs; D. 5, all with arches perfect; S. 13, first with half-sized free ribs, altogether, four pairs of pre-iliac buttresses, and the rudiments of a fifth, the ninth or first uro-sacral has riblets; Cd. 7+3: Total 42.

Opisthocomus cristatus.

C. 19, last two with free ribs, sixteenth and seventeenth with no capitular development of fused riblets; D. 3; S. 15, of which five have pre-iliac buttresses, the first two of these with free ribs, the second of which have sternal pieces incomplete below, the tenth and eleventh or first and second uro-sacrals have riblets; Cd. 5+4: Total 46.

Chauna chavaria.

C. 19, last three with free ribs; D. 5, ribs devoid of appendages; S. 17, with eight pairs of pre-iliac buttresses, the first three of these with developed ribs and sternal pieces, the twelfth and thirteenth and probably the fourteenth had distinct riblets; Cd. 6+5: Total 52.

Crax globicera.

C. 16, two last with free ribs; D. 4; S. 16, the first six with pre-iliac buttresses, of these the first carries perfect ribs, then two follow with no lateral processes, the next two have strong diapophyses and feeble riblets; three sacrals follow with these parts aborted, and of the eight uro-sacrals the first two have riblets and diapophyses; Cd. 6+3: Total 45.

This remark may be made, namely that the same bird differs very much in youth and age; small riblets are apt to lose their distinctness or to become starved; while the diapophyses themselves often shrink, so that a strong buttress may become a small prickle, which often quite disappears on one side. The length of the pre-iliac region of the sacrum in *Chauna* is a Cygnine character; indeed it has one more vertebra in the dorso-lumbo-sacral series than the Swan (*Cygnus olor*). *Opisthocomus* agrees with that Neotropical generalized Chenomorph—*Chauna*—in the length of its neck, a length which attains its highest condition in the Swan, which has 25 cervical vertebræ; in the other regions *Opisthocomus* comes near to the Gallinaceæ generally. The reniform occipital condyle in this bird fits into a notched atlantal cup as in the Fowls. The neural spines begin on the second vertebra, die out on the eighth, reappear on the thirteenth and fourteenth, and become complete on the seventeenth.

The axis and the two next have a small, thick inferior spine, which is nearly obsolete on the fifth. There is a small inferior spine on the fifteenth and sixteenth, and there is a free median spine with a pair of lateral ridges on the last three cervicals. The dorsals are peculiar; they are cylindroidal in their articulation, like the cervicals, and are flat-bottomed. There are no carotid bridges below in the cervical region. The first two or rib-bearing sacrals (dorso-sacrals) are somewhat bicarinate; the rest have merely the usual convex form. Returning to the cervical region there is a structure which is very remarkable, and yet not rare in the Carinatæ. The seventh to the twelfth inclusive have an oblique bony lamina outside the canal for the vertebral artery, a kind of flying buttress. In *Crax globicera* this is seen on the sixth to the ninth inclusive; this structure has its greatest development in certain of the Coccygomorphæ. The cervical riblets are small, but have a large base between the diapophyses and the parapophyses; they only form small additions to the former processes in the sixteenth and seventeenth; altogether the neck is very gallinaceous except as to its length. The sacral region is intensely ossified; the spine never quite dies out even in the true sacrals. Gradually the intervertebral spaces appear behind; but the main part of the pelvis above is largely plastered over with periosteal bone. The caudal vertebræ are not pneumatic, the rest of the spine is; the transverse and upper processes of the caudals are thick and of moderate size; the centra have the usual development. The intercentra are developed all along: that of the first is fused with the last sacral centrum; the second is a small grain of bone; the rest form thick inferior spines to the vertebræ; this is seen also on the uropygial bone, which is formed of four segments in the embryo (Pl. IX. fig. 5); it is thick below as in *Crax*; it is somewhat hooked downwards at the tip. The *ribs* in the old bird are strong bars; those on the eighteenth cervical are 24 millim. long, and have no uncinate processes; those on the nineteenth are 35 millim. long, and those on the first dorsal 37 millims. These two pairs of ribs have evident uncinate processes, whilst those on the second and third dorsals are rudimentary, only widening the ribs somewhat. In the first stage the free cervicals have no appendages (Pl. VII.), but these are seen on the four dorsals and the first dorso-sacral. The ribs gradually narrow backwards; each rib also narrows downwards and becomes the width of the sternal piece; these lower segments are short and strong. Even the costal appendages show that this is a generalized bird, both in their form and in their variability.

V. *The Sternum and Shoulder-girdle of* Opisthocomus.

From a very early period of my study of the Anatomy of Birds, I have been in the habit of comparing these intensely-specialized forms with the Imago Insect; the Reptiles proper being looked at as a sort of active Pupa, and the lower forms of Fishes as representatives of the larval stage of those noble Invertebrates.

Nothing shows this relation better than the shoulder-girdle; for in this part the intense life of these hot-blooded creatures has transformed the old elements, creating them anew, as it were, "into something rich and strange," making of those simple limb-roots the proximal part of the highest type of an organ of flight. The tooth-bearing extinct forms (*Archæopteryx*, *Hesperornis*, *Ichthyornis*) throw a much fainter light on this great change than this isolated archaic Fowl. The lowest Mammals, the oviparous Monotremes, still retain the simple or unfused condition of the splint-bones of the shoulder-girdle. The existing Reptiles, especially Lizards, show these splints in their free state, and also a large generalized shoulder-plate belonging to the endoskeleton, although its most superficial part; for it is formed between the ribs and the skin. Both the ribs and shoulder-plates are formed in the outer layer of the body of the embryo, namely in the somatopleure[1].

The sternum in the 1st stage (Pl. IX. figs. 1, 2) is already perfectly formed in hyaline cartilage; even in the 3rd stage no ossification has appeared. The breadth of this short sternum is five-sixths of its length in the fore half; it narrows in behind the last sternal rib, and then widens out again so as to be 1 millim. wider than in front. The form now attained in this half-ripe chick of *Opisthocomus* is fairly comparable to that which is seen in the sternum of the Common Chick on the sixth or seventh day (Lindsay, pl. xlv. figs. 1–3), and is relatively shorter than in the adult (Huxley, *op. cit.* p. 306, fig. 8). Otherwise, except in its histological condition and its size, the sternum undergoes but little further change. The rostral process (*r.st.*) is small, rounded, and superior; it grows forwards between the upper lips of the coracoid grooves.

[1] The copious illustrations generously allowed me by the Council of the Ray Society in my memoir on the Shoulder-girdle and the Sternum, published in 1868, come in very useful now, to illustrate this, my newer work. I am also greatly indebted to Miss Beatrice Lindsay for her excellent paper "On the Avian Sternum" (P. Z. S. June 16, 1885, pp. 684–716, pls. xlii.–xlv.).

In the Common Fowl this part is very large and deep and is fenestrate, so that the coracoid grooves meet in the middle; on the sixth day of incubation (Lindsay, *op. cit.* pl. xlv. fig. 3) the top of the sternum projects in front but little beyond the bottom where the keel is beginning to form. On the seventh day my figures (soon to appear in the Trans. Linn. Soc.) show an imperforate rudiment of the rostrum and a definite keel, projecting forwards in front, not far behind the rudiment of the rostrum. In this half-ripe 1st stage of *Opisthocomus* the fore edge of the feeble keel is exactly at the middle of the sternum, and does not reach the end; it is behind the middle if the rostrum is taken into account (Pl. VII., Pl. IX. fig. 1, *st.k.*).

This bird, both in this stage and in the adult (see Huxley, *op. cit.* p. 306, figs. 8, 9), is absolutely unique; the Turkey (*Meleagris gallopavo*) comes nearest it in this respect as far as I have seen.

Thus in *Opisthocomus* the space between the Bird and the Lizard is partly bridged over, the endoskeletal sternum receiving considerable support from the exoskeletal interclavicle, as I shall soon show. Nevertheless, the extension backwards of the sternum, with its spreading metasternal outgrowths and its intermuscular keel, makes even this sternum something very different from that of a Lizard; it becomes still more unlike in old age (compare Pl. IX. fig. 1 with Huxley's figure, and with the sternum of various Lacertilia in my memoir, pls. ix., x., xi., xiii.). I see a manifestly archaic character in the very forward setting on of the 1st sternal rib (compare my figures with Miss Lindsay's, *op. cit.* pl. xlv. fig. 2); there is scarcely any precostal process (*pc.p.*). The articulation of the five pairs of sternal ribs (*st.r.*) is already complete; the 3rd is on the most projecting part of the costal margin; these segments are unossified at present and are quite normal. The parts which are developed correlatively with that of the keel for special avian muscular attachment are such as are seen in a large number of existing Carinate birds. These metasternal processes (*m.st.*) are, with the keel, "additions of later phylogenetic date" than the costal margins (Lindsay, *op. cit.* p. 710, fig. 4). In this embryo, and in the adult figured by Prof. Huxley, the outer and intermediate metasternal (or xiphoid) processes are only partially divided by a small, oval fenestra. But in the mounted Hunterian specimen (A) this part is notched by a gap 5 millim. deep and 5 millim. wide; the inner notch is nearly of the same size, but is more angular. These modifications of the metasternum in individuals is interesting in this type; so, also, is the want of symmetry in the two moieties of the sternum, as is seen in the median process of this first stage (Pl. IX. fig. 1, *m.st.*). I have no stage showing the mode of ossification of the sternum; but I strongly suspect that it takes place by distinct ectostoses, as in the Ratitæ, the Hemipods, and the Fowls[1].

[1] In my work on the Shoulder-girdle and Sternum (pls. xvi., xvii.) I have detected an error in my description and figures of the sternum of *Turnix* (p. 184, pl. xvi. figs. 13, 14). The so-called coracosteon was formed by accident; the preparation is still by me, and I see now that what appeared to be a *suture* is merely a *fracture*.

The instance of the tooth-bearing *Ichthyornis*, and also that of the existing Tinamous, show that the keelless sternum is a comparatively recent secondary modification of this part of the skeleton. The dying-out of the keel has manifestly taken place as part of the same withering of unused structures as that which is seen in the wing of absolutely terrestrial birds. These two groups of Pre-Ratitæ—the Opisthocomidæ and the Tinamidæ—probably co-existed with strong, if short-winged, ancestors of the existing struthious birds. It is very remarkable that in the first of these the keel is at its lowest development, apparently in a primary condition; whilst in the Tinamous the sternum is one of the longest and most carinate of any kind of bird. The shoulder-girdle of *Opisthocomus* is still more remarkable than its sternum. In the Vertebrata generally, this part is of great morphological interest, for in it, as in the skull, the cartilaginous tracts, ossified or unossified, are supplemented by parostoses or superficial membrane-bones. It is an awkward necessity of this branch of science that its terminology is dominated by the terms of Human Anatomy, which, when applied to parts of lower and simpler forms, are often either incorrect or absurd. Thus the term "coracoid" for the lower part of the shoulder-plate is absurd—the only coracoid which is like a Crow's beak is that of Man and a few Mammals; whilst the term "clavicle" is incorrect as applied to a lateral parostosis of the shoulder-girdle in most of the cold-blooded types, for they have a simple membrane-bone, whereas the clavicle in Man and his nearest relatives is a compound structure, in which the parostosis is soon blended with endoskeletal elements. This is due to the hot condition of the blood in Mammals, and the same thing appears in most birds—that is, in those that are furthest removed from the Amphibia and Reptilia. Parts of the endoskeleton that are continuous or unsegmented in the cold-blooded types are variously segmented and abortively developed in the nobler Vertebrata; and thus we meet with vestiges or remnants of archaic structures that are used up in many ways in the metamorphosis of the skeletal elements. In the existing Ratitæ, and in this ancient Carinate type, the parts of the shoulder-girdle are in a very primitive condition; in *Opisthocomus* the transformation that takes place is mainly due to arrested growth and to the blending of parts originally separate. At first sight the structure of these parts in the adult does not seem to be different from that of ordinary Carinate birds; the scapula forms a single and complete bone, and so does the coracoid, and they are bent upon each other at an angle less than a right angle, as in flying birds generally.

In the Ratitæ the axes of these two bones are coincident; that, however, is a relapse into a degraded condition; that this was not the case in their ancestors I feel quite certain. In this typically bent and typically narrow shoulder-plate there is, in the half-ripe embryo, a character as unsuspected as it is instructive: the supra-scapula is segmented from the scapula, as the latter is from the coracoid. Even in Man the "posterior edge" of the scapula is feebly ossified, for a long while at least, thus making a suprascapula; but in all known adult birds, extinct or existing, the scapula is ossified throughout by one bony ectostosis. Down below, among cartilaginous and semi-cartilaginous fishes, *e. g.* the Skate and the Sturgeon, the suprascapula is a distinct segment of cartilage (*op. cit.* pl. i.). In the Amphibia Urodela this part is not segmented off, but it remains unossified (*ibid.* pls. iii., iv.); in the Anura, however (*ibid.* pls. v.–vii.), the suprascapula is semi-segmented from the scapula and has its own ectostosis and endostosis. In the Lacertilia (*ibid.* pls. viii.–xi.) the suprascapula has its own endosteal tract, but no outer plate of bone; moreover, the cartilage between the two regions is not so much altered as in the Anura, and therefore the suprascapula cannot be bent upon the scapula to the same extent as in Frogs and Toads. Here, again, the attempt to reconstruct the ancestral bird or birds has to be done in the light of Amphibian Morphology rather than in that of the Reptilia. The suprascapular segment in my 1st stage (Pl. IX. fig. 1, *s.sc.*) is most distinct on the right side; it is one third the length of the scapula (*sc.*), is rounded above, uncinate, and dilated at its base, which enclosed the narrow top of the scapula; that top is as yet unossified as the suprascapula itself.

The main scapular segment has the usual gently-bent shape, and is dilated below to form the upper part of the glenoid cavity and the very short acromial process (*ac.p.*). The coracoid (*cr.*) is much wider than the scapula, but it is only three-fifths the length of the whole bar; its head, which is swollen and large, and its dilated and uncinate base, or epicoracoid region, is as yet unossified; the rounded and narrow shaft is half the length of the whole bar. The shaft-bone ultimately ossifies the whole of the coracoid in this as in all other birds; they have, in their adult state, no semi-cartilaginous tract below, such as is seen in Anura and Lacertilia, nor any separate epicoracoid bone such as we find in the Monotremes [1].

Seen from above (Pl. IX. fig. 2) there is a large uncinate flap of cartilage which grows inwards and hooks downwards upon the upper third of the furcular ramus or clavicle; this is a continuous precoracoid, and this part, in a very diminished condition, forms the so-called "clavicular process of the coracoid;" it is the precoracoid of Sabatier (Lindsay, *op. cit.* p. 715). This part is always present, in the embryo at least, in the Ratitæ (*op. cit.* pl. xvii. *p.cr.*) [2].

In the African Ostrich it is as well developed as in the Anura and Chelonia (*op. cit.* pls. v.–vii., xii.–xvii.). One thing more has to be noticed: this large, continuous, pre-

[1] In her otherwise very accurate memoir, Miss Lindsay has made a curious mistake with an unlooked-for misstatement of my views. She gives a figure (pl. xliv. fig. 1) of the coracoid of *Diomedea exulans*, and calls the rough top or head of the bone the "coracoid epiphysis" (*cor.ep.*), and states that this is "Parker's precoracoid." It is, at most, an *apophysis*; birds have very few epiphyses; generally, the only one is in the "procnemial process" of the tibia. Parker's precoracoid of birds (see 'Shoulder-girdle and Sternum,' pl. xiii. *p.cr.*) is a special segment or remnant of the fore margin of the great continuous and fenestrated shoulder-plate of a cold-blooded type, a part enucleated in birds from the general precoracoidal bar.

[2] My son, Prof. T. J. Parker, finds it well developed in some embryos of the Apteryx.

coracoidal flap lies *over* the clavicle ; the often massive segment, which is manifestly part of the original bar of an archaic type, lies below or behind the clavicle (see in *Phalacrocorax* and *Sula*, *op. cit.* pl. xiii. figs. 3–10, *p.cr.*), and forms, after separate ossification and fusion with the clavicle, the flat-topped shoulder of the furcular ramus in those types. This addition to the clavicle articulates with the head of the coracoid, underpropping it, and this is the part which in birds I have constantly called the precoracoid [1].

But there is in some cases another nucleus of cartilage at the top of the clavicle; this I have called the "meso-scapular segment" (*op. cit.* pl. xv. figs. 12–15, *m.sc.s.*), for it is manifestly a segment from the meso-scapular or acromial region of the shoulder-plate. It gives rise to the enlargement of the upper and posterior lobe of the wide-topped furcular ramus of all true Passerine birds and of some of the Coccygomorphæ, for instance *Rhamphastos*, *Picus*, *Alcedo*, &c. I mention these specializations in the most specialized kinds of birds to show how low is the ornithic level of *Opisthocomus*; its furcula will reveal this in a still clearer manner. The furcula of *Opisthocomus* is composed of three parosteal bones, two clavicles and an interclavicle; and notwithstanding the figures and descriptions given by me long ago, in my large memoir, of a distinct interclavicle in Birds, answering to the long bone of Lizards, Prof. Huxley (*op. cit.* p. 307) has been careful not to use the term, but calls the stem of the Y-shaped merrythought the "hypocleidium." A younger biological sceptic, Miss Lindsay, also doubts my interpretation. She says, speaking of the chick of the 8th day:—"The ribs at any rate have established their *generic* characters at this date, which renders it probable that the broadening ossification of the median region of the clavicles, described by Götte as established during the 8th day, is an outgrowth of the Avian furcula rather than a pre-Avian interclavicle—a view which is expressed by giving to it (as has been done throughout this paper) the name of *median furcular apophysis* rather than of *interclavicle*" (*op. cit.* p. 702).

Opisthocomus has, of all birds, the most perfect Y-shaped furcula (Pl. IX. figs. 1–3, *cl.i.cl.*); its forks and stem are of equal length.

The forks or rami are somewhat sigmoid, are narrow, and bent outwards at the top; they suddenly flatten out and then gently become narrower, the lower part being only half as wide as the upper. The two clavicles not only close in the semi-oval space, they also run down the stem for half its length, lying close together above, and then becoming slightly separate. Into this space there fits a fine needle of bone, the interclavicle; it is two-thirds the length of the stem; thus the hypocleidium is composed of three elements. This interclavicle binds the furcula to the lower face of the sternum, as in the Lizard (*op. cit.* pls. viii.–xi.); it can be seen through the transparent cartilage in this first stage. In Lizards it often gets in between the right and left halves of the

[1] See *op. cit.* p. 150. There I remark that "the line of segmentation between the coracoid and the great precoracoid segment has become a large oval, gliding, synovial joint."

sternum, and appears on the upper surface (see in *Læmanctus, op. cit.* pl. ix. fig. 9, *i.cl.*). A delicate ligament, half the length of the bony style, connects it with the arrested sternal keel. In the adult bird these three elements are fused into the single furcula, and this bone becomes ankylosed above with the coracoids, and below with the sternum, both rostrum and body; the scapula only remains distinct.

This arboreal bird has evidently only developed its organs of flight for flitting; the great amount of ankylosis in its shoulder-girdle suggests this. In my notes on these parts in the Hunterian specimen (old male) I have remarked that "the ankylosis has not obliterated the lines of junction of the large clavicular process of the coracoid with the clavicle, nor of the head of the latter with the acromial process of the scapula, for that bone remains free whilst the others are all melted together—clavicles, interclavicles, coracoids, and sternum."

VI. *The Wings of* Opisthocomus cristatus.

In the 1st stage (Pl. X. figs. 1–3) the wing is as much developed as in my 5th stage of the Common Fowl (Phil. Trans. 1888, B, pl. 62. fig. 7)[1].

It is necessary for me to refer to those figures, for in them is shown what I find to be constant in all the birds I have studied at that stage, namely that there are at first only two proximal carpals. In the paper referred to I have called these the "intermedio-radiale" and the "centralo-ulnare;" in the adult bird the ordinary nomenclature for these carpals is simply "radiale" and "ulnare." It is necessary to remember that in the strangely adaptive abortion of many elements of the bird's fore limb, some parts are primarily, and some secondarily developed, the latter by segmentation of a cartilaginous mass; and this is often very temporary, the parts becoming fused together again, even, in some cases, before the time of hatching.

The wing of *Opisthocomus*, although very much like that of a Fowl in its adult state, yet differs much from it in its development. The long cartilages in the first stage have already a considerable ectosteal sheath (Pls. VII., X. figs. 1–3). As in the true Fowls, the humerus and cubitus differ but little in length; they are quite normal, and need not be described in this stage. The manus, however, shows many parts that are lost and leave no sign in the adult; all these unlooked-for segments are, nevertheless, quite normal parts of a typical cheiropterygium. The two nuclei of cartilage seen in my early stages of the chick attached to the radius and ulna are here seen as *five* more or less distinct tracts (Pl. X. figs. 1, 2). The *radiale* (*re.*) is now a pedate wedge of cartilage lying on the fore margin of the wrist, and most to the flexor or inner side. The *intermedium* (*i.*) is a four-sided short wedge, somewhat lesser than the

[1] In figs. 1 & 2, 1st and 2nd stages in that paper, the distal carpal (*d.c.*[1]) is drawn too near the first metacarpal (*m.c.*[1]). In fig. 3 the true position is given, namely inside the head of the great metacarpal. The first distal carpal is always developed in birds as a free nucleus of cartilage in that position; it is a feeble element, displaced to the flexor side of the limb.

radiale; it lies on the outer or extensor side of the wrist. On the ulnar side of the wrist, instead of the thick, two-lobed U-shaped carpal so familiar to us in all adult birds, there is, on the flexor side, a pear-shaped carpal (*ue.*), the ulnare proper, which sends its narrow end forwards to articulate with the third metacarpal and its distal carpal (*mc.*³, *d.c.*³), and which overlaps at its broad end the bulbous distal end of the ulna (*u.*). The shorter thicker crus of the bilobate ulnare of the adult is here represented by a subcrescentic mass which, behind, is attached to the ulna and free ulnare, and in front by ligament to the second and third distal carpals (*d.c.*², *d.c.*³) at their junction, and also to the postero-distal angle of the intermedium (*i.*). A transverse chink on the inner face of the mass partially subdivides this centrale into an anterior and a posterior segment (*c.*, *c.*¹). These are all the proximal carpals I find in this bird; the distal carpals are three in number, and are constant throughout the Carinatæ, corresponding to the three constantly developed digits. The second and third distal carpals (*d.c.*², *d.c.*³) are formed from one mass in the early embryo, but the hinder and lesser nucleus is soon detached, and then coalesces again with the larger piece (*op. cit.* pl. vi. figs. 1–4, *d.c.*², *d.c.*³). The line of segmentation of these two carpals, at a stage a little earlier than this, is indicated by the direction of the cells of the cartilage, which, in the two regions, curve from each other back to back, thus leaving a fine clear tract between the groups of cells. This is soon obliterated, so rapid is the metamorphosis of the parts in these hot-blooded, fast-growing types. The intense growth of the second carpal, metacarpal, and digit, which form the main part of the framework, for the insertion of the primary quills, has dominated the whole manus, and has thrown the elements of the limb out of gear. The third distal carpal lies along the ulnar or hinder side of the second, and is as much lessened as the metacarpal (*mc.*³) that belongs to it; the two together form a remarkable grooved trochlea on which the proximal carpals roll. The latter are more tightly strapped to the radius and ulna, and here, as in the hind limb, the main movement is between the proximal and distal row of segments. Were there fusion of the proximal carpals with the radius, and did the ulna end in a point, dissimilarity would be complete. Of what service the "alula" is to the bird in flight it is difficult to say; it cannot be of much, as it gives but a slight increase of size to the wing, and that only near the carpal bend. Certain it is that the larger the manus the lesser is the pollex, as we see in the "Macrochires," the Swifts, and Humming-birds. But here, in this Reptilian bird, the pollex is relatively nearly as large as in Man (Pl. X. figs. 1–7); that is, it is so in the embryo, not in the adult (figs. 8, 9). The condition of the first distal carpal is very remarkable; it is a small limpet-shaped cartilage, attached to the head of the first metacarpal on its flexor face (Pl. X. figs. 2, 3, 7, *d.c.*¹). I can give no other interpretation to Dr. R. W. Shufeldt's "pentostium"[1].

[1] See his "Osteology of the North-American Tetraonidæ," Geological Survey of the Territories, Washington Oct. 14, 1882, pl. vii. fig. 59, 8.

In this bird this nucleus of cartilage is further from the metacarpal of the pollex (*m.c.*[1]) than in most birds; I find it nearest to that segment, to which I am satisfied it belongs, in the chick of *Turnix rostrata*[1]. In that type the ventrally displaced distal carpal is phalangiform, and is of the same breadth as the first metacarpal, but only two thirds as long; it is bulbous at its radial end, and is immovably articulated with its own metacarpal, which is hollowed to receive it. My doubts about the nature of this nucleus are still further dissipated when I consider the manner in which my own pollex is ventrally displaced adaptively. This little nucleus (Pl. X. figs. 2, 3, 7, *d.c.*[1]) is, I doubt not, the counterpart of the human "trapezium." The first metacarpal (Pl. X. figs. 1, 2, *mc.*[1]) is nearly as wide as the second, but is only one fourth its length; it has already, in its cartilaginous condition, become fused with the second for a short space proximally, in a manner similar to the fusion of the third distal carpal with the same large dominating segment. The "trochanter" projecting from the short, confluent metacarpal, shows some signs of a marginal addition (see Fowl's Wing, pls. 62–64, *mc.*[1′]); this is the part from which the main spur grows in certain birds. The proximal phalanx of the pollex (*dg.*[1]) is three-fourths the thickness, and two-thirds the length, of the huge metacarpal joint behind it (*mc.*[2]); for half its length in the middle it is ossified; its metacarpal does not ossify until near the time of hatching. The distal or ungual phalanx is relatively larger than the proximal; it is very little less than that of the second digit (*dg.*[2]); that measured with the claw on is 2·5 millim. long; this, of the pollex, is 2 millim.; the tip of this distal joint is beginning to ossify.

If the manus in this stage be measured from the top of the second distal carpal, it will be found that the pollex is more than half the length of the huge index (*dg.*[1], *dg.*[2]); the one is 6·5 millim. long, the other 12·5 millim. On the other side of the Class, in the Macrochires, in the adult state, the abortion of the pollex, with its small quills forming the alula, is very remarkable, as the following instances will show:—

	Length of the Manus along the *Pollex*.	Length of the Manus along the *Index*.
Cypselus affinis . . .	9 millim.	34 millim.
Chætura caudacuta .	15 ,,	68 ,,
Topaza pella . . .	4·4 ,,	21 ,,
Patagona gigas . . .	5·6 ,,	34·5 ,,

Thus, instead of the first finger being more than half the length of the second, this latter is, in these cases, taking the average, four and a half times as long as the aborted

[1] From Formosa, the gift to me, many years since, of the late Consul Swinhoe. The skull of one of these valuable chicks has already been described by me in these Transactions (vol. ix. pl. liv.); the sternum and shoulder-girdle were also described in my work on those parts, and figures and descriptions of the remainder of the skeleton will soon be published.

first digit; the disproportion is greater in the Humming-birds than in the Swifts. I must now notice a remarkable structure. The manner in which the ectosteal sheath of the second metacarpal passes along the ulnar side of the first (Pl. X. figs. 1–7, *mc.*², *mc.*¹) is repeated on a smaller scale in the pollex, while at the radial margin of the top of the proximal phalanx there is a rounded flap of cartilage which runs forwards in a sharp wedge ending in ligamentous fibres at the middle of the joint. Besides this, in all these embryonic stages there is a wedge-shaped mass of inter-articular cartilage (*i.a.c.*), which, solid and definite as it is, only remains for a time; in the adult (figs. 8, 9, *dg.*¹) it is reduced to a mere film. That these structures belong to a veritable "prepollex" I have no doubt; they are not the only cartilaginous tracts on the radial side of the manus to be seen in Birds, as I shall show in another paper. The *index* (*dg.*²) is greatly overgrown; but for that the pollex would be seen to be quite normally developed as compared with that of an average Reptile. The phalanges have undergone the same degree of ossification as those of the pollex, and moreover its metacarpal (*mc.*²) is ossified in an equal degree; its distal phalanx has also the tip ossified even in the 1st stage, as in the pollex. The metacarpus is twice as long as the proximal phalanx, and it is one sixth longer than the second and third. That third phalanx is generally lost, often suppressed, in Birds; here it has its most remarkable development, and is but little less than that of the second digit in the foot (Pl. VII.). This digit is not *simple*; it has been complicated by intercalary or secondary structures; which, however, are not peculiar to this bird, but are very common in the Carinatæ. These are, first, a tract of cartilage on the extensor face of the wrist, which creeps down between the head of the second and third metacarpals (Pl. X. figs. 1, 6, *mc.*²′); this breaks out at the top of the interosseous space into a bead-like swelling, which in Gallinaceous birds (*op. cit.* pls. 62–64, *mc.*²′), in Passerines, and in some of their Cuculine allies, grows into a large flat plate, which bridges over the proximal end of that space. Below, on the ulnar edge of the proximal phalanx of this great digit (*dg.*²), there is a lanceolate tract of newer cartilage that receives its bony matter from the phalanx, and this becomes a mere flange to that joint, broadening it for the insertion of the "primaries;" this part has its own osseous centre in the Raptores. I look upon this structure as a sort of bifurcation, like that which is so often seen in the roughly finished cheiropterygium of the Ichthyosaurs.

The starved third digit (*dg.*³) has its slender metacarpal (*mc.*³) separated from the second by a large lanceolate interosseous space; proximally it begins much lower down than the second; it is continued a little further below; it is largely ossified. The phalanges of the third digit (*dg.*³) are in a curiously-aborted condition; there is an attempt at segmentation into what should be, according to the Reptilian norma, four phalanges. In the 1st stage (Pl. X. fig. 1) there is one cartilaginous tract two-thirds the length and half the breadth of the proximal phalanx of the second digit; the end of this tract is raised and hooked, and is, indeed, a semi-segmented ungual phalanx.

In the 2nd and 3rd stages (figs. 5–7) the main part has an ectosteal sheath, so that it looks as if it were forming three segments. The ungual phalanx has now become a mere cap of cartilage on the end of the main segment (fig. 5, $dg.^3$). In my paper on the Fowl's Wing (pl. 64. figs. 12, 13, pl. 65. figs. 1–3) I have shown that in *Struthio* and *Rhea* there is a very small *unguis* on the third as well as on the first and second digits. In the same paper (pls. 62–64.) I have shown, also, that in many cases there is the rudiment of a fourth digit; this is cautiously lettered ($dg.^4$) as an addendum to the third metacarpal ($mc.^{3'}$). It is a notable part in some old birds, for instance in *Rhamphastos toco* and *Dicholophus cristatus*. Here, as in many other birds, I do not find a fourth metacarpal, but there is a rudimentary phalangeal cartilage in all these three stages (figs. 1, 5, 6, 7, $dg.^4$); it is most clearly seen in the 2nd stage (fig. 5). It is a pyriform lobe of cartilage, with its narrow end forwards, and is adherent to the ulnar edge of the abortive third finger; it is about one third its size. Most of the metamorphosis of a bird occurs in the *encysted stage*, whilst it is still in the egg, and this takes place in a marvellously rapid manner. But during the first year, as I long ago showed in my paper on the Fowl's Skull (Phil. Trans. 1869, pls. 81–87. pp. 755–897), and afterwards to the end of life, in some degree slow obliterative change still takes place through the gradual increase of bony substance. We shall look in vain in the wing-bones of the adult *Opisthocomus* for much of what I have described in the embryo. A comparison of this wing with that of a few other types will show that its manus is unusually long. Notwithstanding the great distance of this bird from the Macrochires, it has like them, but not to the same degree, a long distal segment to its wing-skeleton; in this respect it comes nearer to the Pteroclidæ and Turnicidæ than to the Cracidæ. This wing agrees with that of the Cracidæ and Megapodidæ (Peristeropodes), and also with the Pteroclidæ, Turnicidæ, and Tinamidæ, in having the bridge over the proximal part of the interosseous space of the manus (Pl. X. fig. 8, $mc.^{2'}$); in this, like them, it differs from the Alectoropodous Fowls, the Phasianidæ, Tetraonidæ, &c. The length of the three main divisions of the wing-skeleton in six types is as follows (all these are taken from adults, except *Turnix rostrata*, which was a chick of a week or two old):—

	Humerus.	Cubitus.	Manus.
Opisthocomus cristatus . .	70 millim.	72·5 millim.	69 millim.
Crax globicera	140 ,,	150 ,,	115 ,,
Turnix rostrata	15·2 ,,	12·4 ,,	18 ,,
Chauna chavaria	182 ,,	204 ,,	155 ,,
Corythaix buffoni . . .	45 ,,	42 ,,	37 ,,
Talegalla lathami . . .	84 ,,	86 ,,	71 ,,

So that this type agrees with *Crax*, *Chauna*, and *Talegalla* in having the cubitus larger than the humerus; its manus is but little less than its cubitus, differing in this respect from all the others except *Turnix*, in which the distal is nearly one third longer than the middle segment. The humerus of *Opisthocomus* is almost as well developed as in a Pigeon; the thick uncinate snag below the head and in front of the large pneumatic foramen is very large, and there is a strong crest for the pectoralis major [1].

The radius, ulna, and manus are all strong, normally gallinaceous, and indeed very similar to those of *Crax globicera*; the quill-marks on the ulna are less than in *Corythaix*, but larger than in *Crax*. The two proximal carpals are now normally ornithic; all signs of their division are lost (Pl. X. figs. 8, 9, *i.r.*, *c.u.*). The distal carpals are completely fused with each other and with the three metacarpals (figs. 8, 9, $d.c.^1$, $d.c.^2$, $d.c.^3$; $mc.^1$, $mc.^2$, $mc.^3$). The trochanter on the short first metacarpal is low down, but strong; the first distal carpal (fig. 9, $d.c.^1$) is a rounded knob of bone looking obliquely downwards and forwards toward the first metacarpal. The proximal and distal intercalary parts behind the index ($mc.^{2\prime}$, $dg.^{2\prime}$) are completely fused with that member. There is a distinct semi-oval ungual phalanx to both the pollex and index ($dg.^1$, $dg.^2$), and in spite of growth and ossification the distal joint of the third digit ($dg.^3$) is still visible, and also the still more instructive remnant, the aborted phalanx of the fourth finger ($dg.^4$). Mr. Perrin, in his figures of the wing, shows the unguis both on the index and pollex (*ibid.* pl. lxiv. figs. 1, 2).

VII. *The Hip-girdle of* Opisthocomus cristatus.

In the 1st stage (Pls. VII. & IX. figs. 4 & 5) the moieties of the hip-girdle are scarcely more than half ossified; they have already acquired their permanent form and position, and are passing from the Ornithoscelidan, through the Struthious, to the normal Carinate condition. Thus the axes of the pre-ilium and pubis are nearly coincident (*pr.i.*, *pb.*), and the ischium is still separate from the post-ilium (*pt.i.*). The post-ilium is only three fourths the length of the pre-ilium; this has only a short tract of cartilage in front; the other part is largely unossified at present. The two moieties are now a great width apart—one third more than their own breadth; this is due to the large relative size of the sacral chain of vertebræ. The pre-ilia narrow in forwards sinuously; the post-ilia at the hinder part of the acetabulum form the projecting facet, right and left, for the articular surface of the trochanter major. They then narrow in suddenly, and again widen out to form the projecting eaves of the pelvis; they then become narrow and die out, and the end of the post-ilium has a sub-uncinate form; it is slightly curved inwards. Under the projecting eave the post-ilium grows downwards in its last two-thirds to meet the ischium; its fore third is deficient, and thus forms the sacro-ischiatic space (*s.i.f.*). The three elements of the hip fail to join completely at the acetabulum, which is always, in birds, open within. The ischium (*isc.*) reaches

[1] That muscle is really very massive (see Mr. Perrin's valuable paper, Trans. Zool. Soc. vol. ix. pl. lxiii. fig. 3).

a little further backwards than the post-ilium; behind it is notched above and lobate below. The pubis (*pb.*) is half the breadth of the ischium, but it is one third longer; it thickens behind and then narrows to a rounded point. At the last fourth of its length it is still, as in front, unossified; and this part is twisted upon itself in the same manner as I find it in the Guillemot (*Uria troile*). In that bird the prenasal rostrum and Meckel's cartilages are similarly twisted, as also is the epicerato-hyal band in this bird. If I had found these twisted cartilages in the embryo of a tame or domestic bird I should, of course, have put them to the account of Teratology. I cannot do this either in the Guillemot or the Hoatzin; in these birds, which are in a state of nature, they have manifestly an ontogenetic meaning. In the fossil Toothed Birds (Marsh, 'Odontornithes,' pls. i., xx., xxi., xxii.) the bill is relatively much longer than in average modern birds related to them: *Hesperornis* is a Colymbine Grebe; *Ichthyornis* is an ancient Gull; the length of their jaws bears out this view. In the hyoid arch I have shown that the bird agrees with *Hatteria* (Huxley, P. Z. S. 1869, p. 397, fig. 4); it merely loses part of that arch by absorption, but not without an attempt on its part to grow larger. The rest of the organization forbids this, and it becomes a twisted tape. All these things have but one explanation.

The forms that among extinct Reptiles come nearest to Birds in their hip-girdle—namely, the Ornithoscelida—have an exceedingly long pubis and ischium (Dollo, 'Bulletin du Musée Royal d'Histoire Naturelle de Belgique,' tome i. 1882, planche ix. & tome ii. planche v.). The ancestral birds must have come much nearer these Reptiles than modern types; but these latter all pass in their hip-girdle through an Ornithoscelidan stage after they have lost the general Reptilian condition of this part. The gently modified Ornithoscelidan pelvis of the African Ostrich has its very accurate counterpart in the embryo of the Swan (*Cygnus*), in which bird, for teleological reasons, the postacetabular region of the pelvis is extremely long and the pubes very large, as in the Ostrich, but they are not, as in that bird, fused together below. The hip-girdle of the adult *Opisthocomus* has to be studied with the sacrum as part of the pelvis. Prof. Huxley (*op. cit.* p. 308) says:—"The pelvis (figs. 10, 11) is more like that of *Coturnix* than that of *Corythaix*; but though it resembles both, it differs from both in the absence of any ilio-pectinal process, and in the circumstance that the ilio-sacral fossæ are completely roofed over by bone. The obturator foramen, as in many Gallinaceous birds, is not bounded by bone behind; in *Corythaix* it is:" [*bounded*, but not perfectly enclosed, by ankylosis of the ischium and pubis, any more than in Gallinaceous birds and *Opisthocomus*. Moreover, *Corythaix* has the roofing of the post-ilium over the ilio-sacral fossæ, although not to the same extent as in *Opisthocomus*]. The pelvis of *Opisthocomus* is very generalized, and differs very much from that of the Gallinaceæ proper (Peristeropodes and Alectoropodes); they have the postacetabular region much broader, and the breadth is seen in its most remarkable degree in *Cupidonia cupido* (Shufeldt, *op. cit.* "Tetraonidæ," pl. xii.). In that bird, and in *Talegalla lathami*, the prepubic spur is very small; it is somewhat larger in *Crax*, and still larger in *Penelope* (Huxley, *op. cit.* p. 298, figs. 3, 4). In the Alectoropodes it is, as a rule, well developed, and also in Tinamous (Tr. Z. S. vol. v. pl. xli. fig. 3; Marsh, *op. cit.* p. 73, fig. 20). The greatest development of this part in the Carinatæ is in certain Coccygomorphæ—for instance, *Geococcyx* (Marsh, *op. cit.* p. 73, fig. 19, and Shufeldt, Journ. Anat. Phys. vol. xx. pl. 8. figs. 9 & 11); and I find it in a similar state in that American Cuckoo, *Saurothera vieilloti.* This bird agrees with the Rallidæ, both extinct and existing, in respect of these post-iliac eaves (see Owen on "*Aptornis defossor*," Tr. Z. S., vol. viii. pl. 15, and Shufeldt on "*Porzana carolina*," Journ. of Comp. Med. & Surg. July 1888, art. 17, p. 89, figs. 4 & 5). The existing Rallidæ have the prepubic spur very distinct, although rather smaller than in the high-heeled Fowls. There is a family of birds, however,—the Turnicidæ—in which the spur is suppressed, and in which, also, the post-ilium forms an eave over the sacro-ischiatic fenestra, exactly as in *Opisthocomus*—for instance, *Hemipodius varius* (Tr. Z. S. vol. v. pl. 35. figs. 5 & 8). The same structure, also, is to be seen in *Turnix rostrata.* Another peculiarity of the hip-girdle, in which these two types also agree, is the very generalized condition of the ischium in form and in its relation to the pubis. Long ago (Tr. Z. S. vol. v. p. 172), speaking of the congeners of the Hemipods, I remarked:—"These allies are very numerous; and it is hard to say which of them should be placed nearest this, one of the most 'mixed' forms in the whole range of Ornithology." This family, the Turnicidæ, is not so near extinction as that one-membered family, the Opisthocomidæ.

I will conclude this account of the pelvis of the Hoatzin by giving, for comparison's sake, the length of the pre-ilia and post-alia in six types:—

	Pre-ilium.	Post-ilium.
Corythaix buffoni	24 millim.	21 millim.
Opisthocomus cristatus	33 "	27 "
Hemipodius varius	21 "	17 "
Turnix rostrata, juv.	10·5 "	7 "
Crax globicera	72 "	75 "
Chauna chavaria	68 "	54 "

A careful study of the muscular system of the hind limbs, and its meaning and relation to the habits of these birds, would show cause for the various relative lengths of the two regions of the enormously extended ilium; in the true Gallinaceous birds there is great oscillation, so to speak, in these lengths, as the five figures given by Prof. Huxley show (*op. cit.* pp. 298–301, figs. 3–7). These figures, and those of the Hoatzin (*op. cit.* p. 308, figs. 10 & 11), show that there is one remarkable difference between the pelvis of this bird and that of the Alectoromorphæ. In the latter the pre-ilia are so united with the sacral spine by ankylosis as to form a right and left gallery, open at both ends; the same thing is seen in *Corythaix*; in *Opisthocomus* there is a clear space between these parts, right and left; this is also seen in the Turnicidæ. Even this part of the skeleton, therefore, like the rest, suggests a low ornithological position for this bird, and justifies the use of the term archaic as applied to it.

VIII. *The Hind Limb of* Opisthocomus cristatus.

The leg of *Opisthocomus* in the 1st stage is strong and rather stout (Pl. VII.); its long elements have a considerable ectosteal sheath ossifying the solid cartilage. The parts of this limb differ little from those of an embryo of the Common Fowl at this stage; we shall find a few notable differences, showing that we are, here, at the parting of the ways. The relative length of the main divisions of the limb, at this stage, is very similar to what is seen in a large number of those Carinatæ that have moderately long legs, whether they are Perchers, Walkers, or Runners. Measured from the chief points of flexure, these parts have now their length as below:—

Femur.	Tarso-tibia.	Tarso-metatarsus.	3rd toe.
11 millim.	13 millim.	8 millim.	14 millim.

The ends of the large cartilages are still unossified, and they will not be finished by epiphyses, except in the case of the cnemial process of the tibia: in a few Cuculine birds the top of the fibula has a small epiphysis, but that is rare in the Carinatæ; in the fore limb, in some rare cases, sometimes the radius and sometimes the ulna has an epiphysis. The cnemial process is not large; the fibula (*fb.*) has shrunk to half the length of the tibia (*t.*); the tibia is quite distinct from the proximal tarsals (*tb.*, *fbe.*). All the true tarsal elements are free from bony deposit at present (Pls. VII. & X. fig. 10). There is some contention as yet as to the true nature of these segments; but, after much labour and thought, my own mind is made up as to their morphological meaning. When I first asked whether or no the lower part of the tibia was an epiphysis or "the homologue of the Mammalian astragalus" ("On *Balæniceps rex*," Tr. Z. S. vol. iv. p. 343), I was still in the dark as to the nature of the "sesamoid os calcis." Since then, several anatomists, notably Gegenbaur and Huxley, have worked at this part of the bird's skeleton.

One of the most valuable pieces of work on this subject is Dr. Morse's paper "On the Intermedium in Birds" (Ann. Mem. Boston Nat. Hist. 1880), though his views, which are mine also, have been controverted by Dr. G. Baur[1].

In a paper (ready for publication), my son, Prof. T. J. Parker, also holds the same views as Dr. Baur; his observations have been made on the development of the *Apteryx*. I am perfectly convinced of the truth of Dr. Morse's views. Nevertheless I believe that there are only *two* morphological elements in the proximal tarsal series—an astragalus, or tibiale, and a calcaneum, or fibulare. The so-called *sesamoid*, or

[1] See his paper, "Der Tarsus der Vögel und Dinosaurier," Morph. Jahrb. Bd. viii. pp. 417–456, Taf. 19, 20.

"calcaneal ossicle" of the older writers, belongs to a lower stratum; it is a centrale. The intermedium, the so-called "ascending process" of the astragalus, evidently belongs to a higher series—namely, to those of the leg. I classify it with the tibia and fibula. In the Chick, after seven days' incubation, my 1st stage in this research, in the 2nd stage, after eight days, and in the 3rd stage, after ten days, I have examined these parts with great care. In all these stages the ascending process of the astragalus is an oblique flange of hyaline cartilage, which runs from the top of the tibiale towards its outer side to the top of the fibulare on its inner, and then grows upwards. It cannot, therefore, in this early condition be proved to be the intermedium. Miss Johnson's preparation (Stud. Morph. Lab. Camb. vol. ii. 1886, pl. v. fig. 9) and Dr. Baur's sections (*op. cit.*) do not, in embryos answering to my 1st stage, show the ascending process. At this date the globular fibulare is much more solid than the wedge-shaped tibiale; the front surface of the latter, and especially the part which forms the ascending process, is still composed of indifferent tissue. In a day or two, however, the chondrification is completed, and then the ascending process partly overlaps the fibulare and the end of the fibula. In the Chick the process is short, but in *Opisthocomus*, as in the Ostrich, it is long. In my 1st stage (Pl. X. fig. 10) the tibiale and the fibulare are confluent; the outer condyle is formed by the latter. The rest of the ascending process, which is almost four times as long as the interspace between the two condyles, has become partly confluent with the antero-superior face of the fibulare; a notch marks its line of junction. A little above the notch a small ectosteal sheath has already appeared—the "os intermedium;" above this the cartilage first enlarges and then becomes a narrow style, which lies in front of the tibia towards its outer side. The remaining cartilage, at the lower end of the tibia, which has the same depth as the distal tarsal mass, is still sharply separated from that mass. Postero-internally there is a crescentic cartilage (Pls. VII. & X. fig. 10, *c.*), the centrale or scaphoid, which is formed out of the interarticular plate; this forms the bone which was supposed to be the os calcis. Below the joint the distal tarsal mass ($d.t.^{2-4}$) is cupped right and left to receive the condyles, but sends upwards in the middle an intercondyloid knob; its lower surface fits to the flattened tops of the second, third, and fourth metatarsals, which are not ossified above. A rudiment of a fifth metatarsal did exist on its outer side; the aborted first metatarsal is placed distally; it has also begun to ossify. In the relation of the distal tarsal mass to the three large and one abortive metatarsal segments, a single cartilage or "chondrite" may be the connate representative of several chondrites. In the third stage (Pl. X. fig. 11) the ankle-joint is considerably altered; the tibia has much less cartilage below; that is still, however, distinct from the proximal tarsal mass. Over the interspace between the two condyles there is now a cartilaginous tendon bridge (Pl. X. fig. 11, *t.br.*). The ascending process is relatively narrower in its lower half; its upper three fourths is entirely ossified by an ectostosis, like the tibia and fibula. The larger tibiale and the lesser fibulare have not yet appeared as bony centres; they commence two or three weeks after the intermedium, and are formed as central endostoses, like the bony matter in the lower tarsal mass. This anachronism as to the ossifications of these three parts is very remarkable, and the type of ossification is entirely different; the intermedium is a shaft-bone, whilst the tibiale and fibulare, as in tarsals and carpals generally, are ossified like epiphyses.

The toes at the 1st stage (Pl. VII., *dg.*$^{1-4}$) are already developed; the second is a little shorter and also stouter than the fourth; the third is very long, but its proximal and distal phalanges are smaller than those of the first toe or hallux; the size of this heel is very remarkable. The ossification of the ungual phalanges is at the end and not in the middle, as in the others. The so-called ascending process of the tibiale requires an ontological explanation; its ossification, I am quite satisfied, is an intermedium; and this, I take it, is not a tarsal, but belongs to the leg, as the intermedium in the wing does to the forearm.

The intermedium, in the generalized fore-paddle of certain extinct Reptiles, is seen to reach up to the humerus, between the radius and ulna (see Marsh on "Sauranodon," Amer. Journ. of Sci. vol. xix., Feb. 1880, p. 170, fig. 1; and D'Arcy W. Thompson, Journ. of Anat. & Phys. vol. xx. pp. 1–4). Even in Birds, and those of the higher sort, I find, in some cases, the wedge of the intermedio-radiale, which grows upwards between the radius and ulna, elongated and segmented off, as in the nestling of *Spizella pusilla*, and in another species of *Spizella* I found the apex, representing the intermedium, separately ossified from the radiale.

In *Opisthocomus*, as we have seen, and in some other birds, the intermedium of the carpus is, for a short time, separate. We cannot derive the Bird from any known Reptilian or Amphibian type; the true ancestor of the Feathered Fowl did not possess a cheiropterygium, but its limbs were ichthyopterygia; and the same may be said of the existing Amphibia, all known Reptiles, and the Mammalia also [1]. In the adult *Opisthocomus* the hind limb is stout and strong, like that of a Gallinaceous bird. The femur is well arched; the tarso-tibia also is normal; its cnemial outgrowth is not large; there is the usual tendon bridge below, and a shallow intercondyloid space for the short process of the tarso-metatarsus. The fibula is half the length of the tibia; the centrale forms a notable pseudo-sesamoid. The tarso-metatarsus has a strong grooved process behind its head, which was pre-formed in cartilage developing posterior vertical ridges to serve as pulleys for the flexor tendons. There is only one hole in this mass (Huxley, *op. cit.* p. 309, fig. 12), as in *Corythaix*, and also in *Crax*, and in the Gallinaceæ generally. This hole is finished by a periosteal

[1] The marvellous series of extinct Reptiles discovered in stratum under stratum has emboldened some biologists in the matter of ancestry. Guesswork, however, is not science; and we have no proof that certain archaic forms begat others that are of a more recent date: we "have nothing to draw with, and the well is deep."

plaster. There is a small hole between the middle and inner metatarsals near the top. The lower condyles of the shank agree very closely with those of *Crax*, but the tarso-metatarsus differs from that of the Curassow in its flatness, from side to side, and in the degree of concavity of the anterior outline. The condyle for the fourth digit is quite Cracine, being somewhat grooved, and having an outer process, which reaches a considerable distance backwards. In *Corythaix* this condyle is slightly grooved, but the inner half is larger, and that bird has a mobile outer toe. There is very little difference, in *Opisthocomus*, between the proximal and penultimate phalanges. The hallux, or first digit, is larger than in the Megapodidæ and Cracidæ, and its claw is the largest of the four, as I have shown in the 1st stage (Pl. VII., *dg.*[1]); thus the foot of this bird is truly Insessorial; it is more of a Percher than its nearest relatives, the Curassows.

IX. Recapitulation and Summary.

a. *The Ornithological Position of* Opisthocomus.

The existing Carinate birds are extremely hard to classify; we are embarrassed with the riches of this great Avifauna; but there is one clue that can be used, namely that the fewer there are in any family the more archaic that family is, and *vice versâ*. The Ratitæ have *acquired* their distinguishing character; it is evidently not primary. The Tinamous and the Hoatzin are, in many respects, as archaic as the Ratitæ; in some more so. If the term Dromæomorphæ is to be retained, let it take in the Ratitæ and the Tinamidæ. Next to that group would be the Alectoromorphæ, and the lowest of these would be *Opisthocomus*—the Opisthocomidæ; the highest the Columbidæ: that group would also take in the Pteroclidæ, which lie under the Pigeons.

Here, also, between the Tinamous and the Quails, would be placed the Turnicidæ (not to be called Turnicomorphæ—that term is too general). Then, on the other side of the class, the Cypselomorphæ and the Psittacomorphæ should be melted into the common mass with the rest of the Coccygomorphæ; we should thus get an Order to compare with the Coracomorphæ, as variable as that Order is uniform. Ornithologists must understand that terms taken from the anatomical structure of birds are not ornithological; they are morphological terms, which the Ornithologist uses for taxonomic purposes. Sometimes they are of very little value; at other times they can be applied to large assemblages of birds. Thus Prof. Huxley's term Ægithognathæ is of great value; the only Family outside the great Passerine group (Coracomorphæ) which has that peculiar modification of an open or schizognathous palate is the Cypselidæ. Thus the morphological term Ægithognathæ can be nearly superimposed upon the ornithological term Coracomorphæ. But the term Desmognathæ has no such wide use, nor the term (one of my own coining) Saurognathæ; the Toucans are Desmognathæ, the Woodpeckers are Saurognathæ; yet these two groups are closely related. In the present state of our knowledge Taxonomy is a very tentative science; it is only a sort of rough scaffolding, and not a Temple of Nature; moreover, each ornithological artisan will use his own classification, and that of no one else; thus there are as many systems as there are Ornithologists. We see this most instructively in the case of that most skilful worker, whose classification I have just reviewed. In his Coracomorphæ six thousand species are fagoted together; his Heteromorphæ contains only one species—*Opisthocomus cristatus.* It is true, however, that this bird differs more from any other existing type than any, the most diverging, do amongst the whole multitude of Passerines. Again, by choosing those characters in the members of two distant Families that agree, and forgetting those in which they differ, it is not difficult to make a "happy family" out of very discordant members. If we are desiring to use a comprehensive term, well and good; but the binder round such a group should be made of an elastic withy, and not of cast iron. Now in Prof. Huxley's Cecomorphæ (*op. cit.* pp. 457, 458), the Gulls, Petrels, and Auks are put together; but the Penguins are left out, and the term Spheniscomorphæ merely means the same as Spheniscidæ. But the Great Auk was a very accurate isomorph of a Penguin. The extinct toothed birds, *Hesperornis* and *Ichthyornis*, have to be packed together inside this Cecomorphous bundle; for the former is the quasi-parental form of the Grebes and Loons, and the latter is the Gull of an old dispensation. The problem is rendered more difficult by the fact that the Grebes, Loons, and Petrels, like the ancient *Hesperornis*, have the newest form of avian vertebral articulation. Their cervical and dorsal vertebræ are cylindroidal or heteromorphous; whilst the dorsals in Gulls and the Alcidæ are opisthocœlous. In the Gulls, most instructively, there is a partial retention of the amphicœlous condition, which is seen in the presacrals, generally, of *Ichthyornis.* Now as to *Opisthocomus*, I would drop its group term Heteromorphæ, and yet hold on to the spirit of that term, whilst I discard the letter. This bird, an archaic Fowl, or Gallinaceous type, differs from the Gallinaceous birds of its own Neotropical Territory, namely the Cracidæ, as much as the most Passerine of the Coccygomorphæ do from their nearest allies in the great Passerine group. This bird, like the Tinamous, belongs to the same general stratum of old forms as the Ratitæ; but it has not, nor have the Tinamous, lost the sternal keel, nor the size and strength of the wings.

Its isolation suggests at once its ancientness; its morphology, which throws some light on its ontogeny, teaches the same thing. Like the Tinamou, it is an arrested type; the Ratitæ are both an arrested and a degraded group. I suspect that the earliest birds were Carinatæ.

b. *The Light cast upon the Ontogeny of Birds by the Morphology of* Opisthocomus.

In the skull of *Opisthocomus* we have the fundamental form of that of a Carinate bird; it has undergone that remarkable change by which the upper face can be moved upon the frontal region. In this it is above the Struthionidæ, which, like Reptiles, have no such hinge. Its basipterygoids, although they die out, are truly Struthious. The hyoid arch is not only essentially the same as that of *Hatteria*, but the descending bar of cartilage, which is aborted in the middle in all birds, is in it unusually large and shows signs of secular shortening by its folded or puckered condition. The vertebral chain has the same development as in Gallinaceous birds generally; its dorsals are cylindroidal, but so also are those of the Tinamou, the Ratitæ, and, as I have just mentioned, *Hesperornis*, a bird so long extinct; hence it is evident that this peculiarly avian structure is extremely ancient. The appendages of the ribs are not typical; they, however, are well seen in *Hatteria* and, to some degree, in the Crocodiles, whilst they are absent in *Chauna*—an archaic Chenomorph.

Those parts of the body which, becoming transformed for the purposes of flight, dominate all the rest of the organism—the sternum, shoulder-girdle, and wings—are, in this bird, so very instructive as to make it very precious to the Morphologist: in this it has no peer.

The sternum, in the backward position of its small keel and the feeble development of the postcostal or metasternal region, is an intermediate structure between that of a Bird and that of a Lizard. So also is the shoulder-girdle in all its parts and relations; besides which the scapula is developed in the same manner as in the Frogs and Toads. The wings in the embryonic stage not only have the claws of the first and second digits nearly as large as in the foot, but there is, as in the Ostrich and Rhea, a rudimentary unguis on the third half-aborted digit, and a phalangeal remnant of a fourth digit; a metacarpal remnant is seen in the Fowl and several other birds. The carpus, as in a few other birds, is, for a time, divided into at least seven segments, and is then essentially like that of an Amphibian or a Chelonian.

For a time the pubis strives to attain to an Ornithoscelidan length; after the middle of incubation it acquires its proper relative avian length. But the history was taken up at its middle—at the middle, actually, of incubation; it is, however, in the still earlier stages that the ontogeny of this Class is seen most clearly; those earlier stages have had to be worked out in less archaic types. The true *Archæopteryx* is lost in the almost infinite past; the "so-called *Archæopteryx*" is very doubtful as a parental form. It does, however, help us to imagine how the vertebral internodes became aborted and partly suppressed, so that a feather-shaped tail became fan-shaped, the rectrices being set in a semicircle instead of growing out of the sides of a long Reptilian tail. We have, however, nothing intermediate between these two types of tail even in the Cretaceous birds. Something of the same sort has occurred in the limbs. If the limbs of *Ceratodus* may be taken as a pattern of an ichthyopterygium there has been a secular shortening of some, and suppression of other, axial parts or internodes: thus we get the shortened radiating fan-shaped limb—the proper cheiropterygium; that, in turn, had to be transformed into the avian fore limb or wing.

X. *List of Abbreviations used in the Letterpress and Plates.*

(The Roman Numerals indicate nerves and their foramina.)

ac. Acetabulum.
ac.p. Acromial process.
ag. Angulare.
al.e. Aliethmoid.
al.n. Alinasal.
al.s. Alisphenoid.
al.sp. Aliseptal.
ao. Antorbital.
ar. Articulare.
a.s.c. Anterior semicircular canal.
at. Atlas.
a.t.r. Anterior tympanic recess.
au. Auditory capsule.
ax. Axis.
b.h.br. Basihyobranchial.
b.hy. Basihyal.
b.o. Basioccipital.
b.s. Basisphenoid.
b.t. Basitemporal.
c. Centrale.
c.a. Costal appendage.
c.br. Ceratobranchial.
cd.v. Caudal vertebræ.
c.f.c. Craniofacial cleft.
c.hy. Ceratohyal.
cl. Clavicle.
cm. Centrum.
cn.p. Cnemial process.
cr. Coracoid.
c.r. Cervical rib.
cr.g. Crista galli.
c.u. Centralo-ulnare.
c.v. Cervical vertebræ.
d. Dentary.
d.c. Distal carpals.
dg. Digit.
ds.v. Dorso-sacral vertebræ.
d.v. Dorsal vertebræ.
e.br. Epibranchial.
e.hy. Epihyal.
e.n. External nostril.
e.o. Exoccipital.
e.st. Extrastapedial.
eu. Eustachian opening.
f. Frontal and Femur.
fb. Fibula.
fbe. Fibulare.
f.m. Foramen magnum.
fr. Furcula.
g. Ganglion.
gl. Glenoid cavity.
h. Humerus.
h.s.c. Horizontal semicircular canal.
i. Intermedium.
i.a.c. Interarticular cartilage.
i.ag. Internal angular process.
i.c. Internal carotid.
ic. Intercentrum.
i.cl. Interclavicle.
il. Ilium.
i.o.f. Interorbital fenestra.
i.r. Intermedio-radiale.
isc. Ischium.
i.st. Infrastapedial.
i.tb. Inferior turbinal.
i.tr. Intertrabecula.
j. Jugal.
l. Lachrymal.
l.c. Lachrymal canal.
ls.v. Lumbo-sacral vertebræ.
mk. Meckel's cartilage.
m.st. Metasternum and Mediostapedial.

mc. Metacarpal.
mt. Metatarsal.
m.ty. Membrana tympani.
mx. Maxillary.
mx.p. Maxillo-palatine.
n. Nasal.
nc. Notochord.
n.px. Nasal process of premaxillary.
n.w. Nasal wall.
ob.f. Obturator fenestra.
oc.c. Occipital condyle.
op. Opisthotic.
p. Parietal.
pa. Palatine.
p.ag. Posterior angular process.
pa.s. Parasphenoid.
pb. Pubis.
p.cr. Precoracoid.
pc.p. Precostal process.
p.e. Perpendicular ethmoid.
pg. Pterygoid.
pn. Prenasal.
p.px. Prepollex.
pr.i. Pre-ilium.
pr.o. Prootic.
p.s. Presphenoid.
p.s.c. Posterior semicircular canal.
pt.i. Post-ilium.
px. Premaxillary.
py. Pituitary space.
q. Quadrate.
q.j. Quadrato-jugal.
r. Radius.
r.b.s. Rostrum of basisphenoid.
re. Radiale.
r.st. Rostral process of sternum.
s.ag. Supra-angulare.
sc. Scapula.
s.i.f. Sacro-ischiatic fenestra.
s.n. Septum nasi.
s.o. Supraoccipital.
sp. Splenial.
sq. Squamosal.
s.r. Sacral rib.
s.sc. Suprascapula.
s.st. Suprastapedial.
st. Stapes and Sternum.
st.k. Sternal keel.
st.r. Sternal ribs.
s.v. Sacral vertebra.
t. Tibia.
te. Tibiale.
t.br. Tendon bridge.
t.eo. Tympanic wing of exoccipital.
ty. Tympanic cavity.
u. Ulna.
ue. Ulnare.
up. Uropygium.
us.v. Uro-sacral vertebræ.
v. Vomer.
vb. Vestibule.
v.r. Vertebral rib.

XI. DESCRIPTION OF THE PLATES.

PLATE VII.

Opisthocomus cristatus (1st Stage): skeleton, side view, $\times 4\frac{1}{2}$ diam.

PLATE VIII.

Fig. 1.	The same	(1st Stage):	skull, lower view, × 6 diam.
Fig. 2.	,,	(3rd Stage):	skull, section, × $4\frac{1}{2}$ diam.
Fig. 3.	,,	,,	hyoid arch, upper view, × $4\frac{1}{2}$ diam.
Fig. 4.	,,	(2nd Stage):	nasal labyrinth, section, × 20 diam.
Fig. 5.	,,	,,	section of quadrate and stapes, outer view, × 15 diam.
Fig. 6.	,,	,,	stapes, inner view, × $22\frac{1}{2}$ diam.
Fig. 7.	,,	,,	section of cervical vertebræ, × 24 diam.

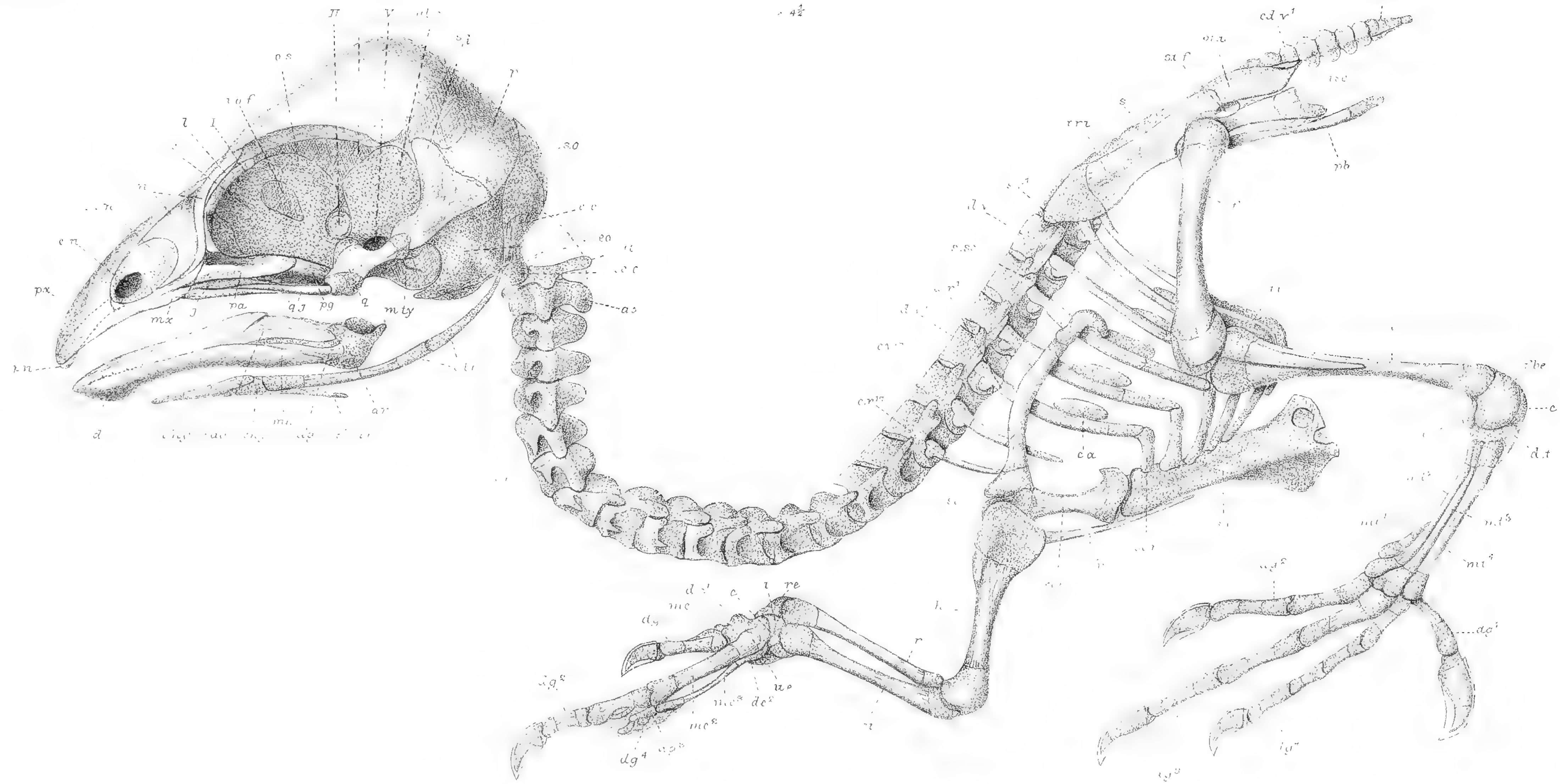
PLATE IX.

Fig. 1.	The same	(1st Stage):	shoulder-girdle and sternum, lower view, × 6 diam.
Fig. 2.	,,	,,	part of shoulder-girdle and sternum, upper view, × 9 diam.
Fig. 3.	,,	,,	furcula, lower view, × 9 diam.
Fig. 4.	,,	,,	pelvis, lower view, × 6 diam.
Fig. 5.	,,	,,	pelvis, upper view, × 6 diam.
Fig. 6.	,,	(3rd Stage):	part of pelvis, lower view, × $7\frac{1}{2}$ diam.

PLATE X.

Fig. 1.	The same	(1st Stage):	manus, outer view, × 9 diam.
Fig. 2.	,,	,,	part of manus, inner view, × 9 diam.
Fig. 3.	,,	,,	part of Fig. 2, × 27 diam.
Fig. 4.	,,	(2nd Stage):	part of pollex, outer view, × 12 diam.
Fig. 5.	,,	,,	second to fourth digits (part), × 12 diam.
Fig. 6.	,,	(3rd Stage):	manus, outer view, × 6 diam.
Fig. 7.	,,	,,	part of same object, inner view, × 6 diam.
Fig. 8.	,,	(Adult):	manus, outer view, × $1\frac{1}{2}$ diam.
Fig. 9.	,,	,,	manus, inner view, × $1\frac{1}{2}$ diam.
Fig. 10.	,,	(1st Stage):	ankle-joint, front view, × 12 diam.
Fig. 11.	,,	(3rd Stage):	ankle-joint, front view, × 6 diam.

[This memoir was not set up in type until after the Author's decease, which took place July 3rd, 1890, nor had the Plates been lettered at that date. It has consequently been a difficult task to correct the proofs, and I have to thank Mr. W. N. Parker and Mr. F. E. Beddard for very material assistance in this matter.—P. L. S., Jan. 12th, 1891.]

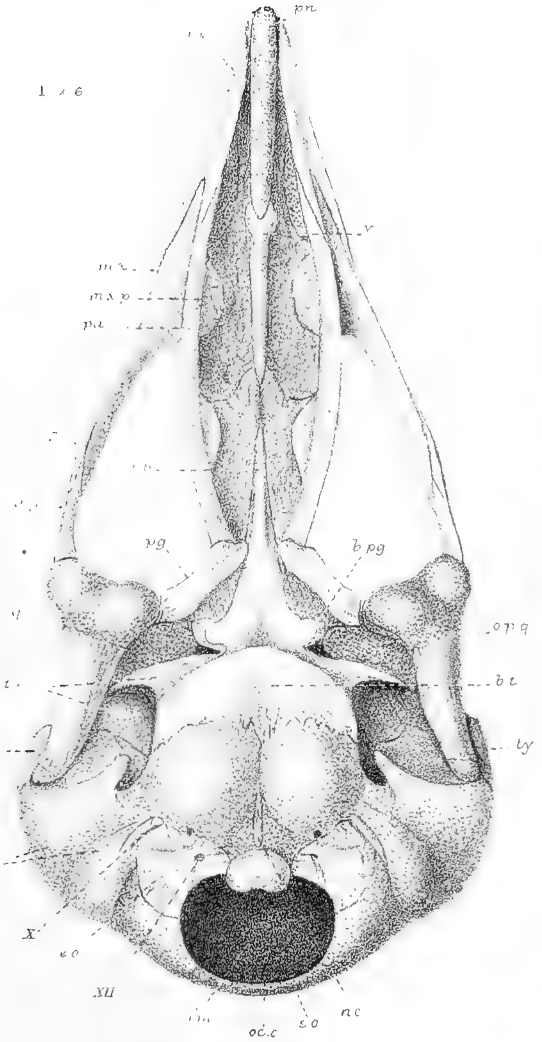


W.K. Parker del.
M.P. Parker lith.

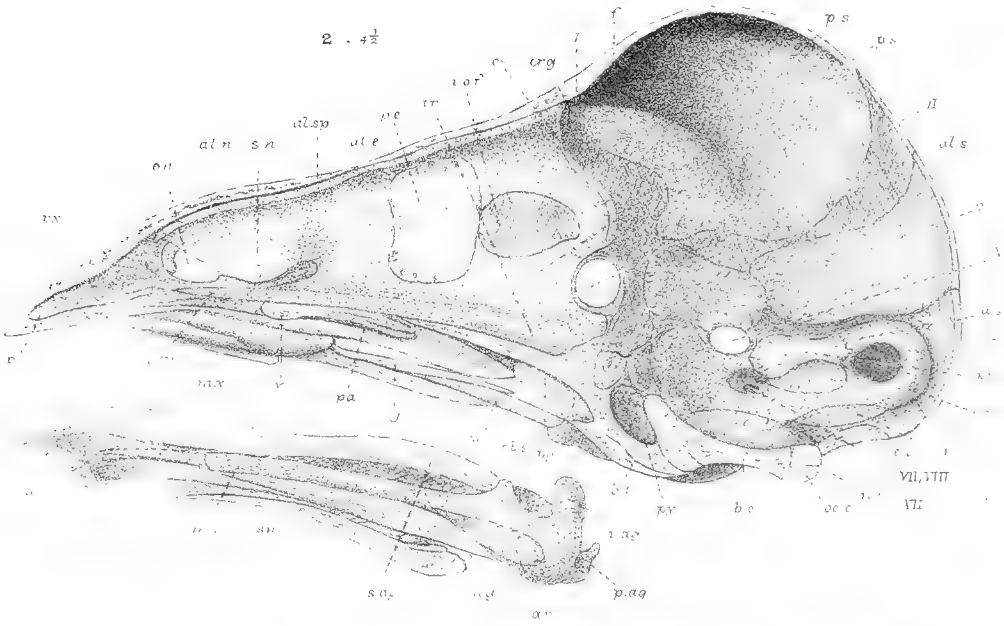
West, Newman imp.

MORPHOLOGY OF OPISTHOCOMUS.

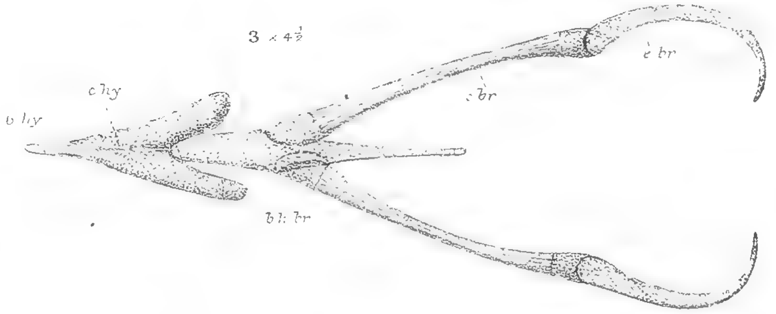
1 × 6



2 × 4½

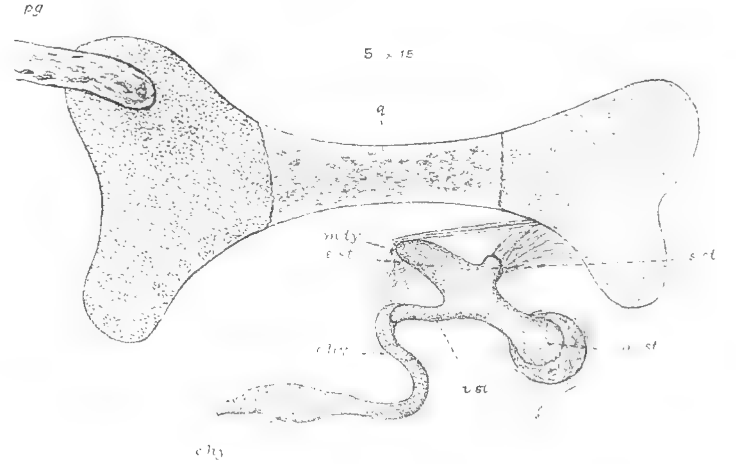


3 × 4½

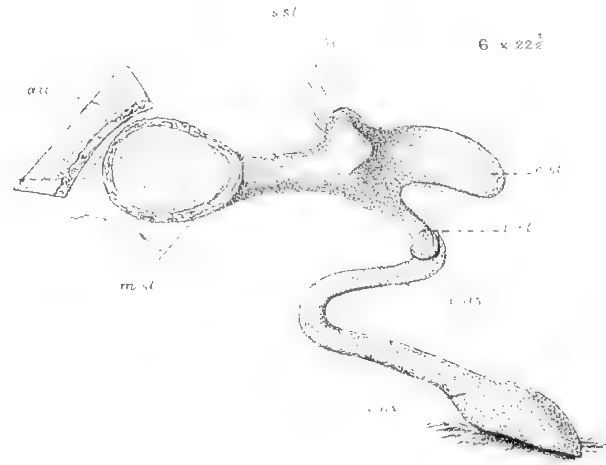


4 × 20

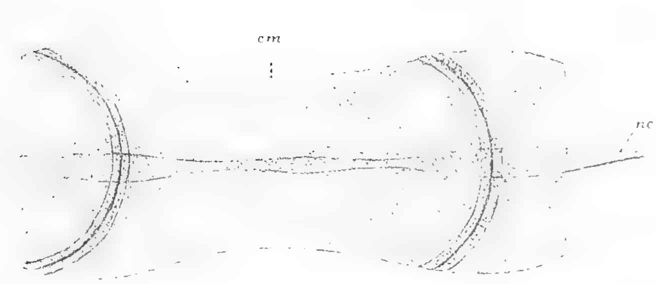
5 × 15

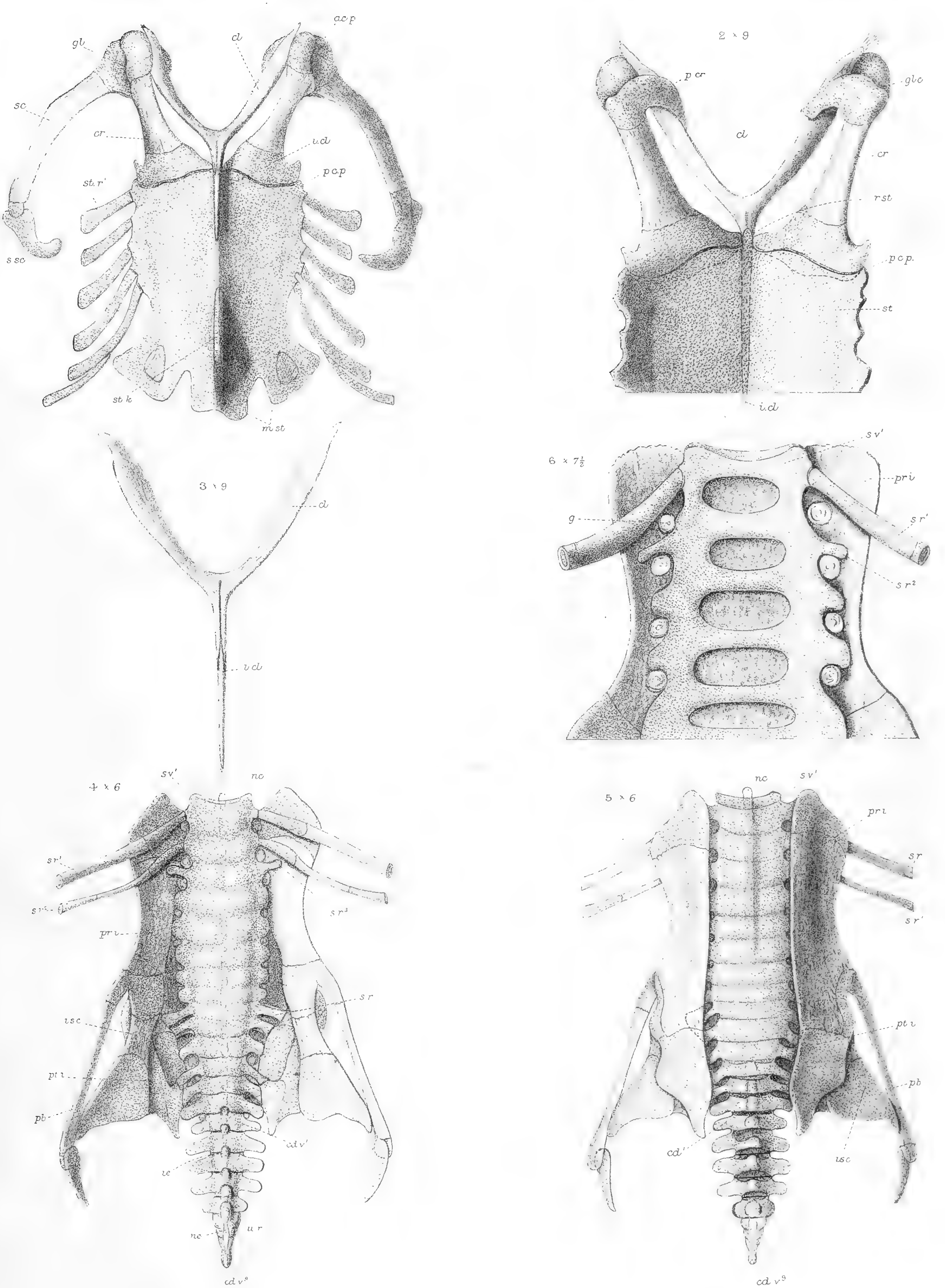


6 × 22½



7 × 24

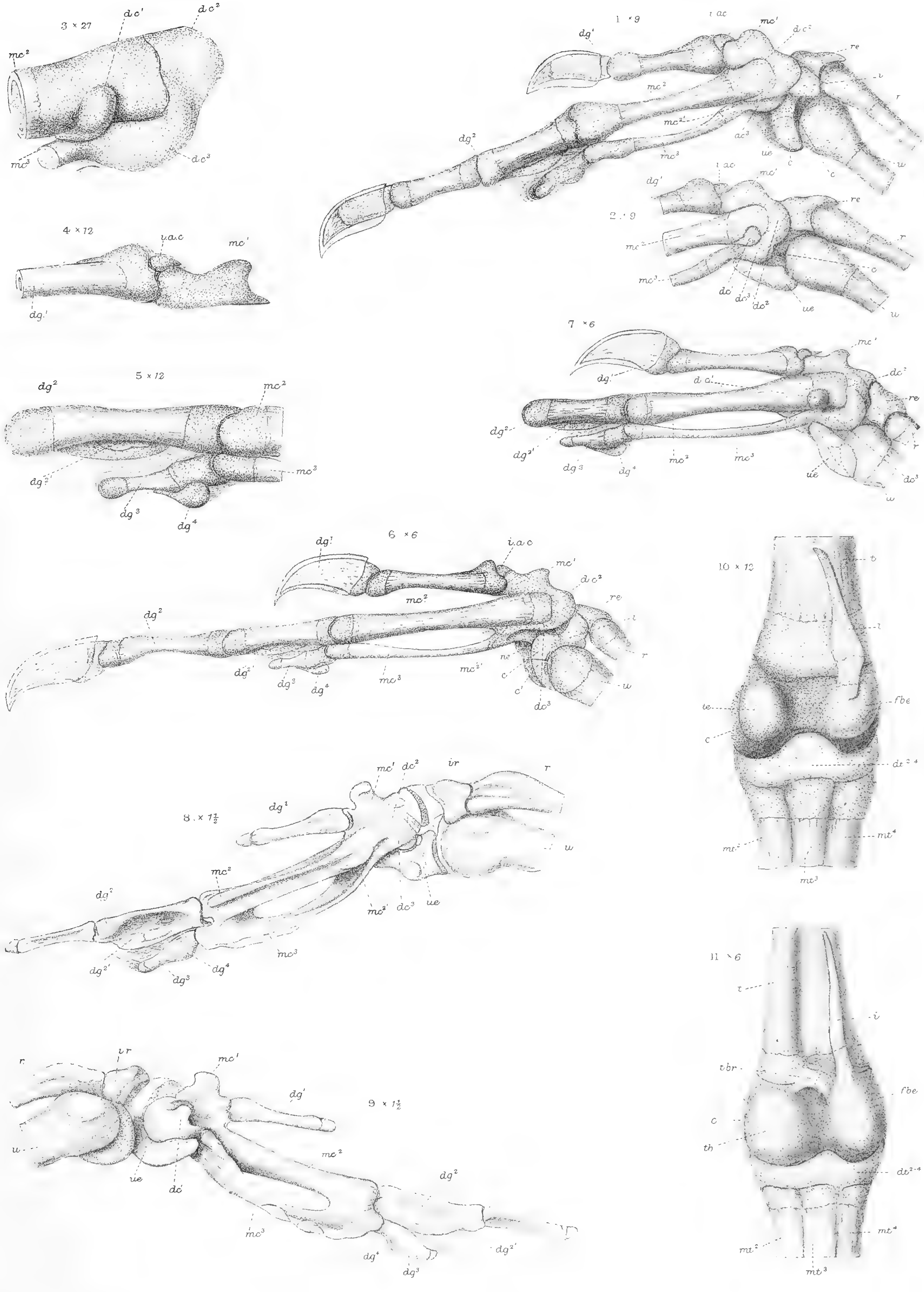




W.K.P. del. ad. nat.
M.P. Parker, lith.

MORPHOLOGY OF OPISTHOCOMUS.

West, Newman imp.



W.K.P. del. ad nat.
M.P. Parker, lith.

MORPHOLOGY OF OPISTHOCOMUS.

West, Newman, imp.

IV. *Contributions to our Knowledge of the Antipatharian Corals.* By F. Jeffrey Bell, *M.A., Sec.R.M.S., Corr. Mem. Linn. Soc. N.S.W., F.Z.S., Professor of Comparative Anatomy and Zoology in King's College, London.*

Received April 11th, read May 6th, 1890.

[Plates XI. & XII.]

I. *Observations on a particularly fine example of the "Black Coral" of the Mediterranean lately acquired by the Trustees of the British Museum.*

The Trustees of the British Museum have lately purchased from Messrs. Cresswell, the well-known importers of Sponges, a very remarkable example of one of the best-known of the products of the Mediterranean. Common enough as pieces of the "black coral" of the Mediterranean are, and elaborate as were the classical researches made on it by the eminent French naturalist, H. de Lacaze-Duthiers [1], the size and beauty of the specimen herewith figured are sufficient to justify me in offering the Society some account of its history and appearance. I have sent photographs [2] of it to various naturalists and curators of museums, and I have been favoured by Dr. v. Marenzeller, of the Museum in Vienna, with the following remarks:—"I have never seen such a splendid specimen. Our Museum possesses an example from the Adriatic nearly as high, but not so densely branched. There are also very large trunks without branches. Your example is indeed what we call 'Cabinetstück ersten Ranges.'"

Dr. F. Bernard, of the Muséum d'Histoire Naturelle of Paris, has favoured me with the following notes on the specimen, which, in the second edition of Lamarck's 'Animaux sans Vertèbres' (t. ii. p. 491), is said to be "un échantillon gigantesque.... dont le tronc égale la grosseur du bras"—:"Il a 63 centim. seulement de hauteur; il est en effet réduit à ses grosses branches; tous les rameaux plus petits ont été brisés. Le tronc mesure 12 centim. environ de large sur 8 du profondeur."

Our President, who has lately visited many of the larger museums of the Continent, assures me that nowhere has he seen a specimen which can vie with that which has lately been acquired for the nation.

Mr. Cresswell tells me that the specimen which he sold us was dredged by sponge-

[1] Ann. Sci. Nat. (Zool.) (5) ii. p. 169.

[2] These were taken for me, with great kindness, by my accomplished colleague Mr. Antony Gepp, M.A., of the Department of Botany.

fishers, in some 20 fathoms of water, not far from the Island of Negropont. The size of the boat and the appliances it contained were doubtless well adapted even for the magnificent sponges which those fishers obtain, but it was not sufficient to carry a specimen more than 6 feet high and more than 6 feet wide. To these unfortunate limitations of strength and space are due the fact that the base of the specimen had to be cleft in twain, so that part of the brittle base was lost. No other serious accident befell the specimen, though tact and diplomacy were needed to effect its removal. It is now in process of being skilfully mounted, and will, no doubt, be for many years one of the most noticeable features in the Zoological Galleries of the Museum.

Description of the Specimen, with measurements.

As will be immediately seen from the figure (Plate XI.), the great beauty of this example lies in the density of the reticulation. The base is convex with a sharp edge, where it is uninjured, and spreads over an area of 350 by 200 millim.; from it at once arise two great trunks, the larger and finer of which gives rise to a fan which is almost 2 metres high (6 ft. 6 in.), while it is more than 2 metres wide (6 ft. $8\frac{1}{2}$ in.); the smaller fan is 1·425 metre (4 ft. 8 in.) high, and is 1·280 metre broad (4 ft. $2\frac{1}{2}$ in.). The main trunk of the former is 425 millim. (1 ft. 5 in.) in circumference, and that of the latter is about 290 millim. ($11\frac{1}{2}$ in.).

This last trunk rises some 100 millim. and then divides into two branches, one of which, that on the left, as seen in the figure, is more than twice as wide as the other; it again rises some 100 millim. before dividing, and then gives off several branches; the one most to the right begins almost at once to enter into intimate reticular connection with the original right trunk; the next does not do so for some distance from the point of origin, and still further off it becomes connected with its neighbour. It is only quite at the top of the whole of this smaller fan that this second trunk to the right becomes connected with the branches given off to the left; but somewhat lower down there are distinct signs of a fracture and loss of pieces which might have well effected a more extensive reticular connection.

Of the trunks which I speak of as being given off to the left four belong distinctly to the left side, and one is almost median in its position; the four laterals almost immediately become connected with one another, and three of them fuse to form a stem 150 millim. in circumference; this rises almost parallel to the more median trunk, with which it enters into close connection. From the middle of the reticulation between them another trunk arises, which effects unions with the continuations of the stems both to the right and to the left of it. To the left, and in a plane more remote from the observer (who may be supposed to be standing in front of the whole colony), a large trunk rises up, soon swelling into a considerable enlargement. Thus, joining their neighbours here, bending forward there, or sidewards, now outwards, then inwards, the stems pass on, getting steadily, if slowly, more and more slender; sometimes the reticulating bands are stout, short, and frequent; sometimes a considerable space is bridged over by a much more delicate bar.

The fan behind is of greater beauty than the more stunted and more injured branch that lies in front of it, but it is needless to enter into the details. It divides into three main branches, one of which occupies the left, and the other two the right halves of the fan; this mass, being more complete than that in front of it, is much more beautiful, far more beautiful than any description of mine would lead the student to suppose; the imagination may well allow itself to revel in the idea of the vision of beauty that must have presented itself when this magnificent fan was covered by the living matter which formed it, when the polyps with their expanded tentacles were drawing on the nourishment around for the means to sustain and increase it.

On the hinder fan there are to be seen outgrowths from stems of various sizes which did not take any share in the formation of the network; these may be merely sessile knobs, or they may be as much as 60 millim. long, but the free end is always converted into a rounded head.

Saving only the information which the specimen gives us as to the size and beauty to which the "black coral" may grow, it adds nothing to our knowledge of the morphology of the species, but this has already been studied. When, however, we reflect on the delight which an object of such beauty can give us, we may congratulate ourselves on the good fortune of the Trustees in securing it.

On the Name to be applied to the "Black Coral" of the Mediterranean.

I must pass from this poor attempt to express to others the feelings that the sight of this object arouses in me, to the more prosaic and infinitely less agreeable question as to the generic and specific names which this species should bear.

Prof. Lacaze-Duthiers has already [1] pointed out that it has received more than one "scientific name" from having been described by different authors in different degrees of perfection; on these there is no need to dilate, as the question was, to a certain extent, settled by the eminent zoologist to whom I have referred, and there may be said to have been a universal acceptation of the name he applied to it, *Gerardia lamarcki*, Haime. Yet more recently we have been again made familiar with the generic name by the same zoologist's beautiful investigations into the history of the crustacean parasite which he has called *Laura gerardiæ* [2].

Mr. Brook, in his valuable report on the Antipatharia collected during the voyage of H.M.S. 'Challenger,' uses the generic name *Savaglia*.

[1] Ann. Sci. Nat. (Zool.) (5) ii. (1864) p. 173.

[2] Mémoires de l'Acad. des Sciences de l'Institut de France, xlii. (1883) no. 2, p. 4.

It has been a matter of some trouble to trace the history of the name *Savaglia*[1]. The first reference which I can find to it is in the "Dell' historia naturale di Ferrante Imperato"[2], published at Naples in 1599; on p. 724 of which we read, "Savaglia. La Savaglia è pianta nel ramiggiare, e l'effigie tutta simile à Corallo," &c.; these words are repeated on p. 632 of the edition of 1672, which was published at Venice. Nearly a century later (in 1755) there were published the "Opere postume" of Giuseppe Ginanni, who takes (p. 17) *Savaglia* as his type of "quelle Pianze dell' Adriatico, che sono di sostanza legnosa senza foglie." Eleven years later Pallas writes in his notes to *Gorgonia Antipathes*—"Quæ cum Corallio nigro vulgo confunditur et a multis auctoribus pro vero descripta fuit, *Savalia* Maris Mediterranei, truncus magnorum Ventilabrorum, detritis ramis, politus esse solit" ('Elenchus Zoophytorum,' pp. 194 & 195).

Up to this time it is clear that the term had no definite generic or specific significance in the Linnean sense. But some years later (in 1819) A. Bertolini published his 'Amœnitates Italicæ,' and gave an account of *Savaglia*, for which he makes a definite zoological position by calling it *Gorgonia savaglia*. In 1844 Nardo, in the 'Atti della quinta Unione degli Scienziati italiani,' published (p. 433) a classification of Zoophytes, wherein the portion which interests us runs thus:—

Fam. IVª. ANTIPATIDI.
Sotto famiglia Iª ANTIPATINI.—Polipi a sei tentacoli.
Gen. *Anthipathes,* Pall. Gen. *Cirripathes,* Blainv.
S. f. IIª SAVALINI.—Polipi a sedici tentacoli.
Gen. *Savalia* N.

The new genus is for the *Gorgonia savoglia* [sic] (Bertolini). Nardo does not write out the full name or names of the species to be placed in this new genus, but it is clear that had he done so he would have then written *Savaglia savaglia* [or *Savalia savalia*]. This use of a specific for a generic name has been forbidden by the rules of the British Association.

Meanwhile this species had become famous by the researches of Lacaze-Duthiers, who, conferring on it (in 1864) the generic name of *Gerardia*, retained for it the specific name of *lamarcki* given it by Haime (in 1849) when he called it *Leiopathes lamarcki.*

Mr. George Brook, in his recently (1889) published 'Challenger' Report, which adds so much to our knowledge of the obscure group of Antipatharia, seems to have suffered from incomplete bibliographical information, for he writes:—"I have not seen the original, and do not know if Nardo gave the species a specific as well as a generic

[1] The word is not in any Italian dictionary that I have been able to consult, and my learned colleagues in the Printed Book Department have been unable to throw any light on the origin of the word. Count Salvadori does not know the word, and his learned friend Prof. Lessona is unable to throw any light on its history.

[2] I was not assisted in my search by Nardo's exquisite misprint of "Ferravite Traparuto;" but I was greatly aided by the bibliographical knowledge of Mr. Carruthers, F.R.S., on whose patience I made severe demands.

name; there is no mention of one in his recent publication. I have, therefore, retained the specific name of Haime."

It is clear that there is no escape from the conclusion that the proper specific name of this Coral is *savalia*, and the generic *Gerardia*, and the synonymy will stand thus:—

Family GERARDIIDÆ, Verrill, Trans. Connectic. Acad. i. p. 499.

Savagliidæ, G. Brook, Chall. Rep. Antipath. 1889, p. 79.

Savalini (subfamily), Nardo, Atti 5ª Union. Scienz. Ital. (1844) p. 433.

Genus GERARDIA.

Gerardia, Lacaze-Duthiers, Ann. Sci. Nat. (Zool.) (5) ii. 1864, p. 175.

Savaglia, Nardo, loc. cit.

Savaglia, id. Atti R. Ist. Veneto, (v.) iii. 1876, p. 674; Brook, loc. cit.

Gorgonia (pars), *Antipathes* (pars), *Leiopathes* (pars), auctor. complur.

Species GERARDIA SAVALIA.

Gorgonia savaglia, Bertolini, Amœn. Ital. (1819) p. 219.

Leiopathes lamarcki, Haime, Ann. Sci. Nat. (Zool.) (3) xii. (1849) p. 225; M.-E. & H. Hist. Nat. Corall. i. p. 322.

Gerardia lamarcki, Lacaze-Duthiers, loc. cit. (1864).

Savaglia lamarcki, Brook, op. cit. p. 80 (1889).

II. *On a remarkable Antipathid from the neighbourhood of Mauritius.*

Shortly after the arrival of the beautiful specimen just described, M. de Robillard forwarded to us a very remarkable Antipathid from the neighbourhood of the island of Mauritius. As the specimen is dry it is impossible to assign it definitely to any one of the genera now strictly limited by Mr. Brook; and, like some other Antipathids, it may, following that naturalist's proposal, be called [*Antipathes*]. As it is proposed to exhibit this example, which I am fairly confident is at present unique, it is necessary to give it a name, and to publish such a description and figure of it as shall enable it to be recognized.

M. de Robillard has forwarded, during the last few years, many fine examples of Anthozoa to the British Museum, and I am glad to have this opportunity of commemorating his services by associating his name with this remarkable growth.

Description of [Antipathes] robillardi. (Plate XII.)

From a small horny base there arise abruptly several trunks; these soon divide and give rise to a number of greatly elongated stems; some of these are, henceforward, simple; others divide at once two or three times, and others do not divide till they are some slight height from the base. In the case of one stem only is there any division at a distance greater than 7·5 centim. from the base. The result of this mode of growth is an appearance quite different from that of most Antipathids.

The stems taper quite gradually, and are fairly flexible near the tip, though rather brittle at their base. Where a branch is given off from a stem it is nearly always given off a short distance only from the base, and is ordinarily set at a very wide angle. In a few cases the stems have, during growth, been diverted from their line of growth, and an angle or elbow is thus produced, or there is a more or less irregular curve in the course of the stem. The stems vary in length and thickness, and those that are thicker and longer appear to be older than those which are thinner and shorter.

Where the sclerenchyma is well preserved it has the appearance of being transversely striated, as its dark yellow colour is relieved by narrower and lighter bands; it is quite rough to the touch owing to the shagreen-like spinulation of its horny axis; the spines on this axis are blunt and very numerous (Plate XII. fig. 3).

There are about 45 of these stems, the longest of which are about 3 feet 3 inches (that is, almost exactly one metre) long; the shortest are about 15 inches, or rather less than 40 centim. long.

Hab. Mauritius.

It is to be hoped that the publication of this notice will lead to a fuller knowledge of this interesting form; for the present we must be content to know of its existence, but the attention of collectors should be called to it and every effort made to obtain examples preserved in spirit; from such specimens alone can we get the information which will enable us to assign a satisfactory systematic position to it, and justify us in speculating as to its origin and affinities.

DESCRIPTION OF THE PLATES.

PLATE XI.

Gerardia savalia; the size of the specimen figured may be estimated by the foot measure placed at the side of the Plate. The figure is a tracing of a photograph of the object, so that the relative proportions of the branches may be relied on.

PLATE XII.

[*Antipathes*] *robillardi.*

1. View of the skeleton of the whole colony, showing its general form, the relations of its stems, and the mode of branching; $\frac{1}{4}$ nat. size.

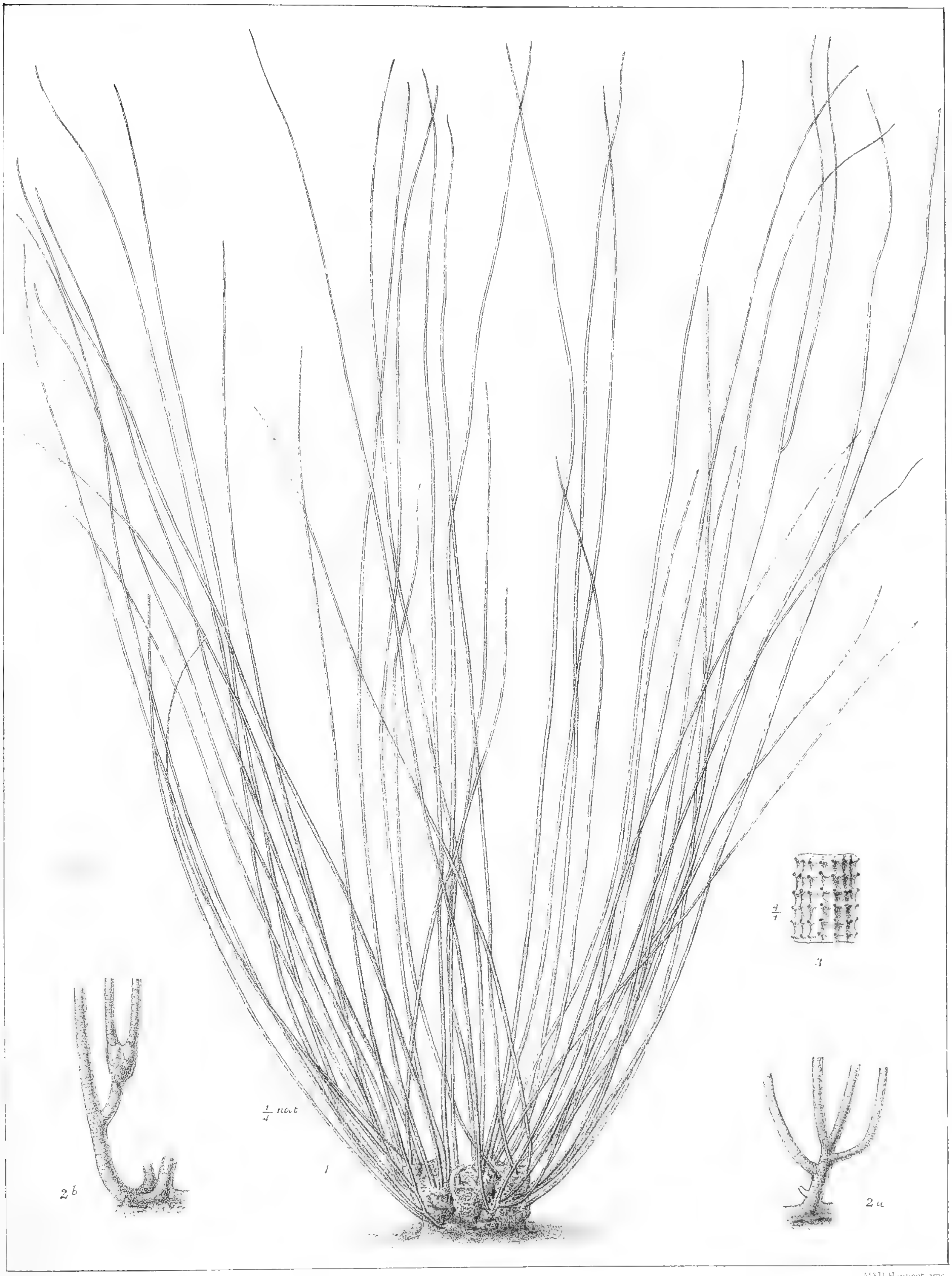
2^a, 2^b. Branches at base; nat. size.

3. Surface of stem, magnified four times, to show the character of its spinulation.

Berjeau & Highley del et lith

Hanhart imp

GERARDIA SAVALIA.



Berjeau & Highley del. et lith.

M&N Hanhart imp.

ANTIPATHES ROBILLARDI

V. *Catalogue of the Reptiles and Batrachians of Barbary* (*Morocco, Algeria, Tunisia*), *based chiefly upon the Notes and Collections made in* 1880–1884 *by* M. Fernand Lataste. *By* G. A. Boulenger.

Received October 2nd, 1890, read November 18th, 1890.

[Plates XIII.–XVIII.]

Introduction.

On his appointment to the posts of Professor of Zoology and Assistant-Director of the Museum in Santiago, Chili, in 1889, M. Lataste felt reluctantly compelled to abandon his projected Catalogue of the Reptiles and Batrachians of Barbary. He handed over to me the whole of his notes, with the request that I should bring out the work. The constant correspondence with my distinguished friend ever since he took up the study of that fauna, as well as my acquaintance with his collection, had prepared me for such a work; and knowing I could rely on his kind help in revising my MS., I thought it would not be presumptuous on my part to undertake the Catalogue which I have now the honour of offering for publication to the Society.

Accounts of his visits to Algeria and Tunisia have been given by M. Lataste in the introduction to his Catalogues of the Mammalia[1], to which I must refer for the detailed itinerary.

The first journey was undertaken in 1880, and lasted from the middle of February to the end of July. The environs of Algiers, Setif, El Guerah, Batna, Lambesa, and Biskra having been explored, an excursion was made in the south of the High Plateaux and far into the Sahara, which lasted from the middle of March to the end of May. The route followed was from Biskra to Wargla through Tuggurt, and back to Biskra through the Mzab, Laghouat, and Bou-Saada. From June 1st the following places were visited in succession:—Batna, Constantine and environs, Bona and environs, Philippeville, Setif, Chabet-el-Acra, Bougie and environs, Dellys, and Tizi-Ouzou and environs.

The second visit, from April 1st to June 20th, was chiefly devoted to the exploration of Kabylia and the region of the Hodna, after a stay of two weeks at Oran and two weeks at Algiers. The itinerary was from Algiers to Aumale, Beni-Mansour, Tilla-Rana, Fort National, Bougie, and thence south to Msila, Wed Magra, Barika, and Batna, and back to Algiers through Constantine, Setif, and Palestro.

[1] "Catalogue des Mammifères Apélagiques sauvages de Barbarie," Actes Soc. Linn. Bordeaux, xxxix. 1885.—Exploration Scientifique de la Tunisie. Catalogue critique des Mammifères Apélagiques sauvages. Paris, 1887.

As a member of the Official Scientific Mission, M. Lataste visited Tunisia in 1884, arriving at Tunis on the 1st April. The greater portion of his stay was spent on the Gulf of Cabes and the Island of Djerba (April 13th to May 25th). He then marched from Cabes, through Tozzer, Taferma, Gafsa, Feriana, and Tamesmida to Tebessa in Algeria (July 1st), whence he proceeded, by coach and rail, to Bona.

On the occasion of the meeting of the "Association Française" at Oran, in April 1888, M. Lataste paid a second visit to that place, again exploring its environs, and making an excursion to Aïn Sefra, on the frontiers of the Sahara and Morocco.

Besides the materials brought together by M. Lataste, the rich collection of the British Museum has afforded me much information, especially respecting Morocco. And I have to tender my best thanks to my friends Dr. O. Boettger, of Frankfort-on-the-Main, and Dr. F. Müller, of Basle, for loan or gift of additional material.

As to the scope of the present Catalogue. My object has been to give only so much description and synonymy (together with a reference to a good figure, when such exists) as is necessary to ensure correct identification of the species, and I hope the keys I have given will prove to work satisfactorily for that purpose. In a few cases I have had to enter into discussions on the value of certain characters, and for some little-known species I have inserted fuller descriptive notes; but the distribution in Barbary of the various forms has been dealt with as comprehensively as the data available at present permit.

I have accepted the geographical delimitation of this fauna as traced out by my friend in his Catalogue of Mammalia, and for the reasons, purely practical, which he has given in that work. For it goes without saying that the Sahara forms no part of Barbary in a zoo-geographical sense, whilst the exclusion of the Cyrenaica, which, as observed by Sir Lambert Playfair, must not be confounded with the Oases of the Sahara, but is an island detached from the eastern spurs of the Atlas in the ocean of the desert, is further justified from the fact that its herpetologicel fauna is still too imperfectly known[1].

Natural Divisions of Barbary.

The division of Algeria into three parallel zones, viz., the Tell, the High Plateaux, and the Sahara, is so familiar as hardly to require a definition. The *Tell* is the region which borders the Mediterranean, and includes the Lesser Atlas; its fauna is essentially

[1] A list of reptiles collected by G. Rhumer around Bengazi in the Cyrenaica, and named by Dr. Reichenow, was published in 1883 in the Sitzungsb. Ges. naturf. Freunde Berlin (p. 149). The following species are enumerated:—*Chamæleon vulgaris*, *Hemidactylus verruculatus* [=*turcicus*], *Agama savignyi*, *Lacerta muralis*, *Acanthodactylus boskianus*, *A. lineomaculatus*, *Gongylus ocellatus*, *Zamenis florulentus*, *Coronella* (*Macroprotodon*) *brevis* [=*cucullata*, var.], *Naia haie*, *Bufo variabilis* [=*viridis*].

The record of *Lacerta muralis* is of especial interest; that of *Acanthodactylus lineomaculatus* may be due to confusion with *A. pardalis*; and the so-called *Agama savignyi* is probably *A. inermis*.

that of the borders of the Mediterranean, and differs but little from that of the Spanish and Italian peninsulas. The *Plateaux*, consisting mostly of nude steppes with a mean altitude of 2000–3000 feet, is the zone comprised between the Tell and the Sahara, and presents in its fauna a mingling of Northern and Southern forms. Geryville, Laghouat, and Biskra are exactly on the limit of the Plateaux and the Sahara. Towards Oran the Plateaux extend almost to the sea-coast. The *Sahara*, south of the Great Atlas, and extending uninterruptedly from the Atlantic Ocean to the valley of the Nile, has an altogether special fauna, only a few of the forms of the Tell (*Rana esculenta*, *Bufo viridis*, and *Tropidonotus viperinus*, for instance) extending into its northern portion. But this distinction applies only to Algeria; the Plateaux, which to the west are limited by the north-eastern ramifications of the Great Atlas of Morocco, form towards the east a wedge which culminates in the east of the Province of Constantine, so that in Tunisia the Tell passes directly into the Sahara, and we consequently obtain in Southern Tunisia a mingling of certain forms which in Algeria, separated as they are by the range of plateaux, are characteristic of either the one or the other district. The lofty Atlas of Morocco separates the Sahara from the plain of Morocco, which to the north and north-east passes into the Tell proper and is completely cut off from the Plateaux; this plain having a distinct fauna, deserves to be dealt with separately, and I propose to allude to it as the *Moroccan* district. Its fauna is still very imperfectly known, the only places at which herpetological collections have been made being Casablanca, Mogador, and the route from Mogador to Morocco. A few forms are known from the valley of Sous, but of the Great Atlas proper we know nothing. Hooker and Ball, remarking on the scarcity of animal life as a characteristic feature of the Great Atlas, state that "of the numerous Reptiles that abound about the skirts of the mountain-range, few, except Lizards, seem to frequent the interior valleys; and the latter are wanting, or at least rare, in the higher region." Of Eastern Morocco we likewise know absolutely nothing. But the northern promontory, which bears Tangier, Ceuta, and Tetuan, has been tolerably well investigated, and forms altogether so distinct a feature in the fauna of Barbary that it deserves to be recognized as the *Tangitanian* district. There we meet with species otherwise peculiar to the Moroccan district, and with a few endemic forms, but with comparatively few, except the most widely distributed, that are identical with those of the Algerian Tell; and, what is still more surprising, no more special affinity is shown to the fauna of Southern Spain than in the latter district, with the only exception of the occurrence of *Molge waltlii*.

Barbary is therefore divided into five districts, viz.:—1, The *Moroccan*; 2, the *Tangitanian*; 3, the *Tell*; 4, the *Plateaux*; 5, the *Sahara*. In addition to these districts, the political divisions of Oran, Algiers, Constantine, and Tunisia are adopted to serve as landmarks in the distribution from West to East of the species shown, as far as present knowledge permits, in the following Table.

List of the Reptiles and Batrachians of Barbary, showing their Distribution.

(The names of genera, species, or varieties confined to Barbary are printed in *italics*.)

A. Moroccan district; B. Tangitanian district; C. Tell; D. Hauts-Plateaux; E. Sahara; F. Prov. Oran; G. Prov. Algiers; H. Prov. Constantine; I. Tunisia.

North—South.					West—East.					
C.	D.	E.			A.	B.	F.	G.	H.	I.
				REPTILES.						
*	*	*	1.	Testudo ibera, *Pall.*	*	..	*	*	*	*
*	..	..	2.	Emys orbicularis, *L.*	..	..	..	*	*	
*	*	*	3.	Clemmys leprosa, *Schw.*	*	*	*	*	*	*
	*	*	4.	Stenodactylus guttatus, *Cuv.*	..	..	*	*	*	*
		*	5.	Tropiocolotes tripolitanus, *Ptrs.*	..	..	..	..	..	*
*	*	*	6.	*Saurodactylus mauritanicus*, D. & B.	*	..	*	*		
			7.	Gymnodactylus *trachyblepharus*, Bttg.	*					
			8.	Phyllodactylus europæus, *Gené* (Galita Isl.)	..	..	..	..	..	*
	*	*	9.	Ptyodactylus lobatus, *Geoffr.*	..	..	*	*	*	
*	*	*	10.	Hemidactylus turcicus, *L.*	..	..	*	*	*	*
*	*	*	11.	Tarentola mauritanica, *L.*	*	*	*	*	*	*
	*	*	12.	—— *neglecta*, Strauch	..	..	..	..	*	
	*	*	13.	Agama inermis, *Reuss*	..	..	..	*	*	*
		*	14.	—— *tournevillii*, Lat.	..	..	..	..	*	
*	*	*	15.	—— *bibronii*, A. Dum.	*	*	*	*		
	*	*	16.	Uromastix *acanthinurus*, Bell	..	..	*	*	*	*
			17.	Ophisaurus *koellikeri*, Gthr.	*					
	*	*	18.	Varanus griseus, *Daud.*	..	..	..	*	*	*
*	*	..	19.	Blanus cinereus, *Vand.*	*	*	*	..	*	
*	*	..	20.	*Trogonophis wiegmanni*, Kaup	*	*	*	*	*	*
*	*	..	21.	Lacerta ocellata, *var. pater*, Lat.	..	..	*	*	*	*
			21*a*.	—— ——, *var. tangitana*, Blgr.	..	*				
*	..	..	22.	—— muralis, *Laur.*	..	*	*	*	*	*
*	..	..	23.	—— *perspicillata*, D. & B.	..	..	*			
*	*	..	24.	Psammodromus *blanci*, Lat.	..	..	..	*	*	*
			25.	—— *microdactylus*, Bttg.	*	*				
*	*	*	26.	—— algirus, *L.*	*	*	*	*	*	*
	*	*	27.	Acanthodactylus boskianus, *Daud.*	..	..	*	*	*	*
	*	*	28.	—— scutellatus, *Aud.*	..	..	*	*	*	*
*	*	*	29.	—— pardalis, *Licht.*	..	..	*	*	*	*
*	*	..	30.	—— vulgaris, *D. & B.*	*	*	*	*	*	
*	*	*	31.	Eremias guttulata, *Licht.*	*	..	*	*	*	*
*	*	*	32.	Ophiops occidentalis, *Blgr.*	..	..	..	*	*	*
	*	*	33.	Mabuia vittata, *Oliv.*	..	..	..	..	*	*
		*	34.	Eumeces schneideri, *Daud.*	..	..	..	..	*	*
*	*	..	35.	—— *algeriensis*, Ptrs.	*	..	*			
		*	36.	Scincus fasciatus, *Ptrs.*	..	..	*	..	..	*
		*	37.	—— officinalis, *Laur.*	..	..	*	*	*	*
		*	38.	Chalcides ocellatus, *Forsk.*	..	..	..	..	*	*
*	*	..	38*a*.	—— ——, var. tiligugu, *Gm.*	..	..	*	*	*	*
			38*b*.	—— ——, *var. vittatus*, Blgr.	..	*				
			38*c*.	—— ——, *var. polylepis*, Blgr.	*					
*	..	..	39.	—— lineatus, *Leuck.*	*	*	..	..	*	
*	*	..	40.	—— tridactylus, *Laur.*	..	..	*	*	*	*
			41.	—— *mionecton*, Bttg.	*	*				

North—South.				West—East.					
C.	D.	E.		A.	B.	F.	G.	H.	I.
*	..	..	42. Chalcides *mauritanicus*, D. & B.	..	..	*			
		*	43. —— sepoides, *Aud.*	..	..	..	*	*	*
*	*	*	44. Chamæleon vulgaris, *Daud.*	*	*	*	*	*	*
*	*	*	45. Eryx jaculus, *L.*	..	..	*	..	*	*
*	..	..	46. Coronella *amaliæ*, Bttg....................	..	*	..	..	*	
*	..	..	47. —— girondica, *Daud.*	*	..	*			
		*	48. Lytorhynchus diadema, *D. & B.*	..	..	*	..	*	*
	*	*	49. Zamenis *algirus*, Jan	..	..	..	*	*	*
*	*	..	50. —— hippocrepis, *L.*....................	*	*	*	*	*	*
		*	51. —— diadema, *Schl.*	..	..	..	*	*	*
*	..	..	52. Tropidonotus natrix, *L.*	..	..	..	*	*	
*	*	*	53. —— viperinus, *Latr.*	*	*	*	*	*	*
*	*	*	54. Macroprotodon cucullatus, *Geoffr.*	*	*	*	*	*	*
	*	*	55. Psammophis sibilans, *L.*, var. punctatus, *D. & B.*	..	..	*	*	*	*
*	*	*	56. Cœlopeltis lacertina, *Wagl.*	*	*	*	*	*	*
		*	57. —— producta, *Gerv.*	..	..	*	..	..	*
		*	58. Naia haie, *L.*, var. annulifera, *Ptrs.*	*	..	..	..	*	*
*	..	..	59. Vipera latastii, *Boscá*	..	*	..	*	*	
*	*	*	60. —— lebetina, *L.*	*	..	*	..	*	*
			61. —— arietans, *Merr.*....................	*					
		*	62. Cerastes vipera, *L.*	..	..	*	*	*	*
	*	*	63. —— cornutus, *Forsk.*	..	..	*	*	*	*
		*	64. Echis carinata, *Schn.*	..	..	..	..	*	*
			BATRACHIANS.						
*	*	*	1. Rana esculenta, *L.*, var. ridibunda, *Pall.*....	*	*	*	*	*	*
*	*	*	2. Bufo viridis, *Laur.*	*	..	*	*	*	*
*	*	..	3. —— *mauritanicus*, Schl.	*	*	*	*	*	*
*	..	..	4. —— vulgaris, *Laur.*....................	..	*	*	*	*	
*	..	..	5. Hyla arborea, *Laur.*, var. meridionalis, *Bttg.*	*	*	*	*	*	*
*	*	..	6. Discoglossus pictus, *Otth*	*	*	*	*	*	*
*	..	..	7. Salamandra maculosa, *Laur.*, *var. algira*, Bdr.	..	*	*	*	*	
*	..	..	8. Molge *poireti*, Gerv.	..	..	*	*	*	*
*	*	..	9. —— *hagenmuelleri*, Lat.	..	..	..	..	*	
			10. —— waltlii, *Mich.*	..	*				

Bibliography.

In the work of

1. SHAW, J. Travels, or Observations relating to several parts of Barbary and the Levant. Oxford: 1738, 4to,

we find the first reference to the "Oviparous Quadrupeds" of Algeria (pp. 249–250), which, although not described, are mostly identifiable, viz., as *Testudo ibera* ("The Land-Tortoise"), *Clemmys leprosa* ("The Water-Tortoise"), *Chamæleon vulgaris* ("The Chamæleon"), *Varanus griseus* ("The Warral"), *Uromastix acanthinurus* ("The Dab"), *Lacerta ocellata* ("The Common Green Lizard"), *Psammodromus algirus* and *P. blanci* ("The Zermoumeah"), and *Tarentola mauritanica* ("The Niji-daimah").

But the first list according to the system of Linnæus is given in the first volume of

2. Poiret. Voyage en Barbarie. Paris: 1789, 8vo,

in which a chapter (pp. 283–290) is devoted to the "Animaux Amphibies" of Algeria. In addition to a marine turtle said to be very common in the Mediterranean, and which therefore could hardly have been the *Testudo coriacea* of Linnæus to which Poiret refers it, the following species are enumerated:—

1. *Testudo græca*, L. (=*T. ibera*, Pall.).
2. *Lacerta agilis*, L. (=*L. ocellata*, var. *pater*, Lat.).
3. *Lacerta algira*, L. (=*Psammodromus algirus*, L.).
4. *Lacerta chamæleon*, L. (=*Chamæleon vulgaris*, Daud.).
5. *Lacerta chalcides*, L. (=*Chalcides tridactylus*, Laur.).
6. *Lacerta vulgaris*, L. (Unidentifiable.—*L. vulgaris*, L.=*Molge vulgaris*.)
7. *Lacerta palustris*, L. (=*Molge poireti*, Gerv., or *M. hagenmuelleri*, Lat.).
8. *Lacerta salamandra*, L. (=*Salamandra maculosa*, Laur.).

The next list is supplied by

3. Rozet, M. Voyage dans la Régence d'Alger. Paris. 1833, 8vo,

who adds (vol. i. pp. 230–233) the following species not recorded by Shaw or Poiret:—

1. *Rana esculenta*, L.
2. *Rana temporaria*, L. (=*Discoglossus pictus*, Otth).
3. *Bufo*, sp. (=*Bufo mauritanicus*, Schleg.).
4. *Coluber natrix*, L., var. (=*Tropidonotus viperinus*, Latr., var.).
5. *Coluber monspessulanus*, Herm. (=*Cœlopeltis lacertina*, Wagl.).
6. *Coluber hippocrepis*, L. (=*Zamenis hippocrepis*, L.).
7. *Vipera daboia*, Lacép. (=? *V. lebetina*, L.).
8. *Tiliqua ocellata*, Gray (=*Chalcides ocellatus*, Forsk.).

The *nomen nudum* of *Lacerta viridissima* is bestowed on *L. ocellata*, and the "Niji-Daimah" of Shaw receives the name of *Platydactylus fascicularis*, Cuv.

4. Gervais, P. Enumération de quelques espèces de Reptiles provenant de Barbarie. Ann. Sci. Nat. (2) vi. 1836, pp. 308–313.

Gives a list of 27 species from Morocco and the Province of Algiers, which, together with a revised nomenclature, adds 13 species, of which as many as five have to be erased, viz., *Testudo marginata*, Schoepff, as undoubtedly due to confusion with old specimens of *T. ibera*, and *Anguis fragilis*, L., *A. punctatissimus*, Bibr., *Pseudopus serpentinus*, Merr., and probably *Coluber agassizii*, Mich., as based on erroneous statement of locality (see p. 114).

The additions are:—

1. *Gecko* (*Hemidactylus*) *verruculatus*, Cuv. (=*turcicus*, L.).
2. *Gymnodactylus mauritanicus*, D. & B. (*Saurodactylus*).—Algiers.

3. *Lacerta agilis*, L. (This I suppose to be meant for *L. muralis.*)—Algiers.
4. *Lerista dumerilii*, Coct., MS. (=*Chalcides mauritanicus*, D. & B.).—Algiers.
5. *Scincus cyprius*, Cuv. (=*Eumeces algeriensis*, Ptrs.).—Algiers.
6. *Amphisbæna cinerea*, Vand.—Tangier.
7. *Amphisbæna elegans*, Gerv. (=*Trogonophis wiegmanni*, Kaup).—Tangier, Zaffarine Islands.
8. *Coluber austriacus*, L. (undoubtedly=*Macroprotodon cucullatus*, Geoffr.).—Algiers, Tangier.

The Tortoises receive the correct names of *Testudo ibera* and *Emys leprosa*; the "Dab" that of *Uromastix acanthinurus*, Bell; *L. ocellata*, var. *pater*, appears as *L. viridis*, *Cœlopeltis* as *Coluber æsculapii*; the variety of *Tropidonotus viperinus*, alluded to by Rozet, receives the name of var. *aurolineatus*, Gerv.; a toad from Bona is named *Bufo arabicus*, Rüpp.; and the name *Triton poireti* is proposed for the *Lacerta palustris* of Poiret.

Several of the Reptiles recorded by Gervais from the province of Algiers have ultimately proved not to occur in that part of Algeria.

Gervais's list was shortly followed by a contribution by Schlegel, published as an Appendix to the first volume of

5. Wagner, M. Reisen in der Regentschaft Algier. Leipzig: 1841, 8vo. Bemerkungen über die in der Regentschaft Algier gesammelten Amphibien, von Schlegel. Pp. 106–139.

The following species are added:—

1. *Stenodactylus guttatus*, Cuv.
2. *Lacerta guttulata*, Licht. (*Eremias*).
3. *Lacerta pardalis*, Licht. (*Acanthodactylus*).
4. *Vipera echis*? and *brachyura*, Cuv., from Oran (=*V. lebetina*, L.).
5. *Vipera cerastes*, L., from Biskra (=*Cerastes cornutus*, Forsk.).
6. *Hyla arborea*, L.

The true Lizards are referred to under the correct names of *Lacerta ocellata* and *L. muralis*, *Macroprotodon* stands as *Coronella lævis*, *Discoglossus* is referred to as *Rana picta*, and the new name *Bufo mauritanicus* is bestowed on the Moorish toad.

A second list by

6. Gervais, P. Sur les Animaux vertébrés de l'Algérie. Ann. Sc. Nat. (3) x. 1848, pp. 204, 205,

enumerates 47 species from Algeria, mostly from specimens received by the Paris Museum, which number, however, is reduced to 40 when we omit synonyms. Of these 40 species, 7 are recorded for the first time in any list dealing specially with the fauna of Barbary, although several had already been noticed by Duméril and Bibron, 'Erpétologie Générale':—

1. *Agama colonorum*, Daud. (=*A. bibronii*, A. Dum.).—From the Chotts in the Province of Oran.
2. *Acanthodactylus lineomaculatus*, D. & B. (originally described from Morocco).
3. *A. scutellatus*, Aud.—From the Souf.
4. *A. boskianus*, Daud.—From Biskra.
5. *Sphenops capistratus*, Fitz. (=*Chalcides sepoides*, Aud.).—From the Souf.
6. *Coluber natrix*, L. (*Tropidonotus*).
7. *Bufo variabilis*, Pall. (=*B. viridis*, Laur.).

7. Guichenot, A. Exploration scientifique de l'Algérie pendant les années 1840–1842. Reptiles. Paris: 1850, 4to. 30 pp., 4 plates.

This work affords but a meagre list of species, and the descriptions have but little original value, being to a great extent compiled from the 'Erpétologie Générale.' And sufficient care was not taken in recording the localities. The following species have to be added to those which we have mentioned before:—

1. *Cistudo europæa*, Schn. (=*Emys orbicularis*, L.).
2. *Lacerta perspicillata*, D. & B.—From Oran.
3. *Acanthodactylus vulgaris*, D. & B.
4. *Bufo vulgaris*, Laur.

Vipera lebetina, L., is described as *Echidna mauritanica*, sp. n.; *Macroprotodon cucullatus*, Geoffr., as *M. mauritanicus*, sp. n.; and *Molge poireti*, Gerv., as *Euproctus rusconii*, Gené, and *Triton nebulosus*, sp. n.

8. Eichwald. Naturhistorische Bemerkungen über Algiers und den Atlas. Nouv. Mém. Soc. Nat. Mosc. (2) ix. 1851. (Rept. and Batr. pp. 414–444.)

This paper contains but a single addition to our list, viz.:—

1. *Agama agilis*, Oliv. (=*inermis*, Reuss).

9. Gervais, P. Sur quelques Ophidiens de l'Algérie. Mém. Ac. Sc. Montpellier, iii. 1857, pp. 511 and 512, pl. v.

Adds 4 species:—

1. *Heterodon diadema*, D. & B. (*Lytorhynchus*).—From the Souf.
2. *Psammophis punctatus*, D. & B.—From the Western frontier of Algeria.
3. *Zamenis florulentus*, Schl. (=*algirus*, Jan).—From Laghouat.
4. *Cœlopeltis productus*, sp. n.—From between Bou-Alem and the Arbas.

10. Günther, A. On the Reptiles and Fishes collected by the Rev. H. B. Tristram in Northern Africa. Proc. Zool. Soc. 1859, pp. 469–474, with notes by Tristram himself, pp. 475, 476.

Enumerates only 12 species, all of which were already on record. *Uromastix spinipes,* Daud., stands for *U. acanthinurus,* Bell, and *Zootoca deserti,* sp. n., for *Acanthodactylus pardalis,* Licht.

The list of "Reptiles of the Sahara" (53 species), which forms Appendix VI. to

11. Tristram, H. B. The Great Sahara: Wanderings South of the Atlas Mountains. London: 1860, 8vo,

is carelessly compiled, and includes the names of many species "not found by the author, but given on the authority of trustworthy local naturalists." And it is to be noticed that the author restricts the term "Sahara" to the High Plateaux and the northernmost part of the desert, using the term "Desert" for the greater portion of what is commonly called the Sahara. This explains how examples of several species which are known not to extend south of the High Plateaux are labelled in the British Museum as from Mr. Tristram's Collection made in the Algerian Sahara. This list contains *Naia haie*?, which has since been found round Biskra by M. Lataste, and, very curiously, a *Salamandra*—? from Tuggurt. However, no information is given as to the source of these entries.

Such was the state of our knowledge of the Herpetological Fauna of Algeria, when Dr. Strauch published an excellent and most conscientious descriptive Catalogue, entitled:—

12. Strauch, A. Essai d'une Erpétologie de l'Algérie. Mém. Ac. St. Pétersb. (7) iv. no. 7, 1862, 86 pp.

This work is based upon the previous literature, the collections of the 'Exposition permanente' in Algiers, and the author's own collections made during several months' stay in Algeria. A great many of the species enumerated on the authority of others have to be erased, as based on errors of determination or of localities, so that of the 76 species included in the list only 56 (including two marine Turtles) deserve to stand.

The additions are:—

1. *Euprepes vittatus*, Oliv. (*Mabuia*).—Mzab.
2. *Eryx jaculus*, L.—Oran.
3. *Coronella austriaca*, Laur. (=? *C. amaliæ*, Boettg.).
4. *Zamenis cliffordii*, Schleg. (=*diadema*, Schl.).—Sahara.
5. *Vipera avicennæ*, Alp. (=*Cerastes vipera*, L.).—Western Sahara.
6. *Vipera aspis*, L. (=*latastii*, Boscá).—Algiers.

13. Lallemant, C. Erpétologie de l'Algérie. Paris: 1867, 8vo. 41 pp.

This opuscule is principally an abridgment of Strauch's "Essai," with notes on the author's own collections.

Thus far, with the exception of Gervais's first list, the contributions to our knowledge of the Reptiles and Batrachians of Barbary had dealt merely with Algeria. The first paper containing a special account of the herpetological fauna of Morocco was published in 1874:—

14. BOETTGER, O. Reptilien von Marocco und von den Canarischen Inseln.—I. Uebersicht der von den Herren Dr. C. von Fritsch und Dr. J. J. Rein im Jahre 1872 in Marocco gesammelten Reptilien. Abh. Senckenb. Ges. ix. 1874, pp. 121–170, pl. i. (With Appendix, *op. cit.* xi. 1877, p. 1, footnote.)

19 Reptiles and 1 Batrachian are therein described, and by adding the species previously noticed by Gervais and in various general works, the total number of Moroccan Reptiles is raised to 24, of Batrachians to 3, the following being the additions:—

1. *Gymnodactylus trachyblepharus*, sp. n.
2. *Seps mionecton*, sp. n. (*Chalcides*).
3. *Coronella girondica*, Daud.
4. *Vipera arietans*, Merr.—(Valley of Sous.)
5. *Naia haie*, L. (*fide* A. Dum.).
6. *Pleurodeles waltlii*, Mich. (*fide* Schreiber) (*Molge*).

A short paper by

15. CAMERANO, L. Osservazioni intorno agli Anfibi Anuri del Marocco. Atti Acc. Torin. xiii. 1878, pp. 542–558,

contains descriptions of *Rana esculenta*, L., *Discoglossus scovazzii*, sp. n. (=*D. pictus*), *Bufo vulgaris*, Laur., from Larache, new to Morocco, *B. pantherinus*, Boie (=*B. mauritanicus*), and *Hyla arborea*, L., from specimens collected by the Italian Consul Scovazzi at Tetuan, Tangier, Larache, Casablanca, Babat, Masagan, Saffi, Mogador.

With M. Lataste's excursions to Algeria in 1880 and 1881 a fresh era was started. Large collections were made both north and south of the Atlas; the discrimination of species was subjected to a severe test upon fresh material; and an investigation into the literature resulted in the elimination of several forms unduly recorded as from Algeria, the amalgamation of certain species previously regarded as distinct, the separation of others previously confounded, the discovery of altogether new forms, and above all in a much clearer understanding of the distribution of the various forms, as will be apparent on comparing the present Catalogue with that of Dr. Strauch.

As stated in the introduction, M. Lataste was prevented from putting his documents into final shape, and his published contributions are merely the following:—

16. LATASTE, F. Descriptions de Reptiles nouveaux d'Algérie. Le Naturaliste, i. 1880 and 1881.

Zerzoumia blanci, sp. n., p. 299 (1880).
Ptyodactylus oudrii, sp. n., p. 299 (1880).
Lacerta ocellata pater, subsp. n., p. 306 (1880).
Agama tournevillei, sp. n., p. 325 (1880).
Acanthodactylus bedriagai, sp. n. (=*A. pardalis*, Licht.), p. 357 (1881).
Glossoliga hagenmuelleri, sp. n., p. 371 (1881).

Also recording for the first time the presence of *Ophiops* and *Naia haie* in Algeria, and giving notes on a supposed *Simotes*? in the collection of the 'Exposition permanente.' The latter snake, which is possibly not from Algeria, I have been unable to identify from M. Lataste's notes, unless it be a dark variety of *Zamenis gemonensis* (*viridiflavus*).

17. Lataste, F. Liste des Vertébrés recueillis par M. le Dr. André pendant l'expédition des Chotts. Arch. Miss. Sc. (3) vii. 1881, pp. 398–400.

A list of 22 species obtained in Southern Tunisia and the neighbouring part of Algeria by the Roudaire expedition.

18. Boettger, O. Liste der von Herrn Dr. W. Kobelt in der Prov. Oran, Algerien, gesammelten Kriechthiere. Ber. Senckenb. Ges. 1880–81, pp. 145–147.

Notices 13 species, among which *Coronella girondica* and *Bufo vulgaris* from Tlemsen are of special interest.

Turning his attention once more to the Reptiles of Morocco, Dr. Boettger supplies a most valuable contribution :—

19. Boettger, O. Die Reptilien und Amphibien von Marocco. II. Abh. Senckenb. Ges. xiii. 1883, pp. 93–146, pl. i.

Based chiefly upon collections brought together by Lieut. Quedenfeldt and Dr. W. Kobelt. Leaving out 4 species which Boettger introduces on the authority of other authors and which should evidently be erased, we see that the list of Moroccan Reptiles has risen to 37 species, of which the following are recorded for the first time :—*Rhinechis amaliæ*, sp. n. (*Coronella*), *Vipera euphratica*, Mart., var. *mauritanica*, D. & B. (=*V. lebetina*, L.), *Vipera latastii*, Boscá, *Lacerta muralis*, Laur., *Algira microdactyla*, sp. n. (*Psammodromus*), *Podarces simoni*, sp. n. (=*Eremias guttulata*, Licht.), *Pseudopus apus*, var. n. *ornata* (=*Ophisaurus koellikeri*, Gthr.), and *Bufo viridis*, Laur.

20. Boettger, O. Liste der von Hrn. Dr. W. Kobelt in Algerien und Tunisien gesammelten Kriechthiere. Appendix to W. Kobelt, Reiseerrinerungen aus Algerien und Tunis. Frankfurt/M.: 1885, 8vo, pp. 457–475.

Notes on 30 species, all previously recorded from Algeria and Tunisia.

21. Boulenger, G. A. On the Reptiles and Batrachians obtained in Morocco by Mr. Henry Vaucher. Ann. & Mag. N. H. (6) iii. 1889, pp. 303–307.

A list of 23 species from the vicinity of Tangier.

New to Morocco:—*Lacerta ocellata*, var. *tangitana*, Blgr., *Chalcides lineatus*, Leuck., *Salamandra maculosa*, Laur.

Catalogue of the Reptiles and Batrachians.

REPTILIA.

The Reptiles with which we have to deal in this Fauna belong to two Orders:—

I. **CHELONIA**, Tortoises and Turtles, in which the body is encased in a bony shell and the jaws are destitute of teeth.

II. **SQUAMATA**, Lizards, Chameleons, and Snakes, with the body covered with scales and the jaws armed with teeth. They are divided into three Suborders.

Order I. CHELONIA.

Apart from the Marine Turtles, three genera of Chelonia, each represented by a single species, occur in Barbary, which are easily distinguished:—

Limbs club-shaped; terrestrial . . . . 1. Testudo.
Digits webbed; aquatic.
  Plastron connected with the carapace by ligament . . . . 2. Emys.
  Plastron united with the carapace by suture . . . . 3. Clemmys.

All three of which belong to a single family.

Fam. 1. TESTUDINIDÆ.

1. Testudo, Linnæus, 1766.

Shell very convex. Head covered with horny shields. Alveolar surface of upper jaw with ridges. Limbs club-shaped. Terrestrial and herbivorous.

1. Testudo ibera, Pallas, 1831.

T. græca, Poiret, Rozet.—*T. mauritanica*, Guichenot.—*T. pusilla*, Strauch.

Supracaudal marginal shield undivided, never spread out and subhorizontal. Hind lobe of plastron movable in the adults; suture between the humeral plastral shields much longer than that between the pectorals; suture between the anal shields nearly as long as, or longer than, that between the humerals. Anterior face of fore limbs with large imbricate scutes, forming four or five longitudinal and five or six transverse series; a large convex or subconical tubercle on the hind side of the thigh. Carapace of young yellowish or pale olive, each shield spotted and bordered with black; the black spots more irregular and predominating in the adult; some specimens uniform brownish or olive; plastron more or less spotted with black.

Length of shell 23 centim.

Common throughout the Tell, from Morocco to Tunisia; also found on the Algerian Plateaux, and even further south in Tunisia. M. Lataste found it at Palestro, Misserghin (Oran), Aumale, Guyotville (Algiers), Salah-Bey (Constantine), and Bou-Saada, in Algeria; at Zarzis and the ruins of Utique in Tunisia. It also inhabits South-western Asia.

For good figures of this tortoise we may refer to Bell's 'Monograph of the Testudinata' (sub nom. *T. græca*), and to Lortet, Arch. Mus. Lyon, iv. 1887, pl. i.

Old specimens have been taken for the allied *T marginata*, Schoepff, s. *campanulata*, Strauch (by Gervais and Lallemant), the habitat of which appears to be restricted to Greece.

2. Emys, Duméril, 1806.

Shell depressed. No shields on the head. Alveolar surface of upper jaw without ridges. Digits distinct, webbed. Plastron joined to carapace by ligament, and divided into two movable lobes in the adult. Aquatic and carnivorous.

1. Emys orbicularis, Linnæus, 1766.

Cistudo europæa, Guichenot.—*C. lutaria*, Strauch.

Carapace with yellowish dots or radiating lines on a dark ground; head dark brown or black above, with yellow or pale brown dots, yellow inferiorly, spotted with black.

Length of shell 19 centim.

Inhabits Southern and Eastern Europe, Western Asia, and Algeria north of the Atlas. In spite of Guichenot's statement that it is found in all the rivers of Algeria, a statement evidently due to a confusion with *Clemmys leprosa*, this tortoise is very locally distributed in Algeria, the only specimens examined by M. Lataste having been obtained by Dr. Hagenmüller near Bona. Lallemant records it from Harrach, Lake Fetzara, and Wed Sebaon.

Figures: Bonaparte, Faun. Ital. (*Emys lutaria*), and Lortet, Arch. Mus. Lyon, iv. 1887, pl. vi.

3. Clemmys, Wagler, 1830.

Shell depressed. No shields on the head. Alveolar surface of upper jaw without ridges. Digits distinct, webbed. Plastron without hinge, united to carapace by suture. Aquatic and carnivorous.

1. Clemmys leprosa, Schweigger, 1814.

Emys vulgaris, Schlegel.—*E. sigriz,* Guichenot.

Carapace dark olive in the young, with an oval orange spot or short longitudinal streak on each shield; uniform olive, or with traces of the orange spots in the adult. Head olive, sides with orange or yellow streaks or vermiculations, and a round orange spot between the eye and the ear, and a more or less defined ring of the same colour round the latter. Neck and limbs with orange or yellow streaks. These bright markings become very indistinct in old specimens.

Length of shell 20 centim.

Inhabits the South of Spain and Portugal, Barbary, and Senegambia. Common throughout Morocco, Algeria, and Tunisia as far as the northern border of the Sahara. M. Lataste's Algerian specimens are from the Wed Zig, near Oran (where he found it in extraordinary abundance), L'Arba, Bona, Batna, and Bou-Saada; he found it in Tunis at Cabes, and his colleague M. Valéry-Mayet at Wed Leben and Gafsa.

Figures: Gray, Cat. Sh. Rept. i. pl. ix., and Proc. Zool. Soc. 1860, pl. xxx., 1869, pls. xxxvii. & l.

Order II. SQUAMATA.

Divided into three Suborders:—

I. LACERTILIA, *Lizards.*—Nasal bones entering the border of the nasal apertures; pterygoid in contact with quadrate; mandibular rami united by suture. Pectoral arch or its vestiges present; clavicle present whenever the limbs are developed. Tongue flattened.

II. RHIPTOGLOSSA, *Chameleons.*—Nasal bones not bounding nasal apertures; pterygoid not reaching quadrate; mandibular rami united by suture. Clavicle absent; limbs well developed. Tongue vermiform, projectile.

III. OPHIDIA, *Snakes.*—Nasal bones bounding nasal apertures; mandibular rami connected by ligament. No trace of pectoral arch. Tongue flattened and bifid at the end, and sheathed at the base.

Suborder I. *LACERTILIA.*

The Lizards of Barbary belong to seven Families, distinguishable as follows:—

I. Tongue smooth or covered with villiform papillæ, feebly nicked at the end, not retractile into a basal sheath.

Head covered with small scales; eyes without movable lids, with vertical pupil . . . . 1. **Geckonidæ.**

Head covered with small scales; eyes with movable lids, with round pupil . 2. **Agamidæ.**

Head with symmetrical shields . . . . 3. **Anguidæ.**

II. Tongue very long and slender, bifid, retractile into a basal sheath . . 4. **Varanidæ.**

III. Tongue bifid, covered with rhomboidal, imbricate papillæ; head with symmetrical shields.

Body vermiform; eyes hidden . . . . 5. **Amphisbænidæ.**
Femoral pores . . . . 6. **Lacertidæ.**
No femoral pores; scales cycloid, imbricate . . . . 7. **Scincidæ.**

Fam. 1. GECKONIDÆ.

The 8 genera by which this family is represented in Barbary may be distinguished by means of the following key:—

I. Digits not dilated.
A. Digits straight, of equal diameter throughout.
1. Digits denticulated laterally and keeled inferiorly.
Scales small . . . . 1. Stenodactylus.
Scales large and imbricate . . . . 2. Tropiocolotes.
2. Digits not denticulated laterally, with smooth lamellæ inferiorly . 3. Saurodactylus.
B. Digits flattened at the base, compressed at the end . . . . . . 4. Gymnodactylus.
II. Digits dilated at the apex only.
Digital expansion inferiorly with two plates . . . . 5. Phyllodactylus.
Digital expansion inferiorly with two diverging series of lamellæ . . . . 6. Ptyodactylus.
III. Digits dilated at the base or throughout.
All the digits clawed, the claw supported by a free, compressed joint; subdigital lamellæ in pairs . . . . 7. Hemidactylus.
Third and fourth digits with a sessile claw; subdigital lamellæ entire . . . 8. Tarentola.

1. Stenodactylus, Fitzinger, 1826.

Digits not dilated, furnished with a long claw, and a lateral fringe or denticulation of pointed scales; inferiorly with a series of keeled scales. Scales juxtaposed or sub imbricate. Pupil vertical. No præanal or femoral pores.

Sand-Geckos, represented by one species in Algeria and Tunisia.

1. Stenodactylus guttatus, Cuvier, 1829.

S. mauritanicus, Guichenot.

Head very variable in shape; snout rounded or more or less pointed. Body short, limbs long and slender. Body covered with subequal granules, which may be convex, smooth, or slightly keeled, or flat and subimbricate on the back; the size of these granules varies considerably. Nostril pierced in the middle of a more or less distinct swelling, between three nasals, the first labial, and usually also the rostral; no chin-shields. Tail covered with small juxtaposed keeled scales. Light buff or brownish above, with round whitish spots between a brown network, sometimes with ill-defined brown cross-bands; tail with brown annuli; white inferiorly.

From snout to vent 58 millim., tail 40.

Material received since the publication of the British Museum Catalogue of Lizards induces me to adopt M. Lataste's view (*in litt.*) that *S. wilkinsonii*, Gray, which I ventured to keep distinct from *S. guttatus*, and which has since been recorded from Batna by Dr. Strauch, is not specifically distinct. In fact the variations, both of scaling and of proportions, are as great in this species, and of the same kind, as in *Ptyodactylus lobatus.* The form that I regard as the typical *S. guttatus* has a moderately pointed snout, the dorsal granules are rather large, convex and coarsely granular, the rostral shield enters the nostril, and the hind limb reaches barely the axil. Stouter specimens with shorter snout have been named *S. mauritanicus.* In Gray's *S. wilkinsonii* the snout is more pointed, the dorsal scales flat and subimbricate, the rostral is excluded from the nostril, and the hind limb reaches the shoulder. All these differences, however, break down, as specific characters, on examination of large series of specimens, and I do not even see my way to distinguishing the three forms as varieties. A specimen from Bou-Saada, collected by M. Lataste, has the short head and short limbs of *S. mauritanicus*; the dorsal scales very small, flattish, smooth, but not imbricate; and the nostril well separated from the rostral.

Stenodactylus guttatus ranges from the Algerian Sahara to Egypt, Arabia, and Syria. It extends also into the Algerian Plateaux (Batna, *Strauch*; Bou-Saada, *Lataste*). M. Lataste found it at Wed Dermel, Laghouat, and Bou-Saada, and received specimens from Mraier and Wargla. Gervais records it from the Souf, and Guichenot from the province of Oran. Dr. André obtained it in the region of the Chotts, at Bir Knafes and Bled Berrada. In Tunisia, M. Lataste found it at Houmt-es-Souk (Djerba Island) and at Wed el Ftour (south of Cabes), and his colleagues M. Valéry-Mayet at Sfax, Kerkenna Island, and Bou-Hedma, and M. Sédillot at Feriana and Gafsa and Kriz.

Good figures of this species are given in the Expédition d'Egypte, Rept. pl. v. fig. 2, and by Guichenot in Explor. Alg., Rept. pl. i. fig. 1.

2. Tropiocolotes, Peters, 1880.

Digits not dilated, furnished with a long claw, and denticulated laterally; inferiorly with a series of keeled scales. Scales rather large and imbricate. Pupil vertical. No præanal or femoral pores.

This genus comprises two species:—*T. tripolitanus*, from Tunisia and Tripoli, and *T. steudneri* (*Gymnodactylus steudneri*, Peters, 1869, *Stenodactylus petersii*, Blgr., 1885), from Egypt and the Sennaar.

1. Tropiocolotes tripolitanus, Peters, 1880.

Body and limbs rather slender, covered with imbricate, rhomboidal, keeled scales; 42 to 44 scales round the middle of the body. Nostril pierced between the rostral, the first labial, and three nasals; mental followed by a pair of chin-shields. Tail tapering to a fine point, and considerably longer than head and body Colour above sandy, with small brown spots; a brown streak on the side of the head and neck, passing through the eye; lower parts white.

From snout to vent 66 millim., tail 38.

The type specimens are from Wadi M'bellem, Tripoli. The same Lizard has since been found in Tunisia; one specimen at Taferma by M. Letourneux, one between Cabes and Gafsa by M. Sédillot, one at Oum-ali, near Gafsa, and another at Bou Hedma by M. Valéry-Mayet.

Described in detail and figured by Peters, Mon. Berl. Ac. 1880, p. 306, pl. —. fig. 1.

3. Saurodactylus, Fitzinger, 1843.

Digits not dilated, clawed, not denticulated laterally, inferiorly with a series of smooth lamellæ. Dorsal scales small, subimbricate. Pupil vertical. No femoral or præanal pores.

This genus is very closely allied to *Tropiocolotes*, differing mainly in the smooth subdigital lamellæ, the absence of a distinct lateral digital denticulation, and the smaller dorsal scales. A single species is known, which was formerly referred to the genus *Gymnodactylus*.

1. Saurodactylus mauritanicus, Dum. & Bibr., 1836. (Plate XIII. fig. 1.)

Habit lacertiform. Snout subacuminate; ear-opening small, roundish-subtriangular. Nostril pierced between the rostral, the first labial, and three nasals; five or six upper and four or five lower labials; mental followed by a pair of chin-shields. Scales on the head small and granular, the granules largest on the snout; dorsal scales small, smooth, flat, roundish, subimbricate, increasing in size towards the belly, where they are large, roundish-hexagonal, and imbricate; about 70 scales round the middle of the body. Tail a little longer than head and body, tapering to a fine point; caudal scales cycloid-imbricate, with the median inferior series transversely enlarged. Grey-brown above, with small white dark-edged ocelli; a dark brown streak on the side of the head, passing through the eye; lower parts white; tail yellowish with brown spots, or brownish with round yellow spots.

From snout to vent 30 millim.

This species is now represented in the British Museum by seven specimens collected at Mogador by Lieut. Quedenfeldt. Boettger has recorded it from Djebel Hadid, near Mogador, from between Mogador and Morocco, and from the Plateau of Chiodma. Duméril and Bibron's statement that the type specimen came from Algiers requires confirmation. Two specimens were obtained at Nemours (Prov. Oran) by M. Gazagnaire in 1888, and are now in M. Lataste's collection. Strauch saw specimens from the Algerian Sahara in the Loche collection, and F. Müller records the species from the Plateau of Sersou, in the Province of Algiers.

4. Gymnodactylus, Spix, 1825.

Digits not dilated, clawed, not denticulated, cylindrical or depressed at the base, compressed in the distal portion, which forms an angle with the basal; inferiorly with a series of smooth lamellæ. Dorsal scales juxtaposed. Pupil vertical. Males usually with femoral or præanal pores.

This large genus is represented in Barbary by a single species from South-western Morocco.

1. Gymnodactylus trachyblepharus, Boettger, 1874.

Head much depressed; snout rounded, a little longer than the distance between the eye and the ear-opening; latter transversely oval. Limbs rather slender; digits elongate, depressed in the basal, compressed in the distal portion. Above uniformly and finely granular, the granules largest on the snout; upper eyelid with several projecting triangular scales on its free border; rostral pentagonal, nearly twice as broad as deep, with median cleft above; nostril between the rostral, the first labial, and four nasals; seven upper and six lower labials; mental large, subtriangular; no regular chin-shields. Ventral scales large, hexagonal, subimbricate. Tail slender, depressed, covered above with uniform small scales, beneath with a median series of enlarged transverse plates. Greyish olive above, whitish beneath; tail with rather indistinct yellowish cross-bands.

From snout to vent 40 millim., tail 57.

A single specimen is known, from Djebel Hadid, near Mogador, which, thanks to Dr. Boettger's courtesy, I have been able to examine.

Figured by Boettger, Abh. Senck. Ges. ix. 1874, pl. i. fig. 3.

5. Phyllodactylus, Gray, 1830.

Digits all clawed, the extremity dilated, with two large plates inferiorly separated by a longitudinal groove in which the claw is retractile. Pupil vertical. No præanal or femoral pores.

1. Phyllodactylus europæus, Gené, 1839.

Upper surfaces covered with equal small smooth granules; no regular chin-shields, but very small polygonal scales passing gradually into the minute granules of the throat. Tail prehensile, covered with equal small squarish scales. Grey-brown above, marbled with darker and dotted with lighter; a more or less distinctly marked dark streak on the side of the head, passing through the eye; lower parts whitish.

From snout to vent 40 millim., tail 30.

This small Gecko inhabits many of the Islands of the Mediterranean west of Italy, and was found on Galita by Marquis Doria.

Figured in Bonaparte's 'Fauna Italica.'

6. Ptyodactylus, Gray, 1825.

Digits all clawed, the extremity dilated, with two diverging series of lamellæ inferiorly disposed somewhat like a fan; the claw retractile in the anterior notch of the distal expansion. Pupil vertical. No præanal or femoral pores.

1. Ptyodactylus lobatus, Geoffroy, 1809. (Plate XIII. fig. 2.)

Head large; body rather short; limbs long and slender. Upper surface of body and limbs covered with granules intermixed with small keeled tubercles; lower surfaces with flat smooth scales. Tail slender, tapering. Greyish or yellowish brown above, spotted with darker; lower parts white.

Ranges from Algeria to Egypt, Nubia, Arabia, and Syria.

In Algeria this species is found in the stony Sahara, and in the southern parts of the Plateaux. M. Lataste collected specimens at Ghardaia, Laghouat, Bou-Saada, between Bou-Saada and Biskra, and between Biskra and Batna, and received a specimen from Djenian bon Resk, near Oran, through Dr. Maury. Dr. Strauch also records it from Batna ('Bemerk. über die Geckoniden-Samml. St. Petersb. Mus.' p. 35, 1887).

The following is M. Lataste's description of Algerian specimens, for which he proposed in 1880 the name *P. oudrii*:—"Smaller and less slender than the Egyptian *Ptyodactylus*. When the arm is stretched forwards in the latter, the wrist reaches the nostril, whilst in the new species it reaches only midway between the eye and the nostril. When the hind limb is stretched forwards the heel reaches the axil in the former, but far from it in the latter. Length of the head twice in the length of the trunk in *P. oudrii*, twice and a half in the other species. The largest specimen measures: head 17 millim., from snout to vent 55, tail 57. Scaling generally coarser in *P. oudrii*, the granules as well as the tubercles larger. The ventral scales, very small and almost granular in the Egyptian species, are comparatively large, distinctly hexagonal, and quite flat in the Algerian; this difference particularly conspicuous on the lower belly, where, as well as under the thigh and leg, the scales reach a considerable size in *P. oudrii*, comparable to that of the sublabials and chin-shields. In the Egyptian species the chin-shields are immediately followed by minute granules, smaller than on the breast, whilst in *P. oudrii* the anterior gulars are larger than the following, which gradually decrease in size. Finally I count 10 distinct sublabials in the Egyptian species, and only 7 or 8 in the Algerian."

I am, however, unable to agree with my friend in separating these Algerian specimens as a distinct species. The difference in the number of lower labials does not hold good. There is every gradation between *P. oudrii* and *P. lobatus*, and some Syrian specimens are undistinguishable from the former, except in their larger size. I think the following notes, taken from all the specimens in the British Museum, are sufficient to show that *P. oudrii* cannot be regarded as more than a variety of *P. lobatus*.

1–5. ♂ & hgr. Bou-Saada (*Lataste*). Types of *P. oudrii*.

Labials $\frac{11}{10}$, $\frac{12}{11}$, $\frac{11}{10}$, $\frac{10}{10}$, $\frac{12}{11}$.

	millim.	millim.	millim.	millim.	millim.
From snout to vent	57	53	47	44	39
Head	16	15	14	13	12
Fore limb	22	21	21	19	16
Hind limb	29	29	27	25	22

6 & 7. ♂ & hgr. Egypt (*Wilkinson*). Typical *P. lobatus*.

Form slender, nostril in a very distinct swelling. Scaling finer than in *P. oudrii*, head less depressed, eye larger, auricular meatus more elongate. Wrist reaching halfway between the eye and the nostril (6) or the tip of the snout (7); heel to the axil (7) or not quite so far (6). Labials $\frac{12}{12}$, $\frac{12}{12}$.

	millim.	millim.
From snout to vent	73	47
Head	21	10
Fore limb	36	25
Hind limb	47	33

8. ♂. Egypt (*Burton*).

Similar to the preceding, but dorsal tubercles larger, quite as large as in *P. oudrii*. Wrist to the nostril, heel to axil. Labials $\frac{13}{12}$.

	millim.
From snout to vent	75
Head	21
Fore limb	36
Hind limb	48

9. ♀. Egypt (*Christy*).

Like 6 & 7, but the shape of the head approaching that of *P. oudrii*, and the nasal swelling less marked. Wrist halfway between the eye and the nostril; heel to $\frac{4}{5}$ the distance between groin and axil. Labials $\frac{11}{11}$.

	millim.
From snout to vent	64
Head	18
Fore limb	27
Hind limb	38·5

10. ♀. Mt. Edfou, Egypt (*Anderson*).

Like the preceding. Labials $\frac{12}{11}$.

	millim.
From snout to vent	58
Head	16
Fore limb	25
Hind limb	34

11. ♀. Mt. Sinai.

Like 6 & 7. Wrist not quite to the nostril; heel nearly to the axil. Labials $\frac{12}{12}$.

	millim.
From snout to vent	70
Head	20
Fore limb	33
Hind limb	44

12. ♀. Muscat, Arabia (*Murray*).

Like the preceding. Wrist to halfway between the eye and the nostril; heel to the axil. Labials $\frac{12}{12}$.

	millim.
From snout to vent	80
Head	24
Fore limb	35
Hind limb	51

13. ♀. Dead Sea (*Tristram*).

Shape of the head intermediate between *P. lobatus*, typ., and *P. oudrii*; eye very large; ear as in *P. oudrii*. Scaling as in *P. lobatus*, typ. Wrist to halfway between the eye and the end of the snout; heel to axilla. Labials $\frac{13}{13}$.

	millim.
From snout to vent	64
Head	19
Fore limb	30
Hind limb	42

14. ♂. Mt. Carmel (*Tristram*).

Agrees in every respect, except size, with *P. oudrii*; the ear-opening is, however, a little more elongate. Labials $\frac{12}{11}$.

	millim.
From snout to vent	77
Head	24
Fore limb	37
Hind limb	49

15. ♀. Jerusalem (*Tristram*).

Like the preceding, but tubercles smaller. Labials $\frac{13}{12}$.

	millim.
From snout to vent	84
Head	25
Fore limb	39
Hind limb	50

16. ♀. Jerusalem (*Anderson*).

Like 14, but the heel reaches the axil. Labials $\frac{13}{12}$.

	millim.
From snout to vent	77
Head	23
Fore limb	39
Hind limb	51

17. ♀. Galilee (*Anderson*).

Agrees with *P. oudrii*, but ventral scales a little smaller, and limbs shorter still. Wrist to the anterior border of the eye, and knee hardly to $\frac{3}{4}$ the distance between groin and axil. Labials $\frac{11}{10}$.

	millim.
From snout to vent	64
Head	19
Fore limb	25
Hind limb	36

18. ♂. Between Khan Tubb Tusef and Ain Mellaha, Palestine (*Anderson*).

Like with the preceding. Labials $\frac{12}{11}$.

	millim.
From snout to vent	66
Head	20
Fore limb	27
Hind limb	36

The typical form is figured by Savigny, Descr. de l'Egypte, Suppl. pl. i. fig. 2. We have figured the Algerian form from one of the type specimens of *P. oudrii*, on Plate XIII. fig. 2.

7. Hemidactylus, Gray, 1825.

Digits free, or more or less webbed, dilated, inferiorly with two rows of lamellæ; all the digits with slender distal clawed joints angularly bent and rising from within the extremity of the dilated portion. Pupil vertical. Males with præanal or femoral pores.

1. Hemidactylus turcicus, Linnæus, 1766.

Hemidactylus verruculatus, Gervais, Guichenot.—*H. cyanodactylus,* Strauch.

Upper surface of body granular, with 14 to 16 longitudinal series of trihedral tubercles; tail with transverse series of large keeled tubercles above. Males with 4 to 10 præanal pores. Light brown or greyish above, spotted with darker; many of the tubercles white; white beneath.

From snout to vent 53 millim.

Found all round the Mediterranean and the coast of the Red Sea, and extending eastwards to Persia and Sind, but not yet recorded from Morocco. It is not very common in Algeria. M. Lataste collected specimens near Oran, Algiers, Beni Mansour, and Bona, and Dr. Kobelt at Biskra. In Tunisia M. Lataste found it at Djebel Rezaz and Zarzis, M. Valéry-Mayet at Sfax, Kerkenna, and Thala, and Marquis Doria on Galita.

The best figure of this species is that given in Bory de St. Vincent's 'Expédition de Morée,' Rept. pl. xi. fig. 2.

8. Tarentola, Gray, 1825.

Digits strongly dilated, free, with undivided lamellæ below, and a flat nail-like scute on their upper surface near the tip; third and fourth clawed, others clawless. Pupil vertical. No femoral or præanal pores.

Two species in Barbary.

1. Tarentola mauritanica, Linnæus, 1766. (Plate XIII. fig. 3.)

Platydactylus fascicularis, Rozet, Gervais.—*P. muralis,* Guichenot.—*P. facetanus,* Strauch.

Head large, with swollen temples, covered above with large convex, usually obtusely keeled scales, 13 to 15 in a transverse line between the eyes; temple with enlarged tubercles; anterior border of ear-opening not denticulated; sides of neck with rosettes of large conical tubercles surrounded with smaller ones. Dorsal region granular, with transverse series of large, strongly keeled, subtrihedral, very prominent tubercles, surrounded by smaller ones; sides with rosettes of conical tubercles. Gular scales much smaller than ventrals; mental shield large, separating the chin-shields, the inner of which are as much developed as the labials. A more or less distinct fold along each side of the belly. Digits strongly dilated at the end. Anterior part of tail with posteriorly directed spine-like tubercles. Grey or grey-brown above, more or less distinctly spotted or marbled with blackish and whitish, or with undulous dark transverse bands on the back; a more or less distinct dark streak on each side of the head, passing through the eye; tail above with dark cross-bands; lower parts white.

From snout to vent 70 to 80 millim.

Saharian specimens (var. *deserti,* Lataste, *in litt.*) are distinguished by a larger size, measuring up to 103 millim. from snout to vent, a somewhat longer and more pointed head, finer granulations between the tubercles and on the throat, and the very pale, yellowish-white coloration, without or with very indistinct pale brown spots.

This Gecko, common all round the Mediterranean, is found all over Barbary, north and south of the Atlas; it frequents houses, old walls, and cliffs.

The typical form is figured in Bonaparte's 'Fauna Italica,' and the var. *deserti* on Plate XIII. fig. 3 of this Memoir.

2. Tarentola neglecta, Strauch, 1887.

T. angusticeps, Strauch, 1887.

This species, which in its physiognomy reminds somewhat of *Hemidactylus turcicus*, was recognized as distinct by Lataste, whose description was, however, anticipated by that of Strauch.

The head is smaller than in *T. mauritanica*, the temples usually less swollen, and the scales on its upper surface larger, smooth or feebly keeled; 10 to 12 scales in a transverse line between the eyes; tubercles on the temple small and feebly prominent. All the tubercles on the back, the sides of the neck and body, and on the limbs much less prominent, never conical; and the dorsals are entirely isolated, not surrounded by smaller ones; the granules between the tubercles larger. Lateral ventral fold absent or very indistinct. Digits less dilated, with subparallel lateral borders. Caudal tubercles less developed. Pale brownish or yellowish white above, without or with small brown spots or interrupted longitudinal lines; head usually with four to six brown longitudinal lines, most distinct on the snout; tail with more or less distinct darker cross-bands; lower parts white.

This is a small species, the largest of many examples examined by M. Lataste measuring 53 millim. from snout to vent; the usual length is 45 millim. from snout to vent, tail 50.

T. neglecta was found in abundance by Lataste in the sandy Sahara in Algeria between El Mala and Arifji, and at Wargla, on old palm-trees, never about houses or walls like its larger congener. I have also received a specimen from Kef el Dhor, between Biskra and Tuggurt. It would appear, however, that the species occurs also on the Plateaux, for Dr. Strauch's specimens were purchased as from Batna.

Figured by Strauch, "Bemerk. üb. d. Geckoniden-Sammlung Zool. Mus. St. Petersb." (Mém. Ac. St. Pétersb. xxxv. 1887, no. 2), pl. —. figs. 1–4.

Fam. 2. AGAMIDÆ.

Two genera in Barbary:—

Tail round or feebly compressed; no femoral pores . . . . 1. Agama.
Tail short, depressed, covered with whorls of large spinose scales; femoral pores . 2. Uromastix.

1. Agama, Daudin, 1802.

Tail round or feebly compressed. No femoral pores; males with callose præanal scales.

Of this African and South-west Asian genus three species occur in Barbary:—

A. Third toe much shorter than fourth, fifth not extending as far as first; occipital scale not enlarged; ear-opening smaller than eye-opening.
  Dorsal scales unequal; head not or but slightly longer than broad; tail cylindrical; male without gular pouch . . . . 1. *inermis.*
  Dorsal scales equal; head longer than broad; tail compressed; male with a large gular pouch . . . . 2. *tournevillii.*
B. Third and fourth toes equal, fifth extending beyond first; occipital considerably larger than the surrounding scales; ear-opening larger than the eye-opening . 3. *bibronii.*

1. Agama inermis, Reuss, 1834.

A. agilis, Eichwald, Strauch.—*A. ruderata,* Strauch.—*A. mutabilis,* Lataste.

Head very short, not or but slightly longer than broad. Nostril directed upwards and backwards, pierced on the canthus rostralis in the posterior part of a flat nasal. Upper head-scales convex, smooth or very slightly keeled; occipital not enlarged; usually a few scattered small spinose scales on the back of the head; a fringe of small spinose scales on the upper edge of the ear, which is smaller than the eye-opening. Male without, or with only an indication of, a gular pouch. Body depressed, covered above with unequal, rhomboidal, imbricate, keeled, more or less mucronate scales; ventral scales smooth or feebly keeled. Limbs moderate; tibia as long as the skull, or a little shorter; third finger shorter than fourth, fifth not extending as far as second; third toe much shorter than fourth, fifth not extending as far as first. Tail about twice as long as the distance from gular fold to vent, rounded, covered with equal keeled scales. Male with a double row of anal pores. Grey-brown or sandy coloured above, with or without more or less distinct quadrangular dark grey, brown, or reddish spots arranged symmetrically on the back; some of the larger scales may be lighter; lower parts white; the breeding male's throat with blue longitudinal lines, or blue with white spots.

From snout to vent 90 millim., tail 130.

This species varies considerably in the scaling of the back, a large series of specimens showing almost every transition between a nearly equal lepidosis and one in which the enlarged scales, scattered far apart, are as much as three or four times as large as the others. Such extremes are, however, not of frequent occurrence.

Numerous specimens were obtained by M. Lataste in the Algerian Sahara at Biskra, Hadjira, Wargla, in the Mzab at Tibremt, Laghouat, Bou-Saada, and on the High Plateaux at Msila; by Dr. André in the district of the Tunisian Chotts; in Tunisia by

M. Lataste at Sidi Guenao, on the hills between Limagues and Kebili, at Tamesmida, Bir-el-Ahmar, Zarzis, Sidi Haïch, El Hammam des Beni Zid, Nebech el Dib, Wed Zitouna, and Gafsa.

The range of *A. inermis* extends eastwards to Egypt.

A good figure accompanies Reuss's description, Mus. Senckenb. i. 1834.

2. Agama tournevillii, Lataste, 1880. (Plate XIII. fig. 4.)

Habit more slender than in the preceding. Head one fourth longer than broad, snout sloping gradually. Nostril directed upwards and backwards, pierced on the canthus rostralis in the posterior part of a small flat nasal. Upper head-scales smooth, convex; occipital not enlarged; no spinose scales; a very slight fringe of pointed scales on the upper border of the ear, which is smaller than the ear-opening. Male with a large gular pouch. Body not or but feebly depressed, covered above with equal, rhomboidal, strongly keeled, not mucronate scales; lateral and ventral scales a little smaller, strongly keeled. Tibia a little shorter than the skull; third finger slightly shorter than fourth, fifth not extending quite as far as first; third toe much shorter than fourth, fifth not extending quite as far as first. Tail twice and a half as long as the distance from gular fold to vent, distinctly compressed, covered with equal keeled scales. Male with a row of anal pores. Sandy coloured above; a transverse brown band between the eyes, two longitudinal ones from the occiput along the nape, and two others on each side of the head; back with regular longitudinal series of quadrangular transverse brown spots separated by rather indistinct longitudinal light lines; tail with dark annuli; lower parts white; gular pouch grey.

From snout to vent 94 millim., tail 162.

Only two specimens are known, a female collected by M. Lataste at Wargla, and a male, labelled "Sahara," which has been for many years in the British Museum. The latter differs from the former in the less depressed body, the slightly larger dorsal scales, the rather larger ear-opening, and the presence of a gular sac.

3. Agama bibronii, A. Duméril, 1851. (Plate XIV. fig. 1.)

A. colonorum, Gervais, Guichenot, Strauch.

Head a little longer than broad. Nostril tubular, directed outwards and backwards, pierced just below the canthus rostralis. Upper head-scales smooth or indistinctly keeled; occipital scale considerably larger than the surrounding ones; eleven to fourteen upper labials; sides of head and neck with groups of spines; ear-opening larger than the eye-opening. Throat strongly plicate; no gular pouch. Body depressed, covered above with large, rhomboidal, mucronate, imbricate scales, with strong keels converging towards the vertebral line; a slight nuchal crest; ventral scales small, smooth. Tibia as long as the skull; third and fourth fingers equal; third and fourth toes nearly equal, fifth extending beyond first. Tail about twice as long as the distance from gular fold to vent, round in the female, very feebly compressed in the male covered with whorls of strongly keeled, spinose scales. Male with a row of anal pores. Bronzy olive or leather-brown above, the vertebral line sometimes yellowish, sometimes with darker and lighter spots; tail with dark annuli; whitish or greyish beneath, the male's throat bluish. Young with three dorsal series of whitish dark-edged ocelli.

From snout to vent 110 millim., tail 150.

This species was founded upon specimens from Mogador. Boettger records it from Tangier (whence the British Museum has also received specimens through M. Henry Vaucher) and between Mogador and Morocco, and states that it is very common on the plateau between Ain-Umest and Sidi-Moktar. In Algeria it is on record from Tlemsen, Bou-Saada, and the Mzab (*Strauch*); the Chotts of the Province of Oran (*Gervais*); and Saïda, eastern frontier of Algeria (*Guichenot*). According to M. Lataste it is only found in the stony parts of the Sahara in the Provinces of Algiers and Constantine; he obtained specimens in the Mzab, at Laghouat, at Bou-Saada, and at Cachrou, near Oran. It has not yet been found in Tunisia.

2. Uromastix, Merrem, 1820.

Incisors large, uniting in the adult into one or two cutting-teeth, separated from the lateral teeth by an interspace. Tail short, depressed, covered with whorls of large spinose scales. Præanal and femoral pores.

These curious essentially phytophagous Lizards inhabit the arid tracts of North Africa and Southern Asia. The Algero-Tunisian species is:—

1. Uromastix acanthinurus, Bell, 1825.

U. spinipes, Günther.—*U. temporalis,* Valenciennes.

Anterior border of ear denticulated. Scales small, no enlarged ones on the back or flanks. 9 to 11 femoral and 4 or 5 præanal pores on each side. Tail above with large spinose scales not separated by smaller ones; below with smaller scales, two or three whorls corresponding to one of the upper surface. Yellowish, greenish, or greyish above, dotted or vermiculated with blackish or brown.

Total length 250 millim., tail 150.

Very common in the stony Sahara, where it makes burrows in the firm soil to the depth of two or three feet. It is found in abundance at Biskra, Bou-Saada, Geryville, Mascara, Laghouat, and the Mzab; also in the Hodna district, in the south of the High Plateaux (Msila and Magra); in Tunisia M. Lataste observed it at Tamesred, Taoudjout (Matmata), Hadedj, Wed-el-Kreil, M. Valéry-Mayet at Gafsa and Kriz, and Dr. André between Cabes and the Chott Fejej.

U. acanthinurus is not recorded west of Algeria or east of Tunisia. It has sometimes been confounded with the more eastern *U. spinipes*, Daud., distinguished by much smaller scales and the presence of scattered small tubercles on the flanks, and which does not occur in Barbary.

The only figure of this Lizard is that accompanying the original description by Bell, Zool. Journ. i. 1825, pl. xvii.

Fam. 3. ANGUIDÆ.

A single representative in Morocco, *Ophisaurus koellikeri.*

Two other Lizards of this family have been ascribed to this fauna, but I have no hesitation in erasing them from the list, viz., *Anguis fragilis*, L., and *Ophisaurus* (*Pseudopus*) *apus*, Pall. They were mentioned by Gervais as having been obtained, together with *Ophiomorus punctatissimus*, Bibr., at Algiers by M. Marloy. The fact that these Lizards, which occur together in the East (Greece, Asia Minor), have never since turned up in Barbary, renders it absolutely incredible that they should have been obtained at or near so well-explored a place as Algiers; I therefore believe the locality to be altogether erroneous. It is true that the supposed Algerian specimen of *Ophiomorus* is now entered in the registers of the Paris Museum, where, thanks to Prof. Vaillant's courtesy, I have been able to examine it, as from Bona, through Dr. Guyon. But this is doubtless again an error, the specimen being surely the same as was mentioned by Gervais, and presented by him to the Museum together with the *Anguis fragilis*, as may be seen by referring to Aug. Duméril's 'Catalogue Méthodique,' pp. 189, 190, where the *Anguis* is referred to as from "Bône: *M. Marloy.*"

1. Ophisaurus, Daudin, 1803.

A lateral fold. Scales squarish rhomboidal, forming straight longitudinal and transverse series. Limbs absent externally, or reduced to rudiments of the hind pair.

1. Ophisaurus koellikeri, Günther, 1873.

Pseudopus apus, forma ornata, Boettger, 1881.

Azygous præfrontal large, quite as broad as the frontal, with which it forms a suture; interparietal much broader than the parietals or the occipital; two shields on a line from the nasal to the azygous præfrontal; five supraoculars. Ear concealed. Dorsal shields in 14 longitudinal and 120 transverse series, the median obtusely keeled, the laterals smooth; ventrals in 10 longitudinal series, smooth. Rudiments of hind limbs. Upper and lower caudal scales keeled. Brownish above, with a darker lateral band and small dark brown spots on the middle line of the anterior part of the back, or with blackish transverse bands spotted with bluish; belly yellowish.

From snout to vent 13 centim.

The type specimen is probably from Mogador; Dr. Boettger examined two specimens from Casablanca.

Figured in Catal. of Lizards, vol. iii. pl. xv. fig. 2.

Fam. 4. VARANIDÆ.

A single genus, confined to the Old World and Australia.

1. Varanus, Merrem, 1820.

Neck much elongate. Dorsal scales roundish, juxtaposed, surrounded by rings of minute granules; ventral scales squarish, arranged in cross rows. No femoral pores.

1. Varanus griseus, Daudin, 1802.

V. arenarius, Gervais, Guichenot.—*V. scincus,* Strauch.

Teeth acute, compressed. Nostril an oblique slit near the eye. Scales of head small, granular, subequal. Tail round or slightly compressed. Greyish yellow, sometimes with more or less distinct brown cross-bands on the back and tail, and brown streaks along the sides of the neck.

From snout to vent 56 centim., tail 71.

Inhabits the Sahara, extending eastwards to the Caspian Sea, Afghanistan, and North-western India. Pretty common in the Algerian Sahara, and also found in the Hodna district, in the south of the High Plateaux. Specimens were brought to M. Lataste at Wargla, Laghouat, Bou-Saada, Biskra, Msila, and in Tunisia M. Lataste obtained it at Tozeur, and M. Valéry-Mayet at Majura.

Figured in the ‘Description de l'Egypte,’ Rept. pl. iii. fig. 2.

Fam. 5. AMPHISBÆNIDÆ.

Worm-like Lizards, represented in this fauna by two genera:—

Præanal pores; nostril pierced in the first labial . . . . 1. Blanus.
No præanal pores; nostril in a separate nasal . . . . 2. Trogonophis.

1. Blanus, Wagler, 1830.

Teeth anchylosed to the sides of the jaws. Nostril pierced in the first labial; a large frontal, forming a suture with the rostral. A well-marked lateral line; a curved postgular fold. No limbs. Tail pointed. Præanal pores.

1. Blanus cinereus, Vandelli, 1797.

Snout rounded, not at all projecting beyond the lower jaw. Four upper and four lower labials; 110–125 annuli on the body and 20–22 on the tail; 4–6 præanal pores. Brownish flesh-colour, the segments of a more or less dark brown.

Total length 250 millim.

This species occurs in Spain and Portugal and Morocco, where it has been obtained at Tangier, Tetuan, and between Mogador and Morocco. From Algeria it is recorded by Lallemant from the western part of the Province of Oran, and from Tebesa, in the Province of Constantine. Dr. Strauch purchased specimens stated to have been obtained at Batna. M. Lataste did not come across it in Algeria, and thinks some of the reports of its occurrence may be due to confusion with the uniform fuliginous variety of *Trogonophis wiegmanni*.

Figured by Gervais, Mag. Zool. 1836, pl. x.

2. Trogonophis, Kaup, 1830.

Teeth anchylosed to the parapet of the jaws. Nostril pierced in a large nasal; two pairs of upper head-shields. A vertebral line and a stronger lateral line. No limbs. Tail conical. No præanal pores.

1. Trogonophis wiegmanni, Kaup, 1830.

Amphisbæna elegans, Gervais.

Snout slightly projecting. Five upper labials, second and fifth smallest; four lower labials. 136–151 annuli on the body and 12–14 on the tail. Yellowish white, chequered with black. A variety, of which a specimen was obtained at La Chiffa by Dr. Bavay, and another at Biskra by M. Hénon, is of a uniform fuliginous grey, a little lighter below.

Total length 259 millim.

This genus is peculiar to Barbary. From Morocco *Trogonophis* is known from Tangier, Tetuan, the Zaffarine Islands, Larache, Casablanca, Coreina, Mogador, and between Mogador and Morocco. It is found in the three provinces of Algeria, and occurs as far south as Biskra. The only Tunisian locality is Tamesmida, between Ferriana and Tebesa, where specimens were collected by M. Lataste.

Figured by Gervais, Mag. Zool. 1836, pl. xi.

Fam. 6. LACERTIDÆ.

The range of this family is restricted to the Old World; the five following genera are represented in Barbary :—

A. Movable eyelids.
  a. Nostril above the first labial, from which it is separated, if at all, by a narrow rim.
    α. Digits not denticulated laterally.
Dorsal scales small . . . . 1. Lacerta.
Dorsal scales large and imbricate . . . . 2. Psammodromus.
    β. Digits denticulated laterally . . . . 3. Acanthodactylus.
  b. Nostril well separated from the labials . . . . 4. Eremias.
B. No movable eyelids . . . . 5. Ophiops.

1. Lacerta, Linnæus, 1766.

Nostril bordered by two or three nasals and the first labial. Eyelids movable. Collar well marked. Dorsal scales much smaller than caudals, not or but feebly imbricate; ventral shields tetragonal, feebly imbricate. Digits with smooth or tubercular lamellæ, not denticulated laterally. Femoral pores.

Three species in Barbary:—

Rostral entering the nostril; collar-edge serrated	1. *ocellata.*
Usually a single postnasal	2. *muralis.*
Lower eyelid with a transparent disk	3. *perspicillata.*

1. Lacerta ocellata, Daudin, 1802. (Plate XV.)

Lower eyelid scaly. Rostral shield entering the nostril; two superposed postnasals; occipital shield large; temple covered with irregular, rather large scales. Collar with serrated edge. Dorsal scales small, roundish-rhomboidal, feebly keeled, 60 or more across the middle of the body. Ventral plates broader than long, in 6 to 10 longitudinal series. Green above, with or without blue or white ocelli, or reticulated black and yellow. Size large (grows to 3 feet).

The typical form of this, the largest species of the genus *Lacerta*, inhabits the south of France, Liguria, and the Pyrenean Peninsula, but is not found in Barbary, where it is represented by the two following races or subspecies.

Var. pater, Lataste, 1880.

L. viridissima, Rozet.—*L. ocellata,* Schlegel, Strauch.—*L. viridis,* Gervais.

The large Algerian green Lizard was long confounded with both the typical *L. ocellata* and *L. viridis*, until M. Lataste showed that it formed a distinct race or subspecies, which, though much nearer the former, presents some points of affinity to the latter. The form has since even been raised to the rank of a species (Bedriaga), but I hold that M. Lataste was well advised in treating it as subordinate to *L. ocellata.* Examination of a good number of specimens from the Spanish Peninsula has even convinced me that the distinctive characters between the two forms are by far not so well marked as M. Lataste thought. But on the whole, taking the *ensemble* of the characters of the Algero-Tunisian form, a separation from the European *L. ocellata* is justified, and the name proposed by Lataste is well chosen, as *L. pater* may be looked upon as most nearly allied to, if not the actual survivor of, the ancestral stock from which the allied *L. ocellata* and *L. viridis* are descended. The affinity to *L. viridis* is shown in the usually more distinctly keeled dorsal scales; the smaller occipital shield, which is as broad as or a little narrower than the frontal; the ventrals in 8 longitudinal rows (8–10 in *L. ocellata*, 6–8 in *L. viridis*); and, in some specimens, the absence of ocellar spots. Not one of these characters, taken by itself, is, however, absolutely distinctive.

The following notes are taken from the specimens in the British Museum :—

The occipital is constantly broader than the interparietal, and usually narrower than the frontal; however, in a male specimen from Tunis it is quite as broad as the frontal, not larger than in a specimen of the typical form from Ferrol (Spain)[1]. The dorsal scales are small, oval-subrhomboidal, feebly keeled, and their number across the middle of the body varies from 70 to 80. The ventral shields form 8 longitudinal series, of which the two median and the outermost are the narrowest. Femoral pores vary from 14 to 16 on each side, 14 being the usual number. Two or three semicircles of small shields on the anal region.

The coloration varies greatly, green being the ground-colour. The young are usually ornamented all over with large bluish-white black-edged ocelli, like the young of the typical *L. ocellata*; others are uniform green. The adult may be uniform or speckled with black, like typical *L. viridis*; or with black rings or small black and white ocelli, thus very similar to the Iberian *L. viridis*, var. *schreiberi*; or with large blue ocelli on the sides like the typical *L. ocellata*. Lower parts uniform greenish yellow.

The largest specimen measures 165 millim. from snout to vent.

This fine Lizard is found all over Algeria, as far south as the northern border of the Sahara. M. Lataste found it very common at Algiers, Aumale, Setif, Bona, Batna, Lambesa, El Guerrah, Bougia; and he received it from the Plateau of Sersou. Dr. Strauch records it from Oran and Constantine; J. von Fischer from Boghar, Blidah, La Chiffa, Tiaret, El Kantarah, El Rouached, St. Arnaud; and Dr. Kobelt collected specimens at Tlemsen and Biskra. In Tunisia, it is known from the city of Tunis, and M. Lataste observed it in the northern parts, between Ferriana and Tebesa. Marquis Doria found it on Galita Island.

Figured on Plate XV. figs. *a–e*.

Var. TANGITANA, Boulenger, 1887.

This interesting form was recently discovered at Tangier by M. H. Vaucher, from whom I received 11 specimens. There was no previous record of either *L. ocellata* or *L. viridis* in Morocco. The var. *tangitana* comes very near the Algerian var. *pater*, but diverges from it as well as from *L. ocellata typica* in the still smaller dorsal scales, of which there are 77 to 100 across the middle of the body, and the greater number of femoral pores, viz. 17 to 21. In the usually smaller size of the occipital and the number (6 or 8) of longitudinal rows of ventral shields, it approaches nearer still the Spanish-Portuguese form of *L. viridis* (var. *schreiberi*, Bedriaga), from which some specimens are with respect to these two characters undistinguishable.

In some specimens the occipital is not or but slightly broader than the interparietal; in others its greatest width equals that of the frontal. 24 to 28 scales on a line between the chin and the collar; latter with 11 to 13 shields. There are usually eight

[1] The head of this Spanish specimen is figured on Plate XV. fig. *g*.

longitudinal rows of ventrals, but sometimes only six. Two or three semicircles of small shields on the anal region. Green above, with whitish or blue black-edged ocelli, which may be confined to the sides; lower parts uniform greenish yellow.

From snout to vent 140 millim., tail 300.

I have given a figure of this variety in the third volume of the British Museum 'Catalogue of Lizards,' pl. iii. fig. 1. The upper surface of the head is represented on Plate XV. fig. *f* of this Memoir.

2. Lacerta muralis, Laurenti, 1768.

L. agilis, Gervais.

Lower eyelid scaly. Rostral shield not entering the nostril; usually a single postnasal; occipital shield small; temple granular, usually with an enlarged circular shield in the middle. Collar with even or very slightly serrated edge. Dorsal scales small, granular, smooth or feebly keeled, 40 or more across the middle of the body. Ventral plates broader than long, in 6 (rarely 8) longitudinal series.

A very variable species, inhabiting Western and Southern Europe, South-western Asia, and Barbary. It is recorded from Cyrenaica by Reichenow.

In the specimens from Tangier, the scales are very small, obtusely keeled, 61 to 73 across the middle of the body, three or four transverse series corresponding to one ventral shield. Four labials anterior to the subocular (one specimen has five on one side, another only three). An enlarged shield, sometimes broken up into two or three, is present in the middle of the granulate temple in five specimens, altogether absent in a sixth. Upper caudal scales strongly keeled. Femoral pores 13 to 19, usually 17. Olive-grey above, with small black spots or reticulations; a more or less defined dark lateral band, bordered above by a whitish streak or series of white spots; hinder side of thighs with round white spots; two series of white, black-edged spots along each side of the tail; belly uniform white in both sexes, or with a few scattered black dots; throat with black dots.

The largest male measures, from snout to vent 52 millim., tail 95; the largest female, from snout to vent 50, tail 79.

In specimens from the plains of the Spanish Peninsula (Valencia, Lisbon), the dorsal scales are smooth and the caudals very feebly keeled; 55 to 60 scales across the middle of the body. Specimens from the Serra de Gerez have 54 to 63 scales across the body, and these are obtusely keeled, and the caudals have well-marked keels. In Persian specimens I count only 45 to 50 scales. In European specimens of the typical form generally, the number of scales across the middle of the body varies from 48 to 65.

In Morocco, this Lizard is as yet only known from Tangier. In Algeria it is widely distributed north of the Sahara, though far less common than on the opposite shores of the Mediterranean. M. Lataste collected specimens at Aumale, Rorfa des Beni Slimam, Constantine, Setif, Chabet-el-Acra, Beni Mansour, Tebesa, and received some from Daya and the Plateau of Sersou. Strauch obtained it from Tlemsen. It is thus recorded from the three provinces. In Tunis, M. Lataste met with *L. muralis* at Guelaat-es-Sinam, and on the route from Ferriana to Tebesa.

The larger green form, var. *tiliguerta*, Gm. (*neapolitana*, Bedriaga), so common in the south of Italy and Malta, is recorded from Tunis by Camerano (Atti Acc. Torin. xiii. 1877, p. 87).

3. LACERTA PERSPICILLATA, Dum. & Bibr. 1839.

Lower eyelid with a transparent disk. Rostral shield not entering the nostril; two superposed postnasals; occipital shield small; temple uniformly granular. Collar with even edge. Dorsal scales small, granular, 50 or more across the middle of the body. Ventral plates square, subequal, in 10 longitudinal series. Green or bronzy above, uniform or with light ocelli; uniform greenish white beneath.

This Lizard is well distinguished from all other members of the genus *Lacerta* by the presence of a transparent disk in the lower eyelid, which permits the animal to see when the eyes are closed. As far as we know at present, its habitat is restricted to the environs of Oran, where it is common on Mount Santa Cruz; it was also found in the town of Oran by M. Gazagnaire; its habits are, like those of *L. muralis*, essentially saxicole. The various statements of the occurrence of *L. perspicillata* outside the Province of Oran appear to be erroneous[1].

The following descriptive details are taken from the specimens in the British Museum:—

A series of granules between the supraoculars and the supraciliaries; occipital smaller than the interparietal, which is at least twice as long as broad; five upper labials anterior to the subocular. A distinct fold across the throat, from ear to ear; 32 to 34 scales on a line between the chin and the collar; latter with 9 or 10 shields. 54 to 56 scales across the middle of the body; three transverse series of scales correspond to one ventral shield. 29 transverse rows of ventrals in the male, 35 in the female. 18 or 19 femoral pores on each side. A single semicircle of small shields borders the anal. Upper caudal scales smooth or very feebly keeled, truncate posteriorly. The hind limb reaches the axil in the male, the elbow of the adpressed fore limb in the female.

From snout to vent 58 millim.

L. perspicillata is figured by Guichenot, Explor. Sc. Alg., Rept. pl. i. fig. 3.

2. PSAMMODROMUS, Fitzinger, 1826.

Nostril between two nasals, in contact with the first labial or separated only by a narrow rim. Eyelids movable, scaly. Collar absent or very feebly marked; a short fold in front of the arm. Back covered with large, rhombic, strongly keeled and imbricate scales. Ventrals imbricate. Digits with tubercular or keeled lamellæ inferiorly. Femoral pores.

[1] *Cf.* Lataste, C. R. Assoc. Franç. Av. Sc., Congrès d'Oran, 1888, i. p. 191.

Three species in Barbary:—

Collar distinguishable . . . . 1. *blanci.*
No trace of a collar; ventral plates of the median and outer series narrower than the others . . . . 2. *microdactylus.*
No trace of a collar; ventral plates subequal . . . . 3. *algirus.*

The fourth and type species of this genus, *P. hispanicus*, Fitz., inhabits the Spanish Peninsula and the south of France. It has been recorded from Tangier in the 'List of Animals living in the Gardens of the Zoological Society of London,' no doubt through confusion with *P. microdactylus*; and from Oran by F. Müller (Verh. nat. Ges. Basel, vi. 1878, p. 625), through confusion with *P. blanci.*

1. Psammodromus blanci, Lataste, 1880. (Plate XIV. fig. 2.)

A more or less distinct gular fold, connecting the ears; collar distinguishable. Ventrals broader than long, the median and outer series narrower than the two others. Digits inferiorly with a double series of more or less strongly or obtusely keeled tubercles. Olive or bronzy brown above, with two yellowish streaks along each side, bordered with small black spots; the upper streak commences from the upper border of the temple, the lower commences on the upper lip and passes through the ear; sometimes a light vertebral band; lower parts uniform yellowish.

The suture between the rostral and the first labial usually falls below the anterior border of the nostril. 28 to 32 scales round the middle of the body, ventrals included. 10 to 12 femoral pores on each side.

From snout to vent 40 millim., tail 61.

This small Lizard is easily mistaken for the young of the much commoner *P. algirus*, which occurs together with it in many localities. When examined, it is, however, found to differ in the gular fold, the collar, and the arrangement and shape of the ventral plates, which much resemble the same in true Lizards, whilst those of *P. algirus* remind one to a certain extent of the Scinks.

Psammodromus blanci is as yet only known from Algeria, but is on record from the three provinces; it does not occur south of the Atlas. M. Lataste found it not uncommon in and near Algiers and near Aumale, very common at Lambesa, and between Tafrant and Meriana, and also obtained it at Youkouss, near Tebesa, and at Oran; his collection contains specimens from Batna, received from M. Henri Martin; and J. v. Fischer records it from Blidah (Prov. Algiers) and Rouached (Prov. Constantine).

2. Psammodromus microdactylus, Boettger, 1881.

No gular fold; no trace of a collar. Ventrals broader than long, the median and outer series narrower than the two others. Digits beneath with a double series of strongly but obtusely keeled tubercles. Upper caudal scales more strongly keeled than the dorsals. Olive or pea-green above, with or without brown or black spots, which may be mixed with white; a more or less distinct brown or reddish lateral band; lower surfaces white, outer row of ventrals lemon-yellow; throat of males bluish. Young with small black and white ocelli on the sides; upper lip pure white; a pure white, black-edged streak from the eye to above the tympanum, and a second from the angle of the mouth through the lower half of the tympanum to the axil.

The suture between the rostral and the first labial falls below the centre of the nostril. 28 to 30 scales round the middle of the body, ventrals included. 10 to 13 femoral pores on each side, the usual number being 12.

From snout to vent 119 millim., tail 73.

This elegant little Lizard has hitherto been found only in Morocco. Dr. Boettger received it from Tangier and Tetuan. In addition to the types in the Senckenberg Museum, I have examined 23 specimens, obtained by M. Vaucher at Tangier, and by Lieut. Quedenfeldt at Mogador.

For a detailed description and figure, *cf.* Boettger, Abh. Senck. Ges. xiii. 1883, p. 111, pl. i. fig. 2.

3. PSAMMODROMUS ALGIRUS, Linnæus, 1766.

Algira barbarica, Gervais.

No gular fold; no trace of a collar. Ventrals subequal, little broader than long, roundish hexagonal, strongly imbricate. Subdigital lamellæ smooth, tubercular, or feebly bicarinate. Upper caudal scales like the dorsals. Bronzy above, with one or two golden, dark-edged lateral streaks; male with a pale blue ocellus above the shoulder, sometimes followed by one or two more; lower surfaces whitish.

From snout to vent 76 millim., tail 190.

This species, which occurs also in the Spanish Peninsula and the south of France, is common and generally distributed in Morocco, Algeria, and Tunisia north of the Sahara. A variety (var. *nollii*) from the Sahara (Tuggurt and Southern Tunisia) has recently been described by J. v. Fischer (Zool. Gart. 1887, p. 69); this variety, which is distinguished by having two additional yellowish stripes along the back, is represented in M. Lataste's collection by a specimen from Founasse, in the south of the Province of Oran, received from M. Maury in 1888. A melanotic form, blackish above, with bluish dots, bluish grey beneath, obtained by Marquis Doria on Galitone Island, near Galita, has been described by Bedriaga as var. *doriæ* (Beitr. Kenntn. Lacert. 1886, . 409).

A good figure of this pretty Lizard is given by Bonaparte in his 'Fauna Italica.'

3. ACANTHODACTYLUS, Wiegmann, 1834.

Nostril pierced between two nasals and the first labial. No occipital shield. Eyelids movable. Collar more or less distinct. Dorsal scales juxtaposed or imbricate; ventrals tetragonal, feebly imbricate. Digits keeled inferiorly and more or less strongly fringed laterally. Femoral pores.

Four species in Barbary:—

Posterior dorsal scales very much larger than the anterior, strongly imbricate, sharply keeled, passing gradually into the caudals . . . . 1. *boskianus.*

Ventrals in 14 to 18 longitudinal series, not or but slightly broader than long; digital denticulations at least as long as the diameter of the corresponding part of the toe . . . . 2. *scutellatus.*

Ventrals in 12 or 14 longitudinal series, the median broader than long . . . . 3. *pardalis.*

Ventrals in 8 or 10 longitudinal series . . . . 4. *vulgaris.*

For fuller details upon the Lizards of this genus, *cf.* Lataste "Les Acanthodactyles de Barbarie et les autres espèces du genre," Ann. Mus. Genova, (2) ii. 1885, pp. 476–516. The only important point in which I differ from M. Lataste with regard to the four species of Barbary is his identification of *Lacerta savignyi*, Audouin (1829), with the species which, from an examination of the types of *Lacerta pardalis*, Lichtenstein (1823), I call *A. pardalis.* I identify the figure of the Egyptian *L. savignyi* with the Lizard from Somaliland described by Lataste as *A. vaillanti.*

These Lizards are only found in sandy localities; they range over the Sahara and the bordering countries as far south as Senegambia and Somaliland, one species extending to the Spanish Peninsula and the south of France. Eastwards they extend through Arabia, Syria, Persia, and Baluchistan to Sind and the Punjab.

1. Acanthodactylus boskianus, Daudin, 1802.

Snout obtuse. Four supraoculars, the fourth very seldom broken up into small scales; front edge of the ear usually distinctly denticulated. Dorsal scales strongly keeled, very much larger on the hinder part of the back than between the shoulders and on the flanks, rhomboidal, strongly imbricate. Ventral plates considerably broader than long, in straight longitudinal and transverse series, 10 (rarely 12) across the middle of the body. Digital denticulations strong, usually shorter than the corresponding diameter of the toe, much more developed on the outer than on the inner edge of the fourth toe. Young with whitish longitudinal lines separated by blackish interspaces with series of round whitish spots; these markings become more indistinct or disappear with age, the adult being greyish, brownish, or buff, with or without small blackish spots; lower parts white; tail of young pink.

The Algerian specimens belong to the var. *asper*, Audouin, distinguished from the typical form (hitherto found only in Egypt) by its larger dorsal scales. These scales form 34 to 42 longitudinal series (exclusive of the ventrals) round the middle of the body, and there are 10 to 14 longitudinal rows of large keeled scales between the hind limbs. The subocular does not reach the lip, but is wedged in between the fourth and fifth or fifth and sixth labials. 19 to 24 femoral pores on each side. A median series of broad præanal plates, posterior largest.

The largest specimen examined by me measures 80 millim. from snout to vent; tail not quite twice as long.

A. boskianus occurs from Southern Algeria and Tunis through Tripoli and Egypt to Syria and Arabia; it is also found in Abyssinia. It is common in the Algerian and Tunisian Sahara, and rare on the Algerian Plateaux. M. Lataste found it on the plateau at Bordj Medjez, Msila, and Ngaous; in the Algerian Sahara at Bordj Tayer Rason, Ghardaia, Berrian, Tilremt, Laghouat, Bou-Saada, and on the route from Bou-Saada to Biskra, and received specimens obtained by M. Maury at Kreder, Prov. of Oran, near the Sahara and the Moroccan frontier; in Tunisia at Cabes, Zarzis, Djerba Island, Limagues, and Ferriana.

Figured, 'Description de l'Egypte,' Rept., Suppl. pl. i. fig. 9.

2. Acanthodactylus scutellatus, Audouin, 1829.

Snout acute. Four supraoculars, fourth sometimes broken up; front edge of the ear usually strongly denticulated. Dorsal scales small, rhomboidal, keeled, slightly enlarged towards the posterior part of the body. Ventral plates as long as broad, or a little longer than broad, rarely a little broader than long, in irregular longitudinal and angular transverse series; 14 to 18 plates in a transverse series in the middle of the body. Digital denticulations strong, at least as long as the diameter of the corresponding part of the toe, much more developed on the outer than on the inner edge of the fourth toe. Greyish or pale buff above, dotted or reticulated with darker; white beneath.

This is a very variable species. The Saharian examples are smaller, more slender and lighter-coloured than the typical form from Egypt, and the name var. *exiguus* (=*Scaptira inornata*, Gray) has been bestowed upon them by Lataste.

The following notes are taken from Algerian and Tunisian examples:—

Dorsal scales very distinctly keeled, juxtaposed, usually passing very gradually into the marginal ventral shields, the exact number of longitudinal rows of which is, therefore, often difficult to ascertain; there are at least 14 well-defined ventrals in a transverse series across the middle of the body, and the number may rise to 18. 61 to 74 scales (ventrals included) round the middle of the body. Præanal shields often all small and subequal. Subocular never reaching the lip, from which it is usually separated by one or two additional labials intercalated between the (normally) fourth and fifth. Femoral pores 18 to 25.

From snout to vent 50 millim., tail 90.

The range of *A. scutellatus* extends from Senegambia through the Sahara to Egypt, Somaliland, the Sinaitic Peninsula, and Syria. It is only found in the sandy parts of the Sahara, just penetrating to some points of the Plateaux. M. Lataste obtained it in Algeria, at Biskra, Mraier, Tuggurt, Bled Ahmar, Hadjira, N'gousa, Tilremt, Laghouat, Aïn-el-Hel, and Bou-Saada, and received from M. Maury specimens at Aïn Sefra, in the south of the Province of Oran; in Tunisia, at Wed-el-Kreil, Kebili, Tozeur, and Nefta. It is not on record from Morocco, although it surely exists in the Saharian parts; we have specimens obtained not far from the southern limit of Morocco, viz. from Cape Jubi, near Cape Nun.

Figured, 'Description de l'Egypte,' Rept., Suppl. pl. i. figs. 7 & 11.

3. Acanthodactylus pardalis, Lichtenstein, 1823.

A. savignyi, Gervais, Guichenot, Strauch, Lataste.—*Zootoca deserti*, Günther.—*A. bedriagæ*, Lataste.

Snout obtuse, or, at any rate, less acute than in *A. scutellatus*. Three supraoculars, the anterior frequently divided into two or three; front edge of ear more or less distinctly denticulated. Dorsal scales very small, granular, or subrhomboidal, smooth or more or less feebly keeled. Ventral plates broader than long, sometimes very slightly, in 12 or 14 regular longitudinal series. Digital denticulations feebly or moderately developed, much shorter than the diameter of the corresponding part of the toe, slightly more developed on the outer than on the inner side. Young longitudinally streaked black and white on the body, with round white spots on the limbs; coloration of adult very variable, usually with longitudinal series of blackish and yellowish or brick-red spots, sometimes with yellowish longitudinal bands; the desert specimens pale greyish or reddish.

A. pardalis is a transitional form between *A. scutellatus* and *A. vulgaris*. It is represented in Algeria and Tunis by two ill-defined varieties, which have been named by Lataste var. *bedriagæ*, the larger, stouter form, approaching *A. vulgaris* in structure as well as coloration, and var. *deserti* (=*Scaptira maculata*, Gray, *Zootoca deserti*, Günther), the smaller form from the Sahara, which often closely approaches *A. scutellatus*.

The subocular rarely reaches the lip; its lower border is usually wedged in between the fourth and fifth or fifth and sixth labials. In Algerian and Tunisian specimens I count 66 to 82 scales round the middle of the body, ventrals included. Femoral pores 15 to 25.

From snout to vent 70 millim., tail 100.

This species occurs from Algeria to Egypt, Somaliland, and Syria. It is the most common and generally distributed species in Algeria and Tunisia; it is common in the Sahara, the Plateaux, and also occurs in the southern parts of the Tell. M. Lataste obtained it in numerous localities both in Algeria and Tunisia, and received it from Kreder, on the Moroccan frontier, from M. Maury in 1888.

Figured, Proc. Zool. Soc. 1881, pl. lxiii. fig. 1.

4. Acanthodactylus vulgaris, Dum. & Bibr. 1839.

A. lineomaculatus, D. & B.

Snout obtuse. Two supraoculars, the first and fourth being broken up into small scales or granules; front edge of the ear not or but feebly denticulated. Dorsal scales smooth, or more or less distinctly keeled, small, rhomboidal, feebly imbricate on the back. Ventral plates much broader than long (the largest nearly or quite twice as broad as long), in straight longitudinal and transverse series; 8 or 10 plates across the middle of the body. Digital denticulations very feebly developed, about equally on both sides. Young longitudinally streaked black and white on the body, with round white spots on the limbs; tail pink; adult greyish or brownish, with more or less distinct traces of light and dark longitudinal lines and longitudinal series of black and pale spots; sometimes with large blue ocelli on the sides.

This species might be divided into two forms—the typical form from Europe and Algeria, with smooth or faintly keeled scales, and the var. *lineomaculatus*, D. & B., from Morocco and Algeria, with strongly keeled scales,—were it not that there exists so complete a transition between the two that it is almost impossible to draw the line. It is a fact, however, that all specimens from Morocco, of which very many have been examined, have strongly keeled scales, and, with rare exceptions, the subocular does not reach the lip, but forms an angle inferiorly, wedged in between the fourth and fifth, rarely fifth and sixth, labials. In Algerian specimens the dorsal scales may be perfectly smooth, or more or less distinctly keeled, and it is but exceptionally that the subocular does not border the lip. Out of 14 Spanish and Portuguese specimens preserved in the British Museum, the subocular borders the lip in two specimens on both sides, and in a third on one side only, the 11 other specimens being in this respect like those from Morocco.

The number of scales round the body (ventrals included) varies from 70 to 85, and that of femoral pores on each side from 22 to 27.

The largest Algerian specimen measures from snout to vent 70 millim., tail 110.

A. vulgaris inhabits the south of France (where very few specimens have been found), the Spanish Peninsula, Morocco, Algeria north of the Sahara, and, probably, Northern Tunisia. It is very common at Tangier, and is on record from Casablanca, Mogador, Morocco, and the Plateau of Chiodma. In Algeria it is found on the coast and rarely on the Plateaux. M. Lataste obtained specimens from Oran, Daya, Plateau of Sersou, Algiers, Wed Sedeur (between Laghouat and Djelfa), Setif, between Aumale and Beni Mansour, Bordj-Bou-Arrerij, and Tebesa.

4. Eremias, Wiegmann, 1834.

Nostril pierced between three (or four) nasals. Eyelids movable. Collar more or less distinct. Dorsal scales small; ventral shields tetragonal, feebly imbricate. Digits with keeled lamellæ inferiorly, not denticulated laterally. Femoral pores.

A single species in Barbary.

1. Eremias guttulata, Lichtenstein, 1823.

E. pardalis, Gervais, Guichenot, Strauch.—*Podarces simoni*, Boettger.

Snout rather pointed; nasals more or less swollen. Lower eyelid with a more or less transparent disk formed of one, two, or several scales. A small occipital, in contact with the interparietal; no auricular denticulation. Collar curved or more or less angular, free or attached in the middle. Dorsal scales granular, smooth. Ventral plates in straight longitudinal and transverse series, broader than long; 10 longitudinal series, the outer composed of very small plates. Coloration very variable, usually pale greyish or brownish above, with blackish dots or series of black spots and white ocelli, or with a broad dark grey vertebral band, &c.; young with dark and light streaks along the sides; lower parts white.

This is a very variable species, especially with respect to the scaling of the lower eyelid and the development of the collar. Specimens with imperfectly transparent eyelid, in which the median disk is broken up into numerous scales, and with the collar distinct only on the sides, have been named *E. simoni* by Boettger, who has kindly enabled me to examine the type specimens preserved in the Senckenberg Museum, two of which are now in the British Museum. Specimens with similar eyelids, but with the collar free right across the throat, were named *E. guttulata* by Duméril and Bibron, and such as have the eyelid perfectly transparent and formed of two scales, and the collar free only at the sides, represent *E. pardalis* of the same authors. The large number of specimens examined by M. Lataste convinced him, however, that no such division can be carried out, and I arrived at the same conclusion when working out the extensive series in the British Museum. The following table shows the variations in the Algerian and Tunisian specimens in the Museum:—

	♂, Aumale.	♀, Tilremt.	♂, Susa.	♀, Cabes
Collar	Distinct, attached in the middle.	Distinct only at the sides.	Distinct, attached in the middle.	Free all round.
Number of scales in transparent palpebral disk	3	2	6	4
Number of scales round middle of body (ventrals included)	68	52	59	52
Femoral pores	17–17	10–10	14–13	11–10

The largest Barbary specimen examined by me measures 45 millim. from snout to vent, tail 72.

The range of *E. guttulata* is a very wide one, extending in Africa from Morocco to Egypt, and in Asia from Arabia and Syria to Sind. In Morocco, the species is recorded by Boettger from Casablanca and between Mogador and Morocco. In Algeria, it is recorded by Strauch from Oran, Algiers, and Laghouat, and by F. Müller (Verh. nat. Ges. Basel, vi. 1878, p. 625) from the Plateau of Sersou; M. Lataste obtained it at Biskra, Mraier, Tuggurt, Gardaia, Berrian, Bou-Guelfaia, Tilremt, Laghouat, near Aumale, between Aumale and Beni-Mansour, and at Bordj-Bou-Arrerij. In Tunisia, the species is known from Susa (Brit. Mus.), Cabes, and the Chotts (André), and was collected by M. Lataste at Cabes, Hadedj, Tamesred and Matmata, Mettamer, Plateau of Haonaia and Djebel Domeur, Zarzis, Kebili, and Djerba Island.

Figured, 'Description de l'Eypte,' Rept., Suppl. pl. iii. figs. 1, 2.

5. Ophiops, Ménétries, 1832.

Nostril between two to four nasals. Eyelids immovable, the lower united with the upper, with a very large transparent disk. Collar absent or very indistinct. Dorsal scales imbricate and strongly keeled. Digits with sharply keeled lamellæ inferiorly, not denticulated laterally. Femoral pores.

A single species in Barbary.

1. Ophiops occidentalis, Boulenger, 1887.

Ophiops elegans, Lataste, Boettger.

Head-shields smooth. Nostril between an upper and a lower nasal, followed by one or two postnasals; four supraoculars, first and fourth small, all in contact with the supraciliaries; occipital very small or absent. Dorsal scales very large and sharply keeled, larger than the laterals, and but little if at all smaller than the caudals; 26 to 30 scales round the middle of the body, ventrals included. 6 to 11 (usually 7 or 8) femoral pores on each side. Olive or bronzy above, with black spots, and one or two light longitudinal streaks on each side; lower parts white.

The North-African *Ophiops* is closely allied to, but perfectly distinct from the South-Eastern Asiatic *O. elegans*, with which it was at first confounded. The absence of granules between the supraoculars and the supraciliaries at once distinguishes it. The scales are also larger, 26 to 30 round the body instead of 30 to 40.

The largest specimen measures 44 millim. from snout to vent, tail 98.

I have given a figure of this species in the third volume of the British Museum 'Catalogue of Lizards,' pl. iii. fig. 2.

The occurrence of *Ophiops* in North Africa was first recorded by Lataste, in 1880; but two specimens from Susa, Tunisia, collected by Mr. Fraser, had been for many years in the British Museum. In 1880, also, Peters recorded it from Tripoli (Mon. Berl. Ac. 1880, p. 308). And in 1885, Boettger (in Kobelt, Reis. Alg. u. Tunis, p. 467) described a specimen obtained by Dr. Kobelt at Biskra. M. Lataste obtained it in Algeria, at Batna, Wed Sedeur, Yukuss (near Tebesa), and Portes de Fer, and examined specimens collected by the Roudaire expedition at the Eastern Chotts; in Tunisia, at Hadedj des Matmata, and between the latter locality and Cabes, Medina, and at Ferriana and Tamesmida.

Fam. 7. SCINCIDÆ.

This large and cosmopolitan family is represented in Barbary by four genera, distinguishable as follows:—

A. Palatine bones in contact on the median line of the palate; nostril in a single nasal . . . . 1. MABUIA.
B. Palatine bones separated on the median line.
a. Rostral not entering the nostril.
Nostril pierced in the nasal; digits not denticulated laterally . . . . 2. EUMECES.
Nostril between an upper and a lower nasal; digits denticulated laterally . . . 3. SCINCUS.
b. Nostril pierced between the rostral and a very small nasal, in an emargination of the former shield . . . . 4. CHALCIDES.

The genus *Ophiomorus*, Bibron, is erased from this fauna for reasons stated above, p. 120.

1. MABUIA, Fitzinger, 1826.

Palatine bones in contact mesially. Eyelids movable. Nostril pierced in a single nasal; supranasals present; præfrontals and frontoparietals present. Limbs well developed, pentadactyle; digits subcylindrical or compressed.

A single species in Barbary.

1. MABUIA VITTATA, Olivier, 1804.

Lower eyelid with an undivided transparent disk. Normally no postnasal; parietals usually in contact behind the interparietal. Ear-opening oval, about as large as a lateral scale, with two or three pointed lobules, one of which usually is long. Nuchal and dorsal scales strongly tricarinate; 32 or 34 scales round the middle of the body, dorsals a little larger than laterals or ventrals. The adpressed limbs meet or slightly overlap, or fail to meet. Olive or brown above, with a more or less distinct lighter vertebral stripe; and two narrow whitish lines on each side, the lower commencing below the eye and passing through the ear; these light streaks may be edged with black lines or bands; lower parts yellowish or greenish white.

From snout to vent 75 millim., tail 105.

Strauch records this Scink from the Mzab, and Lallemant adds the Souf. M. Lataste received specimens from the plateaux of the Province of Constantine and collected two specimens at Biskra. He also found it in Tunisia, at the Oasis of Tozeur, and in abundance at Cabes. The range of *M. vittata* extends eastwards to Egypt and Syria.

Figures: Olivier, Voy. Emp. Othom. pl. xxix. fig. 1; Savigny, Descr. Egypte, Rept., Suppl. pl. ii. figs. 5 & 6.

2. EUMECES, Wiegmann, 1834.

Palatine bones not meeting on the median line of the palate; pterygoids toothed. Eyelids movable, scaly. Nostril pierced in the nasal (which may be divided); supranasals present; præfrontals and frontoparietals present. Limbs well developed, pentadactyle; digits subcylindrical or compressed, not serrated laterally.

Two species in Barbary.

1. EUMECES SCHNEIDERI, Daudin, 1802.

Nasal in contact with the two anterior upper labials; parietals entirely separated by the interparietal. Ear-opening rather large, with four or five long pointed lobules anteriorly. 22 to 28 scales round the middle of the body, perfectly smooth, those of the two median series very broad. The adpressed limbs just meet or fail to meet. Olive-grey or brownish above, uniform or with irregular golden-yellow spots or longitudinal streaks; a yellowish lateral streak, extending from below the eye to the hind limb; lower parts yellowish white.

From snout to vent 160 millim., tail 205.

This large and fine Scincoid inhabits Egypt, Syria, Armenia, Persia, and Baluchistan, and extends westwards to Southern Tunis, where specimens were found by Dr. André at Cherb Berrania, and by M. Lataste at Matmata, Wed Kebiriti (north of Chott Fejej), and Gafsa. The specimen from the south-eastern frontier of Algeria, mentioned by A. Duméril, probably belongs to this species.

Figured in Geoffroy, Descr. Egypte, Rept. pl. iii. fig. 3, and pl. iv. fig. 4.

2. EUMECES ALGERIENSIS, Peters, 1864. (Plate XVI.)

Scincus (*Plestiodon*) *cyprius,* Gervais, Strauch.—? *Plestiodon aldrovandii,* Guichenot.—*Eumeces pavimentatus,* Boettger.

This occidental form is distinguished from the preceding by a somewhat heavier build, the nasal in contact with the first labial only or with a very small portion of the second, shorter ear-lobules, and 30 to 32 scales round the body, the dorsals distinctly striated. Brown above, with small, yellowish, black-edged ocelli and large orange-red spots, which often form irregular transverse bands on the body.

From snout to vent 200 millim., tail 220.

Common in Morocco, at Casablanca and Mogador. In Algeria it appears to occur only in the Province of Oran, where it is recorded by Strauch from St. Cloud, Le Sig, and Arzew. Specimens from Fleurus, near Oran, were examined in the Oran Museum by M. Lataste.

3. SCINCUS, Laurenti, 1768.

Palatine bones not meeting on the median line of the palate; pterygoids toothed. Eyelids movable, scaly. Nostril pierced between two nasals; supranasals present;

præfrontals and frontoparietals present. Limbs well developed, pentadactyle; digits flattened, serrated laterally.

Two species in Barbary.

1. Scincus fasciatus, Peters, 1864.

Head oval, pyramidal, with broad, obtusely truncated snout; nostril lateral; loreal region rounded; eye large; ear-opening large, almost entirely covered by two very large scales. Rostral moderately large, separated from the frontonasal by the supranasals; six supraoculars; parietals as long as interparietal. Body cyclotetragonal, the sides of the belly rounded. 24 or 26 scales round the middle of the body; dorsal scales striated, the two vertebral series largest, at least twice as large as the ventrals; a double series of large transverse nuchals. Digits feebly depressed, feebly denticulated laterally. Yellowish or orange above, with seven transverse black bands, of which the first is on the nape, the second and third on the back, and the fourth on the sacrum.

From snout to vent 147 millim., tail 77.

The type specimen, from Geryville, which I have seen in the Berlin Museum, is described in detail by Peters. The following notes were taken by M. Lataste from his Tunisian specimen:—

Three præfrontals, middle one trapezoid and in contact with the truncate posterior border of the frontonasal; five pairs of nuchals; two superposed anterior loreals, the lower deeper but shorter than the upper; parietals considerably shorter than the frontal; nine upper labials on each side, eighth largest, fifth and sixth under the eye; second and third postmentals divided into two; the two auricular scales much larger than the temporal scales immediately preceding them. 26 rows of scales.

	millim.
From snout to vent	146
From snout to ear	32
Width of head	26

This is a very rare Lizard; only four specimens are actually known. The type specimen noticed by Strauch under *Scincus officinalis* is from Geryville, in the Sahara of the Province of Oran; one specimen was picked up, in a mummified condition, in the plain of Arad, south of Cabes, near Sidi-Guenao, by M. Lataste, and is now preserved in the Paris Museum; a third specimen, from Khartoum, is in the St. Petersburg Museum, as well as the fourth, which is without locality, and served as the type of Strauch's *Cyclodus brandti* in 1866.

2. Scincus officinalis, Laurenti, 1768.

Snout cuneiform, truncate, strongly projecting; nostril pierced in the canthus rostralis; loreal region concave; eye very small; ear-opening distinguishable, covered by two fringed scales. Rostral very large, forming a suture with the frontonasal or in contact with the anterior angle of the latter shield; six supraoculars; parietals shorter than the interparietal, followed by three to five pairs of nuchals; seven to nine upper labials. 26 to 28 (very rarely 30) scales round the middle of the body, all perfectly smooth; dorsals usually not or scarcely larger than ventrals. Sides of belly angular. Digits much depressed and strongly serrated laterally. Yellowish or brownish above, each scale with small brown and whitish spots or shafts; frequently with more or less marked dark transverse bands across the body; lower parts uniform whitish.

From snout to vent 120 millim., tail 85.

This species inhabits the Sahara and the borders of the Red Sea. It is not recorded from Morocco, but was found by M. Maury at Aïn-Sefra, in the south of the Province of Oran, close to the Moroccan frontier. M. Lataste found it common in the Algerian and Tunisian Sahara; its occurrence further north, at Djelfa, for instance, whence it is recorded by Strauch on the authority of Loche, is doubtful. It is only found in the sand, in which it burrows with great rapidity. It is eaten by the Arabs.

Very good figure in 'Description de l'Egypte,' Rept., Suppl. pl. ii. fig. 8.

4. Chalcides, Laurenti, 1768.

Palatine bones not meeting on the median line of the palate, which is toothless. Eyelids movable, lower with an undivided transparent disk. Nostril pierced between the rostral and a very small nasal, in an emargination of the former shield; supranasals present; præfrontals and frontoparietals absent. Limbs short or rudimentary.

Six species in Barbary, distinguishable as follows:—

A. Snout conical.

a. Ear-opening much larger than the nostril.

Limbs pentadactyle . . . . 1. *ocellatus.*
Limbs tridactyle; second and third toes equal . . . . 2. *lineatus.*
Limbs tridactyle; second toe longer than third . . . . 3. *tridactylus.*

b. Ear-opening not or scarcely larger than the nostril.

Limbs tetradactyle (rarely pentadactyle) . . . . 4. *mionecton.*
Fore limb didactyle, hind limb tridactyle . . . . 5. *mauritanicus.*

B. Snout wedge-shaped; sides of belly angular; limbs penta- or tetradactyle. 6. *sepoides.*

1. Chalcides ocellatus, Forskål, 1775.

Snout obtuse, scarcely projecting beyond the labial margin; ear-opening much larger than the nostril. Nostril pierced just above the suture between the rostral and the first labial; supranasals distinct; frontal longer than broad; usually the fifth labial entering the orbit. Body cylindrical or rather depressed. 24 to 40 scales round the middle of the body. Limbs short but well developed and pentadactyle; length of the hind limb thrice and one third to four and a half times in the length from snout to vent. The coloration of the upper parts varies considerably; lower parts uniform whitish.

Four forms occur in Barbary:—

A. Forma typica.

28 or 30 scales round the body. Olive or brown above, ocellated with black spots, sometimes confluent into irregular transverse bands, bearing central white dots or longitudinal shafts. Measures up to 140 millim. from snout to vent.

Figured by Savigny in the Descr. Egypte, Suppl. pl. ii. fig. 7.

Ranges from the Algerian Sahara to Egypt, Syria, Cyprus, Arabia, Persia, and Sind. It is only found south of the Atlas; M. Lataste's specimens are from Tuggurt, Ghardaia, and Cabes.

B. Var. tiliguqu, Gmelin, 1788.

28 to 34 scales round the body (usually 30 or 32). Above olive or brown, with black and white ocelli, and a more or less distinct lighter lateral band sometimes edged with black inferiorly. Stouter and larger than the preceding, reaching a length of 170 millim. from snout to vent.

An excellent figure is given in Bonaparte's 'Fauna Italica.'

Inhabits Sardinia, Sicily, and South Italy, Algeria and Tunis, and the intermediate islands; also Tripoli, Egypt, North-Western Arabia, and Abyssinia. It is common and generally distributed in Algeria and Tunis north of the Sahara.

C. Var. vittatus, Boulenger, 1890. (Plate XVII. fig. 1.)

30 to 34 scales round the body (usually 32). Bronzy brown above, without ocelli; a light upper and a black lower lateral band. From snout to vent 115 millim.

All the specimens from Tangier belong to this variety.

D. Var. polylepis, Boulenger, 1890. (Plate XVII. fig. 2.)

34 to 40 scales round the body (usually 36 or 38). Dark brown above, usually each scale with a small round yellowish spot; sides of neck with vertical black and white bars, which disappear in the adult. From snout to vent 150 millim.

First noticed by Boettger from Casablanca, Mogador, and the city of Morocco.

2. Chalcides lineatus, Leuckart, 1828. (Plate XVII. fig. 3.)

Snout obtuse, scarcely projecting; ear-opening much larger than the nostril. Nostril pierced entirely in advance of the suture between the rostral and the first labial; supranasals distinct; frontal longer than broad; fourth labial entering the orbit. Body cylindrical, much elongate; 22 to 26 scales round the middle of the body. Limbs very small, tridactyle; the second toe as long as the third; the length of the hind limb equals at least the distance between the ear and the fore limb, and is contained 12 to

15 times in the distance from snout to vent. Bronzy olive above, uniform or with nine or eleven dark brown longitudinal streaks, as broad as or broader than the interspaces between them, which occupy the middle of each scale.

From snout to vent 126 millim., tail 134.

C. lineatus inhabits the south of France, Liguria, the Iberian Peninsula, Morocco (whence I have received three specimens from M. H. Vaucher), and Algeria. Whether the specimen of "*Seps chalcides*" from Casablanca, recorded by Dr. Boettger, belongs to this or the following species, is unknown; but Dr. Boettger kindly informs me that a second specimen from Casablanca recently examined by him belongs to *C. lineatus*. The only Algerian specimen I have seen is one obtained by M. Lataste at El Guerra, and now in the collection of Dr. J. de Bedriaga. It is uniform olive above, and has 26 scales round the middle of the body; its length from snout to vent is 140 millim., tail 92, fore limb 10, hind limb 12.

3. CHALCIDES TRIDACTYLUS, Laurenti, 1768.

Seps chalcides, Guichenot, Strauch.

Very closely allied to the preceding. Limbs weaker still, the hind one usually shorter than the distance between the ear and the fore limb, and contained 15 to 24 times in the length from snout to vent; third toe shorter than second. Olive or bronzy above, uniform or with darker and lighter longitudinal streaks, which are constantly in even number.

From snout to vent 183 millim., tail 200.

Inhabits Italy, Sardinia, Sicily, Tunis, and Algeria. Gasco records it from Egypt (Alexandria). M. Lataste found it in Algeria at Oran, Bona, Aumale, between Azesga and Tifrit, and between Bou-Saada and Biskra, and received it from Maison-Carrée and the Plateau of Sersou. Strauch mentions it from the Mzab. M. Lataste states in his notes that specimens of this species were obtained near Tunis by M. M. Sédillot in 1883.

Well figured in Bonaparte's 'Fauna Italica.'

4. CHALCIDES MIONECTON, Boettger, 1873.

Snout rather conical than wedged-shaped, but with distinctly projecting labial edge; ear-opening not or scarcely larger than the nostril, on a line with the mouth. Nostril pierced entirely in advance of the suture between the rostral and the first labial; supranasals distinct or united; frontal longer than broad; fifth labial entering the orbit. Body much elongate; sides of body not distinctly angular, although somewhat more so than in the preceding species; 24, rarely 26, scales round the middle of the body. Limbs short, tetradactyle, rarely with a rudimentary fifth digit: the length of the hind limb equals or a little exceeds the distance between the anterior border of the orbit and the fore limb; the length of the latter equals about three-fourths its distance from the ear-opening. Brown above, usually with small yellowish black-edged ocelli; a broad yellowish stripe on each side of the back; a blackish streak from nostril to eye; lips spotted with blackish; lower surfaces white.

From snout to vent 80 millim., tail 62.

This Moroccan species is intermediate between *C. ocellatus* and *C. sepoides.* Boettger's specimens are from Tangier, Casablanca, and between Mogador and Morocco. I have examined numerous specimens from Tangier, Larache, Casablanca, and Morocco.

Figured by Boettger, Abh. Senck. Ges. ix. 1873, pl. —. fig. 6.

5. Chalcides mauritanicus, Dum. & Bibr. 1839.

Allied to the preceding. Snout conical, slightly projecting; ear-opening minute, scarcely distinguishable; nostril entirely in advance of the suture between the rostral and the first labial; fourth upper labial entering the orbit; supranasals distinct. Body much elongate. 18 scales round the body. Limbs very short; the anterior didactyle, the posterior tridactyle; third toe nearly twice as long as second; the hind limb equals the length of the head, and the fore limb the distance between the end of the snout and the posterior border of the eye. Yellowish or greyish above, with a lateral band formed of closely-set large black dots.

From snout to vent 71 millim., tail 43.

I have examined the two type specimens, from Oran, preserved in the Paris Museum. A third specimen, from Nemours, Province of Oran, obtained by M. Gazagnaire in 1888, is in M. Lataste's collection.

Figured by Guichenot, Explor. Sc. Alg., Rept. pl. ii. fig. 1.

6. Chalcides sepoides, Audouin, 1829.

Sphenops capistratus, Gervais, Strauch.

Snout wedge-shaped, with projecting labial edge; eye very small; ear-opening appearing as an oblique slit at the commissure of the mouth, covered with a fringe of three or four pointed scales. Nostril pierced entirely in advance of the suture between the rostral and the first labial; supranasals fused to a single shield; frontal as broad as or a little broader than long; fourth labial entering the orbit. Body much elongate; sides of belly angular; 24 scales round the middle of the body. Limbs weak, penta- or tetradactyle, the hind pair more developed than the front pair; the length of the fore limb equals half its distance from the centre of the eye, that of the hind limb about the distance between the nostril and the fore limb. Yellowish above, with more or less distinct light brown longitudinal streaks; a dark brown streak on each side of the head, beginning from the nostril and passing through the eye; lower surfaces white.

From snout to vent 95 millim., tail 75.

C. sepoides occurs from Senegambia and Algeria to Egypt, Arabia, and Syria. Like the true Scink, it is essentially a sand Lizard, adapted for burrowing. It is scarce in Algeria and Tunisia. Gervais records it from the Souf and Strauch from the Mzab. M. Lataste received from Major Oudri a specimen from Mraia, and found a single one himself at Tuggurt. He obtained another specimen in Tunisia, at Mettamer, and records it from Tozeur (collected by Dr. André).

Figured in the 'Description de l'Egypte,' Rept., Suppl. pl. ii. figs. 9 & 10.

Suborder II. *RHIPTOGLOSSA.*

Fam. 1. CHAMÆLEONTIDÆ.

1. Chamæleon, Laurenti, 1768.

Eye large, covered by a thick granular lid pierced with a small opening for the pupil. No ear-opening. Body compressed. Digits arranged in bundles of two and three; claws simple; scales on soles smooth. Tail prehensile, at least as long as head and body. A large genus, inhabiting Africa, Madagascar, the south of Spain, Asia Minor, Syria, Arabia, and India and Ceylon.

1. Chamæleon vulgaris, Daudin, 1802.

C. africanus, Schlegel.—*C. cinereus,* Strauch.

Casque raised posteriorly, with strong curved parietal crest; the distance between the commissure of the mouth and the extremity of the casque nearly equals the length of the mouth; a strong lateral crest, becoming indistinct as it ascends towards the extremity of the parietal crest; a small but very distinct occipital dermal lobe on each side, extending to the extremity of the parietal crest. Body uniformly granulate; no dorsal crest; a more or less distinct series of conical scales on the anterior part of the vertebral keel; a series of conical, slightly enlarged granules on the median line of the throat; no ventral crest. No tarsal process. Tail usually a little shorter than head and body. A white line from chin to vent; usually two or three series of pale spots along each side.

Total length 274 millim., tail 135.

The Chameleon inhabits North Africa, the South of Spain, Asia Minor, and Syria. It is more or less common all over Barbary, where shrubs or trees occur, and it is also found in the oases of the Sahara. A good whole figure is given in the "Description de l'Egypte," Rept. pl. iv. fig. 3; and of the head in the British Museum Catalogue of Lizards, iii. pl. xxxix. fig. 1. A specimen from Bou-Saada has recently been described as *C. saharicus* by F. Müller, Verh. nat. Ges. Basel, vii. 1885, p. 715, pl. xi., and viii. 1887, p. 295, but it is nothing but a half-grown *C. vulgaris.*

Suborder III. *OPHIDIA*.

The Snakes of Barbary belong to three families, distinguished as follows:—

Mandible with coronoid element; maxillary horizontal; præfrontal bones forming a suture with nasals; vestiges of pelvis terminating in a claw-like spur visible on each side of the vent . . . . 1. **Boidæ.**

Mandible without coronoid element; maxillary horizontal; præfrontals not forming a suture with nasals; no rudiments of pelvis . . . . 2. **Colubridæ.**

Mandible without coronoid element; maxillary vertically erectile, perpendicular to transpalatine; præfrontals not forming a suture with nasals; no rudiments of pelvis . . . . 3. **Viperidæ.**

Fam. 1. BOIDÆ.

A single genus.

1. Eryx, Daudin, 1803.

Anterior maxillary and mandibular teeth a little longer than posterior. Head covered with small scales; a mental groove. Eye very small, with vertical pupil. Scales very small, smooth or keeled. Tail very short, not or but very slightly prehensile; subcaudals simple.

1. Eryx jaculus, Linnæus, 1766.

Rostral large, with angular horizontal edge; nine to eleven upper labials, separated from the eye by one or two series of scales. Scales smooth, in 40 to 50 longitudinal rows. Pale greyish or yellowish brown above, with large dark brown transverse blotches or alternating spots; belly white, uniform or with black dots.

Total length 510 millim., tail 45.

Inhabits North Africa, Greece, Turkey, and South-western Asia. Strauch records the snake from Oran and the Algerian Sahara, and M. Lataste obtained it at Wed Magra, Barika, and Ngaous, between Msila and Batna. A specimen was obtained in Tunisia at Bir-oum-Ali, south of Tebesa, near Tamesmida, by M. Sédillot. Not on record from Morocco.

Figured, 'Description de l'Egypte,' Rept. pl. vi. fig. 2.

Fam. 2. COLUBRIDÆ.

The *Colubridæ* of Barbary belong to 8 genera, falling into three divisions or series:—

A. *Aglypha*. No grooved fangs. Harmless.

a. Scales smooth or feebly keeled.

Head short; pupil round; no subocular . . . . 1. Coronella.

Snout cuneiform; pupil vertically elliptic . . . . 2. Lytorhynchus.

Head elongate; one or more suboculars below the præocular . . . . . 3. ZAMENIS.
b. Scales strongly keeled . . . . 4. TROPIDONOTUS.
B. *Opisthoglypha.* Grooved fangs behind the series of maxillary teeth. Suspected, or poisonous to a slight degree.
a. Some of the anterior maxillary teeth enlarged and separated from those following by an interspace.
Head short; eyes rather small, pupil vertically subelliptic . . . . . . 5. MACROPROTODON.
Head elongate; eye large, with round pupil . . . . 6. PSAMMOPHIS.
b. Only the grooved maxillary teeth enlarged . . . . 7. CŒLOPELTIS.
C. *Proteroglypha.* Grooved fangs anteriorly. Poisonous.
Neck dilatable; no loreal shield . . . . 8. NAIA.

1. CORONELLA, Laurenti, 1768.

Maxillary teeth 12 to 14, increasing in size posteriorly; mandibular teeth subequal. Head short, scarcely distinct from neck; eye rather small, with round pupil. Body cylindrical; scales smooth, in 19 to 32 rows, with apical pits; ventrals rounded; tail moderate; subcaudals in two rows.

Two species in Barbary.

1. CORONELLA AMALIÆ, Boettger, 1881. (Plate XVIII. fig. 1.)

Snout prominent; rostral as deep as broad, produced posteriorly between the internasals, the portion seen from above about half as long as its distance from the frontal; suture between the internasals one-third the length of that between the præfrontals; frontal a little longer than its distance from the end of the snout, a little shorter than the parietals; loreal longer than deep; one præ- and two postoculars; temporals 2+3; eight upper labials, fourth and fifth entering the eye; four lower labials in contact with the anterior chin-shields; posterior chin-shields three fourths the length of the anterior. Scales in 21 rows. Ventrals 190–193; anal divided; subcaudals 63–64. Grey-brown above, with reddish-brown spots and four rather indistinct dark longitudinal bands; vertebral region light; a pair of elongate dark brown spots on the nape; a black streak on each side of the head, from the nostril, through the eye, to the angle of the mouth; a dark band between the eye crossing the præfrontals; a black line below the eye, on the suture between the fourth and fifth upper labials. Lower surfaces coral-red, with quadrangular black spots.

Total length 390 millim., tail 72.

This species is intermediate between *C. austriaca* and *C. girondica*, agreeing with the former in the size and shape of the rostral shield, with the latter in all other respects.

The two specimens from which the above description is taken were obtained by M. H. Vaucher in the Benider hills, near Tangier. The type specimen of *Rhinechis amaliæ*, Boettg., is from between Tetuan and Tangier. M. Lataste received a single specimen from Bona, through Dr. Hagenmüller.

2. Coronella girondica, Daudin, 1803.

Snout scarcely prominent; rostral much broader than deep, just visible from above; suture between the internasals half as long as that between the præfrontals; frontal a little longer than its distance from the end of the snout, a little shorter than the parietals; loreal longer than deep; one præ- and two postoculars; temporals 2+3; eight upper labials, fourth and fifth entering the eye; four lower labials in contact with the anterior chin-shields, which are as long as the posterior. Scales in 21 rows. Ventrals 200; anal divided; subcaudals 59. Grey-brown above, with blackish spots; a pair of elongate blackish spots on the nape; a black streak on each side of the head, from the nostril, through the eye, to the angle of the mouth; a dark band between the eyes, crossing the præfrontals; a black line below the eye, on the suture between the fourth and fifth upper labials. Lower surfaces yellowish (in spirit), with quadrangular black spots.

Total length 450 millim., tail 80.

The above description is taken from a single female specimen from the city of Morocco, described in 1874 by Dr. Boettger, to whose kindness I am indebted for examining it. The species was recorded from Tangier by Gervais, who probably took for it the common *Macroprotodon cucullatus*, which does not appear in his list. Boettger records it from Tlemsen, in the Province of Oran. Nothing more can be said as to its distribution in Algeria since the records of authors may be based on the closely-allied *C. amaliæ*. M. Lataste did not meet with it in Algeria. *C. girondica* inhabits the south of France, Spain and Portugal, and Italy.

Figured in Bonaparte's 'Fauna Italica,' and in Jan's Icon. Gén. Ophid. livr. 17, pl. iii. figs. 1–3.

2. Lytorhynchus, Peters, 1862.

Maxillary teeth 6 to 9, posterior much longer than anterior; mandibular teeth subequal. Head slightly distinct from neck, with cuneiform projecting snout; eye moderate; pupil vertically elliptic; rostral large, four-sided, projecting, concave beneath; nostril an oblique slit between two nasals. Body cylindrical; scales smooth, in 19 rows, without apical pits; ventrals obtusely angulated laterally; tail moderate; subcaudals in two rows.

A single species in Barbary.

1. Lytorhynchus diadema, Dum. & Bibr. 1854.

Rostral angularly bent, with straight horizontal edge, detached on the sides, the portion visible from above as long as its distance from the frontal; suture between the internasals much shorter than that between the præfrontals; frontal nearly as long as its distance from the end of the snout, slightly shorter than the parietals; a small, squarish loreal; one or two præoculars, with or without a subocular below; two postoculars; temporals 1+2 or 2+3; seven or eight upper labials; fourth, fifth, or fourth and fifth, entering the eye; three lower labials in contact with the anterior chin-shields; posterior chin-shields as long as or a little longer than the anterior, and separated from each other by two series of scales. Scales in 19 rows. Ventrals 160 to 188; anal divided; subcaudals 36 to 46. Pale buff or cream-colour above, with a series of large transversely rhomboidal dark spots; a dark median band along the head and nape, sometimes confluent with an interocular transverse band; an oblique dark band from the eye to the angle of the mouth; lower parts uniform white.

Total length 450 millim., tail 60.

This sand-snake was first described from a specimen obtained in Algeria in the Western Desert. Gervais records another from the Souf. A specimen from Batna is in the St. Petersburg Museum. M. Lataste received it from Mraïer through Major Oudri, and from Ferriana, in Tunisia, through Dr. Robert. M. Valéry-Mayet found it at Gourbata, near Gafsa, and Marquis Doria has it from Kairouan. It is also known to occur in the Sennaar, in Arabia, Syria, and Persia. Figured by Jan, Icon. Gén. Ophid. livr. 10, pl. vi. fig. 2.

3. Zamenis, Wagler, 1830.

Maxillary teeth 10 to 20, increasing in size posteriorly; mandibular teeth subequal. Head elongate, distinct from neck; eye moderate or rather large, with round pupil; one or more suboculars. Body elongate, cylindrical; scales smooth or feebly keeled, in 15 to 31 rows, with apical pits; ventrals rounded or with an obtuse lateral keel; tail long; subcaudals in two rows.

The study of the species of this genus is a most perplexing one, owing to the complete passage which exists between many forms which it seems nevertheless necessary to distinguish. As regards the Barbary *Zamenis*, however, of which only three species are to be distinguished, the only difficulty will be in the definition, otherwise than by coloration, of *Z. algirus* from *Z. hippocrepis*; I am afraid we must at present content ourselves with the statement that the former has the scales disposed in 25 longitudinal rows and usually one labial entering the eye, whilst the latter has the scales usually in 27 rows (at the point where they are most numerous) and usually the eye completely separated from the labials by a series of suboculars.

Three other species have been ascribed to the fauna of Barbary, but must be erased: 1. *Z. florulentus*, Schleg., noticed and head figured by Gervais (Mém. Ac. Montpellier, iii. 1857, p. 512, pl. v. fig. 4), from Laghouat, is, in my opinion, the *Z. algirus*, and therefore widely different from Schlegel's species. 2. *Zamenis atrovirens*, Shaw, recorded from Algiers by Günther (Cat. Colubr. Snakes, 1858, p. 102) from a specimen purchased of a dealer in Paris, and mentioned from Mogador (specimen purchased, 1870) in the list of the animals having lived in the London Zoological Gardens. 3. *Zamenis ater*, Günther (Ann. & Mag. N. H. (4) ix. 1872, p. 22), stated to be from Biskra, is a melanotic variety of the South-American *Liophis reginæ*.

The three species described below may be distinguished as follows:—

Scales perfectly smooth, in 25 rows; usually one labial entering the eye; a pair of internasals and a pair of præfrontals . . . . 1. *algirus.*
Scales perfectly smooth, in 27 (rarely 25 or 29) rows; usually no labial entering the eye; a pair of internasals and a pair of præfrontals . . . . 2. *hippocrepis.*
Scales more or less distinctly keeled, in 25 to 33 rows; no labial entering the eye; usually three or more præfrontals; anal entire . . . . 3. *diadema.*

1. Zamenis algirus, Jan, 1863.

Z. florulentus, Gervais.

Scales smooth, in 25 rows. One præocular, with a subocular below; two postoculars and a subocular; temporals 2+3; nine upper labials, rarely ten, fifth or sixth usually entering the eye, but sometimes separated by an additional subocular. Ventrals 214 to 232; anal divided, rarely entire; subcaudals 92 to 100. Pale olive, yellowish brown, or greyish above, with three alternating series of darker transverse bars, and a series of dark spots along each side of the belly; a more or less distinct blackish crescentic band on the nape, extending to the sides of the throat; a blackish spot below the eye; lower parts white. Young specimens may have the head entirely black above.

Total length 940 millim., tail 230.

This species appears to be restricted to the Algerian and Tunisian Sahara. M. Lataste obtained specimens in Algeria at Biskra, Laghouat, between Bou-Saada and Biskra, and in Tunisia at Cabes, Raz-el-Oued, Aïn-Zerig, Hadedj, Djebel Domeur, Djerba Island, Tozeur, Ferriana, Gafsa; and M. Valéry-Mayet on Kerkenna, and at Djebel Berda and Madjoura; specimens were obtained on the Tunisian Chotts by Dr. André.

Of 14 examples examined by M. Lataste, all have 25 rows of scales; two have the anal single. In 22 out of 28 cases the fifth labial enters the eye, in two cases the sixth, in four the eye is completely separated from the labials by suboculars.

Figure: Jan, Icon. Gén. Ophid. livr. 48, pl. iv. fig. 2.

2. Zamenis hippocrepis, Linnæus, 1766.

Scales smooth, in 25 to 29 rows, usually 27. One or two præoculars; two postoculars; a series of three or four suboculars usually completely separates the eye from the labials; temporals 2+3 or 3+3; eight or nine (rarely ten) upper labials, fifth or sixth very rarely entering the eye. Ventrals 222 to 248; anal divided, rarely entire; subcaudals 79 to 107. Brown, reddish, yellow, or pale olive above, with a dorsal series of large dark brown, black-edged rhomboidal spots, on each side of which is a series of smaller alternating spots; these spots may be black and so large as to reduce the ground-colour to a mere chain or series of X's of pale colour; a dark cross-band between the eyes, and a Λ- or horseshoe-shaped band on the back of the head, which may be confluent with an elongate spot on the nape; the spots confluent into three longitudinal streaks on the tail; yellowish or red beneath, with or without black dots, but constantly with a lateral series of black spots.

Total length 1340 millim., tail 270.

One of the commonest snakes in Morocco and Algeria north of the Sahara, and extending to the northern parts of Tunisia. Obtained by M. Lataste in Algeria, at Oran, Batna, M'sila, and Tebesa, and received by him from the Plateau of Sersou and from Bona. Found also in Spain and Portugal and in Sicily. Recorded from Egypt through confusion with *Z. nummifer*, Rüppell.

Figured in Bonaparte's 'Fauna Italica.'

3. Zamenis diadema, Schlegel, 1837.

Z. cliffordii, Strauch.

Scales more or less obtusely keeled, in 25 to 33 rows. Head-shields more or less broken up, there being frequently three transverse series of shields between the rostral and the frontal; three or more præfrontals; three to five loreals; two to four præ- and three or four postoculars; a series of suboculars separates the labials from the eye; temporals small, scale-like; 10 to 13 upper labials. Ventrals 210 to 278; anal entire; subcaudals 65 to 110. Pale buff or sandy grey above, with more or less marked dark spots, of which the median usually form a series of rhombs; lower parts white, rarely with small blackish spots.

Total length 1800 millim., tail 340.

Ranges from the Algerian Sahara eastwards to North-western India. M. Lataste collected specimens at Biskra, Wargla, and Wed Magra in Algeria, and at Mettamer and Ferriana in Tunisia. The specimen from Biskra has 33 rows of scales, two from Wargla 25, two others from Wargla 27, the one from Wed Magra 32, the one from Mettamer 27, and the one from Ferriana 32.

Figures: Jan, Icon. Gén. Ophid. livr. 20, pl. ii.; Geoffroy, Descr. Egypte, Rept. pl. viii. fig. 1.

4. Tropidonotus, Kuhl, 1824.

Maxillary teeth 12 to 22, posterior longest; mandibulary teeth subequal. Head distinct from neck; eye moderate or rather large, with round pupil. Body cylindrical; scales keeled (rarely smooth), in 15 to 29 rows, with or without apical pits; ventrals rounded; subcaudals in two rows. Nasal bones very small; vertebral hypapophyses distinct throughout the vertebral column.

Two species in Barbary.

1. Tropidonotus natrix, Linnæus, 1766.

Scales in 19 rows. Seven upper labials, third and fourth entering the eye; usually one præ- and three postoculars. Greyish, brownish, or olive above, uniform or with black spots; young with a yellow, black-edged collar, which may disappear in the adult. A variety (*persa*, Pall., *murorum*, Bp.) with two whitish or yellowish stripes along the back is common in Italy, but has not been found in Algeria.

Total length one metre or more.

Found all over Europe, Western and Central Asia. Rare in Algeria; not recorded from Morocco or Tunisia. Dr. Strauch found it at Algiers, M. Lataste at La Chiffa, Algiers, and Tifret, and Dr. Hagenmüller on Mt. Edough, near Bona.

Figures: Bonaparte, 'Fauna Italica' (*Natrix torquata*).

2. Tropidonotus viperinus, Latr., 1802.

Scales in 21 rows, rarely 23 (one specimen from L'Arba and one from Cabes, *Lataste*). Seven upper labials, third and fourth entering the eye; one or two præ- and two postoculars. Greyish, brownish, or reddish, with a more or less distinct black zigzag stripe along the back and ocelli on the sides; frequently (var. *ocellata*, Wagl., *aurolineata*, Gervais) two pale stripes along the back.

Total length 850 millim.

Common all over Morocco, Algeria, and Tunisia, wherever water occurs, for this species is still more aquatic than the preceding. Inhabits also the Iberian Peninsula, France, Switzerland, and Italy.

Figure: Bonaparte, 'Fauna Italica.'

5. Macroprotodon, Guichenot, 1850.

Maxillary teeth 10 or 11, fourth and fifth or fifth and sixth enlarged, followed by an interspace, the two posterior grooved; mandibular teeth increasing in size to the sixth, which is followed by an interspace, the posterior teeth small. Head short, slightly distinct from neck; eye small, with vertically subelliptic pupil. Body moderately elongate, cylindrical; scales smooth, in 19 to 25 rows, with apical pits; ventrals rounded; tail moderate; subcaudals in two rows.

1. Macroprotodon cucullatus, Geoffroy, 1827.

M. mauritanicus, Guichenot.—*Lycognathus tæniatus* et *textilis*, Dum. & Bibr.—*Coronella brevis*, Günther.—*M. maroccanus*, Peters.

The unique species of this genus bears a general similarity to the Palæarctic species of *Coronella*, from which it is, however, easily distinguished by the much depressed snout, the subelliptic pupil, the very broad and low rostral shield, and the presence of a single anterior temporal, which is usually separated from the postoculars, the sixth upper labial touching the parietal. Eight upper labials, fourth and fifth entering the eye; one præ- and two postoculars. The number of rows of scales varies from 19 to 25. Specimens from Tangier and Tetuan appear to have constantly 21 rows of scales, like those from the south of Spain (Badajos, *coll. Lataste*; Andalusia, *Brit. Mus.*). The number varies from 21 to 25, 23 being the usual number, in those from Casablanca, Mogador, and Morocco (*Coronella brevis*, Gthr., *Macroprotodon maroccanus*, Peters); out of 7 specimens from the city of Morocco, I find 5 with 23 rows, one with 21, and one with 25, and variation in a nearly equal proportion is recorded by Boettger on 44 specimens from Casablanca. In Algerian and Tunisian specimens there are usually 19 rows, as in all those from the Baleares, Tripoli, and Egypt; but I note 21 rows in one from Tunis, and M. Lataste found the same number in one specimen from Batna. Ventrals 153 to 192; anal divided; subcaudals 40 to 51. The coloration also varies greatly, and irrespective of the scaling. The large black blotch on the head, whence the name *cucullatus*, is not very frequent in occidental specimens; but a dark collar, descending to the sides of the neck, is usually present, and an oblique dark streak below the eye is constant. The belly may be uniform yellowish or almost entirely black; it is usually yellowish, with quadrangular black spots, as in *Coronella girondica* and *amaliæ*; usually a dark streak along the middle of the subcaudal region.

The largest specimen examined by me measures 490 millim., tail 85.

This species inhabits the south of the Iberian Peninsula, the Baleares, and the whole of North Africa, penetrating into the Sahara. It is common and generally distributed in Morocco, Algeria, and Tunisia.

Figured by Guichenot, Explor. Sc. Alg., Rept. pl. ii. fig. 2.

6. Psammophis, Boie, 1827.

Maxillary teeth 10 to 13, one or two of the middle ones much enlarged, fang-like, and preceded and followed by an interspace, the two posterior grooved; anterior mandibular teeth long, posterior small. Head elongate, distinct from neck, with angular canthus rostralis; eye rather large, with round pupil. Body elongate, cylindrical; scales smooth, in 15 or 17 rows, with apical pits; ventrals rounded or obtusely angulated laterally; tail long; subcaudals in two rows.

A single species in Barbary.

1. Psammophis sibilans, Linnæus, 1766.

Ps. punctatus, D. & B., Gervais.

Head narrow and elongate; internasals much shorter than the præfrontals; frontal very narrow, in contact with the præocular; loreal much elongate; one or two præ- and two or three postoculars; eight or nine upper labials, fourth and fifth, or fifth and sixth[1] entering the eye. Scales in 17 rows. Brown or greenish above, with longitu-

[1] All the specimens obtained in Algeria and Tunis by M. Lataste have 9 upper labials, fifth and sixth entering the eye (var. *punctata*, D. & B.).

dinal series of darker dots, or with two or three yellowish longitudinal streaks; upper lip and lower parts yellowish white, uniform or dotted with black.

Total length 920 millim., tail 290. Reaches a length of $1\frac{1}{2}$ metre.

Inhabits North Africa, Arabia, Syria, Asia Minor, and Southern Russia. Recorded by Gervais from Sefissifa, near the Moroccan frontier of Algeria, and by Strauch from the Mzab. M. Lataste found this snake common in the Algerian and Tunisian Sahara, and in the southern parts of the Plateaux; in Algeria, at Biskra, Tuggurt, Laghouat, Bou-Guelfaia, and Bou-Saada; in Tunisia at Raz-el-Wed, Cabes, Djebel Domeur, El Hamman des Beni-Zib, Fratis, Taferma, Tamesred, Bougrara, Mettamer, and Nebech el Dib.

Figured in 'Description de l'Egypte,' Rept. pl. viii. fig. 4.

7. Cœlopeltis, Wagler, 1830.

Maxillary teeth 10 to 16, subequal, followed by a very long grooved fang; anterior (especially 3rd to 5th or 6th) mandibular teeth long, posterior small. Head more or less elongate, distinct from neck, with angular canthus rostralis and projecting supraocular; eye large, with round pupil; nostril a crescentic slit between two nasals. Body elongate, cylindrical; scales smooth, more or less distinctly grooved longitudinally in the adult, with rather indistinct apical pits, in 17 or 19 rows; ventrals rounded; tail rather long; subcaudals in two rows.

Two species in Barbary.

1. Cœlopeltis lacertina, Wagler, 1824.

C. monspessulanus, Rozet.

Snout rather prominent, obtuse; forehead and loreal region concave. Internasals much shorter than the præfrontals; frontal narrower than the supraocular, in contact with the præocular; two loreal shields; one præ- and two or three postoculars; eight upper labials, fourth and fifth entering the eye. Scales more or less distinctly grooved, in 19 (rarely 17) rows. Olive or brown above, with or without dark spots; sides often blackish; yellowish white beneath, uniform or spotted or clouded with brown or olive.

Total length 1580 millim., tail 350.

This fine snake inhabits Southern Europe, the whole of North Africa, north and south of the Atlas, and South-western Asia. It is one of the commonest snakes all over Morocco, Algeria, and Tunisia.

Excellent figures are given by Bonaparte, 'Fauna Italica,' and by Savigny, 'Description de l'Egypte,' Rept., Suppl. pl. v. figs. 2 & 3.

2. Cœlopeltis producta, Gervais, 1857.

Snout very prominent, obtusely pointed; forehead flat or slightly convex; loreal region concave. Rostral wedged in far between the internasals, which are a little shorter than the præfrontals; frontal as broad as the supraocular; a single loreal; one præ- and two or three postoculars; eight upper labials, fourth and fifth entering the eye. Scales not very distinctly grooved, in 17 rows. Pale yellowish brown or sandy grey above, with brown or blackish spots; two oblique brown bars on each side of the head behind the angle of the mouth; lower parts white.

Total length 600 millim., tail 110.

Originally described from the Algerian Sahara, this species has since been found in Tunisia, Tripoli, Egypt, Nubia, and Arabia.

Gervais's specimen was obtained on the borders of the Sahara, between Bou-Alam and the Arbas, in the Province of Oran. A single specimen was obtained in Tunisia, at Bou-Hedma, near Gafsa, by M. Valéry-Mayet.

Figured by Jan, Icon. Gén. Ophid. livr. 34, pl. ii. fig. 2.

8. Naia, Laurenti, 1768.

Poison-fangs with a distinct groove anteriorly, followed by one to three small solid teeth. Head distinct from neck; no loreal. Eye rather small, with round pupil. Neck dilatable. Body cylindrical; scales disposed obliquely, smooth, in 15 or more rows; tail moderate; subcaudals in a single or double row.

A single species in Barbary.

1. Naia haie, Linnæus, 1766.

Seven upper labials, sixth largest and in contact with the postoculars. 21 to 23 scales across the neck, 19 to 21 across the middle of the body. All the specimens hitherto found in Barbary have the eye completely separated from the labials by a series of suboculars (var. *annulifera*, Peters, 1854) and the coloration of the upper parts is a uniform dark or blackish brown.

Reaches a length of 2 metres.

The African Cobra is found all over Africa south of the Atlas.

A. Duméril (Rev. Mag. Zool. 1856, p. 554) mentions a specimen received by the Paris Museum from Morocco, and Boettger records it from the interior of Morocco. M. Lataste obtained specimens near Biskra, and one at Zarzis, in Tunisia; a second specimen was obtained in Tunisia by M. Valéry-Mayet at the well of El Aïa, near Wed Leben, and a third at Raz-el-Aioun, between Gafsa and Tameghza, by M. Sédillot.

The var. *annulifera* is beautifully figured in the 'Expédition de l'Egypte,' Rept., Suppl. pl. iii.

Fam. 3. VIPERIDÆ.

The Vipers of Barbary belong to three genera:—

Lateral series of scales running in straight longitudinal lines; subcaudals in two rows . . . . 1. VIPERA.
Lateral scales disposed obliquely; subcaudals in two rows . . . . 2. CERASTES.
Lateral scales disposed obliquely; subcaudals in a single row . . . . 3. ECHIS.

1. VIPERA, Laurenti, 1768.

Upper surface of head covered with scales or small shields. Scales keeled, in 21 to 38 straight longitudinal rows. Subcaudals in two rows.

The three species found in Barbary may be distinguished as follows:—

A. Nostrils lateral.
Scales in 21 rows; end of snout turned up . . . . 1. *latastii.*
Scales in 23 to 27 rows; snout blunt . . . . 2. *lebetina.*
B. Nostrils directed upwards; scales in 29 to 31 rows . . . . 3. *arietans.*

1. VIPERA LATASTII, Boscá, 1878.

V. aspis, Strauch.

Snout turned up, terminating in a low erect appendage; rostral twice as deep as broad; a large supraocular shield, separated from its fellow by five to eight longitudinal series of smooth scales; two or three series of scales between the eye and the labials; 9 to 11 upper labials. Scales in 21 rows. Pale brown above, with a zigzag or scalloped dark brown band and a lateral series of dark brown spots; a dark band from the eye to the neck; lower parts blackish, dotted or spotted with white or grey, spotted black and white.

Total length 530 millim., tail 60.

This species, first described from Spain and Portugal, where it had long been confounded with the more oriental *V. ammodytes*, is of particular interest as forming a complete passage between the latter species and *V. aspis*; in fact, the lesser development of the rostral appendage as compared with *V. ammodytes*, and the greater development of the same as compared with *V. aspis*, are the only characters which distinguish *V. latastii* from its two allies.

It was first recorded in Barbary from Guyotville, near Algiers, under the name of *V. aspis*, by Strauch, and it has since been found on Mt. Edough, near Bona, by Dr. Hagenmüller and M. Lataste. Dr. Kobelt collected two specimens near Tangier, which have been described by Boettger.

Figured by Boscá, Bull. Soc. Zool. France, 1878, pl. iv.

2. Vipera lebetina, Linnæus, 1766.

V. brachyura, Schlegel.—*Echidna mauritanica,* Guichenot.

Snout obtuse. Nostril between three shields; rostral a little broader than deep; a narrow supraocular shield is present or absent; upper surface of head covered with small, imbricate, strongly keeled scales, 9 to 12 across the forehead, from eye to eye; three or four series of scales between the eye and the labials; 10 to 12 upper labials. Scales in 23 to 27 rows. Pale grey-brown above, with darker spots or cross-bands, which are very distinct in the young, but feebly marked or absent in the adults; lower parts whitish, powdered with grey.

Total length $1\frac{1}{2}$ metre.

Inhabits North Africa and South-western Asia, and the Greek Island Milo, to Northern Baluchistan, Afghanistan, and Cashmere. It is not uncommon near Oran; has been recorded from the interior of Morocco by Boettger; M. Lataste saw specimens from near Batna and Mt. Edough, Bona[1], in the collection of M. Hénon, and captured others in Tunisia at El Hammam des Beni-Zib, Djebel Domer, Taferma, and Tamesmida, and received a specimen from Tadjera, near Mettamer, through Capt. Rebillot.

Figured by Guichenot, Explor. Sc. Alg., Rept. pl. iii.

3. Vipera arietans, Merrem, 1820.

Snout very short and broad. Nostrils large, directed upwards, pierced between three shields; rostral more than twice as broad as deep; no supraocular shield; upper surface of head covered with small, imbricate, strongly keeled scales, 9 to 11 across the forehead, from eye to eye; three or four series of scales between the eye and the labials; 12 to 15 upper labials. Scales in 29 to 31 rows. Yellowish or pale brown above elegantly marked with large ᴧᴧ-shaped, dark brown, black-edged spots; a large dark blotch covers the crown, separated from a smaller interorbital spot by a transverse yellow line; an oblique dark brown band below, and another behind the eye.

Reaches a length of 1220 millim.

This large and deadly snake is found over the greater part of Tropical and South Africa. From West Africa it penetrates into Southern Morocco, a specimen from the Valley of Sous having been recorded by Boettger.

A good figure is given by Wagler, Icon. Amph. pl. xi.

2. Cerastes, Wagler, 1830.

Upper surface of head covered with scales. Scales keeled, in 23 to 33 rows, the laterals disposed obliquely. Subcaudals in two rows.

Two species in the Algerian and Tunisian Sahara.

[1] This locality, M. Lataste informs me, is somewhat doubtful. The Batna specimens are uniform greenish above.

1. Cerastes vipera, Linnæus, 1766. (Plate XVIII. fig. 2.)

Vipera avicennæ, Strauch.

Snout very short, rounded; eye very small. Head-scales small, tubercularly keeled; nostril between two small shields; no horn-like scales over the eye; three or four series of keeled scales between the eye and the labials. Scales in 23 to 25 rows. A strong keel on each side of the ventrals. Yellowish brown, sand-colour above, with or without darker spots; lower parts white.

Total length 240 millim., tail 30.

This small Viper inhabits the desert of Algeria, Tunisia, Tripoli, and Egypt. It was first recorded in Algeria from the Western Desert by Duméril and Bibron (*Echidna atricauda*), and M. Lataste collected specimens at Bou-Saada, Biskra, and between Bou-Saada and Biskra. M. Lataste did not come across it in Tunisia, but was informed that Marquis Doria possesses several specimens from the southern parts.

The specimen figured by Jan under the name of *Vipera avicennæ* is a *Cerastes cornutus* without horns. As there exists no figure of this viper, I have supplied one on Plate XVIII. fig. 2.

2. Cerastes cornutus, Forskål, 1775.

Vipera cerastes, Schlegel, Gervais, Strauch.

Snout very short and broad; eye rather small, usually with a large, ribbed, horn-like scale above. Head-scales small, tubercularly keeled; nostril in a single small nasal; four or five series of keeled scales between the eye and the labials. Scales in 29 to 33 rows. An obtuse keel on each side of the ventrals. Yellowish-brown sand-colour above, with or without brown spots forming regular longitudinal series, white below.

Total length 630 millim., tail 75.

Inhabits the Sahara, extending eastwards to Arabia. Schlegel records it from Biskra, Strauch from Djelfa, Laghouat, Saïda, Biskra, and Batna, and Boettger from Geryville. M. Lataste obtained it in Algeria, at Bou-Saada and at Bordj-Tayer-Rasson, and in other localities in the sandy Sahara, and at Wed Magra, in the southern parts of the High Plateaux; he found it common throughout Southern Tunisia.

Figures: Jan, Icon. Ophid. livr. 45, pl. v. (*Vipera cerastes* and *V. avicennæ*), and Geoffroy, Descr. de l'Egypte, Rept. pl. vi. fig. 3.

3. Echis, Merrem, 1820.

Upper surface of head covered with scales. Scales keeled, in 25 to 35 rows, the laterals disposed obliquely. Subcaudals in a single row.

A single species in Barbary.

1. Echis carinata, Schneider, 1801.

Snout very short and rounded. Nostril between three shields, the anterior and upper of which are in contact with the rostral; head covered with small keeled scales, among which an enlarged supraocular is sometimes present; two series of scales between the eye and the labials; 11 or 12 upper labials. Scales in 29 to 35 rows. Pale buff, greyish, reddish, or pale brown above, with three series of whitish spots edged with dark brown; a zigzag dark brown band may run along each side: a cruciform or ᛦ-shaped, whitish, dark-edged marking on the head; lower parts whitish, uniform or with brown dots.

Total length 600 millim., tail 65.

Inhabits the desert sandy districts of North Africa, South-western Asia, and India. M. Lataste examined several specimens from Biskra in M. Hénon's collection at Constantine, and a single specimen was found at Tadjera, near Mettamer, in Tunisia, by M. Letourneux.

Figure: 'Description de l'Egypte,' Rept., Suppl. pl. iv. fig. 1.

BATRACHIA.

The Batrachians are very poorly represented in North Africa. They fall into two Orders:—

I. **ECAUDATA**, Frogs and Toads, in which the tail is present only during the larval period.
II. **CAUDATA**, Newts and Salamanders, in which the tail persists throughout life.

Order I. ECAUDATA.

Four Families:—

1. **Ranidæ.** Upper jaw toothed; diapophyses of sacral vertebra not dilated.
2. **Bufonidæ.** Jaws toothless; diapophyses of sacral vertebra dilated.
3. **Hylidæ.** Upper jaw toothed; diapophyses of sacral vertebra dilated; digits expanded at the end, the distal phalanx claw-shaped and swollen at the base.
4. **Discoglossidæ.** Upper jaw toothed; diapophyses of sacral vertebra dilated; anterior dorsal vertebræ with short ribs.

Each of these four Families is represented in Barbary by a single genus. The four genera may be distinguished as follows:—

I. Pupil horizontal; vomerine teeth, if present, between the choanæ.
  A. Digits not dilated at the end.
    Tongue deeply notched, bifid posteriorly; teeth in upper jaw and on palate. 1. Rana.
    Tongue elliptical, entire; no teeth . . . . 2. Bufo.
  A. Digits dilated at the end . . . . 3. Hyla.
II. Pupil round or subtriangular; vomerine teeth behind the choanæ . . . . 4. Discoglossus.

Fam. 1. RANIDÆ.

1. Rana, Linnæus, 1766.

Pupil horizontal. Vomerine teeth. Tongue forked and free behind. Fingers free, toes webbed.

This almost cosmopolitan genus is represented in Barbary by a single species.

1. Rana esculenta, Linnæus, 1766.

R. viridis, Guichenot.

Vomerine teeth between the choanæ. Interorbital space narrower than the upper eyelid; tympanum distinct, about two thirds the size of the eye. Toes entirely webbed. A glandular lateral fold. Green, olive, or bronzy brown above, usually with black spots and a pale green vertebral line. Male with two external vocal sacs.

This species is distributed over nearly the whole of the Palæarctic Region. The form found in Barbary, which has been named var. *latastii* by Camerano, I regard as inseparable from the var. *ridibunda*, Pall., which is found in Western and Central Asia, Eastern Europe and Germany, the south of France and the Pyrenean Peninsula, Tripoli, Egypt (?), and the Sinaitic Peninsula. It is distinguished from the typical form by the smaller size of the inner metatarsal tubercle, which is blunt, not compressed. It is found throughout Morocco, Algeria, and Tunis, penetrating into the desert, where it was obtained as far as Wargla by M. Lataste, who also found it everywhere in Tunisia.

I append measurements in millimetres of several specimens (females) in the collection of the British Museum:—

	Tangier.				Constantine.		Tunis.	
From snout to vent	85	69	69	65	90	53	75	75
Length of tibia	45	37	35	35	44	27	37	37
Length of foot (from outer metatarsal tubercle)	45	37	34	34	46	27	38	38
Length of inner toe	13	11	10	10	13	$7\frac{1}{2}$	11	$10\frac{1}{2}$
Length of inner metatarsal tubercle	4	3	3	3	4	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$

From which we see that the length of the inner metatarsal tubercle is contained from 3 to $3\frac{2}{3}$ times in the length of the inner toe, and from 11 to 12 times in the length of the foot, which nearly equals that of the tibia.

The var. *ridibunda* is figured, from German specimens, in Proc. Zool. Soc. 1885, pl. xl.

Fam. 2. BUFONIDÆ.

1. Bufo, Laurenti, 1768.

Pupil horizontal. Tongue elliptic or pyriform, entire and free behind. Fingers free, toes webbed.

The true Toads form a large genus, represented over the greater part of the world. Three species are found in Barbary, distinguishable as follows:—

A. Subarticular tubercles under the toes all single; a tarsal fold; tympanum about half the diameter of the eye . . . . 1. *viridis.*
B. Subarticular tubercles under the median toes in pairs.
  A tarsal fold; first finger much longer than second . . . . 2. *mauritanicus.*
  No tarsal fold . . . . 3. *vulgaris.*

1. Bufo viridis, Laurenti, 1768.

B. variabilis, Gervais.

Interorbital space narrower than the upper eyelid; tympanum about half the diameter of the eye. First finger extending a little beyond second; toes half or two-thirds webbed, with single subarticular tubercles; a tarsal fold. Above with olive or greenish spots on a greyish or pinkish ground; sometimes a yellow vertebral line. Male with a subgular vocal sac.

From snout to vent 95 millim.

This Toad has a very wide distribution, being found over the greater part of Europe, though not west of the Alps, Central and Western Asia, the Himalayas, and North Africa. Common in Italy and the Baleares, but absent from the Iberian Peninsula. It is known in Morocco, from Casablanca and between Mogador and Morocco, but has not been found in the Northern Promontory. Strauch says it is common near Oran, and Eichwald found it at Musaya, on the Algerian Atlas. Lataste received it from the Plateau of Sersou, collected specimens at Oran, El Guerah, Bona, and Ghardaia, and Tilremt, and found it common everywhere in Tunisia.

The characters upon which *Bufo boulengeri*, Lataste (Rev. Int. des Sciences, 1879, p. 438), was founded, upon a single specimen from the Plateau of Sersou, have proved to be individual, and M. Lataste now entertains no doubt that the name should be regarded as a synonym of *B. viridis.*

2. Bufo mauritanicus, Schlegel, 1841.

Bufo pantherinus, Guichenot, Strauch.—*B. arabicus,* Gervais.

Interorbital space concave, broader than the upper eyelid; tympanum very distinct, vertically oval, its greatest diameter not much more than half that of the eye. First finger much longer than second; toes webbed at the base, with double subarticular tubercles; a tarsal fold. Above usually with large insuliform, dark-edged, reddish-brown spots. Male with a subgular vocal sac.

From snout to vent 140 millim.

This fine large Toad appears to be peculiar to Barbary. It has been found in every part of Morocco yet investigated, and is very common all over Algeria as far south as the limit of the Sahara, M. Lataste having obtained it at Biskra, Bou-Saada, and Laghouat. It is found near Tunis, and M. Lataste met with it at Tozeur, Gafsa, and Ferriana, but not at Cabes, where *Bufo viridis* and *Rana esculenta* are abundant.

I have given a figure of *B. mauritanicus* in Proc. Zool. Soc. 1880, pl. li.

3. Bufo vulgaris, Laurenti, 1768.

Interorbital space broader than the upper eyelid; tympanum more or less distinct. First finger extending scarcely beyond second; toes at least half webbed, with double subarticular tubercles; no tarsal fold. Brown or dull olive above, with darker spots; parotoid glands with a dark outer margin. Male without vocal sac.

From snout to vent 130 millim.

The Common Toad of Europe and Palæarctic Asia is rare in Algeria, and at present only known from Algiers (*Strauch*, *Lataste*), Tlemsen (*Boettger*), and Bona, where Dr. Hagenmüller states it is not unfrequent. It is undoubtedly the rarer of the three toads of Barbary. Camerano has recorded it from Larache in Morocco. It has not yet been obtained in Tunisia.

Fam. 3. HYLIDÆ.

1. Hyla, Laurenti, 1768.

Pupil horizontal. Vomerine teeth. Tongue subcircular, entire or slightly nicked and more or less free behind. Fingers free or webbed, toes webbed.

Of this large genus a single species occurs in Europe and round the Mediterranean.

1. Hyla arborea, Linnæus, 1766.

H. viridis, Guichenot.

Fingers webbed at the base; tympanum distinct; upper parts perfectly smooth, belly granular. Male with a large subgular vocal sac.

From snout to vent 50 millim.

The Tree-Frog of Barbary belongs to the var. *meridionalis*, Boettg., 1874 (=*perezi*, Boscá, 1880, *barytonus*, Héron-Royer, 1884), which is uniform green, without a dark stripe along the side of the body, and with the green colour extending to the sides of the throat. It inhabits the south of France, North Italy, Spain and Portugal, the Canary Islands and Madeira, and Barbary, where it is common all over the Tell. It has been found everywhere in Morocco.

This variety is figured by Boscá, Ann. Soc. Esp. x. 1881, pl. ii. figs. 7–10, and by Héron-Royer, Bull. Soc. Zool. France, 1884, pl. ix.

Fam. 4. DISCOGLOSSIDÆ.

1. Discoglossus, Otth, 1836.

Pupil roundish-subtriangular. Tongue circular, entire, scarcely free behind. Vomerine teeth in long transverse series behind the choanæ. Fingers free, toes webbed.

1. Discoglossus pictus, Otth, 1836.

Snout longer than the diameter of the orbit, without canthus rostralis; tympanum hidden or slightly distinct. First finger shorter than second; three metacarpal tubercles, the inner very much developed in the male; toes webbed at the base in the female, almost entirely in the male; a small inner metatarsal tubercle. Skin smooth or with small flat warts above. Brownish, yellowish, reddish, or olive above, with dark light-edged spots, sometimes confluent into longitudinal bands; some specimens with three light dorsal stripes. Male without vocal sacs; during the breeding-season with black rugosities on the chin, the inner metacarpal tubercle, the inner digits, and on the free border of the web between the toes.

From snout to vent 60 millim.

North-African specimens have been distinguished by Camerano (Atti Acc. Torin. xiii. 1878, p. 548, and xiv. 1879, p. 447, figs.) under the name of *D. scovazzi*, chiefly on account of their distinct tympanum; and this distinction has been recently upheld by Héron-Royer with the new name of *D. auritus* (Bull. Soc. Angers, 1889, p. 177). A renewed examination of the rich series in the British Museum has convinced me that, as shown by Lataste ("Etude sur le Discoglosse," Act. Soc. Linn. Bordeaux (4) iii. 1879, p. 275), but one species of *Discoglossus* can be admitted. A male specimen, collected at Algiers by Mr. Sclater, has the tympanum completely concealed, and, on the other hand, the organ is perfectly distinct in a male collected by M. Boscá on the Serra Morena. The shape and extent of the dark temporal band are subject to much variation in specimens from the same locality, and I have failed to find any constancy in the other very trivial distinctive characters pointed out by M. Héron-Royer.

D. pictus abounds in the Tell, from Morocco to Tunis, and is also found in the intermediate zone between the Tell and the Sahara, M. Lataste having obtained it as far south as Batna. Moroccan localities are Tangier, Tetuan, Casablanca, Mogador, and Morocco. Common round Tunis, and found on Galita Island by Marquis Doria. Also recorded by Lataste from the Tunisian Chotts (Tozeur and Nefta). In Europe *D. pictus* is known from Spain and Portugal, Corsica, Sardinia, Malta, and small neighbouring islands.

M. Lataste has observed that, as in the European *Alytes*, the breeding-season extends from the early spring to the end of summer.

Excellent figures of this Batrachian accompany Lataste's memoir quoted above.

Order II. CAUDATA.

Fam. 1. SALAMANDRIDÆ.

Lizard-like Batrachians breathing by lungs in the perfect condition, with well-developed eyelids. Represented in Barbary by two genera.

1. Salamandra, Laurenti, 1768.

Tail subcylindrical. Terrestrial.

1. Salamandra maculosa, Laurenti, 1768. (Plate XVIII. fig. 3.)

Skin smooth, shining, porous above; a distinct parotoid gland on each side of the neck; a lateral series of large warts; a strong gular fold. Black, with yellow markings. Inhabits Central and Southern Europe, Syria, Morocco, and Algeria.

The Moroccan and Algerian specimens are separable as a variety which has been named var. *algira*, by Bedriaga (Arch. f. Nat. 1883, p. 245). It is distinguished from the European Salamander, including the Corsican form, *S. corsica*, Savi, to which the Algerian specimens have been erroneously referred by some authors, by the more slender build, the longer digits, and the longer tail, as may be seen from the following measurements, in millimetres, of specimens in the British Museum:—

	Tangier.				Bona.	
From snout to vent	86	73	62	47	85	60
Tail	77	65	55	43	80	52
Third toe	8	6·5	5	4	8	5
Fifth toe	3	3	2	2	3·5	2

The yellow spots are few, round or oval, and disposed alternately in two series, but never form longitudinal bands as is frequently the case in European specimens.

The Salamander is very local in Algeria, but abundant where it occurs. Guichenot found it at Oran, and states that Col. Levaillant got it at Constantine. Lallemant records it, on the authority of Letourneux, from Kabylia and Bona (Mt. Edough). It has been found in great numbers in the latter locality by Dr. Hagenmüller. M. Lataste received it from L'Arba through M. Lallemant, and collected himself larval specimens in that locality. Hanoteau and Letourneux record it from the forest of Akfadou, Bougia, and Fort National, and Dr. Boettger from Bougia. The only locality in Morocco where the Salamander has yet been found is the Benider Hills, near Tangier; we are indebted to M. H. Vaucher for this discovery.

The North-African variety of *Salamandra maculosa* has not been figured before. Fig. 3 *a* on Plate XVIII. represents a specimen from Mt. Edough, near Bona, and figs. 3 *b*, *c* two young from the Benider Hills, near Tangier.

2. Molge, Merrem, 1820.

Tail compressed. Aquatic during the breeding-season.

Three species in Barbary.

A. Palatine teeth not extending forwards beyond the line of the choanæ.
Palatine teeth forming a ∩; contour of lower jaw semicircular . . . . . . 1. *poireti.*
Palatine teeth forming a Λ; contour of lower jaw semielliptic . . . . 2. *hagenmuelleri.*
B. Palatine teeth extending forwards beyond the line of the choanæ. . . . 3. *waltlii.*

1. Molge poireti, Gervais, 1835.

Euproctus rusconii, Guichenot. *Triton nebulosus,* Guichenot.

Palatine teeth in two slightly curved series, approximating in front, forming a ∩. Tongue subcircular or oval, free behind and on the sides. Head much depressed, as long as broad or a little longer; snout broad, rounded, the contour of the jaws semicircular. Tail longer than head and body. Skin tuberculate; a more or less distinct gular fold. Olive above, yellow or orange beneath, with or without small black spots.

Total length 150 millim.

Common near Algiers and at L'Arba, whence M. Lataste received specimens. He also observed it at Guyotville, and received a specimen from Bougie, through Dr. Hagenmüller, in 1882. Guichenot records it from Oran, and Giglioli from near Tunis.

Figured under two different names by Guichenot.

2. Molge hagenmuelleri, Lataste, 1881. (Plate XVIII. fig. 4.)

Distinguished from the preceding by the series of palatine teeth being less far apart anteriorly, forming a Λ; head longer, contour of jaws semielliptic. Fingers and toes more slender.

Size smaller, 100 millim.

This species was founded on numerous specimens sent from Bona and its environs by Dr. Hagenmüller to M. F. Lataste. It has since been recorded from Biskra by Dr. Boettger. Specimens received from Constantine through M. Hénon in 1881, induce M. Lataste to regard *M. hagenmuelleri* as a variety of *M. poireti,* as there appears to be a complete passage between them and the specimen from Bougie noticed above.

I have given figures of typical specimens from Bona, on Plate XVIII. fig. 4.

3. Molge waltlii, Michahelles, 1830.

Palatine teeth in two slightly curved series approximating in front, commencing in front of the line of the choanæ. Tongue subcircular, free on the sides and behind. Head much depressed, as long as broad. Tail longer than head and body. Ribs very long, ending in a sharp point, which frequently perforates the skin. Skin tuberculate; a strong gular fold. Olive-brown above, yellowish beneath, with blackish markings.

Total length 224 millim.

Inhabits the south of Spain and Portugal, and has been found in Morocco at Tangier, Ceuta, and between Tangier and Tetuan. Specimens recently sent by M. Vaucher were obtained in the marshes of Charf-la-Kaab, a few miles south of Tangier.

Molge waltlii has been several times figured; the least unsatisfactory figure is that given by Bonaparte, 'Fauna Italica.'

EXPLANATION OF THE PLATES.

PLATE XIII.

Fig. 1. *Saurodactylus mauritanicus*, D. & B. Mogador. (Page 109.)
- *a.* Natural size.
- *b.* Side view of head, × 3.
- *c.* Lower view of head, × 3.

Fig. 2. *Ptyodactylus lobatus*, var. *oudrii*, Lataste. Bou-Saada. (Page 114.)
- *a.* Natural size.
- *b.* Side view of head, × 2.
- *c.* Lower view of head, × 2.

Fig. 3. *Tarentola mauritanica*, var. *deserti*, Lataste. Wargla. (Page 116.)
- *a.* Natural size.
- *b.* Side view of head, natural size.
- *c.* Lower view of head, natural size.

Fig. 4. *Agama tournevillii*, Lataste. Sahara. (Page 118.)
- *a.* Natural size.
- *b.* Side view of head, natural size.

PLATE XIV.

Fig. 1. *Agama bibronii*, A. Dum. Tangier. (Page 118.)
- *a.* ♂, natural size.
- *b.* ♂, side view of head, natural size.
- *c.* ♀, natural size.
- *d.* Young, natural size.

Fig. 2. *Psammodromus blanci*, Lataste. Lambesa. (Page 127.)
- *a.* ♀, natural size, upper view.
- *b.* Lower view.
- *c.* Upper view of head, × 2.
- *d.* Side view of head, × 2.

PLATE XV.

Lacerta ocellata, Daud. (Page 123.)

Figs. *a*, *b*, *c*, *d*. Adult ♂. Tunis. (Var. *pater*, Lataste.)
Fig. *e*. Young. Algiers. (Var. *pater*, Lataste.)
Fig. *f*. Upper view of head of ♀. Tangier. (Var. *tangitana*, Blgr.)
Fig. *g*. Upper view of head of ♂. Ferrol, Spain.
All the figures natural size.

PLATE XVI.

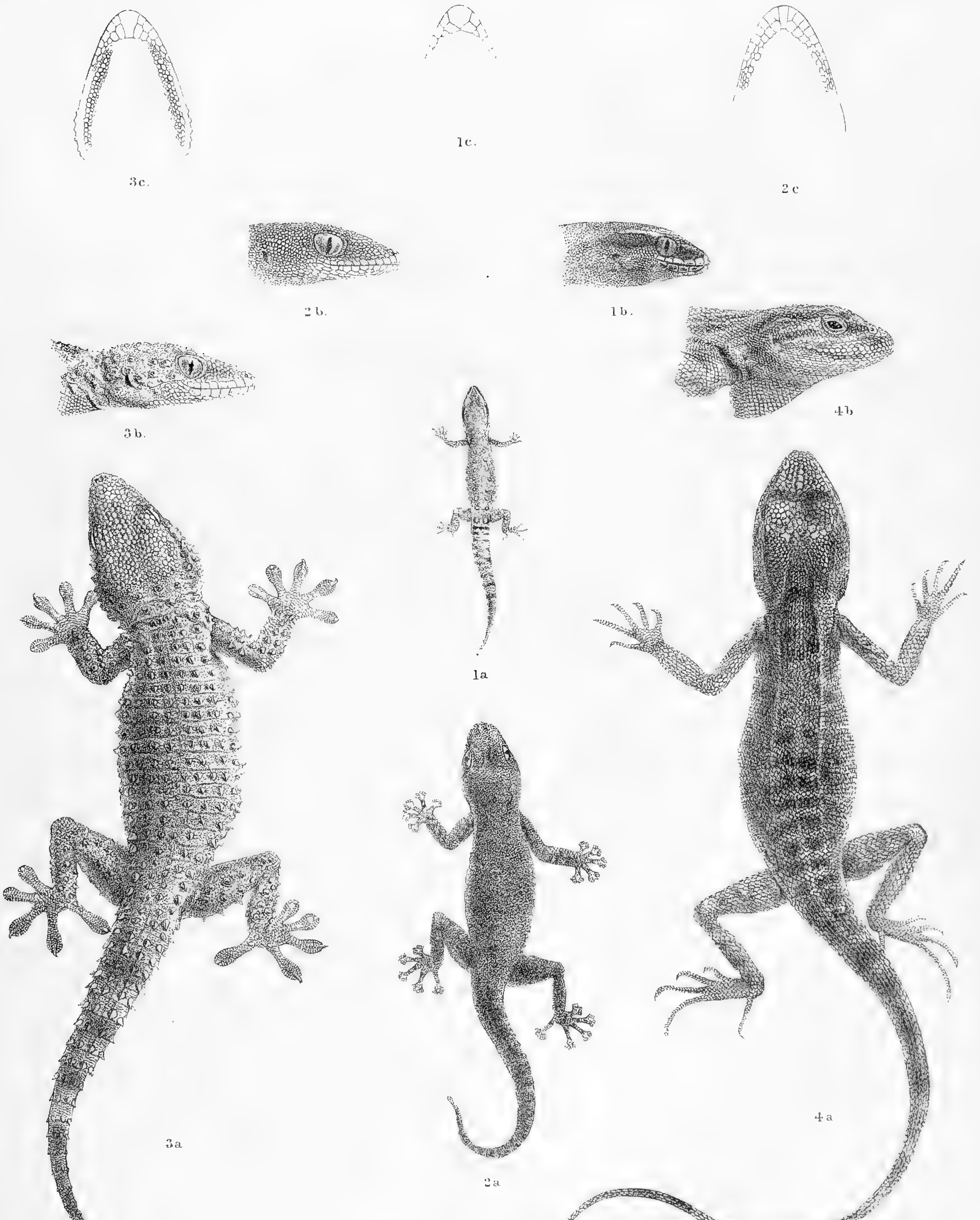
Eumeces algeriensis, Peters, natural size. Mogador. (Page 136.)

PLATE XVII.

Fig. 1. *Chalcides ocellatus*, var. *vittatus*, Blgr. Tangier. (Page 139.)
And (*a*) side view of head and anterior part of body, natural size.
Fig. 2. *Chalcides ocellatus*, var. *polylepis*, Blgr., natural size. City of Morocco. (Page 139.)
And (*a*) side view of head and anterior part of body, × 2.
Fig. 3. *Chalcides lineatus*, Leuck. Tangier. (Page 139.)

PLATE XVIII.

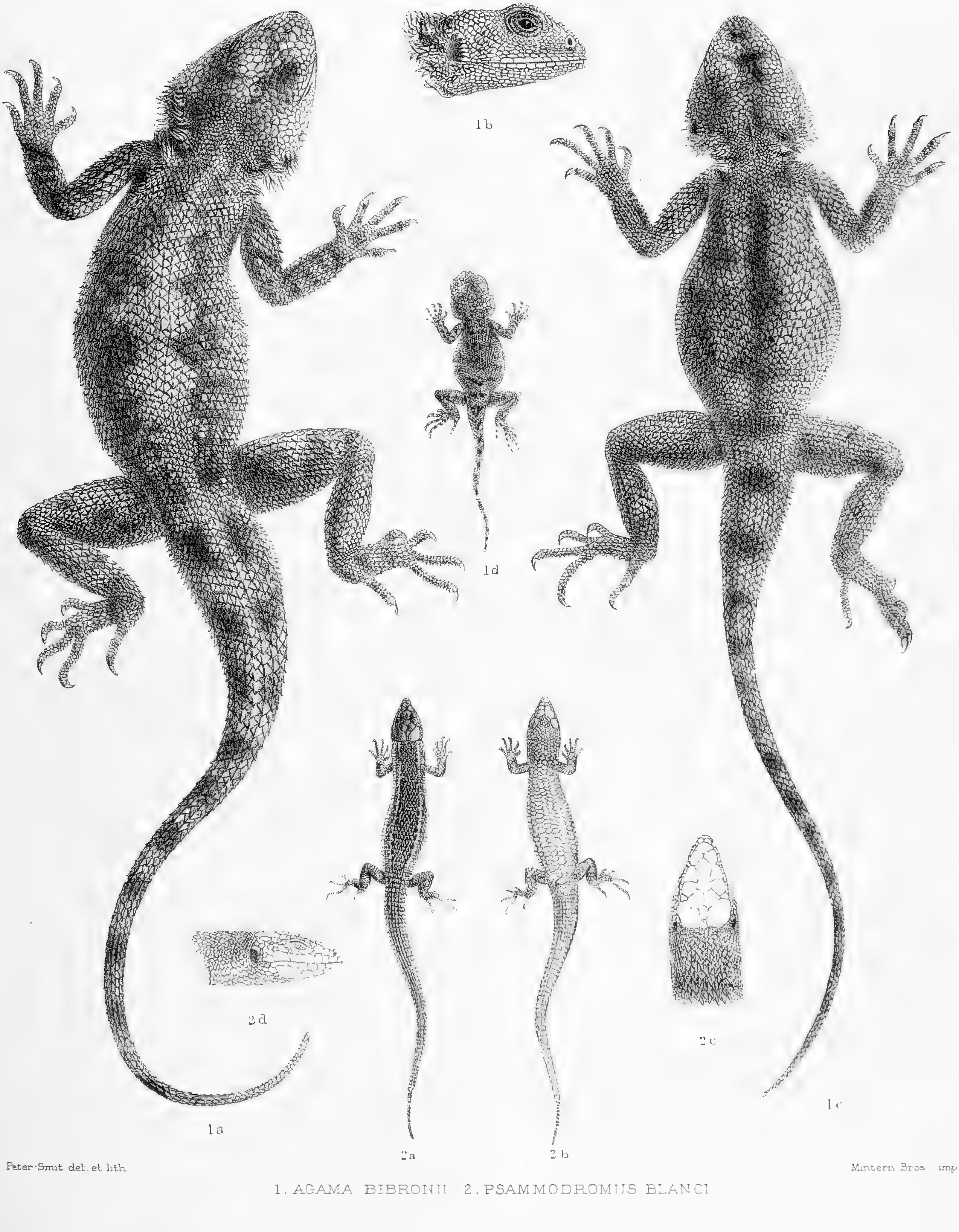
Fig. 1. *Coronella amaliæ*, Boettg. Tangier. (Page 144.)
a. Natural size.
b. Upper view of head, × 2.
c. Side view of head, × 2.
Fig. 2. *Cerastes vipera*, L. Tripoli. (Page 155.)
a. Natural size.
b. Upper view of head, × 2.
c. Side view of head, × 2.
Fig. 3. *Salamandra maculosa*, var. *algira*, Bedr. (Page 161.)
a. ♀, natural size. Bona.
b, *c*. Young. Tangier.
Fig. 4. *Molge hagenmuelleri*, Lataste. Bona. (Page 162.)
a. ♂, Natural size.
b. ♀, natural size.
c. Open mouth, × 2.



Peter Smit del. et lith.

Mintern Bros. imp.

1. SAURODACTYLUS MAURITANICUS 2. PTYODACTYLUS LOBATUS, VAR. OUDRII
3. TARENTOLA MAURITANICA, VAR. DESERTI. 4. AGAMA TOURNEVILLII.



Peter Smit del. et lith. Mintern Bros. imp.

1. AGAMA BIBRONII 2. PSAMMODROMUS BLANCI

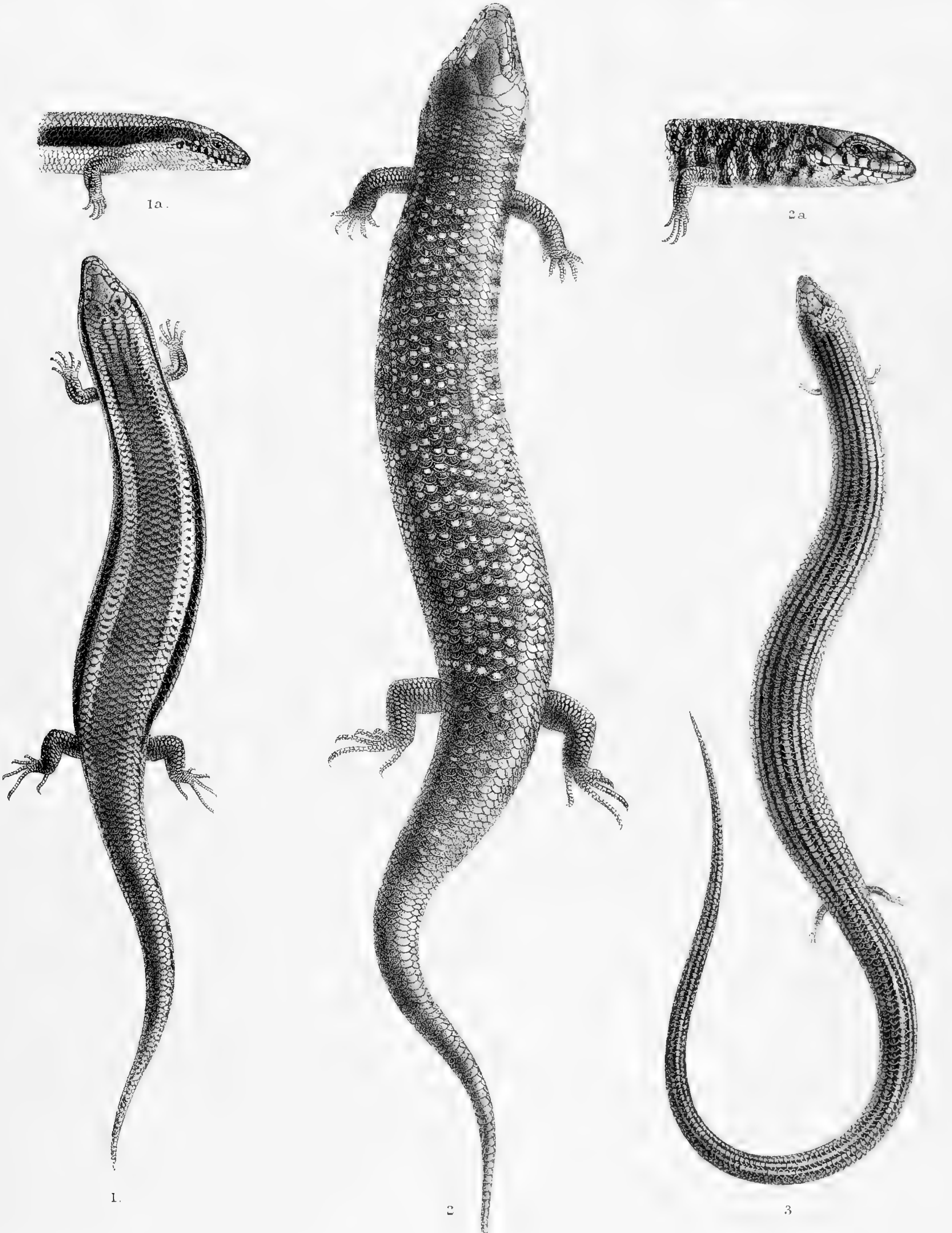
Peter Smit del. et lith.

Mintern Bros. imp.

LACERTA OCELLATA.

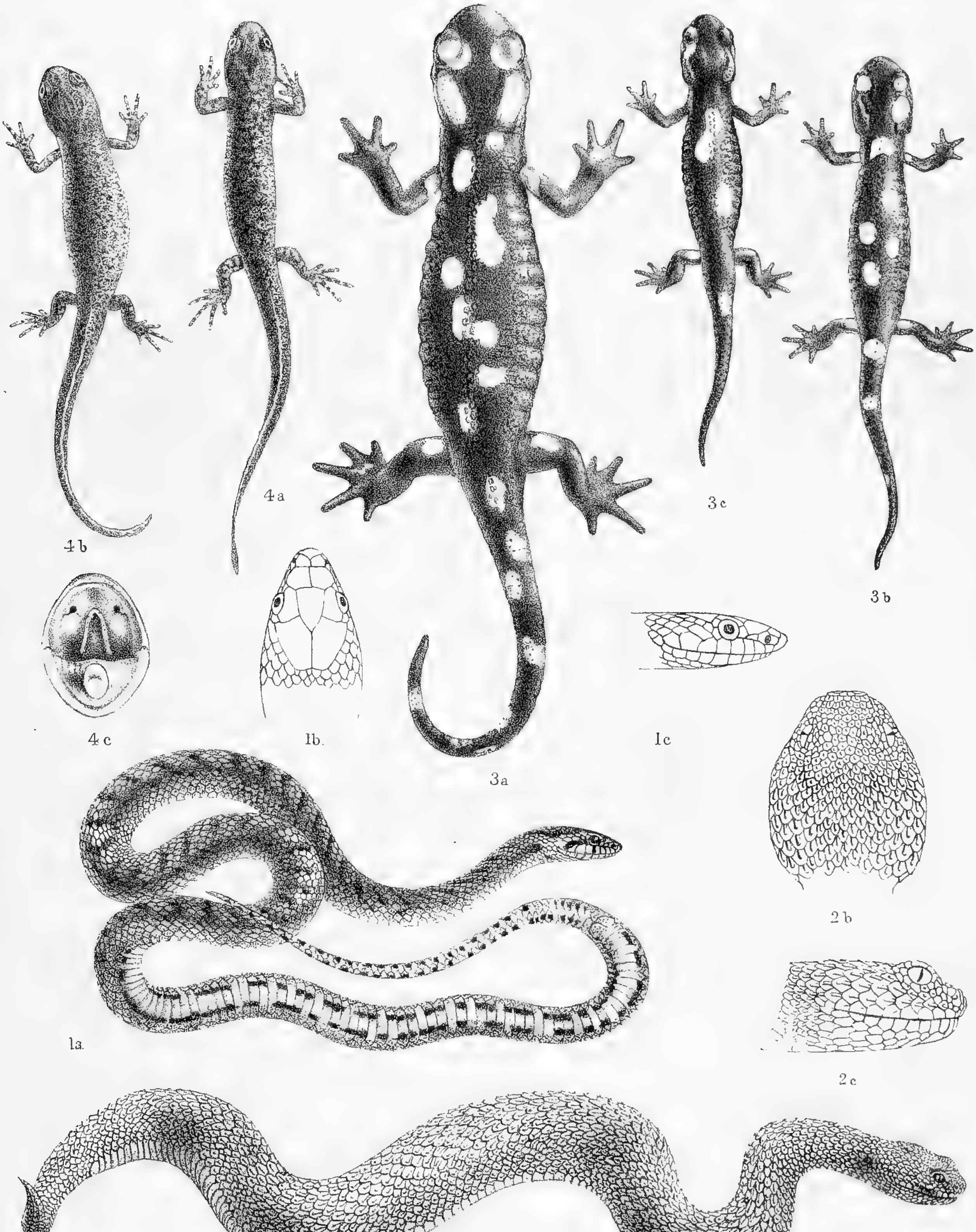
Peter Smit del. et lith. Mintern Bros imp.

EUMECES ALGERIENSIS.



Peter Smit del. et lith. Mintern Bros. imp.

1. CHALCIDES OCELLATUS VAR. VITTATUS 2. CHALCIDES OCELLATUS. VAR. POLYLEPIS.
3. CHALCIDES LINEATUS.



Peter Smit del et lith.

Mintern Bros imp.

1. CORONELLA AMALIÆ 2. CERASTES VIPERA
3. SALAMANDRA MACULOSA, VAR. ALGIRA. 4. MOLGE HAGENMUELLERI

VI. *On a Skull of* Trogontherium cuvieri *from the Forest Bed of East Runton, near Cromer. By* E. T. Newton, *F.G.S., F.Z.S., Geological Survey.*

Received March 17th, 1891, read April 21st, 1891.

[Plate XIX.]

Contents.

1. *Introductory.*

At the time when the Geological Survey Memoir on the Vertebrata of the Forest Bed was published (1882), the parts of the skull of *Trogontherium*, which were known in this country, were the maxillæ and premaxillæ, with incisors and cheek-teeth; the only example, however, of a last upper molar was the half tooth preserved, with the first and second molars, in the maxilla described by Sir R. Owen [1], which is preserved in the King Collection in the Museum of Practical Geology. The imperfect condition of this last upper tooth deprived us of one of the chief characters by which *Trogontherium* is distinguished from *Castor*, and rendered the determination of the British specimens less certain than it would otherwise have been; the available materials, however, were sufficient to justify Sir R. Owen's reference of them to *Trogontherium cuvieri*, a form described by Fischer [2] from near the Sea of Azof.

A skull of this rodent, from British deposits, has long been a desideratum, in order that a close comparison might be made with the nearly perfect type skull; and such a specimen has now been secured from the Forest Bed of East Runton by Mr. A. Savin, of Cromer, who has been kind enough to send it to me for identification and description. In many particulars this specimen (Plate XIX.) is in a more satisfactory condition for examination than Fischer's type, which is so much obscured by hard sandy matrix that the relations of the bones cannot be clearly seen, while Mr. Savin's specimen is almost free from matrix, and the surfaces of the bones, as well as the sutures, are well displayed.

[1] Geol. Mag. vol. vi. p. 49 (1869).
[2] Moscow Soc. Nat., Mém. vol. ii. p. 250 (1809).

It is proposed in the first place to describe this new specimen in detail, at the same time comparing it with the skull of the Beaver, to which it is nearly allied, and then to institute a comparison between it and Fischer's type; and finally to consider its relation to the skull from the Pliocene of Saint-Prest, called by M. Laugel in 1862 *Conodontes boisvillettii*[1], which is believed to be referable to the same genus and species.

There has been much diversity of opinion as to the genus to which these Forest Bed remains should be referred, and consequently the synonymy is very perplexing; this has, however, been explained in the Memoir of the Geological Survey already referred to, and the new specimen seems to me fully to confirm the opinions there expressed. References to the authors who have written upon the subject will be found at the end of this paper.

2. *Description of the Skull of* Trogontherium *from East Runton.*

This Forest Bed skull has very nearly the same parts preserved as Fischer's type; it is of a dark brown colour, and is much impregnated with iron. The nasal bones, as might be expected, have fallen away; and both the incisor teeth are absent, but their alveoli are intact. The jugal arch on both sides is broken off close to the cranium, leaving only the bases of the maxillary and squamosal buttresses. The bony external auditory meatus is wanting on the right side, and the thin laminæ of the palatines and pterygoids are broken away. There has evidently been a strong supraoccipital crest, probably as well developed as in the Beaver; but it is now much abraded.

As this skull (Plate XIX.) bears a very close resemblance to that of a Beaver, its description will be most intelligible if given in terms of comparison with that animal; and it is so little longer than the specimen from the fens, which will be used for comparison, that the relative proportions, indicated by the measurements given in the table on page 173, will be very obvious.

When viewed from above (fig. 1) the difference in general proportion between the two skulls is clearly seen. The length of the cavity exposed by the removal of the nasal bones is about the same in both specimens, but is much the widest in the *Trogontherium*. The fronto-premaxillary suture in the *Trogontherium* is opposite the middle of the maxillary buttress for the jugal arch, and the premaxilla is consequently almost wholly in front of the maxillary buttress. In the Beaver this buttress is further forwards, and the premaxilla extends for some little distance behind it. The frontals are longer and wider in *Trogontherium* than in the Beaver; and the postorbital process is about halfway between the anterior and posterior buttresses of the jugal arch, while in the Beaver this process is further forwards. The parietals are much shorter than they are in the Beaver, and the same may be said of the interparietal. On each parietal, near the sagittal suture, there is a ridge, which, running backwards, meets its fellow at their junction with the triangular interparietal, and they are continued as a

[1] Bull. Soc. Géol. Fr. sér. 2, vol. xix. p. 167 (1862).

prominent median crest along the latter bone. The position of these parietal ridges, depending as they do upon the development of the temporal muscles, would no doubt vary in form in older skulls. The sagittal suture is even shorter than it is in the Beaver, the parietals only joining for about half an inch. The squamosal bone has much the same form that it has in the Beaver; but its parietal margin is more deeply sinuous, and the suture forms a strongly impressed groove along the side of the brain-case.

On the side of the skull (fig. 3) the squamosal sends down a process from its hinder part between the auditory meatus and mastoid, and it has a large foramen a little behind the jugal buttress; while anteriorly it ends at the postorbital process.

The jugal buttress of the maxilla descends from the upper surface of the skull about halfway towards the alveolar margin; while in the Beaver this buttress extends as a distinct ridge quite to the lower edge of the maxilla.

The suborbital foramen is situated as it is in the Beaver, but the plate of bone by which it was covered is partly broken away on both sides. This plate of bone in the Beaver is developed anteriorly into a strong ridge for the attachment of muscles; and judging from the still larger process remaining in the fossil below the foramen, the muscles attached in this region were more strongly developed than they are in the Beaver.

The premaxilla in the fossil commences directly in front of the suborbital foramen, and is relatively larger than in the Beaver, being altogether more strongly developed, evidently in relation to the powerful incisor, indicated by the large size of the alveolus. The two premaxillæ form in front of the snout a vertical, roughened, triangular area, the upper part of which is separated by a deep transverse groove, and forms a pair of tubercles which encroach upon the lower part of the external nasal opening, and give it a nearly horizontal lower margin: the Beaver's nasal aperture is pointed inferiorly. Seen from below (fig. 2) the premaxillæ are broader than in the Beaver, and especially so at their front part: where the two bones meet on the palate they form a median crest, which, dividing, is continued around the palatal foramina, and again uniting extends along the entire length of the palate to the posterior nares. The palatal foramina are elongated slits as in the Beaver, but are differently situated, being about twice as far from the incisors as they are from the anterior grinders, while in the Beaver they are placed about midway between these two points; and further, in the fossil the maxillo-premaxillary sutures divide these foramina at about their middle into anterior and posterior moieties, the maxillæ and premaxillæ taking about equal shares in the formation of the apertures; in the Beaver, on the other hand, these sutures are quite at the hinder part of the foramina, which are thus almost wholly formed by the premaxillæ.

The palatal aspect of the maxillæ shows very clearly the large size of the processes below the suborbital foramina (*sof.*), as well as two deep depressions at their bases, just in front of the anterior grinders. These depressions are not present in the Beaver. The two rows of cheek-teeth diverge more rapidly than in the Beaver: the anterior pair of teeth being nearer together, and the hinder ones further apart.

The palatine bones end anteriorly in a more broadly truncated extremity than do those of the Beaver; but in both skulls there is a similar pair of foramina, placed one at each angle of this truncation. Posteriorly the palatines are somewhat broken; but at the hindermost angle of each may be seen a large pit (or foramen filled with matrix) placed just on the inner side of the last molar. This pit is not present in the Beaver.

The notch of the hinder palatal margin extends forwards to a little within the hinder extremities of the last molars; it is narrower than in the Beaver, and there is no median process. In the Beaver the palatine notch is altogether behind the last molars, and it has a median process. The pterygoids seem to be entirely broken away.

The under surface of the basioccipital bone is characterized by a median longitudinal ridge with an oval depression on each side. Posteriorly the ridge widens and then dividing joins the two occipital condyles; these, however, are separated by a distinct median groove. Anteriorly the ridge is lost in the wide groove which occupies the front part of the basioccipital. In the Beaver the whole under surface of the basioccipital is occupied by a deep round fossa. Only a small part of the basisphenoid can be seen in the fossil, this region being obscured by the hard sandy matrix.

The tympanic bullæ (*tb.*) are not so rounded and inflated as they are in the Beaver, and the ridge which runs up the external auditory meatus is not so strongly developed. The mastoid portion of the periotic forms a well-marked prominence upon the side of the occipital region (fig. 3), and is separated from the bony auditory meatus by a downward process of the squamosal similar to, but not precisely like, that of the Beaver.

The foramen magnum (fig. 4) is triangular, its height and width being about the same; while in the Beaver it is rather more rounded and is proportionally higher. The exoccipitals form lateral plates, which, extending downwards on each side, become paroccipital processes; these are now denuded, but when perfect could not have been so large as those of the Beaver. The exoccipital plate also extends upwards and outwards, covering much more of the mastoid than it does in the Beaver; and it may be that it extends to the line seen near the outer margin of the occiput, thus almost excluding the mastoid from the back of the skull; it is not quite certain, however, that this line is really a suture, and possibly the exoccipital only extends as far as the large foramina seen in this region. Each exoccipital is marked by a deep depression, just above the occipital condyle. The general contour of the back of the skull is unlike that of the Beaver: for, even when allowance is made for the absence of the occipital crest, the occiput is found to be much wider, the paroccipitals do not project to the same extent, and the supraoccipital bone is certainly wider.

Dentition.—The incisor teeth are absent, but the size and roundness of the alveoli leave no doubt that the teeth they supported were much larger and rounder than those of the Beaver, even if this fact were not known from other specimens.

All the upper cheek-teeth are preserved (figs. 2, 3), and, notwithstanding the chipping and rounding of the enamel edges, their patterns may be distinguished (fig. 5). The grinding-surface of each tooth is of a triangular form. Although the teeth have not been much worn by use, it is only the single internal enamel fold of some of them which remains open on the inner side; the external enamel folds having all become isolated, and it is only from other specimens that we know they were originally open to the exterior of the teeth.

The anterior tooth (pm. 4), on each side, is distinctly larger than any of the others; it has one inner and three outer enamel folds. The second tooth (m. 1) has one inner and two outer folds, the antero-external fold being very small. No doubt there was originally a small third outer fold, as in the next tooth, which may have been worn away during life, or has perhaps been broken away since it became fossilized. The third tooth (m. 2) has one internal and three external folds, the anterior and posterior external folds being very small. The fourth or hindermost tooth (m. 3) is about the same width as the one next in front of it, but is longer from before backwards; it has one internal and four external folds. In the Beaver the anterior upper grinder (pm. 4) is not so much larger than the second tooth (m. 1) as it is in the fossil, and the entire series gradually decreases in size from before backwards; while in this *Trogontherium* the last tooth (m. 3) is larger than either of the two (m. 1, m. 2) next preceding it. In the Beaver both the internal and external enamel folds of all the grinders are open to the outer surface down to the bases of the teeth, so that they always appear as folds on the grinding-surface, while in *Trogontherium* they very early become isolated.

Summary of the Distinctive Characters of the Forest Bed Skull.—The chief points of difference between this skull and that of the Beaver may be thus summarized:—

The premaxillary region is wider and stronger. The frontals are longer, the parietals are shorter, and the postorbital processes are further back.

The anterior jugal buttress descends only about halfway down the maxilla, and not to the alveolar margin as it does in the Beaver.

The palatine foramina are much nearer to the front grinders than to the incisors, and they are formed about equally by the maxillæ and premaxillæ; in the Beaver they are midway between the incisors and grinders, and are almost wholly formed by the premaxillæ.

The posterior palatine notch is further forwards than in the Beaver, and the pits in the hinder extremities of the palatines are not seen in the Beaver.

The under surface of the basioccipital has a median ridge with a fossa on each side of it; in the Beaver the basioccipital is entirely occupied by one large and deep fossa.

The tympanic bullæ are less inflated; and the foramen magnum is more triangular than in the Beaver.

3. *Dental Characters of the* Trogontherium *of the Forest Bed.*

In order rightly to compare the dentition of the skull above described, it is necessary to bear in mind the changes which the patterns of the teeth undergo during wear, as shown by a study of the many teeth which have been obtained from the Forest Bed. It will be desirable, therefore, to give a brief account of the entire dentition as at present known.

The incisors of both upper and lower jaws are larger than in the Beaver, the enamelled fronts are much more convex, and the enamel itself is rough and not smooth. The upper incisors are nearly circular in transverse section, and seem to have been thicker than the lower ones, although the entire tooth forms a segment of a smaller circle. The lower incisors are elliptical in transverse section, and, in some cases at least, are worn to a point (or nearly so) and not to a chisel edge like the flat-fronted incisors of the Beaver.

The cheek-teeth are all characterized by having the enamel folds connected with the exterior of the tooth for only a short distance from the summit, and consequently at an early stage of wear the folds become isolated.

Upper pm. 4.—This is the largest of the upper cheek-teeth; it has one inner and three outer folds, and all the examples of this tooth I have yet seen retain these four areas of enamel.

Upper m. 1 *and m.* 2.—These teeth have each one inner and three outer folds (m. 2, fig. 5); but the posterior outer fold is soon isolated and then worn out, reducing the folds to three, as in m. 1 (fig. 5) of the skull above described; and then the anterior outer enamel area is lost, leaving only two folds, as in the maxilla described by Sir R. Owen (*loc. cit.*) (m. 1 & 2, fig. 6).

Upper m. 3 has one inner and four outer folds, as shown in the skull above described (m. 3, fig. 5); but the anterior outer fold is small and soon lost, as exemplified in the maxilla described by Sir R. Owen (m. 3, fig. 6). This tooth is longer from before backwards than either of the other two molars, but its width is about the same.

Lower pm. 4.—This is the largest of the lower cheek-teeth; it has one outer and three inner enamel folds; sometimes there is an additional, very small enamel area at the front of the tooth.

Lower m. 1 is the smallest of the lower true molars; it has one outer and three inner folds, but these may be reduced by wear to two, as in some of the upper molars.

Lower m. 2 is a little larger than m. 1, but not so large as m. 3; it has four folds, the same as in m. 1, and probably by wear they may be reduced to two.

Lower m. 3.—This tooth is perhaps a little larger than m. 2, but not nearly so large as pm. 4. There are four folds as in the other true molars, and these doubtless become reduced in number by wear, but definite evidence on this point is wanting. In one example some of the folds of molars 2 and 3 have become broken up into small islands.

A milk-tooth preceding the lower pm. 4 has been found in two or three instances.

4. *Comparison of the Forest Bed Skull with Fischer's* Trogontherium cuvieri.

It will be obvious, from the description of the Forest Bed skull given above, that it differs widely from that of the Beaver, and confirms the view held by Sir R. Owen and other writers, as to the Forest Bed rodent belonging to a genus distinct from *Castor*. It now remains to be seen whether we are also justified in referring it to the *Trogontherium* of M. Gotthelf Fischer, and finally to ascertain whether *Conodontes boisvillettii* is, or is not, to be included in the same species.

The skull from the Forest Bed agrees so closely with that of *Trogontherium cuvieri*, so far as one can judge from a comparison with the published figures of Fischer's type skull and with a cast of the original specimen, kindly sent me from Moscow by the late Dr. Kowalewsky, that our purpose will be best served by pointing out the differences between them, rather than by alluding to their many points of resemblance.

Fischer's type is certainly larger than the Forest Bed skull, a difference especially noticeable in the premaxillary region; but this cannot be looked upon as of much importance, and certainly not as an indication of specific distinction; for some of the fragments from the Forest Bed, and more particularly a pair of premaxillary bones in Mr. A. Savin's collection, must have belonged to larger skulls than Fischer's type, and it is tolerably certain that the premaxillæ of this Pliocene rodent became elongated in proportion to the gradually increasing size of the incisor teeth.

The cheek-teeth of Fischer's type (fig. 7) are a little larger than those of this English specimen (fig. 5), though not so large as some teeth found in the Forest Bed; the patterns of the teeth, however, are essentially the same. The first and second molars in the maxilla described by Sir R. Owen (fig. 6), and alluded to above, having only two folds instead of four, it was thought impossible for it to belong to Fischer's genus; but we now know that the loss of folds is due to the stage of wearing of the teeth. The Forest Bed skull forms an interesting link in the chain of evidence, for while the first true molar (m. 1, fig. 5) has only three folds (that is, one more than in Owen's specimen, m. 1, fig. 6), the second true molar (m. 2, fig. 5) still retains the four folds as in Fischer's type (m. 1 & 2, fig. 7). Hitherto no English example of the upper third true molar has been available for comparison; but the present specimen has both these teeth preserved (fig. 2), and the folds are essentially the same as in Fischer's type—that is, one inner and four outer folds. It is true that in Fischer's specimen the hindermost fold is represented by two small islands of enamel; but this I regard as an individual peculiarity, having seen a similar tendency in teeth from the Forest Bed.

Much of the type specimen is obscured by the sandy matrix adhering to it, so that the sutures and other details of structure cannot be compared. Nearly all the minor differences which are seen on a close comparison seem to me to be due either to this obscuring by matrix, or to the different condition of wearing. There is, however, one point about which I am in some doubt; in the description of Fischer's type attention is called to a deep fossa, situated on the base of the skull between the tympanic bullæ. The cast of the specimen has a deep hole in this region, which has evidently been made by some instrument, and it seems very doubtful whether it properly represents a natural fossa of the specimen. If there is a single fossa in the basioccipital it will be an important difference between this skull and the English one; but the basal region is much hidden by the matrix, and it seems highly probable that bone has been drilled away; for it is very unlikely that two skulls agreeing so closely in other particulars should differ so materially in this one point, and I am constrained to regard this peculiarity as due to accident. It may be that a too great confidence in the similarity between this skull and that of the Beaver led to an injudicious clearing away of the matrix, which resulted in the removal of some of the bone at the same time. The large fossa in the basioccipital of the Beaver is quite unlike that in the cast, and the skull itself makes no nearer approach to Fischer's specimen than it does to that from the Forest Bed. Paying due regard to all the circumstances, it seems to me that, until this fossa in Fischer's type can be proved to be a natural one, Sir R. Owen's identification must be held to be correct, and these Forest Bed rodents regarded as specifically identical with *Trogontherium cuvieri*.

5. *Comparison of the Forest Bed Skull with that of* Conodontes boisvillettii.

The type specimen of *Conodontes boisvillettii* was found in the Pliocene deposit at Saint-Prest, and is preserved in the École des Mines, Paris. This skull has been figured and described by Gervais; it has the three true molars in place, but wants the anterior cheek-tooth (pm. 4) as well as the premaxillary bones. Some carefully prepared casts of the surfaces of the teeth (fig. 8), which were kindly sent to me by Prof. Daubrée some years since, serve well for comparison, and show the teeth to be somewhat smaller than the figures of them given by Gervais; it seems, therefore, that the entire figures given by the last-named author represent the skull a little larger than its natural size, which would thus appear to be as nearly as possible the same as the Forest Bed specimen.

The hindermost tooth of *C. boisvillettii* (m. 3, fig. 8) has four folds of enamel, all of which are isolated from the exterior of the tooth, and differs from the corresponding tooth of the Forest Bed skull (m. 3, fig. 5) only in the absence of the small anterior outer fold, which has doubtless been lost by wear. The first and second molars have only two folds each, thus differing from the Forest Bed specimen, in which these teeth have three and four folds respectively; this difference, however, is due to the teeth of the latter being somewhat less worn, the Saint-Prest specimen having lost by wear the anterior and posterior outer folds; indeed the three teeth of this specimen agree precisely with those in the maxilla already alluded to (fig. 6).

The palate presents the closest resemblance to that of the Forest Bed skull; there are the same anterior grooves, just between the alveoli for the premolars, which run backwards about halfway along the palate; each palatine bone has a similar pit, or foramen, at its hinder and outermost corner, the posterior palatine notch is likewise without a median process; the tympanic bullæ have the same form; and the basioccipital has a median ridge.

When viewed from above, the median crest of the Saint-Prest skull is seen to be narrower than that in the Forest Bed specimen, and to extend further forwards before dividing and passing outwards to the postorbital processes; this, however, is a difference due to age and the development of the masseter muscles. In other respects the two skulls are remarkably alike; the interparietal is perhaps a little shorter in the Saint-Prest specimen; but the general form and proportions, as well as the outlines of the bones, agree as closely as could be expected in two skulls of the same species. The parieto-squamosal suture has the same deeply sinuous form, and at its hinder part, in both skulls, there is a foramen; there is also a large foramen on the outside of each squamosal between the auditory meatus and the jugal buttress.

The backs of these skulls cannot well be compared, as the Forest Bed specimen is somewhat denuded of its prominent parts, and the flatness of this region, in the figures of the Saint-Prest skull, seems to indicate considerable obscurity in the original. However, the general form is the same in both, and the depressions just above the condyles are similar. The foramina seen on each side in the mastoid region are not the same in the two specimens; but as neither of the skulls has the two sides alike, this cannot be of very great importance, and the differences may be entirely due to imperfections, and not to any structural difference between the specimens.

In a side view the two skulls also agree, in so far as they can be compared, and perhaps the most important feature is their similarity in the non-extension of the maxillary buttress downwards to the alveolar margin.

6. *Measurements.*

	Beaver from Fens.	Forest Bed skull.	Fischer's type.
Basioccipital between condyles to point between incisors	m. ·135	m. ·133	m. ·158
,, to one of the hinder molars	·0475	·042	·046 ?
Series of cheek-teeth at alveolar margin	·034	·038	·044
Front cheek-tooth to point between incisors	·057	·061	·075
,, ,, ,, to palatal foramen	·019	·015	·016
Palatal foramen, length	·019	·021	·021
,, ,, to incisors	·023	·030	·044
Distance between premolars	·0075	·004	·0065
,, ,, hindermost molars	·022	·026	·027
Brain-case, width at temporal fossa	·048	·050	·050
,, ,, ,, between orbits	·0295	·0335	·034 ?
Parietal, length	·070	·056	....
,, width of each	·021	·021	....
Frontal, length obliquely	·054	·064	....
,, width of both in front of orbit	·049	·052	·054 ?
Premaxillæ, width of both in front of maxilla	·037	·043	....
,, ,, at incisor alveoli	·027	·038	....
Height of skull, from palate between premolars to hinder end of nasals	·052	·055	·059

7. *Conclusions.*

To summarize in a few words the results of the above examination and comparison of the skull from the Forest Bed of East Runton :—In the first place, there can be no question that, although presenting many points of resemblance to the Beaver's skull, the differences are nevertheless of greater importance, and indicate at least a generic distinction.

In the second place, this skull, in all its essential characters, agrees so closely with the type of *Trogontherium cuvieri*, described by M. Fischer, that there are no sufficient grounds for regarding them as representatives of more than one species; the fossa in the basioccipital bone of Fischer's type having been, as I believe, artificially produced.

And thirdly, the skull from Saint-Prest, named *Conodontes boisvillettii* by M. Laugel, also agrees so well with Fischer's type and with the Forest Bed skull that it must be included with them in the same species.

The earliest name given to this rodent was *Trogontherium cuvieri*; it does not appear, however, in M. Fischer's first description of the skull, but seems to have been used by him in a letter to Cuvier, who gave it in the heading of his article in the 'Ossemens Fossiles,' but did not adopt it for the fossil. It was not until the year 1846 that Sir R. Owen, in his 'British Fossil Mammals and Birds,' used this name for the English Forest Bed specimens; but fortunately the other generic and specific names proposed for these fossils are of subsequent date, and cannot therefore be used.

Bones of other parts of the skeleton, which, for cogent reasons, are believed to belong to this rodent, have been found in the Cromer Forest Bed, and were described by Sir R. Owen in the 'Geological Magazine' for 1869, and by the present writer, in the 'Vertebrata of the Forest Bed,' in 1882; no important additional specimens have been obtained until the finding of the skull which has formed the subject of the present communication.

8. *Bibliography.*

1809. Fischer de Waldheim, Gotthelf. Sur l'*Elasmotherium* et le *Trogontherium*. Moscow Soc. Nat., Mém. vol. ii. p. 250.

1824–25. Cuvier, G. Recherches sur les Ossemens Fossiles. Edit. 3, vol. v, p. 59.

1833–34. Schmerling, P. C. Recherches sur les Ossemens Fossiles découverts dans les Cavernes de la Province de Liége.

1840. Lyell, C. On the Boulder Formation or Drift and the associated Freshwater Deposits composing the Mud-cliffs of Eastern Norfolk. Phil. Mag. ser. 3, vol. xvi, p. 345.

1846. Owen, R. British Fossil Mammals and Birds, p. 184.

1847. Rouillier, C. Jubilæum semisæcularem Doctoris Gotthelf Fischer de Waldheim, celebrant Sodales Soc. cæs. nat. scrut. mosquensis &c.

1848. Pomel, A. *Diabroticus schmerlingi*. Biblio. Univ. Genève, Archiv. Sci. vol. ix, p. 167.

1862. Laugel, A. *Conodontes boisvillettii*. Bull. Soc. Géol. France, sér. 2, vol. xix, p. 709.

1864. Lartet, E. Comptes Rendus, vol. 58, p. 1201.

1867. Lartet, E. Comptes Rendus, vol. 64, p. 48.
1857–69. Gervais, Paul. Zool. Pal. Gén. p. 80.
1869. Owen, R. On the Distinction between *Castor* and *Trogontherium*. Geol. Mag. vol. vi. p. 49.
1876. Alston, E. R. On the Classification of the order Glires. Proc. Zool. Soc. 1876, p. 78.
1882. Newton, E. T. Vertebrata of the Forest Bed, p. 65. Mem. Geol. Surv. United Kingdom.
1890. ——. On some New Mammals from the Red and Norwich Crags. Quart. Journ. Geol. Soc. vol. xlvi, p. 447.
1891. ——. Vertebrata of the Pliocene Deposits of Britain. Mem. Geol. Surv. United Kingdom.

9. EXPLANATION OF THE PLATE.

Trogontherium cuvieri, Fischer. All figures natural size.

bo., basioccipital.
eo., exoccipital.
exa., external auditory meatus.
fr., frontal.
in., incisor alveolus.
ip., interparietal.
m. 1, 2, 3, molar teeth.
mt., mastoid portion of periotic.
mx., maxilla.
oc., occipital condyle.
or., orbit.
pa., parietal.
pl., palatine.
plf., palatine foramen.
pm. 4, premolar 4.
pmx., premaxilla.
so., supraoccipital.
sof., suborbital foramen.
sq., squamosal.
tb., tympanic bulla.

Fig. 1. Skull from the Forest Bed of East Runton, near Cromer, in the possession of Mr. A. Savin, seen from above.

Fig. 2. Same specimen, palatal view.

Fig. 3. „ „ left side.

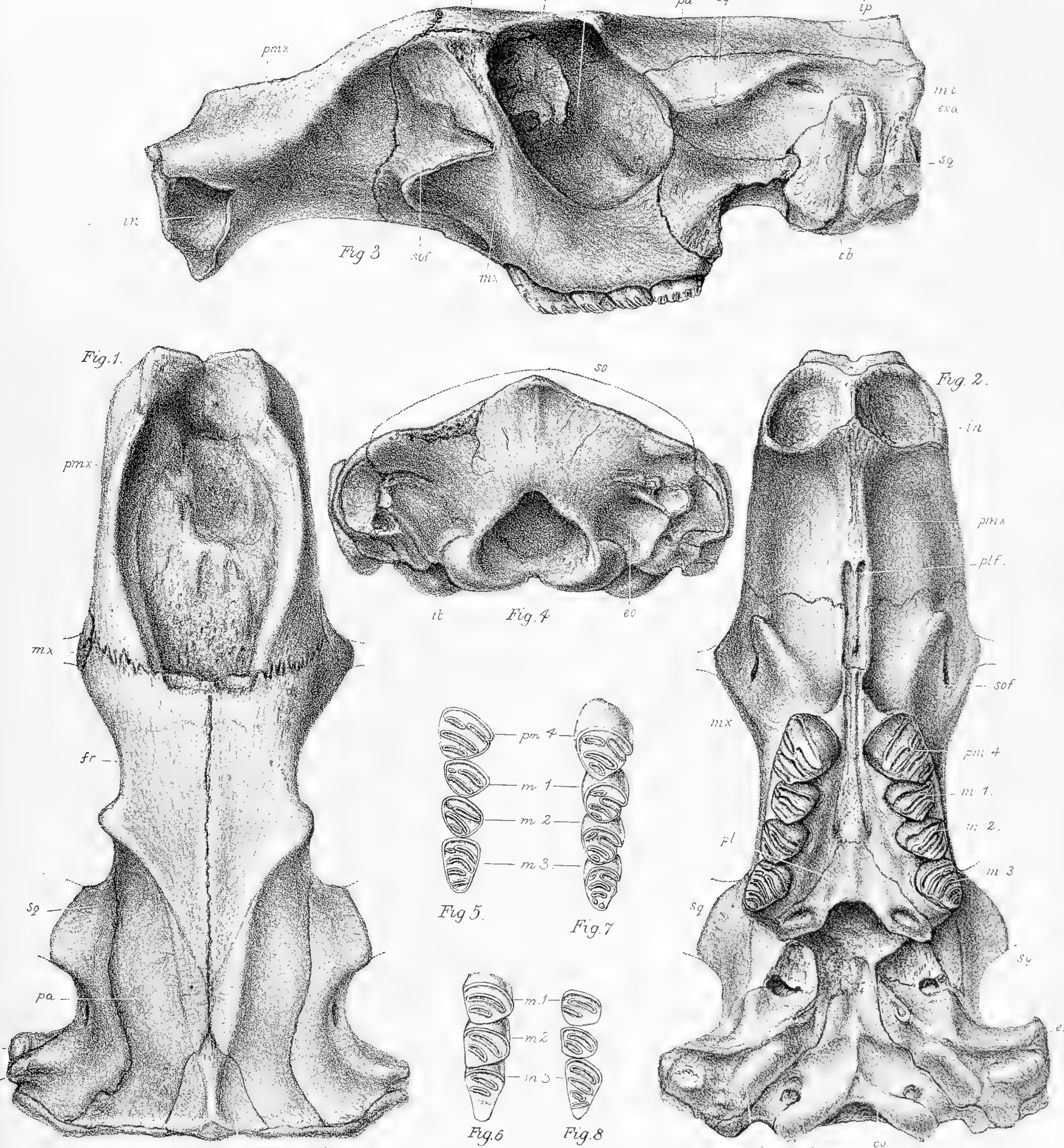
Fig. 4. „ „ seen from behind; the dotted line indicates the probable extent of the occipital crest.

Fig. 5. Right cheek-teeth of same specimen, grinding-surfaces slightly restored to show the enamel folds.

Fig. 6. Grinding-surface of three molars in the right maxilla described by Sir R. Owen in 1869, and now in the King Collection, Museum of Practical Geology.

Fig. 7. Grinding-surface of the right cheek-teeth of Fischer's type skull from the Sea of Azof, preserved in the Museum at Moscow. Copied from Rouillier's figure, and reduced to natural size.

Fig. 8. Grinding-surface of the right molars of the type skull of *Conodontes boisvillettii*, from the Pliocene of Saint-Prest, preserved in the École des Mines, Paris. Drawn from wax impressions of the teeth kindly supplied by Prof. Daubrée.



Berjeau & Highley del. et lith

Hanhart imp.

TROGONTHERIUM CUVIERI

VII. *Contributions to the Anatomy of the Anthropoid Apes.* *By* FRANK E. BEDDARD, *M.A., Prosector to the Society, and Lecturer on Biology at Guy's Hospital.*

Received February 15th, 1892, read February 16th, 1892.

[PLATES XX.–XXVIII.]

TABLE OF CONTENTS.

I. INTRODUCTORY.

DURING the last year the Society has lost two of the most valuable and interesting Anthropoid Apes from its collection—viz., the Bald-headed Chimpanzee " Sally " and the Lesser Orang " George." As neither of these forms has been investigated anatomically, except as regards the skeleton, I desire to offer to the Society some account of their structure as an addition to the existing knowledge of the Anthropoid Apes. Indeed, these are about the only two forms of the structure of the soft parts of which we have at present absolutely no knowledge. Unfortunately both animals were in certain respects in an unfavourable condition for dissection. The viscera of the Chimpanzee were very greatly diseased, while the enormous quantity of fat deposited round the abdominal viscera of the Orang rendered their condition if possible still more unfavourable for examination.

The Chimpanzee " Sally," as is well known, lived for a longer time in the Society's Gardens than has been recorded of any other Anthropoid Ape. She was purchased in October 1883, and died in August 1891, having thus been with us for eight years and some months. For notices of the character and intelligence of this animal, the reader is referred to papers by Mr. A. D. Bartlett [1] and Mr. Romanes [2]. Immediately after the death of the animal Mr. Smit made some careful drawings of the hands and feet and other external characters, which I now exhibit (Plates XX.–XXII.). A figure used in illustration of Mr. Bartlett's paper upon the Ape shows the general aspect and

[1] "On a Female Chimpanzee now living in the Society's Gardens," P. Z. S. 1885, pp. 673–675, pl. xli. The plate is reproduced in the present paper.

[2] "On the Mental Faculties of the Bald Chimpanzee (*Anthropopithecus calvus*)," P. Z. S. 1889, pp. 316–321.

coloration of "Sally" just after her arrival. The brain was carefully extracted and preserved in alcohol, and the muscles, after being soaked in alcohol, were kept in spirit vapour before being dissected. On opening the abdominal cavity the contained viscera were found to be extensively diseased, so much so that I have not attempted any description of them: so far as I could see, there were no differences from the Common Chimpanzee; I thought it would be worse than useless to give any accurate measurements and description. In the liver, for instance, there may be differences in the proportions of the lobes from the Chimpanzee; but, as the organ was greatly enlarged and had undergone fatty degeneration, it would obviously be misleading to give any measurements; its general form was, so far as I could judge, in no way different from that of the liver of the Chimpanzee as described by Prof. Flower in his published lectures upon the organs of digestion in the mammalian series [1]. Peritonitis was so extensive that the intestines were greatly matted together. The lungs also were diseased and were adherent to the pleural cavity. The bones of the vertebral column were diseased, being very friable. The muscles were somewhat wasted and there was no fat upon the body. The skin was preserved, and has been stuffed by Mr. Gerrard, Jun.; it has been purchased by the Hon. Walter Rothschild for the Tring Museum.

II. External Characters and Anatomy of Troglodytes calvus.

When the Ape first arrived at the Society's Gardens she was, as I infer from the teeth characters, about two years old; she was purchased from Mr. Cross, of Liverpool, in 1883. Two years after she had been in the Gardens, a notice of the principal external characters and of the habits by Mr. Bartlett appeared in the 'Proceedings' [2], illustrated by a coloured plate of the head and shoulders. The principal features to which Mr. Bartlett called attention as distinguishing this animal from *Troglodytes niger* were more evident at the time of her death. The face is quite black, as is also the hair covering the body. The hair on the top of the head only extends for a short distance in front of the level of the ears; on the sides of the face there is a scanty growth on the temporal region and on the cheeks; the chin is sparsely covered with short hairs, many of which are white, and there is also a still more sparse growth of short, chiefly white, hairs upon the upper lip. From the prominent supraciliary ridges spring the long scattered black hairs of the eyebrows, which do not meet in the middle line.

§ 1. *The Ear.*

The accompanying drawing (Plate XXVIII. fig. 3) shows the right ear of the natural size; the drawing was made immediately after the animal's death. It may be compared

[1] 'Medical Times and Gazette' for 1872.

[2] "On a Female Chimpanzee now living in the Society's Gardens," P. Z. S. 1885, p. 673.

with Hartmann's figure of the ear of the Common Chimpanzee[1] and with Gratiolet's and Alix's figures of the external ear of their supposed species *T. aubryi*. The ear is relatively quite as large as in these Chimpanzees, nor does it present any marked features which could distinguish it. This organ, however, varies in the Common Chimpanzee, even if we allow *T. aubryi* to be a distinct species. The margin of the ear of *T. calvus* agrees with that of *T. aubryi* in not being folded for the greater part of its length. Both the *tragus* and the *antitragus*, particularly the former, are very much marked, and they are divided by a very deep fossa. The margin of the ear is naked. Superiorly the helix is continuous with the antihelix, the fossa of the helix (at the letter H in the figure) becoming so shallow as to be practically non-existent. The fossa of the antihelix (F) is well marked, and there is no lobule.

§ 2. *The Hand.*

The accompanying drawing (Plate XXII. fig. 1) illustrates the lines upon the palmar surface of the hand, which were carefully drawn immediately after death. The figure itself does away with the need of any elaborate description; it may be compared with the drawing (Plate XXVII. fig. 1) of the palm of the hand of the Orang-Outang. I have also had the opportunity, through the death of a specimen at the Gardens on November 16th, of comparing the Bald-headed Chimpanzee with the Common Chimpanzee. The latter has been carefully described and illustrated by Alix[2]: his figure, however, evidently gives only the chief lines, those lettered *a*, *b*, *c*, in the accompanying drawing of the right hand of "Sally." There are no important differences that I can detect in the two Apes, except that in the Common Chimpanzee there are two longitudinal lines running from *a* to the roots of the fingers, such as occur in Man and in the Orang. The line *e*, which is not figured by M. Alix, seems to be of importance, as it occurs in both Chimpanzees. There is, no doubt, just as much variation in the lines on the hands of Apes as in the human hand. I do not, therefore, think it worth while at present to do much more than direct attention to the drawing. I have seen in the human hand the lines *a* and *b* running at right angles to the axis, as in the Chimpanzee, instead of somewhat obliquely, as in my own hand, for example.

§ 3. *The Foot.*

The accompanying drawing illustrates the plantar surface of the foot (Plate XXII. fig. 2). There are two principal cross lines, lettered *a* and *b*, which appear to correspond to those similarly lettered in the hand, and which by their direction show the prehensile nature of the foot; so do the strongly marked lines upon the hallux, which are hardly marked upon the pollex. The principal longitudinal line *e* is more marked than in the Orang.

[1] 'Der Gorilla,' pl. iv.
[2] "Des lignes papillaires du main et du pied," Ann. Sci. Nat. t. ix. 1868.

M. Du Chaillu's[1] description of the external characters of *T. calvus* agrees nearly absolutely with the above description of "Sally." I should, however, be inclined to dispute, on the hypothesis that "Sally" is an individual of that species, M. Du Chaillu's statement that the ears, though large, are smaller than in *T. niger*. Dr. Gray[2], it should be remarked, was disinclined to allow the species, and remarked later[3] that "the specimen received with the above name in the Museum was in too bad a state to determine with accuracy if it is distinct from *T. niger*. The baldness of the forehead appeared to be accidental." After this opinion, which certainly erred on the side of caution, it is curious to find a brief diagnosis of what is perhaps the "worst species" of Chimpanzee ever described, viz. *T. vellerosus*, immediately following. The N'tschego, according to Dr. Franquet, has a black face and small ears, thus contrasting with the Common Chimpanzee, which has a flesh-coloured face and very large ears. He says, as M. Du Chaillu has remarked, nothing about the baldness, which, if at all marked, would hardly have escaped his attention. We may therefore assume that there was no baldness; the smallness of the ears again distinguishes the animal described by Franquet and by Duvernoy. With regard to the black face, Du Chaillu says that *old* Chimpanzees of the common species are black in the face. The name also appears to have misled Dr. Franquet. According to Du Chaillu, "the natives of the Camma country call the *T. niger* 'Nschiego' and the *T. calvus* 'Nschiego M'bouve,' the latter meaning something like 'another tribe of the Nschiego.' The Mpongwé called the *T. niger* 'Nschiego,' or the 'N'chiego' of Dr. Franquet." Du Chaillu considered that the N'chiego of Franquet is simply *T. niger*, and, as I point out below, there is nothing in the osteology to contradict this opinion. I quite agree with Geoffroy St.-Hilaire when he writes[4]:—"Le Troglodytes tschego a été regardé avec raison par tous les zoologistes comme une espèce au moins très-douteuse." Geoffroy St.-Hilaire remarks also in this paper that a specimen of Franquet's species was on its way to the Paris Museum. In 1866[5] MM. Gratiolet and Alix described, in an elaborate and well-illustrated memoir, the external characters and anatomy of a species of Chimpanzee which they called *Troglodytes aubryi*. The anatomical account given in the paper is much fuller and more important than the section dealing with the external characters; for *post-mortem* changes had caused the almost complete loss of the hair and of the skin itself in the palmar and plantar regions. Nevertheless it is possible to institute comparison between that Chimpanzee and the animal which forms the subject of the present communication, which will be more valuable inasmuch as both individuals are females and of about the same size. This *Troglodytes aubryi*, which has been con-

[1] Proc. Boston Nat. Hist. Soc. 1860.

[2] P. Z. S. 1861, p. 273.

[3] 'Catalogue of Monkeys, &c.' 1870, p. 7.

[4] Arch. d. Mus. t. x. p. 17, footnote.

[5] "Recherches sur l'Anatomie du *Troglodytes aubryi*, Chimpanzé d'une espèce nouvelle," Nouv. Arch. Mus. d'Hist. Nat. t. ii. (1866) 264 pp. 9 pls.

sidered[1] to belong to the same species as a Chimpanzee ("Mafuca") living in the Dresden Zoological Gardens in 1876, has a black face, a more pronounced prognathism, and a more massive form than the ordinary Chimpanzee; the hair is black with a red reflection. In all these characters, except the last, it agrees with the Chimpanzee dissected by myself. I did not observe any reddish tinge in the hair of "Sally;" indeed the entirely black hair of this animal is one of the most marked differences from the *Troglodytes niger*. As to the prognathism, I have gone into the matter more fully below in describing the skull. On p. 35 of their memoir, MM. Gratiolet and Alix describe in detail the pigmentation of the skin, which is not uniformly black. The external characters mentioned above, of which a necessarily incomplete account is given, hardly permit of a definite opinion as to the specific distinctions of *T. aubryi* or its identity with *T. calvus*. Later in this paper (p. 183) I point out that the skull-characters, at any rate, are not those of *T. calvus*. The Chimpanzee called "Mafuca" was examined after its death by Dr. A. B. Meyer[1] and by Dr. Bischoff[2]. The coloured sketch of the face shows no resemblances to *T. calvus*; the skin is yellowish brown, except on the nose and round the eyes, and there is no baldness on the top of the head.

§ 4. *The Skull.*

I have carefully compared the skull of "Sally" with a skull of a nearly adult male Chimpanzee which arrived at the Society's Gardens on the same day, and died 29th October, 1883. This individual was slightly larger and had all its permanent teeth; the canines, however, had evidently only just cut the gums. The teeth of "Sally" are in the following condition[3]:—In the upper jaw the permanent incisors and bicuspids are present; the first molar is the only one of the molar series which is in place. The canines are a long way from their definitive position; the point of the tooth is fully half an inch from the rim of the socket; the extremity of the root of the tooth is barely half an inch from the rim of the orbit. Those teeth, which are not covered by bone, look as if they had been artificially inserted into excavations of the maxilla, and are very prominent and affect the contour of the face. The milk-canines are the only representatives of the milk-teeth which have not been replaced. The condition of the teeth, were their possessor a human being, would suggest the age to be between ten and eleven years. The brain-caps of both apes belonging to the prosector's stores had been removed for the purpose of extracting the brain; this showed the greater density as well as the greater thickness in front of the bones of *T. calvus*.

In a preliminary account of *Troglodytes aubryi* communicated by M. Gratiolet to the

[1] "Notizen über die Anthropomorphen Affen des Dresdener Museum," Mitth. Mus. Dresd. Heft ii. p. 223 (1877).

[2] See a paper immediately following that of which the title has just been quoted.

[3] Many of them are diseased and defective, but I think that the above account is complete; I made certain that the bicuspids are the permanent teeth by cutting into the jaw.

French Academy of Sciences [1], the author distinguishes this species by the presence of an additional cusp upon the last molar of the lower jaw. In the complete paper, on p. 73, the following statement is made about the 5th molar of the lower jaw :—" Elle a cinq tubercules, comme les deux dents qui la précèdent. Ce caractère sépare le *Troglodytes aubryi* du *T. niger* et du *T. tschego*, et le rapproche au *Gorilla gina*." I quote the passage in full in order to leave no room for any doubt of a misunderstanding on my part in case my own statements are questioned. In the lower jaw of *Troglodytes niger* belonging to the individual mentioned above the *last molar of the lower jaw*, though smaller than either M. 1 or M. 2, *has an identical pattern*. I have not been able to compare the corresponding molar of *T. calvus*.

A comparison of these two skulls shows a good many points of difference; but the series of skulls in the Natural History Museum, comprising animals of various ages and of both sexes, makes it a matter of considerable difficulty to draw up very definite specific distinctions. The examination of a larger series would probably increase these difficulties. On the whole it appeared to me that the prognathism of the face is more marked in *T. calvus*; the face in profile shows a very much more concave outline, the interorbital region being vertical or even (in " Sally's " skull) slightly directed backwards, while in *T. niger* the line passing from the top of the skull to the extremity of the upper jaw is almost flat or slightly concave; in an adult skull from Sierra Leone the concavity of the profile outline was fully as marked as in *T. calvus*. In none of the specimens in the Natural History Museum was it possible to examine the interior of the skull.

The inside of the skull of " Sally " showed a few points of difference in the two animals. In *T. calvus* the cribriform plate has a distinct crista galli; this ridge is wanting in *T. niger*. The transverse groove for the optic chiasma is decidedly deeper in *T. calvus* than in *T. niger*; the foramen lacerum anterius is also more extensive, the outwardly directed part being wider as well as larger in *T. calvus*. The orbits as seen from the inside of the skull were rather different in the two Chimpanzees. In the Common Chimpanzee a strong transverse ridge marks the highest part of the convexity formed by these lines. In *T. calvus* there is no marked ridge, the surfaces sloping gradually, and the concavity for the lodgment of the anterior part of the temporal lobes of the brain being in consequence less deep. On the other hand, in the skull of *T. calvus* the petrous bone was produced into a much sharper edge, and the excavations for the occipital lobes of the brain were in consequence decidedly deeper. The vomer of *T. niger* is bifurcate behind, the diverging plates being attached to the pterygoids. In *T. calvus* the hinder part of the vomer is covered by the pterygoids, the two little plates of bone which cover over the vomer being distinct from the rest of the pterygoid. The relative length of the basi-occipital and basi-sphenoid is different in the two

[1] This is reprinted at the end of the elaborated Memoir already referred to.

species: in *T. niger* the junction of these two bones is situated about a quarter of an inch behind the anterior end of the petrosal; in *T. calvus* the line of division is farther forwards, nearly on a line with the anterior extremity of the petrosals: this produces also a difference in the shape of the basisphenoid; it is a triangular bone in *T. calvus*; in *T. niger* it ends in a point anteriorly in the same way, but it has parallel margins from behind the points where the pterygoids lose their connection with it.

If the existence of the crista galli and the grooving for the optic chiasma prove to be really differential characters, they are particularly interesting from the fact that they occur in the Gorilla. The *nasal bone* in the skull of "Sally" was distinctly ridged in the middle line; this character, however, was not found in the two skulls of *T. calvus* in the Natural History Museum nor in any of the skulls of *T. niger*. This character is also of some little interest, as it occurs in the Gorilla, and is indeed mentioned by Owen as one of the points of distinction between these Anthropoids. In *T. calvus* the spheno-maxillary fissure is very wide and continuous with the groove lodging the orbital branch of the trigeminus. In *T. niger* this groove is not always open behind: in the male Chimpanzee skull belonging to the Society the groove in question is connected posteriorly into a tube by the complete closing in of the walls; and in other specimens of *T. niger* I found a partial indication of such a closing in. In the male Chimpanzee just referred to, the spheno-maxillary fissure is remarkably narrow, instead of presenting the appearance of a deep wide gash. And this apparent difference between the two species is very clearly marked in the two skulls belonging to the Society; but it will probably require revising when a large number of skulls are available.

No doubt it would be possible to institute a more detailed comparison between the two species; but the above notes contain, I believe, the principal points of difference, and I would submit that, taken collectively, they fully justify the separation of the two Chimpanzees. It is now necessary to inquire how far *T. calvus* agrees with any other "species" of Chimpanzee.

Prof. Hartmann[1] does not consider that any case has yet been made out for dividing up the Chimpanzees, though admitting "that there are not inconsiderable, and perhaps even specific, varieties from the ordinary type." He is inclined to allow provisionally three varieties, viz. the typical form of *T. niger*, Giglioli's variety (which may be the same as MM. Gratiolet and Alix's *T. aubryi*), and thirdly Duvernoy's *T. tschego*, probably the same as the Chimpanzee "Mafuca" already referred to. What claims has *T. aubryi* to be regarded as a distinct species? Of the external characters our knowledge is far too incomplete to allow of an attempt to answer this question. With regard to the skeleton, I do not find that the skull offers any character that one can seize upon as being of specific value. The skull of *T. aubryi* is figured in four

[1] "Anthropoid Apes," Int. Sci. Series.

aspects[1], which enables one to get a very good idea of its principal characters, even without reference to the careful description in the accompanying letterpress. Judging from the figures, it seems to me that *T. aubryi* does not differ so much from *T. niger* as does *T. calvus.* In the text MM. Gratiolet and Alix do not call attention to any points of difference between their species and the Common Chimpanzee, except as regards the teeth. I have pointed out, on pp. 182, 183, the main cranial characters of *Troglodytes calvus* which seem to distinguish it from *Troglodytes niger*: none of these characters are shown in the illustrations of the cranium of *Troglodytes aubryi*; in the regular slope of the face (shown in the lateral view, *l. c.* fig. 4) and in the regular and narrow palate the skull of this ape precisely resembles that of the typical *Troglodytes niger.*

Another "species" of Chimpanzee was described nearly forty years ago by Duvernoy[2] in a paper dealing with the Anthropoids in general. This Chimpanzee was called *T. tschego*, and the whole skeleton is described and for the greater part illustrated. With regard to the skull, which measures in extreme length 20 cm., and is therefore larger than that of "Sally," I cannot make out either from the description or from the plate (plate vi.) any marked differences from *T. niger.* This species having been identified by some with *T. calvus*, I naturally paid attention to the differences indicated by Duvernoy in order to see how far the characters agreed with those of the animal described in the present communication. One of the characters upon which Duvernoy lays some stress is the fusion of the temporal crests in *T. tschego* and the separation of those crests in *T. niger.* This supposed difference is indicated in the plate accompanying Duvernoy's memoir. With regard to this matter, one cannot dissent from the opinion of Geoffroy St.-Hilaire[3], who writes: "Les caractères ostéologiques que donne, à l'appui, M. Duvernoy, sont-ils véritablement spécifiques? Ne peuvent-ils s'expliquer par de simples différences de sexe et d'âge?" The skull of *T. tschego* showing the convergence and junction of the said crests is larger (and, having the complete dentition, therefore older) than the skull of "Sally," in which these crests do not meet. Hartmann mentions the single crest in the adult Chimpanzee without suggesting that this is a specific distinction. He speaks also of the muzzle being enlarged in front, the greater width of the palate in front, and states that the alveolar border of incisors and canines forms "un arc assez bombé." I do not think that anyone will be disposed to lay great value upon these characters, and at all events they do not indicate any particular resemblance to the skull of *T. calvus.* The plate does seem to show a rather thicker supraorbital ridge; but this is not probably by itself a difference of great importance.

[1] *Loc. cit.* pl. ii. figs. 1–4.

[2] "Des caractères anatomiques des grands Singes pseudo-anthropomorphes," Arch. d. Mus. t. viii.

[3] "Description des Mammifères nouveaux ou imparfaitement connus," &c., Arch. d. Mus. t. x.

§ 5. *Muscular System.*

As *Troglodytes calvus* is undoubtedly a distinct species, I have thought it worth while to give such notes upon the muscles as I am able from my dissections of the limbs. The other muscles I have not touched at all. There is no account of the myology of this Chimpanzee, unless it be identical with *T. aubryi*; but this identification, as I have already pointed out, is hardly possible.

§ 6. *The Muscular Anatomy of the Fore Limb.*

(1) *Pectoralis major.*—This muscle has a clavicular origin as in Man; it is large and powerful and undivided at its insertion, which is two and a half inches in length; anteriorly a tendinous slip reaches the head of the humerus. The muscle where it is inserted is tendinous on the under surface, but fleshy above; posteriorly it is inserted in common with a part of the *deltoid*, this part of the muscle being fleshy on both faces.

(2) *Pectoralis minor.*—The stout tendon of insertion of this muscle is upon the coracoid process, just above the origin of the conjoined *biceps* and *coraco-brachialis.*

(3) *Subclavius* is largely ensheathed by the coraco-clavicular ligament; its fleshy insertion is on to the proximal half of the clavicle.

(4) *Coraco-brachialis.*—The *coraco-brachialis* arises, in common with the coracoidal head of the *biceps*, from the coracoid process; the two muscles become separate at a distance of three inches from their origin; its insertion measures two inches in length; near to its insertion some of the fibres of the *triceps* and of the *brachialis anticus* arise from it.

(5) *Biceps* is composed of two very distinct portions, of which the scapular half is rather, but not very markedly, the thicker; the two parts of the muscle fuse together about three and a half inches in front of their common insertion; the two halves of the muscle are fleshy where they join. The tendon of insertion measures about two inches up to its beginning on the "coracoid" side of the muscle. It is inserted on to the radius, the diameter at the insertion being three-fifths of an inch.

(6) *Latissimus dorsi.*—This muscle gradually narrows towards its insertion, but gets slightly thicker just before it gives off the *dorso-epitrochlear*; it has a diameter of $\frac{9}{10}$ inch. The *dorso-epitrochlear* slip is very large and fleshy; it ends in a tendon two and a half inches in length, inserted on to the flexor condyle. The insertion of the *latissimus dorsi* measures one inch in length; it is completely free from the *teres*, and there is no division of the muscle into two parts such as occurs in the Orang. The tendon of the muscle commences earlier on its ventral side; an inch and a half is the length of the completely tendinous part.

(7) *Trapezius.*—The insertion of this muscle is on to the external half of the clavicle and on to the greater part of the scapular spine.

(8, 9) The insertion of the two *rhomboidei* is a common insertion. I have found it impossible to distinguish one from the other; the insertion extends along three quarters of the base of the scapula, commencing more than an inch and a half on the dorsal side of the point where the spine reaches the posterior margin.

(10) I could find no *rhomboideus occipitalis.*

(11) *Levator anguli scapulæ.*—This muscle is unusually well developed and consists of two distinct parts, which are perfectly separate from each other at their insertion. The anterior of them is inserted along a line measuring one inch and a quarter, commencing exactly at the angle of the scapula. The muscle becomes suddenly wider just at the insertion; at a distance of one inch from the actual insertion it only measures half an inch in diameter. This insertion is entirely of fleshy fibres. The second half of the *levator* is inserted by an almost entirely tendinous attachment to the next three quarters of an inch of the posterior border; it is mostly covered by the *rhomboideus* [1].

(12) The *Omohyoid* is of considerable size; its insertion nearly fills up the concavity on the inferior border; the insertion is slightly tendinous on the lower surface.

(13) *Serratus magnus.*—The attachment of this muscle is precisely as in the Orang.

(14) *Deltoid.*—The muscle is very large. It arises from the outer half of the clavicle, from a considerable portion of the scapular spine, and from the septa between itself and the *infraspinatus, teres minor*, scapular head of *triceps*, and *teres major*; also from the posterior portion of the scapula just in front of the origin of the *teres major.* The insertion is chiefly on to a rough triangular area upon the humerus; it is also connected with the humeral heads of the *triceps*, and, as already mentioned, with the insertion of the *pectoralis major.*

(15) *Teres major.*—This large and fleshy muscle arises along a line measuring two inches and three quarters. Its origin is chiefly from the scapular border, commencing immediately behind the insertion of the *serratus magnus* and from the septum between itself and the *teres minor, deltoid*, and *subscapularis.* The line of insertion on to the humerus measures one inch and three quarters; it commences just in front of the insertion of the *coraco-brachialis.* The insertion is largely muscular, but that this is so is not obvious on account of it being concealed by a sheet of tendon covering the muscle on each side; the anterior half-inch or so of the insertion is entirely fleshy, the last half-inch or so is nearly wholly tendinous.

(16) *Teres minor.*—The *teres minor* arises partly from the lower border of the scapula and also from the septa between itself and the following muscles, viz., *deltoid, infraspinatus, triceps*, and *teres major.* The insertion of the muscle is partly on to

[1] It is possible that this muscle is really the *rhomboideus minor.* Not having its origin I cannot be certain about the point.

the scapular ligament, and partly on to the head of the humerus, but chiefly on to the greater tuberosity, and just below the insertion of the *infraspinatus.*

(17) *Infraspinatus.*—This muscle covers over the whole of the infraspinous fossa. It does not, however, arise from the middle of the fossa, only from the spine and from the lower border, except posteriorly; it also arises from the septa between itself and the following muscles: *deltoid*, *teres major*, *teres minor.* It is largely tendinous at its insertion: the tendon arises first just within the muscle, but subsequently reaches the lower surface; it is inserted partly on to the capsular ligament of the humerus, and partly on to the humerus itself.

(18) *Supraspinatus.*—This muscle, unlike the *infraspinatus*, arises from the greater part of the supraspinous fossa; its tendon of attachment first commences within the substance of the muscle.

(19) *Subscapularis.*—This muscle is covered below (on the free surface) by a strong aponeurosis, from which its fibres partly arise; this fascia has a specially strong attachment to the lower angle of the scapula. The muscle arises from the greater part of the subscapular fossa.

(20) *Triceps.*—This muscle has the usual three heads (not reckoning the *dorso-epitrochlear*, which has been already described in connection with the *latissimus dorsi*); the scapular head is largely tendinous on the lower surface; the tendinous aponeurosis gradually diminishes in extent, and terminates just after the junction of the scapular and humeral heads of the muscle. The scapular head arises chiefly from the lower border of the scapula along a line measuring two and a half inches in length; the origin is partially from the septa between itself and the *teres major*, *teres minor*, and *subscapularis.* The origin of the outer humeral head commences just below the head of the humerus; the inner humeral head commences much lower down; anteriorly some of its fibres arise in common with those of the outer humeral head; further back the origins of the two heads are quite distinct. Both humeral heads arise not only from the humerus, but also from the septa between themselves and adjacent muscles.

(21) *Brachialis anticus.*—The origin of this muscle commences just below the *deltoid.*

(22) *Supinator radii longus* arises just in front of the *supinator carpi radialis longior* from the humerus; it also takes origin from the septa between itself and the *triceps*, the *brachialis anticus*, and the *supinator*; the line of origin measures two and a half inches; it is inserted by a broad flat tendon two and a half inches in length.

(23) *Extensor carpi radialis longior* is the most external of the extensor muscles of the hand; it arises chiefly from the lower part of the external condylar ridge of the humerus just below the last muscle, and from the external condyle itself in common with the *extensor carpi radialis brevior.* The muscle is short, not reaching halfway down the forearm; the long tendon passing under the tendon of the extensors of the thumb is inserted on to the inner side of the base of the second metacarpal.

(24) *Extensor carpi radialis brevior.*—This muscle is larger than the last; it rises, in common with the other extensors, from the extensor condyle of the humerus; it does not become free from the *extensor communis* until a point four inches distant from the humerus; it becomes entirely tendinous about two inches further on; the tendon is quite twice the breadth of that of the last extensor; it is inserted on to the base of the metacarpal of the third digit.

(25) *Extensor communis digitorum.*—This extensor is of course the largest of all; it arises from the extensor condyle of the humerus, from the septa between itself and adjacent muscles, and from the fascia covering the deep extensors; it divides into four separate muscles, which end in tendons at various distances from their insertion; the longest tendon is that supplying the third digit; each tendon supplies one of the digits II.–V.; it is inserted on the first and second phalanges, and spreads out into a thin layer almost covering these bones.

(26) *Extensor minimi digiti* appears to be totally absent, unless it is a part of *extensor communis* that is absent; the tendon of that division of the "*communis*" which supplies digit V. is separated from the others at the wrist.

(27) *Extensor carpi ulnaris* is the outermost of the extensors; its origin extends down the arm to a point beyond the middle; the tendon, which is very strong and round rather than flat, is inserted on to the outer side of the base of the last metacarpal.

(28) *Supinator radii brevis.*—This muscle is distinctly double as in the Orang; the posterior boundary is marked by the exit of the nerve; the entire muscle is inserted on to the radius for more than one third of its length; the insertion of the deeper layer extends nearly an inch below that of the upper layer.

(29) *Extensor ossis metacarpi pollicis.*—The origin of this muscle is from the radius and ulna, and from the interosseous ligament; the muscle divides early, and the two tendons pass down in close contact, and are inserted on to radial carpal and base of metacarpal respectively.

(30) *Extensor secundi internodii pollicis.*—This muscle arises from the inner side of the ulna, from the interosseous membrane, and from the septa between itself and the *extensor indicis* and other adjacent muscles; its long tendon is inserted on to the second phalanx of the thumb.

(31) *Extensor indicis.*—This muscle is almost exactly the same size as the last, and their origins are close together, being partly from the septum dividing them; the *extensor indicis* also arises from the upper surface of the ulna, below the origin of the *extensor carpi ulnaris*; it is attached to the index only by a strong tendon which joins that of the branch of the *extensor communis* supplying that digit.

(32) *Extensor primi internodii pollicis.*—This muscle is superficial to the *extensor ossis metacarpi pollicis*, from which, however, it is hardly separable; it arises, with that muscle, from the radius, from the interosseous membrane, and from the septa between

itself and adjacent muscles; its tendon commences at the wrist, and is therefore rather shorter than that of the *extensor ossis metacarpi pollicis*, but almost exactly of the same thickness; the two tendons run in very close contact; it is inserted on to the base of the metacarpal of the thumb on the inner side.

(33) *Pronator radii teres.*—The origin of this muscle is much more distinctly double than in the Orang; its insertion on to the radius is chiefly tendinous, and measures two and a half inches in length.

(34) *Palmaris longus.*—This muscle is very slender, and ends in a tendon about halfway down the arm; towards its origin from the flexor condyle the muscle is not at all distinct. Its tendon is continuous with a vertical tendinous sheet, from which fibres of the *flexor carpi radialis* and of the *flexor sublimis* arise; at the wrist it is continuous with the very dense and stout palmar fascia.

(35) *Flexor carpi radialis.*—It arises from the flexor condyle, from the septa between itself and the *pronator radii teres*, *flexor sublimis*, and *palmaris longus*; the muscle becomes free about three inches in front of the wrist; its tendon is visible upon the under surface of the muscle, first of all about halfway down the arm; the muscular fibres cease only just at the wrist. It is inserted on to the base of the second metacarpal.

(36) *Flexor carpi ulnaris.*—The muscle arises from the flexor condyle and from a considerable portion of the ulna, and from the septa between itself and adjacent muscles, as well as from the fascia covering the arm; it becomes tendinous only on the ventral side, and is inserted principally on to the ulnar distal carpal (pisiform); it measures half an inch in diameter at its insertion.

(37) *Flexor sublimis (perforatus) digitorum.*—The four muscular bellies which together make up this muscle are quite separate from each other halfway down the arm; the undivided muscle arises from the flexor condyle, from the septa between itself and adjacent muscles, and from the radius; the part which arises from the radius mainly belongs to the flexor of the third digit, which has the stoutest tendon, commencing earlier than in the others upon the under surface of the muscle; the actual tendon itself of the fourth digit is the longest; that supplying the little finger is very much more slender than the rest; the tendons supplying digits III., IV., and V. lie superficially to the remaining tendon; a muscular slip measuring three and a half inches in length arises from a tendinous intersection upon that part of the *flexor sublimis* belonging to the little finger, and is inserted on to the deep flexor tendons of digit IV. by a short flat tendon of its own.

(38) *Flexor longus pollicis.*—This muscle is very distinct from the next to be described; it arises chiefly from the radius and from the interosseous membrane, but also from the septum between itself and the *flexor carpi radialis*; its tendon commences on the under surface of the muscle about halfway down the forearm; the tendon is free from muscle on a line with the base of the thumb metacarpal; at this

point it gives off a very slender tendon running to the thumb; the main tendon of the muscle supplies the index.

(39) *Flexor profundus* (*perforans*) *digitorum* is a muscle rather larger than the last; it arises chiefly from the ulna and from the interosseous membrane; the three tendons become separate at the wrist after perforating the tendons of the *flexor sublimis*; they are attached to the terminal digits of the fingers (Nos. III., IV., and V.).

(40) There are four *Lumbricales*: the first arises from the deep flexor tendon of the index; it gives off a slip to the tendon of the *flexor sublimis* belonging to this digit; the second muscle arises wholly from the tendon (deep flexor) of digit III.; the third muscle arises from this tendon and from the next one, that of the fourth digit; the fourth muscle arises from the two last tendons of the series; each *lumbricalis* is inserted on to the extensor tendon of the digit to which it belongs.

§ 7. *The Muscular Anatomy of the Hind Limb.*

(1) *Glutæus maximus* arises from the fascia lata, from the ilium itself, and from the coccyx; it is inserted partly on to the fascia covering the thigh and partly by a strong tendon on to the femur just opposite the end of the insertion of the *quadratus femoris*, continuously with the *glutæus maximus*; but arising from the tuber ischii, in common with the *biceps* and other muscles which take their origin therein, is a fleshy mass which is inserted on to the femur continuously with the tendon of the *glutæus*, and which also partly fuses with the *rectus externus* and the femoral head of the *biceps*. I cannot find any sharp demarcation between the fibres of this muscle and those of the *glutæus maximus* at their insertion, though the posterior part, which has a mainly muscular insertion, evidently corresponds to the *ischio-femoral* of the Orang (see p. 211). The length of the line along which the conjoined muscles are inserted is three and a half inches.

(2) *Glutæus medius* arises chiefly from the ilium as far down as on a line with the anterior boundary of the origin of the *glutæus minimus*; it also arises from the fascia lata. The fibres of the muscle rapidly converge towards its insertion; some way in front of the insertion a strong tendinous band is developed within the muscle; the under and upper surfaces of the muscle only become tendinous a short way in front of its insertion. At its insertion (on to the great trochanter) it comes into close connection with the tendon of the *pyriformis*.

(3) *Glutæus minimus.*—This muscle has a fleshy origin of an inch and three quarters in length from the border of the greater sciatic notch. It becomes partly tendinous on the upper surface some way in front of its insertion; its insertion is so perfectly continuous with that of the *scansorius* that it is impossible to say where one begins and the other leaves off. The line of insertion of the two muscles together measures an inch and three quarters.

(4) The *scansorius* is well developed; it arises chiefly from nearly the whole of the

anterior border between the anterior spine and the glenoid cavity, but also—though to a very slight extent—from the fascia lata and from the septum between itself and the *glutæus medius.* Its insertion behind that of *glutæus minimus* has been already mentioned. The muscle begins to be tendinous on the upper surface rather more than an inch away from the actual insertion, at a less distance on the ventral surface; the actual tendon of insertion measures about half an inch in length.

(5) *Pyriformis* runs in close proximity to the *glutæus medius*; it ends in a somewhat rounded tendon, which is attached to the femur, on to the great trochanter, between the insertions of the *glutæi medius* and *minimus.*

(6) *Obturator internus*, together with the *gemelli* (of which the external is the larger), is inserted into the upper part of the fossa behind the great trochanter.

(7) *Obturator externus* has an entirely fleshy insertion just behind the lesser trochanter.

(8) *Quadratus femoris* is fleshy throughout.

(9) *Biceps femoris.*—This muscle has two heads; the ischial head arises from the tuber ischii in common with the *semimembranosus* and *semitendinosus*; it forms a round fleshy belly, which is tendinous on the lower surface near its origin, and becomes tendinous on the outer surface about halfway along; it ends in a flat tendon, which widens out, becoming continuous with the fascia covering this part of the leg, and is also inserted on to the fibula; this upper part inserted on to the fibula remains thicker than the rest. The femoral head arises from the femur and from the septum between itself and the *vastus externus* along a line measuring two inches and three quarters; its fibres are partly inserted on to the tendon of the long head, and partly become continuous with the fascia covering the thigh.

(10) *Semimembranosus.*—This leaves the head of origin common to itself, the *biceps*, and the *semitendinosus* as a flat tendon one inch and three quarters in length, and one quarter of an inch in breadth; it forms a fleshy belly, slightly tendinous on the inner surface at both ends; it is inserted by a short strong tendon on to the inner side of the tibia below the ligament uniting the tibia and the femur.

(11) *Semitendinosus.*—This muscle is rather larger than the last; it leaves the common muscular origin, which it shares with the last two muscles, almost simultaneously with them, *i.e.*, the common head becomes trifurcate. Its tendon of insertion measures rather over an inch and a half in length; it becomes wider at the actual insertion, which is close to and below that of the *gracilis.*

(12) *Iliaco-psoas.*—The two separate muscles are inserted by a common tendon on to the lesser trochanter.

(13) *Sartorius.*—This muscle is roundish at its origin, but becomes flat and strap-shaped before the middle of the thigh; it is more slender than the *gracilis.* Its diameter some way in front of the insertion is three fifths of an inch. At its insertion it becomes much wider. The insertion is half tendinous and half muscular, the

tendinous insertion being anterior and lying just to the outside of that of the *gracilis.* The line of insertion measures one inch and a half.

(14) *Rectus femoris.*—This muscle is partly tendinous and partly muscular at its origin from the ilium below the *scansorius* and just in front of the glenoid cavity; about halfway down the thigh it fuses with the external vastus muscle.

(15) *Vastus.*—The *vastus externus*, *vastus internus*, and *cruræus* were all present; but they were so closely connected the one with the other that it is best to regard them as one muscle arising from the greater part of the surface of the femur, and inserted on to the patella and its ligament.

(16) *Gracilis.*—The *gracilis* arises from the symphysis pubis by a thin tendon; the muscle is flat, and gradually narrows towards its insertion, which is by a tendon rather more than an inch in length and about half an inch in breadth; the insertion lies between that of the *sartorius* and *semitendinosus.*

(17) *Pectineus.*—This muscle arises in front of the *adductor longus*, and is very slightly overlapped by it; its origin is chiefly fleshy, but there is a tendinous surface of small extent on the posterior surface of the muscle, which is overlapped by the *adductor.* The insertion measures three quarters of an inch in length, and lies immediately behind the lesser trochanter; for almost one quarter of its extent it is entirely tendinous, and the whole of the upper surface glistens.

(18) *Adductor longus* arises from the pubis, immediately behind the origin of the *pectineus,* which it slightly overlaps, and from the septa between itself and the adjacent muscles; at a distance of four and a half inches from its origin it fuses with the *adductor magnus,* and is inserted in common with that muscle.

(19) *Adductor brevis.*—This muscle arises below the *adductor magnus*; it consists of two parts: one arises from the pubis, below the *adductor longus,* and from the symphysis, the other arises further back from the ischium and from the septa between itself and the *adductor magnus* and *obturator internus*; the two join just before the insertion; its line of insertion measures an inch and a half in length; it commences about on a level with the middle of the lesser trochanter, and ends on a level with the end of the insertion of the *glutæus maximus*; the insertion is partly muscular and partly tendinous.

(20) *Adductor magnus.*—This muscle is divided into two distinct parts, which are perfectly separate both at origin and insertion: one part is inserted in common with the *adductor longus,* and it is a question whether these two together should not be regarded as the equivalent of the *adductor longus.* The outer part of the muscle arises from the ischium just behind the *gracilis* and in contact with it in front; behind it is in contact with the origins of the *semimembranosus* and the other muscles which arise from the tuber ischii; together with the *gracilis* it completely covers over the deeper part of the *adductor magnus.* The muscle is flattish at first, but afterwards becomes thicker; its origin is fleshy above, but in the middle line below it has a tendon, which soon dies

away. It is inserted on to the inner condyle of the femur. The second part of the *adductor magnus* arises below the first head and the *gracilis* from the symphysis pubis and from the ischium; the line of origin extends from close to the anterior extremity of the symphysis back to a point upon the ischium corresponding to about the middle of the origin of the first half of the *adductor magnus*; it arises not only from the bone but from the septa between itself and the posterior head of the *adductor brevis* and *obturator internus*; at about an inch from its insertion it is joined by the *adductor longus*. The insertion of the muscle upon the femur extends from the end of the first third of the bone up to its very extremity; on the inner side, where the insertion is common to it and the *adductor longus*, the muscle is strongly tendinous; on the outer side the attachment is muscular and formed by coarsely fasciculate fibres.

(21) *Tibialis anticus*.—This muscle is formed of two distinct parts, which, however, originate in common; the two tendons pass close together below the ligament connecting the astragalus with the first metatarsal; the hinder of the two tendons, which is the shortest, is inserted on to the cuneiform bone; the anterior tendon is inserted, in common with the astragalo-metatarsal ligament, on to the proximal end of the first metacarpal.

(22) *Extensor proprius hallucis*.—This muscle arises from the fibula, from the interosseous ligament, and from the septa between itself and the adjacent muscles; it becomes entirely tendinous just at the astragalo-metatarsal ligament, underneath which it passes, and, running along the upperside of the hallux, is inserted on to the distal phalanx.

(23) *Extensor longus digitorum pedis*.—The muscle arises from the fibula, from the interosseous membrane, from the fascia covering the leg, and from the septa between itself and the *tibialis anticus*, *extensor proprius hallucis*, and *peronæus tertius*. The muscle becomes free about two inches in front of the ankle. The tendons of insertion are visible upon the upper surface of the muscle about an inch before they become free from muscular fibres. In the middle of the ankle the muscle splits into two: one division is entirely tendinous, the other is invested on the lower side with muscle for a distance of about an inch beyond the division. The front tendon supplies the second and third digits; it divides rather beyond the middle of the metacarpal into two tendons, of which that supplying digit II. is rather less than half the diameter of that supplying digit III. The second division of the muscle again divides, just at the commencement of the metatarsal region, into two equally sized tendons, which are each as large as the tendon of digit III.; they supply digits IV. and V.; in every case the tendons are inserted on to the terminal of the phalanx of the digit.

(24) *Extensor brevis digitorum* consists of four muscular slips, which supply the thumb and the next three digits; their tendons join the long extensors of the digits just at the commencement of the first phalanx; the four muscles arise in common from the os calcis, but they become almost immediately distinguishable into the four slips;

those supplying the three middle digits lie between the metatarsals, the first of them lying between the second and third metatarsals; their tendons arise at the commencement of about the last third of the metatarsals.

(25) *Peronæus longus.*—This is the outer of the two peroneal muscles (there are *only* two); it arises from the fibula and from the septa between itself and adjacent muscles.

(26) *Peronæus brevis* arises from the fibula and from the septa between itself and adjacent muscles; its tendon, which is superficial to that of the last muscle, is inserted on to the outer side of the head of the first metatarsal; some way before its insertion it gives off a very fine tendon, which passes along the extensor surface of the last metatarsal; at the end of this bone the tendon passes over to the outer side and joins the tendon of the long extensor of this digit.

(27) *Gastrocnemius.*—This has the usual two heads, which join at about the middle of the calf. The outer head is entirely tendinous at its origin from the external tuberosity; for half an inch or so from the point of origin it is fused with the fleshy head of the *plantaris*; the tendon spreads out over the outer surface of the muscular belly, and gradually dies away. The inner head is half fleshy and half tendinous at its origin, which is more extensive than that of the outer head, extending as it does over the condyle ventral of and behind the tuberosity as well as from the tuberosity itself; the relative positions of the fleshy and tendinous parts of the head of origin are precisely those of the fleshy *plantaris* and the tendinous head of the outer half of the *gastrocnemius*; the fleshy parts are both internal. The tendon spreads over the upper surface of the muscle and reaches back rather further than in the case of the outer head; the conjoined muscles become tendinous on the inner surface some distance in front of their insertion (largely muscular) on to the calcaneum.

(28) The *soleus* may be regarded as a third head of the *gastrocnemius*, which is, however, distinct from it nearly up to the point of their common insertion. The muscle arises from the lower surface of the head of the fibula; its origin is fleshy above; below there is a layer of tendon, which extends back, covering nearly the whole of the ventral surface of the muscle, to about the middle of the calf of the leg; further back still it is the upper surface which becomes tendinous.

(29) *Plantaris.*—This is a slender muscle, arising, as already mentioned, in common with the outer head of the *gastrocnemius*; the muscle passes into a slender tendon; four inches from its origin this tendon passes between the *gastrocnemius* and the *soleus*, though in closer connection with the former.

(30) *Popliteus* arises from the external condyle of the femur by a strong thick tendon; this passes just beneath the external ligament of the knee; the muscle is inserted on to the head and shaft of the tibia along a line measuring three inches in length. The tendon of origin of the muscle ends in the interior of the muscle, being ensheathed in muscular fibres.

(31) *Flexor longus digitorum pedis.*—This muscle arises from the anterior two-thirds of the shaft of the tibia and from the septa between itself and adjacent muscles. Its tendon commences a little way in front of the ankle-joint, but it is covered on the palmar surface with muscle continuously; the fibres belonging to itself do not end until the commencement of the *lumbricales.* It divides into three tendons, which supply digits II., IV., V.

(32) *Flexor brevis* arises from the calcaneum below the *abductor hallucis*; at about the middle of the sole of the foot it gives off a delicate muscular slip which ends in a very fine tendon joining the *flexor perforatus* of the fourth digit; beyond this it divides into two tendons, of which the outer is the stronger of the two; this becomes the perforatus tendon of digit III. At the point where the muscle passes into tendon it is reinforced by a muscular slip from the *flexor longus digitorum*; it is difficult, therefore, to say whether the tendon belongs to one muscle or the other. The inner tendon of the muscle becomes the perforatus tendon of the index, the perforatus tendon being furnished, not by the *flexor profundus,* as in the other digits, but by the *flexor longus digitorum pedis.*

(33) *Flexor profundus digitorum.*—The muscle arises from the upper two-thirds of the shaft of the fibula and from the septa between itself and adjacent muscles; the tendon becomes quite free from muscular fibres at the ankle. It gives off a strong branch to the thumb, which runs to the distal phalanx of the same; half an inch beyond this it is joined to the tendon of the *flexor longus digitorum pedis,* just in front of the origin of the branch of the latter going to the last digit; beyond this it divides into two tendons, approximately equal in thickness, which are the perforating tendons of digits III. and IV.

(34) *Lumbricales.*—There are three *lumbricales.* The innermost of these arises from the branch of the tendon of the *flexor longus digitorum* belonging to the index, and from the inner of the two tendons of the deep flexor; the outermost of the three arises partly from the outer surface of the outer of the two tendons of the deep flexor and partly from the tendon of the *flexor longus digitorum* supplying the fifth digit.

(35) *Tibialis posticus.*—This muscle is the deepest of the three flexor muscles; it arises from the tibia, from the fibula, from the interosseous membrane, and from the septa between itself and the two remaining flexors; its tendon of insertion is as large as those of either of the two other flexors; it is inserted partly on to the ligaments of the sole of the foot lying deep of the long flexor tendon and partly on to the tibia.

(36) *Abductor hallucis* arises from the calcaneum and ligaments of the sole of the foot, and is inserted on to the base of the first phalanx of the hallux by a fleshy insertion.

(37) *Abductor minimi digiti* arises principally from the calcaneum, but also from the plantar fascia of the foot; it is inserted by a short tendon on to the base of the first phalanx.

(38) *Flexor brevis hallucis* arises from the cuboid bone by a short flat tendon; it is inserted by a single insertion, in common with the *adductor hallucis*, which is fleshy.

(39) *Adductor hallucis.*—This is a strong fleshy muscle which arises partly from the sheath of the *peronæus longus*, partly from the plantar fascia, and partly from the heads of the metatarsals; the muscle measures one inch in diameter at the middle; it is inserted in common with the fleshy *flexor brevis* on to the base of the first metacarpal.

(40) A very small slender muscle arises by a tendon measuring half an inch in length from the sheath of the *peronæus longus*; the delicate muscular belly in which it ends measures 3 mm. in diameter and about an inch in length; it passes across the *transversus pedis* in close connection with it, but I could not determine its insertion; I found this muscle only in one foot.

(41) *Transversus pedis* is of some size; it arises from the metatarsal ligament of the second, third, and fourth digits; it is inserted on to the thumb in common with the *adductor hallucis.*

§ 8. *Comparison of Musculature with that of the Common Chimpanzee.*

In the following table the principal differences between *Troglodytes calvus* and *Troglodytes niger* are shown (according to Sutton's account of the myology of the latter[1]):—

	T. calvus.	*T. niger.*
Pect. minor	Insertion: coracoid.	Insertion: capsule of shoulder-joint.
Biceps cruris	Ischial head present.	Ischial head absent.
Soleus	From head of fibula only.	From upper third of posterior surface of fibula only.
Flex. prof. digit.	Attached by a vinculum to Flex. long. digit.	No such vinculum[2] (?).
Flex. long. digit.	Supplies digits I., IV., V.	Supplies digits II., V.
Lumbricales...........	Three.	Four.
Flex. long. poll.	Well-developed; supplies index and pollex.	Absent or feebly developed; supplies only pollex.
Ext. min. digit.	Absent.	Present.

Macalister[3] has noted that in the Chimpanzee the *dorso-epitrochlear* ended in a fascia in the middle third of the arm; it is thus more rudimentary than in *Troglodytes calvus.* The *flexores profundus* and *pollicis* were found by Macalister to be fused into a single muscle; but the double condition shown in the Ape described in the present

[1] Journ. Anat. & Phys. vol. xviii. p. 66 (1884).

[2] This vinculum, however, is stated by Macalister to occur. Sutton does not say it is absent; he does not refer to it.

[3] "On some points in the Myology of the Chimpanzee and others of the Primates," Ann. & Mag. Nat. Hist. vii. (1871) p. 341.

paper has been recorded by Wilder. The *extensor indicis*, which I found to supply the index only, may in the Common Chimpanzee send a tendon to the middle finger also. I have referred above to Mr. Sutton's statement that the fibular head of the *soleus* is the only head present, but that it is more extensive than in the present species. Sir G. Humphry found in a Common Chimpanzee the fibular origin restricted, as in the case of "Sally," to the head of the fibula; but in the specimen dissected by him the tibial head also was present. Dr. Chapman [1] found no *plantaris* in the Chimpanzee [2] dissected by him, and no *transversus pedis*. It is clear from the above very brief and incomplete notes upon recorded investigations into the myology of the Common Chimpanzee that it is not easy at present to say exactly what is the normal arrangement of the muscular structure of that animal; we are evidently not yet in a position to discriminate between what are variations and what are characteristic arrangements. If this is the case with the Common Chimpanzee, which has been dissected by so many anatomists, it is obviously much more the case with the Bald-headed Chimpanzee, of which, at present, only a single specimen has been dissected. I do not think it, therefore, worth while to attempt an exhaustive comparison of its muscles with those of other Anthropoids; the value of such a comparison would be very far indeed from being commensurate with the labour of collecting various papers and abstracting the necessary data. There is no reason to suppose that when other examples of *Troglodytes calvus* have been dissected they will prove to be identical in every point with the individual studied by myself. I must therefore leave to further workers the task of constructing a muscle formula of this Ape for comparison with other Anthropoids.

§ 9. *The Palate.*

The accompanying drawing (Plate XXV. fig. 2) illustrates the palatal rugæ of this Chimpanzee. It will be observed that the folds upon the hard palate, although fairly well marked, are irregular in their arrangement and incomplete compared with what they are in the lower Apes. This holds good for all the Anthropoid Apes so far as they are known, and for Man. Sir Richard Owen says [3], on the other hand, "In the higher Quadrumana the palate is smooth or unridged as in Man." The palate is certainly smoother in Man than in the Chimpanzee, but there are ridges which, however, are much fewer than in the Ape.

The drawing (Plate XXV. fig. 2) precludes the necessity of an elaborate description f the palatal ridges of *Troglodytes calvus*, which, moreover, possibly have some range of variation as they have in Man [4]; it is, however (in my opinion), important to illus-

[1] "On the Structure of the Chimpanzee," Proc. Acad. Nat. Sci. Philadelphia, 1879, p. 52.

[2] Its absence is also asserted by Bischoff and Brühl. Hartmann, however ('Der Gorilla,' p. 52), says that it is normally present.

[3] Comp. Anat. vol. iii. p. 396.

[4] H. Allen, "The Palatal Rugæ in Man," Proc. Acad. Nat. Sci. Philad. 1888, p. 254.

trate a point of this sort in an animal which cannot be readily examined by a person who is treating of the subject of the palatal rugæ.

§ 10. *The Brain.*

I have compared the brain of the Bald-headed Chimpanzee with the brains of two Common Chimpanzees; the latter, however, naturally presented some differences from each other, which rendered the task of comparison more difficult.

The brain of "Sally" weighed, after removal of the pia mater and after an immersion of four months in spirit, $8\frac{3}{5}$ oz.; it had been allowed to dry for about an hour and a half before weighing; it was then damp but not wet.

The two other Chimpanzees' brains were weighed under the same conditions [1], and were found to weigh respectively $6\frac{1}{2}$ oz. and $6\frac{3}{5}$ oz.

These two Chimpanzees were of about the same size, and not much more than half the size of "Sally." They were both a little larger (about 4 or 5 inches taller) than the animal examined by Dr. Symington [2], the brain of which weighed under pretty much the same conditions $8\frac{1}{2}$ oz. I cannot account for the very great difference; it prevents me from attempting to draw any conclusions as to the weight of the brain in *Troglodytes calvus.*

The brain of *Troglodytes calvus* is deeper in proportion to its length than either of the two brains of *Troglodytes niger* with which I compared it.

The lengths of the brain as compared with their height are as follows:—

	Length. mm.	Height. mm.
Troglodytes calvus	108	65
,, *niger* (A)	100	58
,, *niger* (B)	102	62 [3]

The measurements are taken by placing vertical plates beside the brain, and are therefore only true as regards the proportions.

The actual measurements of the brain of *Troglodytes calvus* are as follows:— Length 103 mm., breadth 80 mm., height 62 mm.

In viewing the cerebrum from the upper surface (Plate XXIII. fig. 3), the most striking difference between the two species was the condition of the *parieto-occipital fissure* (the "Simian fissure," as it has been called). In Man this fissure is of small

[1] One of them has been eight months, the other ten months in spirit.

[2] "On the Viscera of a Female Chimpanzee," Proc. Roy. Phys. Soc. Edinb. vol. x. p. 300.

[3] In this Chimpanzee the temporo-sphenoidal lobes projected downwards in a much more marked degree than in the other. The vertical diameter of the brain was naturally increased thereby; 5 or 6 mm. must be allowed for this difference.

extent; the length is generally (according to Quain's 'Anatomy') about an inch. In the Chimpanzee, on the other hand, these fissures on each side are very long; in both of the specimens which I examined they extended to within one-sixth to half an inch of the furrow lying between the cerebrum and cerebellum; and as figured by Hartmann[1] they pass in an almost straight course across the brain, being traceable up to the median furrow of the brain. In the brain of "Sally," on the other hand, these fissures, although recognizable laterally, were connected with the median furrow (on Plate XXIII. fig. 3, *P.o.f.*) by an irregular bent fissure on one side only. A closer comparison of the two brains showed an interesting reason for this difference. In the Common Chimpanzee the parieto-occipital fissure is deep, and its posterior wall is said to be markedly convoluted. This was so, at any rate, with one of the two individuals whose brains are among my stores at the Gardens. If that part of the brain of *Troglodytes calvus* lying between the letters *P.o.f.*? and *P.o.f.* in fig. 3 of Plate XXIII., the median longitudinal furrow of the brain, were infolded, we should get a very close resemblance to the brain of *Troglodytes niger*.

The *Sylvian fissure* of *Troglodytes calvus* presents, at any rate, one very interesting point. It has been more than once pointed out that the posterior and longer of the two branches of the *Sylvian fissure* is more upright in the Chimpanzee than in Man. This was undoubtedly the case with the two brains examined by myself, the angle of inclination being pretty much the same in both. In the brain of *Troglodytes calvus*, however (Plate XXIII. fig. 2 *F.s.*), *the posterior limb of the Sylvian fissure was much more upright than in the Common Chimpanzee*, resembling therefore that of the Gorilla, the Gibbon, and the Orang, though not so upright as in the latter.

The fissure in the brain of *Troglodytes calvus*, which appears to correspond to the anterior branch of the Sylvian fissure as figured by Gratiolet[2], is quite as large as in the Common Chimpanzee, but more horizontal in direction. I take it, however, that this is not the true anterior branch of the Sylvian fissure. For this long fissure, which lies in front of (below) the true anterior branch of the Sylvian fissure, is not continuous with the posterior branch of the Sylvian fissure, as can be seen by raising the temporo-sphenoidal lobe. Comparing the brains of the Chimpanzees with that of the Orang and the Gibbon, the true anterior branch of the Sylvian fissure (*F.s.a.*) is seen to be very short. In *Troglodytes calvus* it is directed more upwards than in *T. niger*.

The *fissure of Rolando* certainly varies in position in the Common Chimpanzee. In one of the two specimens which I have before me this fissure is not much behind the transverse axis of the brain; this is the case also with the brain of *Troglodytes calvus*. But in another Common Chimpanzee the point of the V formed by the two converging furrows is distinctly (more than half an inch) behind the transverse axis.

[1] 'Anthropoid Apes,' fig. 37, p. 192.

[2] 'Mémoire sur les plis cérébraux de l'homme et des primatès,' pl. vi. figs. 2, 6.

It is evident, therefore, that much stress cannot be laid upon this alleged difference between Man and the Chimpanzee. The following measurements will show these differences more clearly:—

	Total length of cerebrum measured from above a vertical plate at each end and covering the cerebrum.	Length between anterior end of cerebrum and point of V in fissure of Rolando.
	mm.	mm.
Troglodytes calvus	100	54
„ *niger* (A)	98	52
„ *niger* (B)	96	57

The fissure of Rolando in the brain of the Bald-headed Chimpanzee has the same two anterior connections that it has in the common species; its shape is that of the letter W; the innermost convexity is, however, much more marked than in either of the two Chimpanzees' brains with which I have compared it. As to the other fissures, they show such variation in individuals that I do not think a detailed description of one brain will serve any useful purpose. I therefore direct attention to the accompanying drawings (Plate XXIII.) of the brain, which will be of more assistance to investigation in the future than any description.

The under surface of the brain shows one noteworthy difference between the two species of Chimpanzee. In the Common Chimpanzee the frontal lobes are, as in the lower Apes, keeled below in the middle ventral line, looking as if they had been artificially pressed together by the thumb and forefinger. There was hardly any sign of this in *Troglodytes calvus*, and in this particular the brain is more like that of the Orang.

The interval between the temporo-sphenoidal lobes was very much less in *Troglodytes calvus* than in the Common Chimpanzee, not very much more than one half. This is partly due to the position of the lobes in question, and is correlated of course with the more vertical direction of the Sylvian fissure already referred to. The apex of the temporo-sphenoidal lobes is decidedly less blunt than in the Common Chimpanzee.

The posterior aspect of the brain is also characteristic. The lateral masses of the cerebellum (Plate XXVIII. figs. 1, 2) come into contact behind, overlapping the median tract, which they largely conceal. This is precisely what occurs in the Orang, but not in *Troglodytes niger*. In that Chimpanzee (Plate XXVIII. fig. 2) the median tract of the cerebellum is not concealed by any overgrowth of the cerebellar hemispheres. The peculiar form of this region of the cerebellum, as compared with that of the Common Chimpanzee, will be best appreciated by a comparison of figs. 1 and 2 of Plate XXVIII., which represent the posterior aspect of the brain of "Sally" and of one of the two Common Chimpanzees belonging to the Prosector's stores.

§ 11. *Conclusions.*

In the preceding pages I have incidentally attempted to criticize the various species of Chimpanzee that have at one time or another been proposed; but the main object has been to endeavour to show that the Chimpanzee which lived in the Society's Gardens from 1883–91 is Du Chaillu's *Troglodytes calvus*, is *not* Duvernoy's *T. tschego* or any other variety, and *is* a perfectly distinct species of Chimpanzee, which has, however, hardly a claim to represent a distinct generic type. *Troglodytes calvus* differs from *T. niger* in well-marked external characters, in less well-marked skull characters, and apparently in its muscular anatomy and brain. I am not, however, desirous of emphasizing too much the myological differences, since we obviously do not know the range of variation in *T. calvus*, or, for the matter of that, in *T. niger*. The skull of *T. calvus* may be said to show an exaggeration of the characters proper to the genus *Troglodytes*, from which I exclude the Gorilla.

III. On the Orang reputed to be Simia morio.

Although perhaps most persons now consider that there is only one species of Orang Outang, more than one name has been given to supposed different forms. The Sumatran Orang, for example, has been regarded as distinct from the Bornean ape, and the smaller Bornean Orang has been distinguished from the larger animal (*Simia satyrus*) under the name of *Simia morio*. The small Orang presented to the Society on 15th April, 1891, which died on September 22nd, was believed to be a representative of the latter species.

The best figures known to me of the large Orang illustrate a paper by Dr. Hermes published some fifteen years ago [1]. In those plates the young and adult Orangs are shown in several ways. Other figures which I have consulted are Gervais's [2], Chenu's [3], Wallace's [4], and Chapman's [5], and that of Flower and Lydekker [6]. I do not trouble to indicate older illustrations, such as those given by Temminck, for most of them show signs of inaccurate drawing or reproduction, and it would be unprofitable to build any conclusion upon them. Of the coloured figures referred to, it seems to me that Dr. Hermes's are far away the best, and they are the only ones besides that of Dr. Chapman which give a good lateral view of the head. If the coloured drawing of the head of "George," which I now exhibit (Plate XXIV.), be compared with Hermes's

[1] Zeitschr. f. Ethnologie, Bd. viii. 1876, pls. xv. & xvi.

[2] Mammifères, vol. i. pl. i.

[3] Encycl. d'Hist. Nat., Quadrumanes, p. 39, fig. 42.

[4] 'The Malay Archipelago,' vol. i. p. 64.

[5] "The Structure of the Orang," Proc. Acad. Nat. Sci. Philad. 1879, pl. xi.

[6] 'Mammals Living and Extinct,' p. 733. The cut is from a drawing by Wolf.

illustration of the side view of the head of a young Orang, a number of important differences at once appear. In the first place, the shape of the head is quite different. The larger Orang shows the "brachycephaly" which is characteristic of the Orang, as compared with the Chimpanzee or Gorilla, to a very much greater degree than does the head of the supposed lesser Orang. Indeed, the head of this animal is not unlike that of a Chimpanzee; its shortness, however, as compared with its breadth becomes plainer after an inspection of the accompanying drawings (Plates XXI. and XXV. fig. 1), which represent the vertex of the Orang and the Chimpanzee. But even here the discrepancy is not very great, the measurement being:—

	Length of cranium.	Breadth of cranium.
Chimpanzee (*Troglodytes calvus*)	140 mm.	116 mm.
Orang (*Simia morio*?)	132 mm.	113 mm.

The difference in the height of the forehead is also very marked. It is well known that this is a character of age, the older Orangs having less lofty foreheads than the young; but "George" was probably not more than four or five years old at the time of his death, inasmuch as none of the permanent teeth had put in an appearance.

Again, the relative baldness of the forehead of the two Apes furnishes a remarkable difference. In the Orang examined by myself the baldness was more pronounced than in the animal figured by Dr. Hermes. It will be noticed that the hair on the temples stops short on a level with the ear, whereas it extends much further forward in the animal illustrated in Hermes's figure, and also in the Orang's head figured by Abel [1]. It is true that in Chenu's figure the hair stops at the same point as it does in the Orang which forms the subject of the present communication; but the forehead of the animal figured by Chenu is much higher, and in other respects it agrees with the typical Orang.

The length of the hair also is greater in the young of the larger Orang. This is shown in Hermes's figure and in the woodcut given by Mr. Wallace. But the length of the hair upon the head seems to be a question of age. It is short in the adult Orang figured by Hermes.

I do not, however, propose on these characters to establish a species, whether called *Simia morio* or by some other name. My object is rather to take the opportunity afforded me of contributing fresh data to the gradually accumulating material, which will ultimately permit of a definite opinion upon the question. In the meantime I submit that the differences between the animal of which a drawing is exhibited (Plate XXIV.) and the typical Orang figured by Dr. Hermes are quite as marked as the differences between, say, a Tartar and an Aryan.

[1] "Some Account of the Ourang Outang etc.," Asiat. Research. vol. xv. pl. i.

In this case the differences are not believed to amount to a difference of species; but if a Mongolian were to come under scientific observation for the first time, the peculiar characters of the face would be undoubtedly sketched and published for purposes of reference. I think, therefore, that it is worth while to publish the drawing of the Orang "George," even if it were definitely known to belong to the same species as the Orang figured by Dr. Hermes, which is far from being proved. At the very least the two drawings exhibit the extreme range of variation of one species. While describing the head I may call attention to the scanty eyebrows and to the slight development of beard upon the chin.

§ 1. *The Hand.*

The back of the hand is illustrated in the accompanying drawing (Plate XXVI. fig. 1), and the palm of the hand in another drawing which I also exhibit (Plate XXVII. fig. 1). I am not acquainted with any good illustrations of this member or of the foot in the Orang.

The back of the hand is hairy down to the distal extremity of the second phalanx in all the fingers except the second (index). But there is a remarkable patch covered with very short stubbly hair, caused, no doubt, by the friction produced as the animal walks resting partly upon the backs of the hands. This patch runs obliquely across the back of the hand, as shown in the drawing, and is about $\frac{1}{2}$ an inch to $\frac{3}{4}$ in breadth. The hairs upon the fingers are short and stubbly; on the index they are nearly absent, a narrow line only on the outer side of that finger being hairy.

The grooves on the palm of the hand may be compared with those of the Chimpanzee. The right hand has in both cases been selected for illustration. They are distinctly more human in the Orang, the greater resemblance to man being chiefly due to the fewness of the cross lines. The two lines also which run to the roots of the third and fourth fingers from the transverse line dividing the palm are seen in the human hand, but are barely traceable in that of the Chimpanzee. It will be noted that there is only one continuous cross line (*a*, *b*), and that the line *e* of the Chimpanzee hand is wanting. The palm of the hand is illustrated in Alix's paper referred to in my description of the Chimpanzee's head. There is also a figure of the palmar as well as the upper surface of the manus of the Sumatran Orang (regarded by Fischer and Anderson [1] as a distinct species and synonymous with Geoffroy's *T. bicolor*) in a paper by Abel [2], but there is no indication of the grooves nor of the patches covered with short hair on the back of the hand; it is very probable that these characters are at least accentuated during life in captivity, which necessarily gives less opportunities for climbing and more for walking upon a hard surface.

[1] Cat. of Mamm. Indian Museum, vol. i.

[2] "Some Account of the Ourang Outang etc.," Asiat. Research. vol. xv. (1825) p. 489.

§ 2. *The Foot.*

The upper and plantar surfaces of the foot (Plate XXVI. fig. 2 and Plate XXVII. fig. 2) will now be described. The great toe, as has often been pointed out, has no nail. The covering of hair extends, as in the case of the hand, as far as the end of the second phalanx; but the hair is considerably longer on the foot than on the hand; the difference in this respect of hand and foot is well illustrated in the accompanying drawings (Plate XXVI. figs. 1, 2). The long hair, however, stops short at the first phalanx; the second is covered with short stubbly hair only.

The lines on the sole of the foot differ from those of the Chimpanzee. The second transverse line (*b* in Plate XXVI. fig. 2) is absent; the line *a* goes right across the sole. Other differences will be apparent on comparing the two figures.

§ 3. *The Muscular System.*

The muscular anatomy of the greater Orang has been described by several anatomists, including Duvernoy [1], Bischoff [2], Chapman [3], Lange [4], and Westling [5]. It might therefore seem unnecessary for me to burden zoological literature with further observations upon a topic which is very far from being new. Nevertheless, I venture to submit the following account of the myology of the animal, sheltering myself from criticism behind the opinion of the foremost authority upon the Anthropoids—Prof. Hartmann.

Prof. Hartmann says:—" The muscular system of Anthropoid Apes is very interesting. . . . . The amount of material which has been collected up to this time is, unfortunately, too scanty to enable us to draw satisfactory conclusions in all cases. We are often unable to decide whether the conditions presented to us in the case of Anthropoids are normal or exceptional. . . . . The assertions on the subject which have been published to the world and accepted as authoritative have already been shown to be to some extent untrustworthy. . . . . Brühl justly remarks that in no department of anatomy more than in that which treats of the muscles is it more essential that we should not decide whether a form is normal or exceptional until it has been repeatedly examined" ('Anthropoid Apes,' p. 150).

[1] "Des caractères anatomiques etc.," Arch. Mus. t. 8 (1855).

[2] "Beiträge zur Anatomie des *Hylobates leuciscus* und zu einer vergleichenden Anatomie der Muskeln des Affen und des Menschen," Abh. Bayer. Akad. Bd. x. (1870).

[3] "On the Structure of the Orang Outang," Proc. Acad. Nat. Sc. Philad. 1880, p. 160.

[4] SB. Akad. Wien, Bd. lxxix.

[5] "Beiträge zur Kenntniss des peripherischen Nervensystem," Bihang K. Svensk. Vet.-Akad. Bd. ix. no. 8.

§ 4. *The Muscular Anatomy of the Fore Limb.*

(1) *Pectoralis major* (Plate XXVIII. fig. 4, *Pect.* 1).—This muscle is divided into two distinct portions, separated by a distance of an inch and a half at their origin, but gradually converging towards their common insertion. The posterior half of the muscle is rather more than an inch and a half wide at its origin; its fibres arise from the sternal part of the 3rd, 4th, and 5th ribs and from the edge of the sternum adjacent; at its origin the muscle is flat and thin, but gradually gets thicker as well as narrower; at about an inch before its insertion it again widens out, and is formed of a wide flat tendon and a narrow muscular strip. The anterior half of the muscle is thick and narrow, being approximately of the same diameter throughout, except at the insertion, where it becomes wider and thinner; it arises by a head, measuring rather less than one-third of an inch in diameter, just below the *omohyoid* of its side from the sternum; it has no connection whatever with the clavicle. It becomes fused with the second part of the pectoral just before their common insertion and lies above it; the line of insertion of the pectoral upon the forearm measures two inches and a half, and commences from the head of the humerus just above the biceps; it is tendinous on the lower surface but muscular above.

(2) *Pectoralis minor* (Plate XXVIII. fig. 4, *Pect.* 2).—This muscle is composed of two perfectly distinct parts: the first arises from the third and fourth ribs at the junction of the bony ribs with their cartilaginous portions; it is partly overlapped at its origin by the second part of the muscle. It measures one inch and a quarter in greatest breadth, and rapidly narrows to the tendon of insertion, which commences (on the inferior surface of the muscle) an inch and a half from the actual insertion.

(3) The second half of the *Pectoralis minor* has a broad thin origin from ribs four, five, and six; but the muscle is already very narrow before it becomes free from the attachment at its origin. It is inserted by a long and narrow tendon just above and in common with the anterior extremity of the tendinous insertion of the *pectoralis major* on to the head of the humerus.

The sterno-clavicular ligament is attached to the coracoid process in common with the tendon of the anterior part of the *pectoralis minor*; its entire length is two inches and three-fifths; it arises by a few fibres from the anterior end of the sternum in front and to the outside of the origin of the *pectoralis major*. It is figured by Miss Westling.

(4) *Coraco-brachialis* arises in common with the *biceps* from the coracoid process; the apparent attachment of the muscle is along a line two inches and three-fifths in length; it is, however, really fixed to the humerus by two separate attachments, between which intervenes a thick tendinous ridge attached at both its ends to the humerus, but free in the middle; upon these are inserted some of the fibres of the *coraco-brachialis*; the anterior end of the tendon is attached to the flat broad tendon

of the *latissimus dorsi*; the posterior attachment of the muscle is to the humerus direct along a line measuring as nearly as possible an inch, ending at the middle of the humerus.

(5) The *biceps* is composed of two very distinct portions: the coracoidal head arises from the coracoid process in common with the *coraco-brachialis*; the two are fused for a length of two and a half inches. This muscle is rather thinner than the humeral half; it fuses with the latter one inch and seven-tenths in front of their common insertion. The muscle is fleshy except just at its origin and for a short way beyond, where it is covered by a glistening tendinous layer; its connection with the humeral half of the muscle is as follows—rather more than half an inch before the fusion of the two the coracoid head becomes tendinous on one side; this tendinous part is inserted on to the fleshy part of the humeral head on the side of the muscle which faces the bone; the fleshy part of the muscle is inserted on to the conjoined tendon of the two heads.

The humeral head arises in the usual way by a strong tendon which gradually passes into muscle; it begins again to be tendinous some little way in front of its fusion with the coracoid head.

(6) *Latissimus dorsi* is a large, flat muscle extending in its origin as far back as the crest of the ilium; it also arises from lumbar fascia and from posterior ribs; the muscle rapidly narrows towards its insertion, and at a point about on a level with where the *teres major* becomes free from its attachment to the scapula divides into two portions, one of which is very small. It has a nearly circular section, and measures in diameter only one-fifth of an inch; its total length is three and a half inches from the point where it leaves the rest of the *latissimus dorsi* to where it joins the *teres major*, in common with which it is inserted. The remaining portion of the muscle passes into a broad flat tendon one inch and one-third in length; the insertion of this tendon is J-shaped, the recurved bit being anterior and joining the insertion of the *teres major*; the straight part of the tendon is inserted on the tricipital grooves just below the insertion of the *pectoralis major*: it is nearly coextensive with the insertion of that muscle. I have already mentioned that the *coraco-brachialis* is partly inserted on to the tendon of the *latissimus dorsi*. Just at the point where *latissimus dorsi* passes into tendon it gives off a *dorso-epitrochlear* slip, which is a round and fleshy muscle about one-third of an inch in diameter; at a distance of two inches from the elbow the muscle passes into a tendinous strip to which are attached some of the fibres of the *triceps* and of the *brachialis anticus*; it is therefore vertical, being apparently attached to the humerus; a little later it becomes free as an extremely fine tendon which lies lightly stretched like a violin-string between the shaft of the humerus and its flexor condyle.

(7) *Trapezius.*—The origin of this muscle from the spines of the vertebra extends back as far as the commencement of the origin of the *latissimus dorsi*; anteriorly the origin reaches the head, but owing to the removal of the brain I could not make out

the exact manner of its origin. It is inserted on to the external third of the clavicle and on to the greater part of the scapular spine.

(8) *Rhomboideus major.*—This muscle arises below the last from the spines of the cervical and first dorsal vertebra; its line of origin measures three and a half inches; it arises by fleshy fibres, among which there is, here and there, a slight admixture of tendon. It is inserted on to the posterior border of the scapula immediately above the insertion of the *serratus* for a length of one and nine-tenths of an inch about two-thirds of the length of the border of the bone.

(9) *Rhomboideus minor.*—This muscle, unlike *rhomboideus major*, has a distinctly tendinous origin of about one quarter of an inch in length; the muscle arises just behind the *rhomboideus major*, but is not overlapped by it, except for about a quarter of an inch anteriorly; the origin of the muscle is about one and a quarter inch in length. Its insertion is not very distinct from that of the last muscle; it occupies the rest of the posterior border of the scapula; it overlaps the insertion of the last muscle before they become joined.

(10) *Rhomboideus occipitalis.*—This is a slender flat muscle, measuring nearly one inch across at the origin from the occipital and gradually diminishing towards its insertion. For the last inch and a half or so of its course it runs parallel to, and in close contact with, the *rhomboideus major*. But it is quite distinct from it, being not flat but cylindrical, and ending in a longish and very narrow tendon of insertion on to the extreme upper angle of the scapula.

(11) *Levator anguli scapula.*—The insertion of this muscle is on to the outer angle of the scapula just above the termination of the line of insertion of the *serratus magnus.*

(12) *Omohyoid* has a fleshy origin from a tubercle on the inferior border of the scapula one inch from the glenoid fossa.

(13) *Serratus magnus* arises from all twelve ribs and by twelve more or less marked digitations; the posterior four or five are less marked than those in front; it is inserted to the whole of the posterior border of the scapula along a line below the insertion of the *rhomboideus*, extending as far as the *teres major* in front.

(14) *Deltoid.*—This muscle is very large; it arises from the last inch or so of the clavicle, from the acromion, and from the spine and posterior border of the scapula, mainly by a thin tendon which forms a fascia covering the underlying *supra-spinatus*; the latter origin forms an almost distinct head. The muscle is fleshy down to just before its insertion; the insertion is mainly on a rough triangular area, the deltoid impression, which measures nearly two inches in length. A few fibres from the *deltoid* are continued on to the *brachialis anticus.*

(15) The *teres major* arises from an area of the scapula near the upper inner border (axillary), from the axillary border itself, and from the septum between itself and the *infra-spinatus*, which is really, as has already been pointed out, partly the origin of

the deltoid. The area of origin of the *teres major* measures rather more than one inch and a quarter in length. The muscle is flat and strap-shaped and of some thickness; it is inserted on to the humerus by a flat tendon, some of which, as has been already explained, belongs to the *latissimus dorsi*; the line of insertion, which is just opposite to that of the greater part of the insertion of the *latissimus dorsi*, measures about an inch and a half.

(16) *Teres minor.*—This muscle has an entirely fleshy origin partly from the axillary border of the scapula, partly from the septum between itself and the *infra-spinatus*; the line of origin measures one inch and three-fifths; it is inserted on to the head of the humerus by an almost entirely fleshy insertion below, and separated by an interval from, the insertion of the *infra-spinatus.*

(17) *Infra-spinatus* occupies the whole of the infra-spinous fossa, to the greater part of which, however, it is not attached; it arises from the spine of the scapula up to the head, from the posterior border, from the axillary border, and from the fascia covering it; it also arises from the septa between itself and the two *teres* muscles. Its tendinous insertion is continuous with, and cannot be separated from, the insertion of *supra-spinatus* and the ligament uniting the scapula with the humerus.

(18) *Supra-spinatus* occupies the whole of the supra-spinous fossa.

(19) *Subscapularis* covers and arises from nearly the whole of the subscapular fossa; the insertion on to the humerus measures one inch and a quarter in length, the lower part of the insertion below the tuberosity being fleshy.

(20) *Triceps.*—This muscle has (excluding the *dorso-epitrochlear*) three heads of origin. The middle or long head arises from the border of the glenoid cavity, and from the inferior border of the scapula for an inch behind this; this origin is chiefly muscular, though tendinous where it is attached to the glenoid border; its inferior surface is covered by six or seven narrow tendinous bands which extend for a very short way down the muscle. The outer head arises from the humerus commencing about half an inch below the insertion of the *teres minor*: the origin of the inner head commences a little below that of the outer head.

(21) *Brachialis anticus.*—This muscle is large and fleshy; it arises from a large portion of the shaft of the humerus on both sides of the insertion of the *deltoid*; on the inner side of the humerus the origin extends a little way above the origin of the internal humeral head of the *triceps*; it passes under a tendinous arch left in the origin of the external humeral head of the *triceps.* The origin of the muscle is also from the septum between itself and the external head of the *triceps*; on the outer side of the insertion of the *deltoid* the origin of the muscle does not extend forwards much beyond the termination of the *deltoid* insertion, from this point downwards the origin of the muscle occupies the whole of the inferior surface of the humerus, coming into contact, on each side, with the origins of the *triceps* and *supinator longus.* Towards the distal end of the attachment some of the fibres arise from a septum between itself

and the *triceps*; this septum is continuous with the *dorso-epitrochlear*; posteriorly it becomes a narrow ligament, inserted on to the flexor condyle of the humerus; an inch and a half from the distal extremity of the humerus the muscle becomes free, and, curving over the joint, is inserted on to the ulna, being continuous also with the ligament binding the humerus and ulna. On the outer face the insertion is muscular; on the inner face it is tendinous anteriorly, and also where it joins the aforesaid ligament.

(22) *Anconæus* is present, and looks like a continuation of the *triceps.*

(23) *Supinator radii longus.*—This is a large muscle; it arises just in front of the *extensor carpi radialis longior*, from the upper part of the external ridge of the humerus; anteriorly to this it is continuous with the fibres of the *coraco-brachialis*, of which it appears to be a continuation; the origin from the bone measures an inch and three-quarters in length. It is inserted by a flat broad tendon, two inches long, upon a prominent ridge on the external border of the radius.

(24) *Extensor carpi radialis longior.*—This muscle arises from the lower part of the external condylar ridge of the humerus, just below the last muscle. Three inches from its origin it becomes a tendon, which passes over the wrist in close connection with the tendon of the next muscle, and is inserted on to the base of the metacarpal of the index; just before its insertion it is reinforced by a thin tendon arising from the *extensor carpi radialis brevior.*

(25) *Extensor carpi radialis brevior* arises from the extensor condyle of the humerus by a tendon common to it and the other extensors; also from the fascia covering the *supinator brevis*, and from the septum between itself and the *extensor communis*; it becomes entirely tendinous three inches from the wrist. At about an inch from the wrist it gives off a thin tendon which, running obliquely forwards, joins the tendon of the *extensor carpi radialis longior* just before its insertion. The main tendon of the present muscle, which is slightly broader than that of the "longior," is inserted into the base of the metacarpal of the middle digit.

(26) *Extensor communis digitorum.*—This muscle arises from the extensor condyle, and lies between the *extensor carpi radialis brevior* and the *extensor minimi digiti*, from the septa between which muscles and itself it also arises; about halfway down the forearm it divides into four muscles, from each of which a tendon arises supplying digits II.–V.; that supplying digit IV. gives off a very thin tendon, which joins the deep extensor of digit III.; they are inserted over the first and second phalanges.

(27) *Extensor minimi digiti* lies between the *extensor communis digitorum* and the *extensor carpi ulnaris*; just before the wrist it divides into two, which join the tendons of the *extensor communis*, which go to the fourth and fifth digits.

(28) *Extensor carpi ulnaris* arises from the extensor condyle and from a considerable length of the ulna; the short thick tendon is inserted on to the outer side of the base of the last metacarpal.

(29) *Supinator radii brevis.*—This muscle appears to be divided into two parts: one superficial and one deep. The upper part of the muscle is covered by a fascia, from which some of the extensors partly arise; it arises from the ligament of the elbow-joint and from the ulna; it passes right round the radius on to the flexor side, and is inserted on to that bone as far down as the beginning of the insertion of the *pronator radii teres*; the lower layer of the muscle is inserted on to the extensor side of the radius.

(30) *Extensor ossis metacarpi pollicis.*—This muscle is considerably the largest of the deep extensors; it takes origin from the radius, from the ulna, from the interosseous ligament, and from the septum between itself and the *extensor secundi internodii pollicis*; the radial origin commences two and a half inches below the bend of the radius, and a little in front of, and below, the attachment of the deep layer of the *supinator radii brevis*; the tendon of this muscle is short (two inches in length), and is inserted on to the radial carpal.

(31) *Extensor secundi internodii pollicis.*—This is a slender muscle, arising from the ulna just below the ulnar origin of the last muscle; it also arises from the interosseous ligament; the tendon, which is long and thin, passes above the tendon of the *extensores carpi radialis* to be inserted on to the proximal end of the last phalanx of the thumb.

(32) *Extensor indicis* arises from the ulna, from the interosseous ligament, and from the septum between itself and the *extensor carpi ulnaris*; it divides into two just before the wrist, and it is inserted on to the first phalanx of the index, and on to the corresponding phalanx of the third digit.

(33) There is an *extensor primi internodii pollicis*, the tendon of which passes in close contact with the tendon of the *extensor ossis metacarpi*; it is inserted on to the inner side of the base of the thumb metacarpal.

(34) *Pronator radii teres.*—This muscle arises from the flexor condyle of the humerus, beside the *palmaris longus* and above the other flexors; it also arises from the radius and from the septa between itself and adjacent muscles; on the radial side, where it is free, it is largely covered by glistening tendon; on the opposite surface it is nowhere free, some fibres taking origin from the *flexor carpi radialis* just at the end of the muscle; its insertion on to the radius, which is fleshy, measures one inch and two-fifths in length, and commences immediately behind the insertion of the *supinator brevis*.

(35) *Flexor carpi radialis* arises from the flexor condyle of the humerus and from the septa between itself and the *pronator radii teres* and the *flexor sublimis*; it becomes free immediately below the insertion of the *pronator radii teres*; its tendon of insertion does not commence until just before the wrist; it is inserted on to the base of the second metacarpal.

(36) *Palmaris longus.*—This muscle is the most external and superficial of the flexors, as well as the smallest; it is hardly more than one quarter of an inch in width at the

widest part; it becomes tendinous about halfway down the arm; the tendon is inserted on to the palmar fascia just at the wrist.

(37) *Flexor carpi ulnaris.*—This muscle arises from the flexor condyle of the humerus, from the fascia covering the forearm, from the septum between itself and the *flexor sublimis*, and from the first two-thirds of the ulna; its tendon of insertion (on to pisiform) is very short and strap-shaped.

(38) *Flexor sublimis (perforatus) digitorum* arises from the flexor condyle between the *flexor ulnaris* and *flexor carpi radialis*, from the septum between itself and these muscles and also the *flexor profundus*, and from a part of the radius behind the insertion of the *pronator radii teres*; it separates into four tendons in front of the wrist, each of which is inserted on to the second phalanx of digits II.–V., being perforated by the tendon of the *flexor profundus*. All four tendons are approximately equal in size.

(39) *Flexor profundus (perforatus) digitorum.*—This muscle appears to represent both the muscle so called and the *flexor pollicis longus* of human anatomy, since it arises both from the radius and ulna; it also arises from the interosseous ligament, and from the septa between itself and adjacent muscles. The muscle itself divides into four some way in front of the wrist; of these divisions those belonging to the tendons of digits II. and III. are the most prominent, each with a glistening tendinous surface beneath. The tendons of the two outer digits arise earlier than the other two, from the common muscular mass; the four tendons are associated in pairs, those of the two outer digits forming one pair, those of the two inner digits another pair. Each tendon is towards its insertion not obscurely grooved upon the under surface; more distally still the two halves of each tendon are easily separable; each is inserted on to the terminal phalanx. A small muscular slip arises from the fourth muscle and passes into a long fine tendon, which joins the tendon of the fourth digit some way beyond the origin of the *lumbricales*.

(40) The *lumbricales* are four in number; each passes from the deep flexor to the extensor tendon on the dorsal side of the first phalanx of its digit.

(41) The *pronator quadratus* is about an inch and a half in length; it passes across from the radius to the ulna at the wrist end of these bones.

§ 5. *The Muscular Anatomy of the Hind Limb.*

(1) *Glutæus maximus.*—This muscle has an extensive tendinous origin from the anterior and posterior border of the ilium, and an entirely fleshy origin from the coccyx; the tendon of insertion rapidly narrows towards the actual insertion.

(1*a*) *Ischio-femoral*[1].—This muscle arises in common with the three next muscles from the tuber ischii; its fleshy insertion is on to the femur just above the origin of

[1] I use the name given by MM. Gratiolet and Alix (*loc. cit.* on p. 180 of this memoir).

the femoral head of the *biceps*, and measures two and a half inches, being continuous with that of the *glutæus maximus*.

(2) *Glutæus medius* is largely covered by the last; it arises from the greater part of the fossa of the ilium, and from the tendon of the *glutæus maximus* (=*fascia lata*); the tendon of insertion on to the head of the femur is dorsad of that of the *glutæus minimus*.

(3) *Glutæus minimus*.—This is of course the smallest of the three *glutæi*; its greatest diameter is three quarters of an inch; it arises from the border of the greater sciatic notch; it is inserted partly on to the ligamentous capsule of the head of the femur, partly on to the femur itself between the insertions of the *glutæus medius* and the next muscle.

(4) I am not quite certain what name to give to a triangular fleshy muscle taking origin from the ilium, and inserted on to the femur in front of and below *glutæus minimus*.

(5) *Pyriformis*.—This muscle comes through the great sciatic notch; it adheres closely to the *glutæus medius*, and is inserted by a tendon on to the femur just behind the insertion of that muscle.

(6) *Obturator internus* has, as usual, accompanying it two *gemelli*, and is inserted in common with the next.

(7) *Obturator externus* arises before the last, and is inserted in common with it on to the fossa behind the great trochanter.

(8) *Quadratus femoris*.—This muscle is entirely fleshy; it arises from the tuber ischii below the muscle next to be described; it measures about half an inch across at the widest part.

(9) *Biceps femoris*.—This muscle has two heads: one of them arises from the hip-bones, the other from the femur; the first origin is from the tuber ischii, in common with the last muscle and the two next to be described; the muscle gets wider and thinner towards its insertion, which is partly on to the fascia covering the knee-joint, and partly (in common with the femoral head) on to the head of the fibula; the femoral head of the *biceps* arises from the femur along a line measuring two and a half inches, almost exactly co-extensive with the insertion of the *quadratus femoris*, from the tendon of insertion of which some of its fibres take origin; its insertion is continuous with that of the long head, and is on to the fibula in common with the very small portion of the humeral head which is so attached; some of its fibres seem to run down and become continuous with *flexor*, which muscle, at any rate partly, arises from the tendon of insertion of the *biceps*.

(10) *Semimembranosus* arises by a flat, mainly tendinous, head in common with and below the origins of the *biceps* and *semitendinosus*; it is inserted by a short and stout tendon on to the inner side of the tibia.

(11) *Semitendinosus*.—This muscle is nearly of the same size as the last; its origin

is in common with the last muscle; it becomes free from the *semimembranosus* three quarters of an inch from the *biceps* and one inch and a half from the commencement of the common origin. The muscle is entirely fleshy until an inch and a half before its insertion by tendon; this tendinous insertion is thin and flat, and becomes considerably wider at the actual connection of its fibres with the bone; the insertion is higher up the leg than that of the *gracilis*, but is situated to the inside of it.

(12) *Sartorius.*—This muscle is exceedingly slender; it arises from the anterior end of the ilium, and passes obliquely over the thigh to be inserted by a broad flat tendon on to the tibia above insertions of the *gracilis* and *semitendinosus.*

(13) *Rectus femoris.*—The origin of this muscle is entirely tendinous below, and half tendinous, half muscular above; it arises from the ilium just in front of the glenoid cavity, and from the fascia covering itself and the *vastus externus*; towards its insertion it becomes glistening on the under surface; the insertion is by a flat short tendon on to the patella in common with a part of the tendon of the conjoined *vasti.*

(14) *Vastus.*—I cannot separate the *vastus externus* from the *internus*, or either of them from the *cruræus*; they all form together one muscle, which arises from a large portion of the surface of the femur below the head, and by a tendon from the outer side of the head continuous with the insertion of the *glutæus minimus.* The conjoined muscle is inserted by a wide tendon partly on to the patella and partly on to the ligaments of the knee-cap.

(15) *Gracilis.*—This muscle arises from the symphysis pubis by an origin measuring nearly an inch and a half in length, and lying superficial to that of all the other muscles arising here; the muscle becomes gradually narrower towards the tendon of insertion, which measures rather more than an inch in length; this tendon is at first narrow, but widens out to a diameter of about three quarters of an inch at its actual insertion, which is outside, and for the most part below, that of the *semitendinosus.*

(16) *Pectineus.*—The origin of this muscle is in front of, and in contact with, that of the *adductor longus*; its insertion on to the femur is posterior to and above the lesser trochanter, and below, as well as partly posterior to, the insertion of the *adductor brevis.*

(17) *Adductor longus.*—The origin of this muscle is, as just stated, from the pubis, immediately behind that of the *pectineus*; its insertion is on to the linea aspera of the femur, ventrad of the insertion of the *adductor magnus*; some of the fibres of the *vastus* arise from its tendon of insertion.

(18) *Adductor brevis.*—The origin of the *adductor brevis* is behind that of the *adductor longus*, and slightly overlapped by it; it lies in front of, and is hardly distinguishable from, that of the *adductor magnus*; it is inserted by a very thin and flat tendon between the insertion of the *pectineus* and the *glutæus maximus*; the length of the insertion is three quarters of an inch; it commences just below the trochanter.

(19) *Adductor magnus* is, of course, much the largest of the three adductors; its

origin extends right round from the anterior part of the symphysis pubis to the ischial tuberosity ; it divides near its insertion into two bands of muscle, of which the anterior is the wider; this (the anterior) is inserted along a line measuring an inch and a quarter, and lying between the insertion of the *adductor longus* and the origin of the femoral head of the *biceps* ; the second part is inserted close to the end of the femur.

(20) *Tibialis anticus.*—This muscle arises from the head of the tibia, and from its shaft down to about the middle ; it also arises from the septum between itself and the *extensor communis* and from the fascia covering the leg. It is inserted by a stout tendon measuring one inch and a half in length to the radial tarsal.

(21) *Extensor proprius hallucis* is a slender delicate muscle arising from the fibula and from the interosseous membrane; the area of origin of the muscle is an inch and a half or so in length; the tendon in which the muscle ends is slender; its expanded flattened extremity is inserted on to the base of the phalanx of the hallux.

(22) *Extensor longus digitorum pedis.*—This muscle arises from the tibia and for rather more than half of the fibula, from the interosseous membrane, and from the septa between itself and the *tibialis anticus* and *peronæus* ; at the ankle-joint the muscle gives rise to three tendons, which are inserted on to the last phalanx of each of the last three toes.

(23) *Extensor brevis digitorum* is represented by the fleshy mass covering the foot; this is really separable into three muscular slips, which supply digits II.–IV.; the muscle supplying digit III. is partly inserted on to the tendon of the long extensor; the two extensors supplying digit IV. do not join until long after they have both become tendinous.

(24) *Peronæus longus.*—The muscle arises from the head of the fibula and from its shaft down to about the middle, from the septum between itself and the flexor on one side and the *extensor longus digitorum* on the other; the tendon crosses the foot between the tarsal bones and the metatarsals, and deep of the intrinsic muscles of the foot: it is inserted on to the metatarsal of the hallux.

(25) *Peronæus brevis.*—This muscle arises from the lower part of the shaft of the fibula and from the septum between itself and the *peronæus longus* and from the fascia covering the leg; its tendon is inserted on to the outside of the last metacarpal.

These are the only two *peroneal muscles.*

(26) *Gastrocnemius.*—The *gastrocnemius* arises by three distinct heads. The outer head arises in common with the *flexor* from the outer head of the femur; it becomes separate from the *flexor* two and a quarter inches from their common origin. The inner head arises from the femur just behind the internal condyle, and just below, and in front of, the insertion of the hinder part of the *adductor magnus.* The third head, which corresponds to the *soleus* of other animals, including Man, arises by a stout tendon on the under surface of the head of the fibula. The three heads join rather further than halfway down the leg. The common tendon is inserted on to the os

calcis; the muscular fibres continue to within a quarter of an inch of the actual insertion.

The *plantaris* muscle appears to be totally absent.

(27) *Popliteus.*—The muscle runs obliquely across under the surface of the knee from the external condyle of the femur to the tibia. Its insertion on to the latter measures an inch and a quarter in length.

(28) *Flexor longus (perforatus) digitorum pedis.*—The origin of this muscle extends from just below the head of the tibia and the insertion of the *popliteus* to more than halfway down the bone. It is connected also with the origins of the two remaining long flexors. It divides beyond the ankle-joint into three tendons, which go to digits II., III., and V.

(29) *Flexor brevis* is a broad strap-shaped muscle arising from the calcaneum; beyond the trifurcation of the *flexor longus* tendon it divides into three tendons, one of which joins the superficial (perforated) tendons of digit IV., the other two supply digits II. and III.; these branches become the perforated tendons of those digits, being quite indistinguishable in their characters from the perforated tendons of adjacent digits. The tendon supplying the second digit does not become fused to the superficial long tendon, as it does in the case of that supplying the fourth digit; what happens is that the tendon of the *flexor accessorius* takes the place of the superficial tendon, which the tendon of the real superficial tendon perforates; the former runs to the last phalanx of the digit as if it were a branch of the *flexor profundus.* The same thing occurs with the tendon supplying the third digit, only that here the perforating tendon is really the deep flexor.

(30) *Flexor profundus digitorum.*—The origin of this muscle is from the outer condyle of the femur, from the fibula to beyond its middle point, and from the septa between itself and adjacent muscles; it divides at the middle of the sole of the foot into two tendons, which supply digits III. and IV.

(31) There are four *lumbricales*, as in the hand: that supplying the index arises only from the *flexor perforatus* of that digit; the others are attached partly to the deep and partly to the superficial flexors, binding them together in a complicated fashion, of which there is only a trace in the hand.

(32) *Tibialis posticus.*—This muscle lies deep of the other long flexors, and is smaller than either of them; its tendon is inserted on to the wrist.

(33) *Abductor hallucis* is a fleshy muscle arising from the calcaneum; it ends in a tendinous expansion inserted on to the phalanx of the great toe.

(34) *Abductor minimi digiti* is a fusiform muscle, also arising from the calcaneum; it divides into two muscles just before the head of the metatarsal; these soon become long tendons, which are inserted on to the distal extremity of the metatarsal of the little finger and on the proximal end of the first phalanx; the latter tendon is the larger.

(35) *Flexor brevis hallucis.*—This muscle divides near its insertion into two bellies, one of which is inserted in common with the *abductor*, the other with the *adductor*.

(36) *Adductor hallucis.*—This is a large fleshy muscle arising from the plantar fascia and from the heads of metacarpals II. and III.; it is inserted in common with the last muscle.

(37) *Transversus pedis.*—This muscle is much more limited in extent than in the Chimpanzee; it arises along a narrow line of the plantar fascia, measuring four-fifths of an inch in length on a line with the second metatarsal; it is inserted entirely on to the end of the metatarsal of the great toe, and not at all on to the phalanx.

Prof. Huxley, in his 'Manual of the Anatomy of Vertebrate Animals,' mentioned some of the principal muscles of the Anthropomorpha. My dissection of the Orang does not, however, bear out all his statements, though no doubt there are variations. Thus the *transversus pedis* is *not* absent, though it is smaller than in the Chimpanzee. The *adductor brevis* is not absent, as Bischoff stated [1], but is present, as Miss Westling has pointed out [1]. Dr. Chapman [1] speaks of the *scansorius* as "glutæus minimus." It has been shown in the preceding pages that both these muscles are present in the Orang dissected by myself; it is possible, therefore, that in the Orang dissected by Dr. Chapman the *glutæus minimus* was really absent; the probability of the absence of this muscle in the Orang is increased by the fact that Dr. Chapman identified it in the Chimpanzee. Dr. Chapman found, as I did, no trace of a *plantaris*; but Sandifort (quoted by Dr. Chapman) asserted the presence of this muscle. Dr. Hartmann, however, failed to find it; its absence, therefore, must be regarded as typical. The same observer has described a double origin to the *dorso-epitrochlear*, part of it arising from the clavicle; I found nothing of the kind.

§ 6. *The Palate.*

The ridges upon the hard palate of the Orang have been figured by Gegenbaur [2]; but this figure shows certain differences from what I have observed in the individual described in the present paper. The number of these ridges appears to be about the same; but they are much more regular in the palate described and figured by Gegenbaur. This is particularly so with the last four ridges. In both specimens (pl. v.) the palatal ridges are more numerous than in the Chimpanzee, indicating, so far as this character can be made use of, the greater proximity to Man of the Chimpanzee. On the other hand, the great irregularity of the palatal ridges in the Orang is such as is met with in the Anthropoids generally. A peculiar feature about the palate of the Orang which I examined is its deep black pigmentation, shown in the figure (Plate XXV. fig. 3). After it had been allowed to macerate for some days, in order to prepare the skull for

[1] These references will be found on p. 204 of the present memoir.

[2] "Die Gaumenfalten des Menschen," Morph. Jahrb. Bd. iv. p. 573.

examination, the black colour could be rubbed off, staining the fingers. I am uncertain whether to regard it as pathological; if normal, it would strengthen the reasons for regarding this animal as a distinct species of Orang.

IV. EXPLANATION OF THE PLATES.

PLATE XX.

Head of *Troglodytes calvus*, drawn after death in August 1891: full face, natural size.

PLATE XXI.

Troglodytes calvus, head of the same animal, viewed vertically from above, natural size.

PLATE XXII.

A hand and foot of the same, palmar surface, natural size: Fig. 1. Hand; Fig. 2. Foot.—The letters refer to the lines on the palm of the hand and on the sole of the foot, which are described in the text.

PLATE XXIII.

Brain of the same, natural size.

Fig. 1. Lateral view of right side.
Fig. 2. Lateral view of left side.
Fig. 3. Brain, viewed from above.
Fig. 4. Brain, viewed from the underside.

F.s. Sylvian fissure; *F.s.a.* Anterior branch of Sylvian fissure; *P.o.f.* Parieto-occipital fissure; *F.R.* Fissure of Rolando.

PLATE XXIV.

Head of young Orang "George," natural size.

PLATE XXV.

Fig. 1. Head of the same, viewed vertically from above.
Fig. 2. Palate of *Troglodytes calvus* ("Sally"), to illustrate the ridges.
Fig. 3. Palate of *Simia satyrus* (?) ("George").

PLATE XXVI.

Upper surface of hand and foot of Orang ("George"): Fig. 1. Hand; Fig. 2. Foot.

PLATE XXVII.

Palmar surface of hand and foot of Orang ("George"): Fig. 1. Hand; Fig. 2. Foot. —The letters refer to the lines on the palm and sole, which are described in the text.

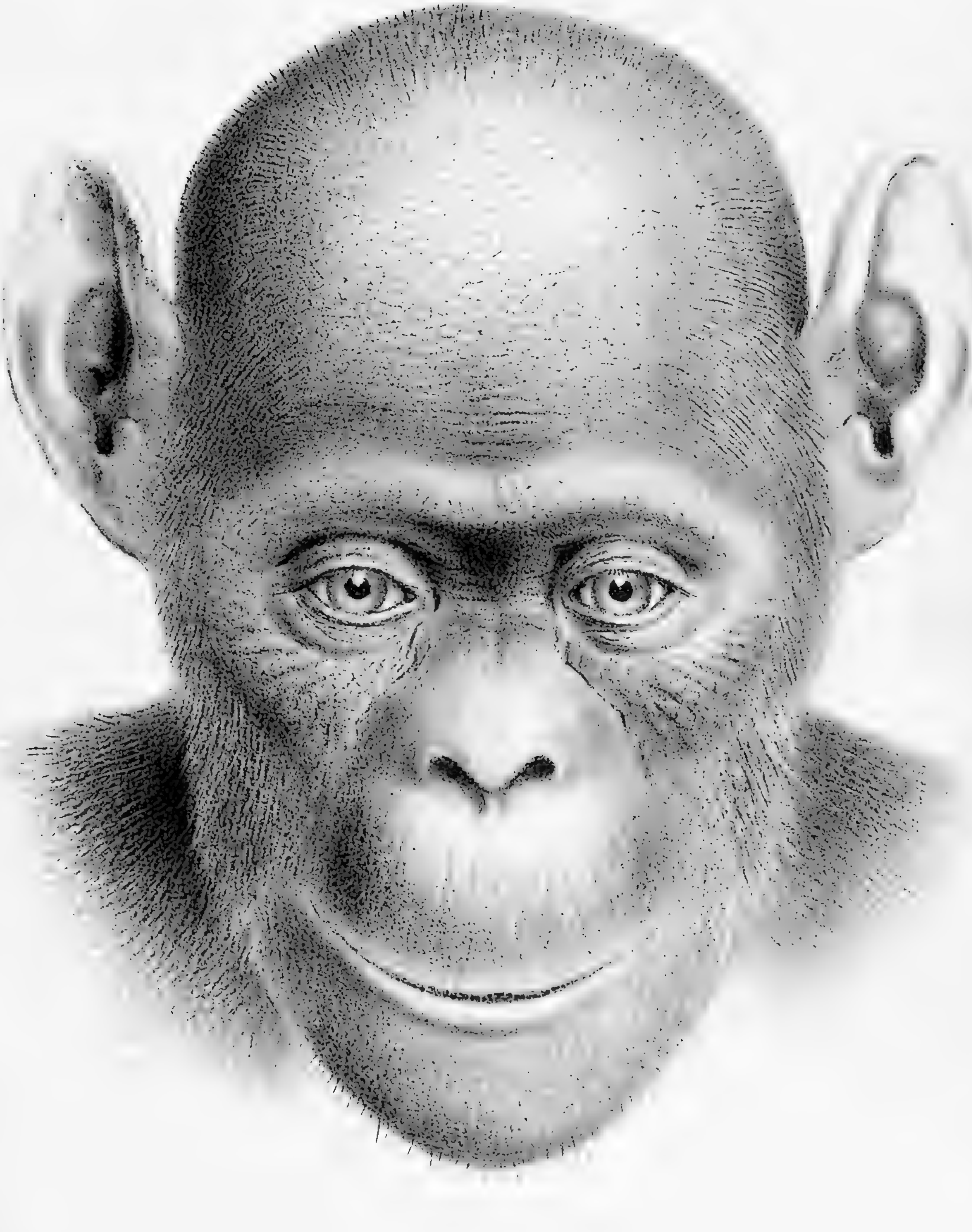
PLATE XXVIII.

Fig. 1. Brain of *Troglodytes calvus* ("Sally"), from behind. *c.* Cerebellum.

Fig. 2. Brain of *Troglodytes niger*, from behind. *c.* Cerebellum. *x.* Median part of cerebellum not concealed by lateral lobes.

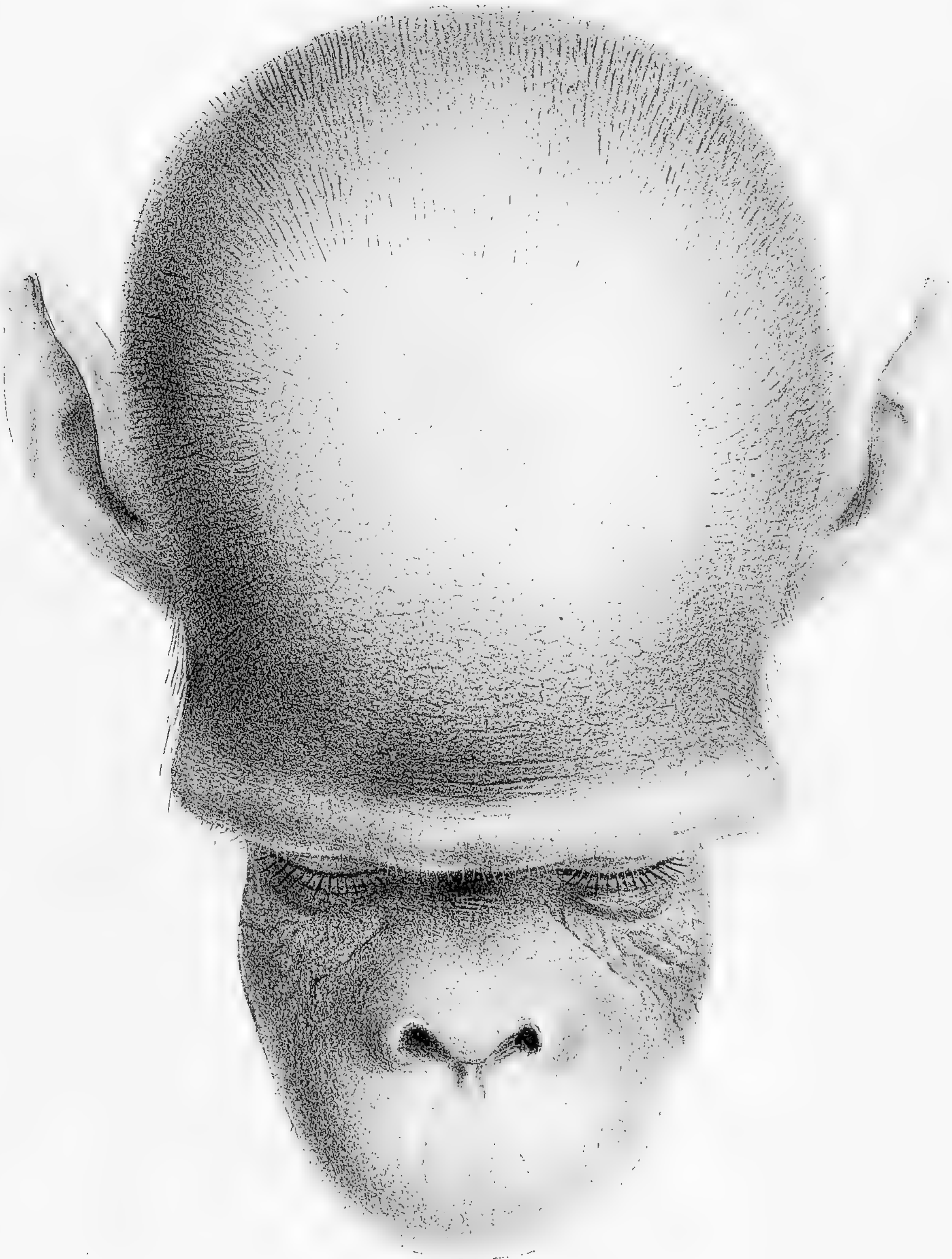
Fig. 3. Ear of *Troglodytes calvus* ("Sally"). *H.* Helix; *T.* Tragus; *F.* Fossa.

Fig. 4. Pectoral muscles of Orang ("George"). *Cl.* Clavicle; 1–5. Ribs; *Pect.* 1. Pectoralis primus; *Pect.* 2. Pectoralis secundus.



Mintern Bro

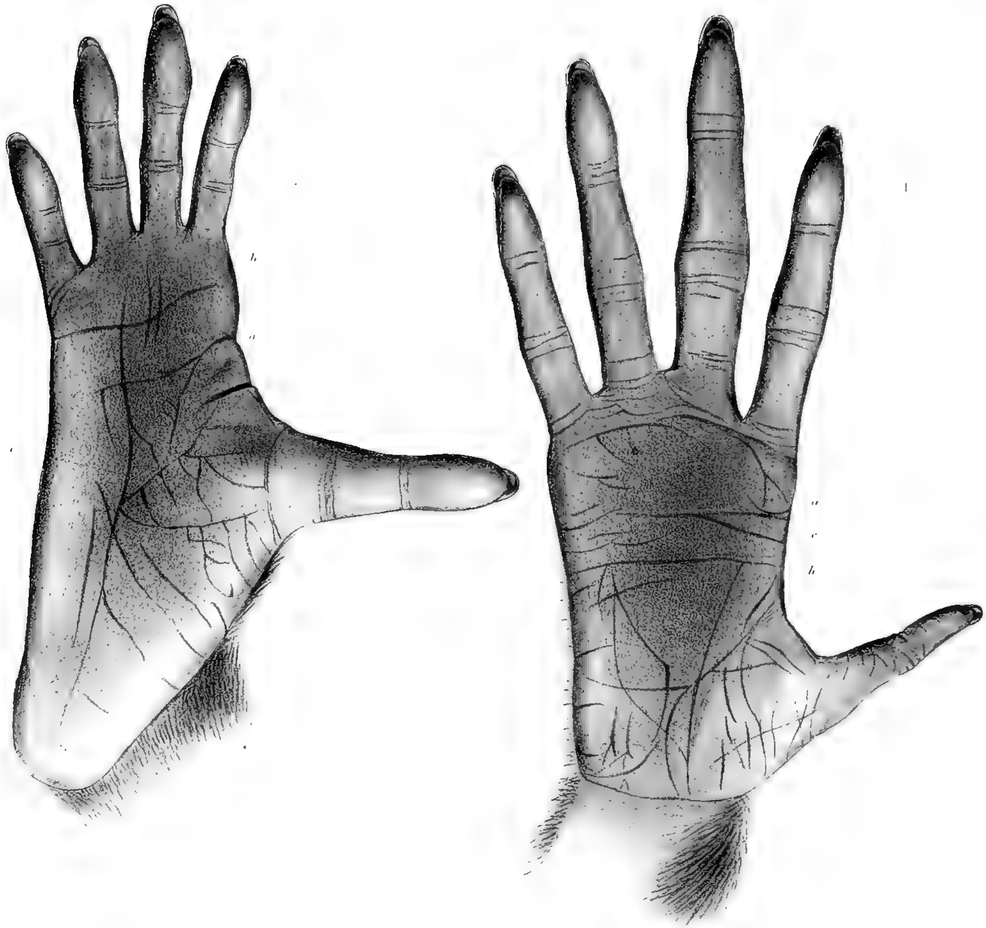
TROGL



J. Smit del et lith.

Mintern Bros. imp.

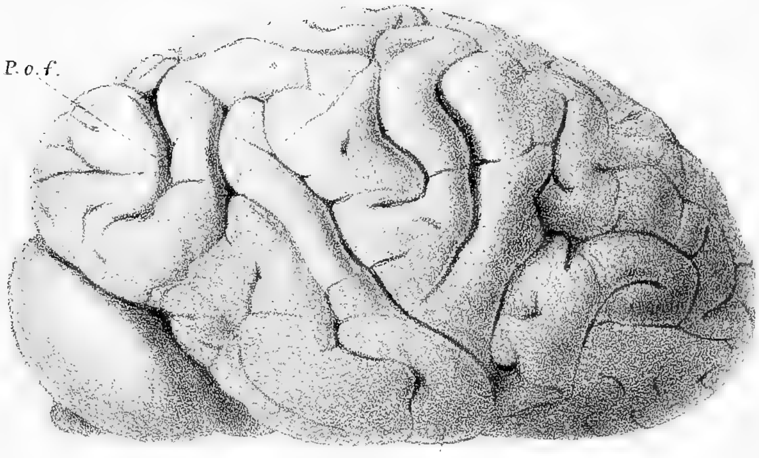
HEAD OF TROGLODYTES CALVUS,
FROM ABOVE.



J. Smit del. et lith.

HAND & FOOT OF TROGLODYTE[illegible] [illegible]

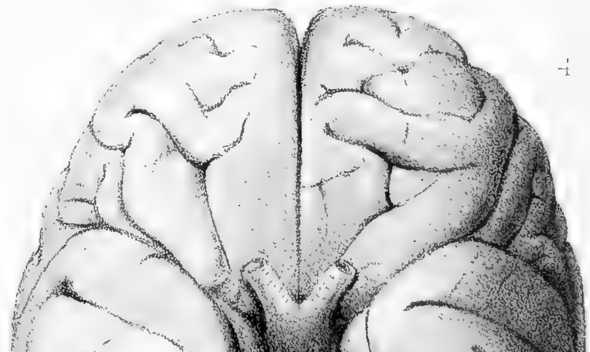
Mintern Bros. imp.



2

3

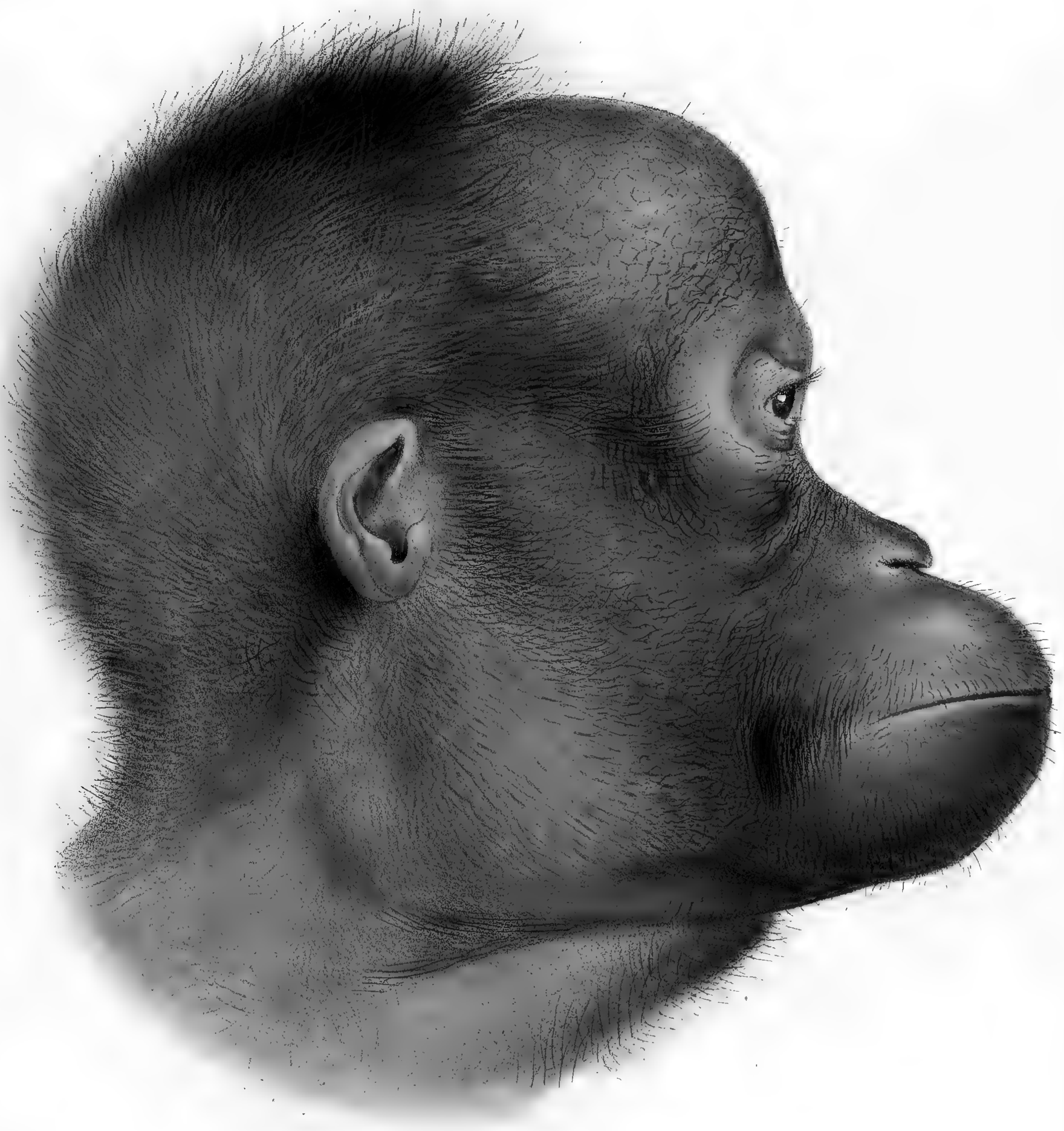
4



J. Smit del. et lith.

Mintern Bros. imp.

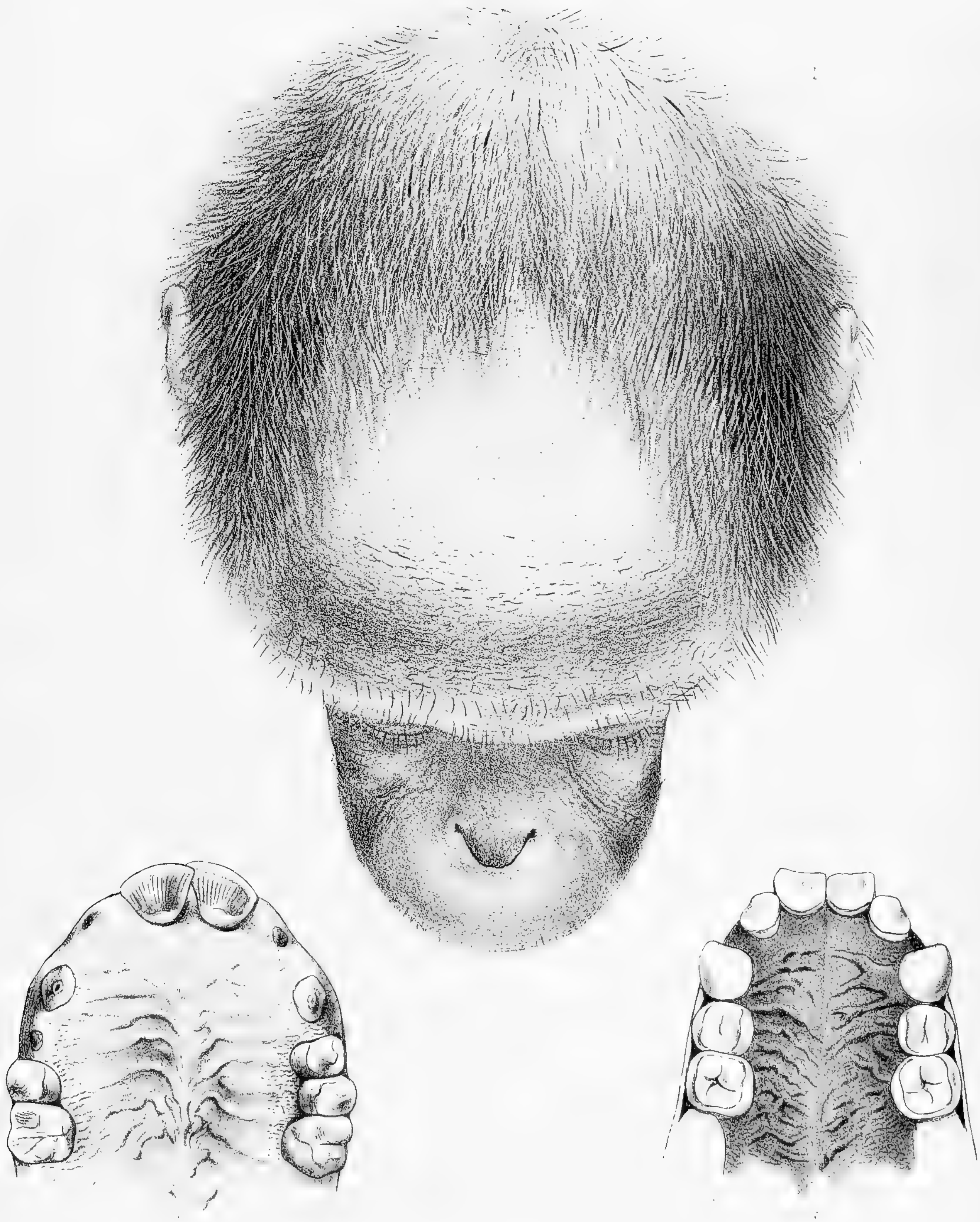
BRAIN OF TROGLODYTES CALVUS.



J. Smit del et lith.

Mintern Bros. imp.

HEAD OF ORANG.

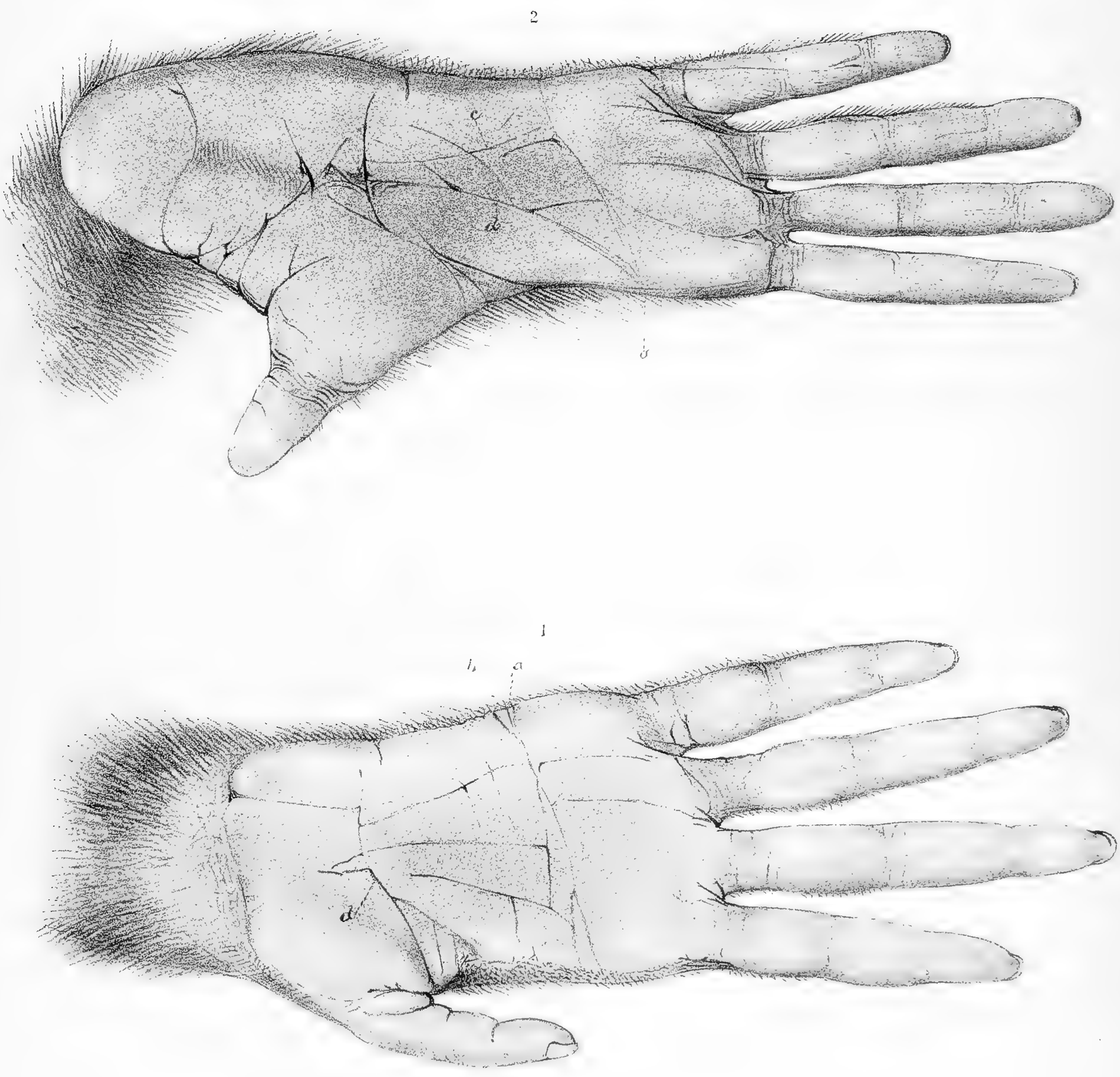


J. Smit del. et lith.

Mintern Bros. imp.

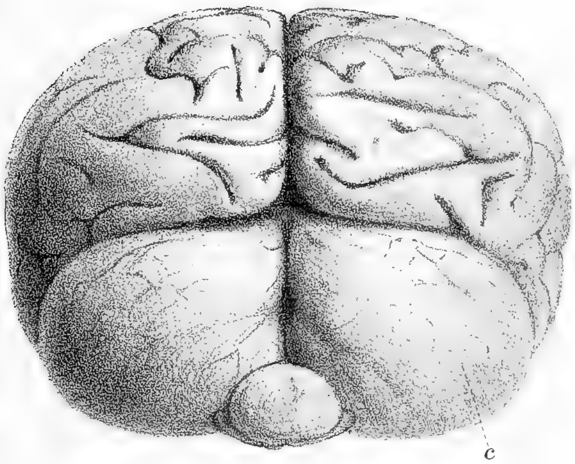
HEAD OF ORANG
PALATE OF CHIMPANZEE & ORANG.

J. Smit del. et lith.

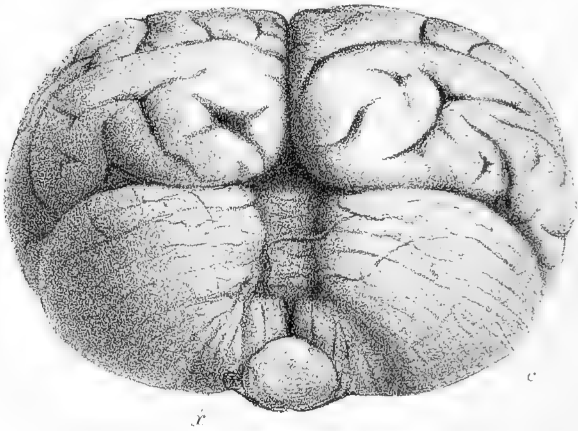


J. Smit del. et lith.

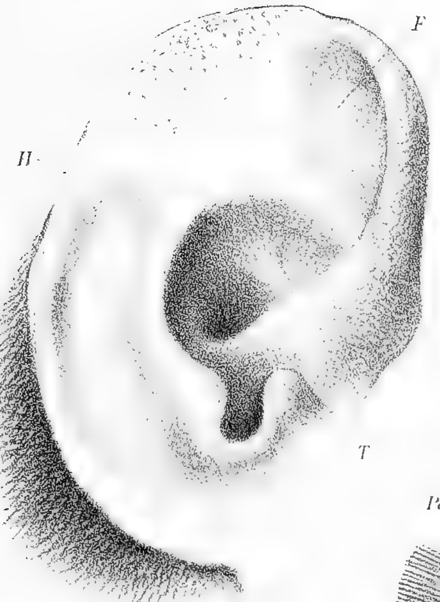
1.

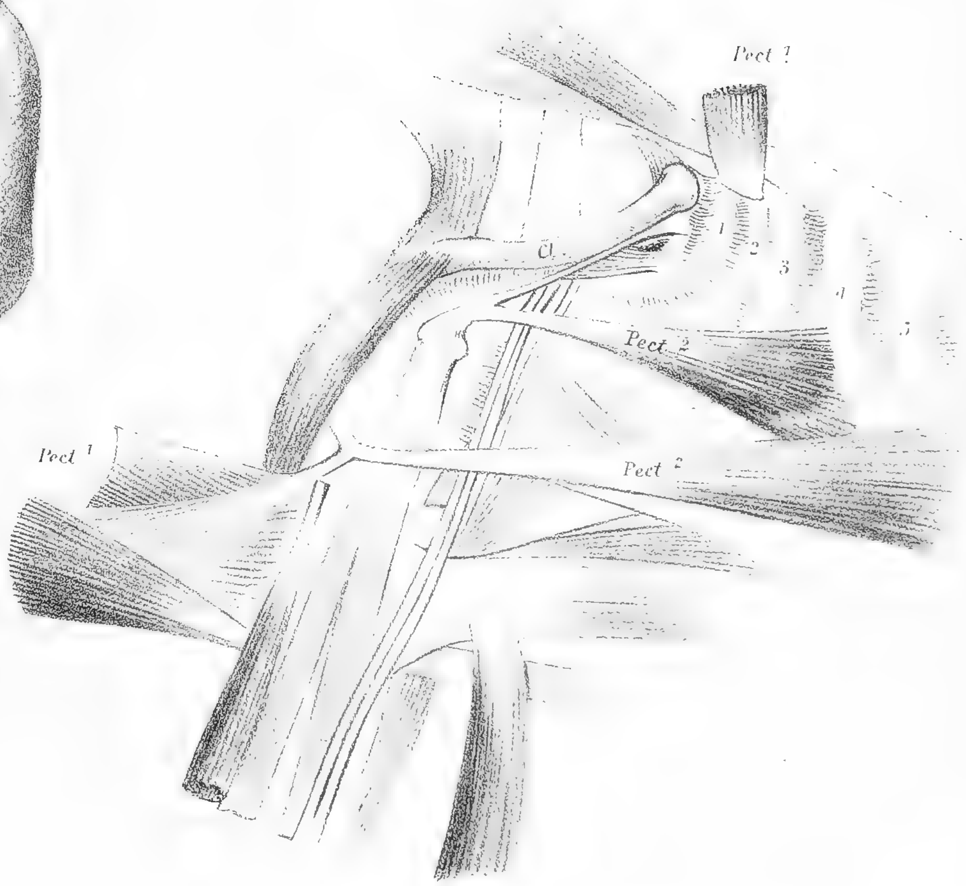


2.



3.





J. Smit del. et lith.

ANATOMY OF

VIII. *On the British Palæogene Bryozoa.* By J. W. Gregory, *B.Sc., F.Z.S., British Museum (Nat. Hist.).*

Received May 17th, 1892, read June 14th, 1892.

[Plates XXIX.–XXXII.]

Contents.

I. *Introduction.*

PROBABLY few groups of British Neozoic fossils have been so much neglected as the British Lower Cainozoic Bryozoa. While those of the Crag were carefully monographed by Busk in 1850 and those of the Cretaceous, Jurassic, and Palæozoic rocks have been described in numerous memoirs, but little has been done on the Palæogene fauna. In Morris's 'Catalogue of British Fossils' published in 1843 only one species is mentioned, and it was not till 1850 that some were described and figured by Lonsdale in Dixon's 'Geology of Sussex'; he described four species, of which only one was regarded as new. In 1866 the next contribution was made by Busk [No. 7] in a paper entitled "Description of three Species of Polyzoa from the London Clay of Highgate, in the collection of N. T. Wetherell, Esq., F.G.S." This paper, short though it be, is the best piece of work that has been done on the British Eocene Bryozoa. Since then Mr. G. R. Vine [A, p. 673] has published a list of the recorded species and has subsequently described two collections, both of which are now in the British Museum. With these additions the list numbered twenty-one, but of these only four are here retained, as the remainder are either based on identifications that I have been unable to verify or on indeterminable fragments.

The neglect of this group has no doubt been mainly due to the comparative rarity of specimens: collectors who have devoted a good deal of time to our Lower Tertiaries have only met with a few fragments and have not felt much interest in them. Even in the principal Museums the British Palæogene Bryozoa are very sparsely represented, with the single exception of the British Museum, which contains all the material from many large collections; the collection there now includes all existing types and figured specimens, with the exception of one specimen figured in this communication. The principal part of the Bryozoa collection in the British Museum consists of the

"F. E. Edwards Collection," including Lonsdale's types. Busk's types and many other specimens were obtained with the "Wetherell Collection," while additions from the London Clay of Fareham and Sheppey were made by the acquisition of the collections of Mr. G. R. Vine and Mr. A. Bell.

The present paper therefore consists mainly of a description of the British Museum Collection, and for permission to undertake this I have to thank Dr. H. Woodward, F.R.S. I have of course examined all other available material, including that in the Reed Collection at York, at the Woodwardian Museum, Cambridge, and in the Museum of Practical Geology. I must also thank Mr. E. H. M. Platnauer and Mr. E. T. Newton for valuable assistance when examining the collections under their care; and I am especially indebted to Mr. H. Woods for the kind loan of the Cambridge specimens.

Furthermore I must express my best thanks to my colleague Mr. R. Kirkpatrick, of the Zoological Department, for his ever-ready assistance; owing to his kindness, I have enjoyed every opportunity for the examination of the collections of recent Bryozoa, and especially the type specimens, to which constant reference has been necessary; he has also repeatedly discussed the difficulties that have been met with, and his knowledge of the recent Bryozoa and their literature has always been placed most generously at my service.

II. *Terminology.*

Most of the terms employed have a well-established meaning, and consequently do not require to be here referred to; but the apertures and pores of the Cheilostomata are so important in diagnosis, and have been so differently employed therein, that it seems advisable to define them. At the same time a few alterations in terminology are suggested, as it is hoped thereby to secure greater precision in the description of the fauna.

Orifice. The opening of the mouth of the polypide: it corresponds in size and shape to the operculum. In fossil Membraniporidæ, &c., it cannot be determined.

Aperture. The opening occupied by the membranous area which surrounds the orifice. The aperture may be *primary* and either correspond to the orifice as in *Lepralia* or may be a large space in the middle of which the orifice opened, as in *Membranipora.* Or it may be *secondary,* formed by the peristome rising up into a tube and concealing the original primary aperture; the form of the latter may, however, be always told from the operculum.

Sinus. A notch on the lower side of the aperture, as in *Schizoporella.*

Trypa. A pore which perforates the front wall of the zoœcium; it occurs only in the Microporellidæ: it is generally assumed to correspond to the sinus.

Other names have been previously given to this, but there seem to be valid objections to them all. Jullien has called it the "fenestrula;" but this term is already in use for the interspaces in the zoarium of the Fenestellidæ. D'Orbigny included it among the "special pores," and as such it is often referred to, though this also includes different structures. The term "zoœcial pore" is hardly definite enough; the terms "true pore," "accessory opening" (*D'Orbigny*), "central pore" (*Busk*), are subject to the same objection.

Peristomial Pore ("Sublabial pore" of Busk). A pore below the aperture which simply leads into the peristomial chamber.

Punctures. A series of pores left between the anastomosing spines of the front wall of *Cribrilina*, &c.

Areolæ. Pits or tubular depressions occurring in linear series around the margins of zoœcia, *e. g.* in *Notamia wetherelli.*

Maculæ. A term suggested for the small irregular cavities in the walls of the zoœcia: they correspond to the main part of the "pores d'origelles" of Jullien [No. 3, p. 607], but since Pergens [No. 7] has thrown such discredit on Jullien's views on these structures it seems hardly advisable to circulate this term. The name is derived from "maculæ," the meshes of a net, as, according to Pergens, they originate simply by non-calcification of part of the wall. When seen on the front wall of a zoœcium they resemble small pits or depressions.

Opesiulæ. A term applied by Jullien to the secondary small apertures, of which a pair usually occur on the front walls of the zoœcia of *Micropora*, &c.

III. *Classification.*

Probably no one who has tried to determine to which of the twenty to thirty families of Cheilostomata some form new to him must be referred will complain of an attempt to arrange these families into groups. Among the Euechinoidea, for example, there are twenty-five families distributed amongst five orders, some of which are divided into sub-orders. But among the Cheilostomata we have as many or more families, without any definite larger groups, except the ill-fated ones proposed by Dr. Jullien [No. 4] and the antiquated ones of Mr. Busk [1]. The inconveniences of this are manifold; the diagnosis of each family has to be of inconvenient length, and the task of discovering the exact systematic position of any species is a matter of much difficulty.

Neither the Rev. T. H. Hincks nor Mr. Waters offer much encouragement to an attempt at any serious alteration, as the former points out emphatically that all classifications at present must be tentative and the latter discourages what he calls "an attack along the whole line." But then all classifications are probably more or less tentative and temporary, and, so far as I am able to judge, some grouping of the families is an essential preliminary to an attempt to revise the families in detail and dissipate the chaos in which at present the fossil Bryozoa are involved.

Though there is of course much uncertainty as to the exact taxonomic value of several characters, there does seem to be a pretty general agreement as to the most important structures. The development of the front wall seems about the leading feature, as so many of the other characters, *e. g.* the aperture, the position and development of avicularia, &c., are correlated with this. The use made by Jullien of the front wall has perhaps prejudiced some workers against this structure; but Jullien has based his classification on modifications that most workers regard as of very slight value, while his method of nomenclature is quite his own. As M. Dollfus has pointed out in an admirable criticism, Dr. Jullien simply does not accept the principle of priority.

[1] Busk of course based his divisions on zoarial characters, and these, though somewhat improved by Dr. Ortmann [No. 1, pp. 3, 4], are now quite inadequate.

Three groups of the Cheilostomata may be conveniently based on the character of the front wall. In one, including the Membraniporidan series, this structure is absent or only imperfectly developed: the name of "Athyriata" (from α and θυρεὸς, an oblong shield) is therefore suggested for it. In a second group the wall is well developed, but there is an additional communication between the exterior and the polypide by means of a pore (trypa) on the front wall or by a sinus on the lower margin of the orifice. The exact homology of these two structures has never, so far as I am aware, been clearly demonstrated, but it has been generally accepted, for example, by Hincks, Waters, and Macgillivray. For this group the name of "Schizothyriata" is proposed. Finally, there is the group in which the calcification of the front wall is complete; it may therefore be called the "Holothyriata."

In addition to these there is a series of forms whose affinities seen very doubtful. With one or two exceptions they are rarely or never found fossil, and my opportunities of studying them have been but limited. They may be divided into two divisions, one of which may be a natural group. This includes the Œtiidæ, Chlidoniidæ, and Eucratiidæ; the terminal or subterminal apertures and simple tubular or pyriform zoœcia of these families suggest that they are among the most primitive of living Cheilostomata. They are here left grouped together, and Busk's name, the Stolonata, is accepted. For the other division Smitt's name of "Cellularina" is adopted; but this is certainly not a natural group. Thus some, such as the Cellulariidæ, Bicellariidæ, and Epistomiidæ (Notamiidæ of Hincks), seem clearly allied by their large membranous areas and aperture to the Membraniporidan group; the Catenariidæ may include representatives of both the Holothyriata (e. g. *Catenicella utriculus,* Macgill.) and the Schizothyriata. Among the latter there may be divisions corresponding to both of the great families; thus *Catenicella amphora*, Busk, is analogous to the Microporellidæ, and *C. pulchella* (Maplestone) to the Schizoporellidæ. It is, however, not improbable that the Catenicellidæ branched off independently from the main Cheilostomatous stem at a very early period.

Without more detailed information upon the anatomical structure of the polypides of the families in this "carpet-bag" group it seems unadvisable to attempt to place them definitely. In the Catenariidæ we have both holostomatous and schizostomatous (e. g. *Claviporella*) genera, but until we know more of the anatomy of the polypides it seems very uncertain as to whether this character possesses the same significance as in those higher Cheilostomata where the skeleton is of a specialized and complex type. Amongst these the hard parts certainly seem to offer reliable classificatory characters.

Through each of the three suborders an evolutionary series can be traced. Thus among the Athyriata the Membranoporidæ seem to be the most primitive, and this family passes up into the Cribrilinidæ and Hiantoporidæ in the manner suggested by Mr. Hincks [No. 2, pp. 199–200, and No. 5 [pt. 3], pp. 471–472 and 479–480] and Mr. Kirkpatrick [No. 2, pp. 616–617].

There seems to be a similar evolutionary series in the Holothyriata, where the main branch develops from the simple *Cyclicoporinæ* through the *Lepralinæ* to the more specialized Smittiidæ; also in the Schizothyriata from the simple *Schizoporella* or *Schismoporella* to such a form as *Adeonella pectinata.*

The division of both the Reteporidæ and Celleporidæ into the schizostomatous and holostomatous groups appears to be generally regarded as inevitable. The dismemberment of the Selenariidæ is more likely to be criticized, but it is not a new idea. It was first done by Prof. Smitt in 1873 [No. 3], and Mr. Hincks [No. 7, p. 125] has given it the sanction of his high authority by the remark in describing *Cupularia umbellata*, Defr., that "this form clearly belongs to the Steganoporellidan series and must be transferred to it."

The survival of the family Selenariidæ seems to me to well illustrate the necessity for a grouping of the families; so long as these have been allowed to remain in independence, such an *olla-podrida* of species of different families agreeing only in zoarial form has been able to hang together. The moment we introduce a more scientific system, define suborders, and try to indicate the affinities of the families, such a group as the Selenariidæ falls to pieces.

These remarks are not intended as a formal defence of the classification. Its publication will be justified only if it is found to aid in bringing the Cheilostomata, and especially the fossil forms, into better order than they are in at present.

Synopsis of the Classification followed.

Order CHEILOSTOMATA.

I. Suborder Stolonata.

Forms with simple tubular zoœcia and terminal or subterminal apertures.

Family 1. Aeteidæ. For diagnosis see Macgillivray, No. 3, p. 195.
2. Eucratiidæ. „ „ „ p. 196.
3. Chilidoniidæ. „ „ „ p. 196.

II. Suborder Cellularina.

A group of forms with simple zoœcia and tufted phytoid zoaria, and probably including representatives of the three following suborders.

Family 4. Cellulariidæ. For diagnosis see Macgillivray, No. 3, p. 199.
5. Bicellariidæ. „ „ „ p. 202.
6. Epistomiidæ (Notamiidæ). „ Hincks, No. 2, p. 98.
7. Catenicellidæ. „ Macgillivray, No. 3, p. 197.
8. Bifaxariidæ. „ „ „ p. 199.

III. Suborder Athyriata.

Cheilostomata with the front wall uncalcified or incompletely calcified.

Family 9. Farciminariidæ. For diagnosis see Macgillivray, No. 3, p. 204.
10. Flustridæ. „ „ „ p. 203.

Family 11. Membraniporidæ. Athyriata with the front wall mainly membranous and occupied by an opesial aperture; this does not correspond to the operculum. The opesium is surrounded by a raised margin. External oœcia.

Subfamily 1. *Membraniporinæ.* Membraniporidæ with open opesia and without, or with but a small, extra-opesial front wall

Subfamily 2. *Electrininæ.* Membraniporidæ with the normal zoœcia tubular and with a terminal opesium.

Subfamily 3. *Lunulitinæ.* Membraniporidæ with patelliform zoaria, and with vibracularia systematically arranged.

Family 12. Cribrilinidæ. Athyriata with a front wall formed by the overarching and branching of one or more spines. External oœcia.

Subfamily 1. *Cribrilininæ.* Cribrilinidæ with the front wall formed by the overarching and fusion of numerous circumareal spines; the interspaces remain as grooves or pores.

Subfamily 2. *Hiantoporinæ.* Cribrilinidæ with the front wall formed of one large spine arising from the margin.

Subfamily 3. *Steginoporinæ.* Cribrilinidæ with the front wall formed by the overarching of spines arising from the peristome.

Family 13. Microporidæ. Athyriata with a calcified front wall. Zoœcia surrounded by raised margins. No internal diaphragms. External oœcia.

Subfamily 1. *Microporinæ.* Zoœcia all normal or onychocellaria (large vicarious avicularia) irregularly distributed.

Subfamily 2. *Selenarinæ.* Microporidæ with patelliform zoaria and vibracularia systematically arranged.

Family 14. Steganoporellidæ. Athyriata without external oœcia and with the zoœcia divided into two chambers by a calcareous diaphragm.

Family 15. Cellariidæ. Athyriata with internal oœcia which open by a pore above the aperture. The zoœcia are surrounded by raised margins; the aperture is situated within the depressed front wall.

IV. Suborder Schizothyriata.

Cheilostomata which are schizostomatous or trypiate (*i. e.* provided with a trypa; see p. 220) or both.

Family 16. Schizoporellidæ. Schizothyriata not provided with a trypa.

Subfamily 1. *Schizoporellinæ.* Schizoporellidæ with simple primary aperture and external oœcia.

Subfamily 2. *Schizoreteporineæ.*[1] Schizoporellidæ with the zoœcia obliquely placed on a unilaminar, reticulate or ramose, erect zoarium.

Subfamily 3. *Schismoporinæ.*[2] Schizoporellidæ with urceolate zoœcia growing in dense masses; aperture terminal or subterminal.

Subfamily 4. *Biporineæ.* Schizoporellidæ with a patelliform unilaminate zoarium, with vibracularia systematically arranged.

[1] *Schizoretepora*, n. gen., for which at present the subfamily diagnosis also serves as the diagnosis, is the type genus; it includes the schizostomatous Reteporas, of which *S.* (*R.*) *tessellata* (Hincks) [No. 2, p. 358, pl. xix. figs. 9–12], is a convenient type.

[2] *Schismopora*, Macgillivray [No. 4, p. 29], is the type genus, and *S. costata* the type species: it does not

Family 17. ADEONELLIDÆ. Schizothyriata with a schizostomatous primary aperture and a variable secondary aperture. Gonœcia and no external marsupia.

Family 18. MICROPORELLIDÆ. Schizothyriata provided with a trypa.

Subfamily 1. *Microporellinæ.* Holostomatous Microporellidæ with external marsupia.

,, 2. *Schismoporellineæ.* Microporellidæ which are both schizostomatous and trypiate.

,, 3. *Adeoninæ.* Microporellidæ which are holostomatous and have gonœcia, but no external marsupia.

V. Suborder HOLOTHYRIATA.

Holostomatous Cheilostomata which have the front wall wholly calcified.

Family 19. LEPRALIIDÆ. Holothyriata with a simple primary aperture.

Subfamily 1. *Lepraliinæ.* Lepraliidæ with external oœcia.

Alliance 1. *Cycliopora.* Lepraliinæ with simple zoœcia having orbicular apertures which are often surrounded by raised rims.

Alliance 2. *Lepralia.* Lepraliinæ with the aperture usually horseshoe-shaped and never truly orbicular.

Subfamily 2. *Teichoporinæ.* Lepraliidæ with gonœcia and no external oœcia.

,, 3. *Reteporinæ.* Lepraliidæ with the zoœcia obliquely placed on a unilaminar, reticulate or ramose, erect zoarium.

Family 20. CELLEPORIDÆ. Holothyriata with barrel-shaped or urceolate zoœcia, usually growing in heaped masses; aperture terminal or subterminal.

Family 21. SMITTIIDÆ. Holothyriata with a raised secondary orifice; the primary orifice is often denticulate.

Order CYCLOSTOMATA.

Family 1. IDMONEIDÆ. | Family 2. HETEROPORIDÆ.

IV. *Systematic Synopsis.*

Class ECTOPROCTA.

Subclass GYMNOLÆMATA.

Order *CHEILOSTOMATA.*

Suborder STOLONATA.

Family EUCRATIIDÆ.

Genus NOTAMIA, Fleming, 1828 (non Busk, Hincks, &c.).

Diagnosis. Zoarium erect and phytoid; zoœcia biserial, joined back to back; the apertures of each series respectively open in the same direction. Aperture large, on the front of the cell. Neither vibracula, avicularia, nor oœcia. [Fleming, No. 1, p. 541.]

appear to have been formally diagnosed; but the list of six species with the figures of their opercula published in the 'Prodromus' leaves no doubt as to its nature. [Macgillivray, No. 1, dec. xvii. pp. 168, figs. 1–6. See also Macgillivray, No. 2, pt. v. pl. ii.]

Species 1. Notamia wetherelli (Busk), 1866.

Syn. *Dittosaria wetherelli,* G. Busk, 1866, Geol. Mag. iii. p. 301 ; G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. pp. 158–159, pl. v. fig. 1.

Records. W. Whitaker, No. 1, p. 594; G. R. Vine, No. 1, p. 673.

Diagnosis. Zoarium in small phytoid tufts; imperfectly known. Branching dichotomous.

Zoœcia elongate, pyriform. Aperture median and symmetrical, oval, the longer axis in the direction of the length of the zoarium. The aperture opens on the upper border and occupies about a quarter of the front of the zoœcium. The surface is ornamented with a double series of areolæ; the innermost series forms an ellipse passing close round the upperside of the aperture and crossing the front wall at about the middle; the outermost series runs close along the hinder margin. The number varies from 8 to 16 in the inner series, and from 20 to 26 in the outer.

Distribution. London Clay, Highgate (Brit. Mus.).

Dimensions. The zoœcia of the specimen figured measure a trifle over ·5 mm. in length.

Figures. Pl. XXIX. figs. 1 *a*, *b*. Part of a zoarium, × 37 diam. Brit. Mus.

Affinities of the Species. This species differs from *Notamia loricata* (Linn.) in that in the recent species the aperture occupies half the front of the zoœcium and is obliquely placed; it also has no regular series of areolæ. The same characters serve to distinguish it from *Notamia americana* (Lamx.)[1]. A nearer ally is the *Notamia prima* (Reuss)[2], which differs from it by the smallness of the mouth and the absence of areolæ.

Remarks. This species was founded by Busk on a specimen in the Wetherell Collection which cannot now be recognized, but other specimens labelled by Busk occur and enjoy almost as much authority as the actual figured specimens. Busk made it the type of a new genus, *Dittosaria*, which has been ignored or overlooked by nearly all subsequent writers. He recognized that it was a close ally of *Notamia* (*Gemellaria*), but distinguished it by its mode of branching; he restricted the old genus to those which at every fork retain a continuation of the main stem in addition to the two branches. But this is not even a specific character, as is shown by the following quotation from Mr. Hincks's [No. 2, p. 20] description of *Notamia* (*G.*) *loricata*:—"The branches are given off from each side of the uppermost pair in a stem close to the top, and at times the stem ascends between them and a triplet is formed in place of the more usual bifurcation." The only other point of difference is that the mouth in this species is not "slightly oblique" as it should be to conform to Mr. Hincks's diagnosis of the genus. But this is hardly of generic value, and Busk certainly regarded the other as the main character. The genus differs from *Pasythea*, Lamx., by the absence of the two notches at the lower corners of the aperture.

[1] *Loricaria americana,* Lamouroux, No. 2, p. 7, pl. lxv. fig. 9.

[2] *Gemellaria prima,* Reuss, No. 7, p. 170, pl. vii. figs. 6, 7.

NOTE ON THE USE OF THE NAME *Gemellaria*.—The name *Gemellaria* was first invented for a genus of Bryozoa by J. C. Savigny somewhere about the year 1810; it was not, however, published till 1826 [Audouin, No. 1, p. 242], and then only in the French form of *Gémellaire*; so far as I am aware, it was first used in a Latinized form in 1830 by Blainville [No. 2, p. 425], who did not himself accept it. Before the publication of *Gemellaria* or *Gémellaire* the genus had been described in 1821 by Lamouroux [No. 2, p. 7], who named it *Loricaria*. Audouin, who completed Savigny's work when the latter was disabled by ill-health, of course treated "*Gémellaire*" as a manuscript name and accepted *Loricaria*. Most subsequent authorities, however, have accepted *Gemellaria* and date it from 1805, 1809, or 1811. Johnston [No. 2, p. 293, footnote] seems to have entertained doubts as to the accuracy of this proceeding, but accepted it on the idea that copies of some work of Savigny's had been placed in the principal libraries; he obviously could get no reliable information regarding it.

Mr. Hincks accepts the genus and quotes as its author "Savigny, 1811." The only reference he gives in his Bibliography [No. 2, p. 588] to Savigny is "Iconographie des Zoophytes de l'Egypte," from the 'Description de l'Egypte.' Miss Jelly [No. 1, p. 284] quotes the same work, and so does Macgillivray [No. 3, p. 223], who, however, adds "not seen by me." I regret to have been unable to find any such work; there is none such in the Natural History Museum copy of the 'Description de l'Egypte,' nor is any referred to in "A Bibliographical Account and Collation of 'La Description de l'Egypte'" (London Institution: private circulation, 1838, 8vo, 76 pp.). None of the ordinary bibliographical works of reference give any information regarding it. I therefore cannot help concluding that the authorities who have quoted this mysterious "Iconographie" really refer to Audouin's "Explication sommaire des planches de Zoophytes de l'Egypte . . . . ." That the date of this is 1826 and not 1811 admits of no doubt: the work was only entrusted to Audouin for completion in 1825, and monographs issued in 1821 are quoted. *Loricaria* has therefore the prior claim to adoption, but unfortunately it had been previously used among fishes. Fleming [No. 1, p. 541], therefore, in 1828 renamed it *Notamia*. *N. loricata* he clearly regarded as the type, for the only other species he associated with it (*N. bursaria*) he made the type of a new genus, *Epistomia*. Lamouroux did not include this latter species in his *Loricaria*, but in the Sertularian *Dynanema* [No. 1, p. 79]. Fleming, it must be remembered, only proposed *Notamia* as a change of name owing to the preoccupation of *Loricaria*. The name *Notamia* cannot therefore be separated from its type species and applied to one which both Lamouroux and Fleming assigned to another genus. There is therefore no option but to follow Fleming and substitute *Notamia* for *Gemellaria* and regard the species *bursaria* as the type of *Epistomia*.

The only alternative is to accept Blainville's name *Gemicellaria* [No. 1, p. 425], proposed in 1830, but there does not seem any sufficient reason for a departure from the ordinary rule of nomenclature.

Suborder ATHYRIATA.

Family MEMBRANIPORIDÆ.

Subfamily MEMBRANIPORINÆ.

Genus MEMBRANIPORA, Blainville, 1834.

[Blainville, No. 2, p. 447.]

Diagnosis.[1] Membraniporidæ in which the opesial aperture is generally of a simple form and the lamina is absent or but slightly developed.

[1] It will be seen from this diagnosis that in deference to recognized opinion *Amphiblestrum* is accepted; it appears to be an artificial but very convenient group.

Species 1. Membranipora eocena (Busk), 1866.

Syn. *Biflustra eocena,* G. Busk, 1866, Geol. Mag. iii. p. 300, pl. xii. fig. 2; W. Whitaker, 1872, Mem. Geol. Surv. iv. pt. 1, p. 594; G. R. Vine, 1886, Rep. Brit. Assoc. 1885, p. 673.

Biflustra (*Membranipora*) *eocena,* G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 160, pl. v. fig. 4.

Flustra crassa, Desm., J. Morris, 1843, Cat. Brit. Foss. p. 37; Huxley & Etheridge, 1865, Cat. Foss. M. P. G. p. 332; Huxley & Newton, 1878, Cat. Tert. & Post-Tert. Foss. M. P. G. p. 14.

Diagnosis. Zoarium large, expanded, foliaceous. Bilaminar, the internal face ribbed by long and prominent angular ridges.

Zoœcia quadrangular, arranged in long, oblique lines. The opesia are elliptic and fairly regular, with a strong, slightly raised rim; this is surrounded by a flat area, on the part of which that covers the continuation of the zoœcium are two distinct rounded avicularia. The width of the surrounding area and the prominence of the rim vary somewhat in different parts of the zoarium, but within a restricted area are quite uniform.

Avicularia: usually a pair on the front wall below the aperture.

Figures. Pl. XXIX. fig. 2. Part of zoarium, from a specimen from the London Clay, Highgate; Brit. Mus. No. 49729; × 16 diam. Fig. 3. Another specimen showing back view, × 21.

Distribution. Thanet Sand, Pegwell Bay (M. P. G.). London Clay, Southampton. London Clay, Highgate. Edwards Coll. Brit. Mus. 49729.

? Bracklesham Beds, Bracklesham.

Remarks. This species was founded by Busk, who gave four figures of it; these well show the general form of the zoarium, the thickened longitudinally ribbed back, the form of the opesia, and the large front wall below the aperture. These are the main specific characters. Busk's type was in the Wetherell Collection, but it cannot now be found. Though the figures do not show the pair of avicularia, there can be no doubt of the species, for the Wetherell Collection contains many specimens from Highgate labelled by Busk and Wetherell. The specimen from which the accompanying figures have been drawn is from Southampton. A small specimen in the Edwards Collection from Bracklesham appears to belong to this species, but as it only shows the back view of the inner lamina it is impossible to be certain. The Thanet Sand specimens are so much worn that one cannot be sure of the identification.

The species belongs to the group of *Membranipora* of which *M. savarti* (Aud.) [No. 1, p. 240, pl. x. fig. 10; see also the figures by Smitt, No. 3, p. 20, pl. iv. figs. 92–5] is a convenient type; from this, however, it differs in the absence of the crenulate margin and the two tubercles sometimes present in that species; the area of the front wall is much larger than in Audouin's species, and the back is longitudinally ribbed instead of having the flat surface marked off into regular rectangles as shown by Smitt. The plain prominent rim and large front wall also separate this species from

M. lacroixi (Aud.) [No. 1, p. 240, pl. x. fig. 9]. *M. eocena* is more nearly allied to *Membranipora appendiculata* (Reuss), of which a good figure has been given by Mr. A. W. Waters [No. 12, pl. ii. fig. 3], but from this it differs in that Reuss's species has a single large avicularium on the lower side of the aperture and not quite in the median line; the opesia is also somewhat too large. *M. macrostoma* (Reuss) is another ally; but this has the rim that borders the opesia closer to the margin of the zoœcia, so that the flat depressed marginal space is absent.

Species 2. MEMBRANIPORA BUSKI, n. sp.

Syn. *Membranipora lacroixi*, G. Busk (non Aud.), 1866, Geol. Mag. vol. iii. pl. xii. figs. 1 *a* & *d*; (fide Vine), J. W. Judd, 1883, Geol. Mag. dec. 2, vol. x. p. 527; G. R. Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pt. 2, pp. 159–160, pl. v. fig. 2 (copied from Busk), fig. 3 (original); H. W. Bristow, 1889, Geol. I. Wight, ed. 2, p. 284.

Membranipora reticulum, Vine (non Linn.), ibid. vol. xii. pt. 1, pp. 59, 60.

Diagnosis. Zoarium encrusting or foliaceous. The back is flat and not ribbed.

Zoœcia arranged in long series. Opesia very large: no lamina or front wall, the raised rims of adjoining zoœcia being in contact. The general form is oblong, the length being not much greater than the width, except at the bifurcations of a row, where the two zoœcia are long and narrow. The raised rims are thick and plain.

Avicularia irregularly scattered, small, generally in the lower right-hand corner of the zoœcia.

Oœcia not always present, narrow, globose.

Distribution. Headon Beds, Colwell Bay, I. of Wight; London Clay, Highgate.

Type. Brit. Mus. No. B 4625.

Figures. Pl. XXIX. fig. 11. Part of a zoarium with an oœcium; × 55 diam. Brit. Mus. No. B 4625. Fig. 12. Part of a specimen (Mus. Pract. Geol.) with oœcia, × 55 diam.

Affinities. This species in its general characters very closely approaches *M. lacroixi*, Aud. [No. 1, p. 240, pl. x. fig. 9], and as such the London Clay specimen has been figured by Busk. With this identification I agreed until seeing the specimens in the Museum of Practical Geology: these were collected by Mr. Chapman and are clearly the same as those which he has kindly presented to the British Museum. They, however, show the oœcia, and thus clearly separate the species from *M. lacroixi*, from which, according to Mr. Hincks's diagnosis [No. 2, p. 130], these structures are absent.

Species 3. MEMBRANIPORA CRASSOMURALIS, n. sp.

Diagnosis. Zoarium irregular, encrusting.

Zoœcia oval, irregularly distributed. Each zoœcium surrounded by a thick prominent rim. The interspaces between these rims are very narrow. When encrusting ribbed bivalves the zoœcia are more regularly arranged, running along the ribs or pressed into the furrows. Opesia usually occupying the whole of the area, but in some a thin narrow lamina occurs.

Oœcia triangular: surrounded by a rim like that around the zoœcia.

Avicularia sparsely and irregularly scattered over the zoarium: occupying the small triangular areas between the zoœcial margins.

The raised rim is usually plain, but may bear a single minute tubercle, the base of a small spine.

Distribution. Barton Beds, Barton. Bracklesham Beds, Bracklesham.

Type. Brit. Mus. No. 49741.

Figures. Pl. XXIX. fig. 10 *a*. From Barton. Several zoœcia, showing the oœcia, avicularia, bases of spines, and lamina. Fig. 10 *b*. Another specimen, growing on a strongly ribbed *Pecten*.

Remarks. This species appears to be most closely related to that figured by Reuss [No. 14, p. 179, pl. ix. figs. 1, 2] as *Membranipora elliptica* (Hag.) from the Leithakalk (Helvetian) of Eisenstadt. But the London Clay species appears to be certainly distinct from that represented in von Hagenow's original figure [No. 1, p. 268, pl. iv. fig. 6], in which the rims surround the area instead of the zoœcia and thus are separated by a wide space, both in the centre and youngest part of the zoarium; there are neither laminæ nor oœcia. Hagenow remarks on the "vertieften Zwischenräumen" with ring-shaped pores. But as to the identity of *M. crassomuralis* with the Eisenstadt species I do not care to express a definite opinion without seeing Reuss's type. Pergens [No. 1, pp. 15, 16] seems to have entertained the same doubts as to the correctness of Reuss's identification, for though he quotes *M. elliptica* from the Austro-Hungarian Miocenes, he does not include Reuss's reference in his synonymy.

This species belongs to the *M. lacroixi* group, but it differs in the following characters: (1) it has triangular oœcia, whereas these structures are said by Hincks [No. 2, p. 130] to be absent in the recent species; (2) the rim is not crenulate; (3) the avicularia are fewer, and there is never more than one spine on the rim.

From *Membranipora eocena* (Busk) it differs in the absence of any space below the area and outside the rim, and also of the two small lateral avicularia; the zoœcia are also arranged more irregularly.

Membranipora temporaria, Waters [No. 6, p. 288, pl. vii. fig. 16], from the Murray River cliffs, is an allied species, but differs in the presence of two small lateral avicularia and a larger "infra-area."

Another species with which this new one must be compared is *Membranipora loxopora* (Reuss) [No. 2, p. 166, pl. viii. fig. 11: for later figures see No. 14, pp. 39–40, pl. ix. figs. 4, 5; the author's original figure in No. 1, p. 97, pl. xi. fig. 24, has been subsequently repudiated by him], but this has larger front walls, on which the avicularia are placed, instead of in the angles.

Reuss [No. 13, p. 101, pl. xxiv. figs. 4 & 5 *c*] has himself also figured the typical Cretaceous *M. elliptica* from the Unter Pläner of Saxony, and one of his figures shows pores at the ends of some of the zoœcia in the positions occupied by the oœcia in *M. crassomuralis*; Reuss, however, regards them, no doubt correctly, as avicularia. In the same work Reuss [ib. pl. xxiv. fig. 3, pp. 100–101] has figured a variety of *M. subtilimargo* which resembles *M. crassomuralis* more than does the typical form; but the absence of oœcia and laminæ clearly distinguishes it.

Species 4. MEMBRANIPORA TENUIMURALIS, n. sp.

Syn. *Membranipora lacroixi,* Busk, 1866, Geol. Mag. iii. pl. xii. figs. 1 *b* & 1 *c*; W. Whitaker, 1872, Mem. Geol. Surv. iv. pt. 1, p. 594.

Diagnosis. Zoarium encrusting (or ? sometimes free), spreading as a thin gauze-like layer.

Zoœcia irregularly distributed. Form irregular, oval, quadrangular, hexagonal or polygonal: closely crowded. The opesia are very large, almost as large as the zoœcia: coincident with the area. There are small triangular depressions between the margins of the opesia of the different zoœcia. Walls thin, sometimes crenulate. There is often a pair of tubercles on the margins of the zoœcia, and these may fuse to a single large tubercle on the infra-area.

Avicularia: usually a pair of small ones in the infra-area covering the continuation of the zoœcia.

Oœcia, none.

Distribution. London Clay, Highgate. Clarendon Hill, Fareham, Portsmouth.

Type. Wetherell Coll. Brit. Mus. No. 49736.

Figures. Pl. XXIX. fig. 5. London Clay, Highgate. Brit. Mus. No. 49736 (one of Busk's type specimens).—Figs. 6 & 7. Other specimens from same locality.

Affinities. This is also a species of the puzzling *lacroixi* group. Its nearest ally is probably *M. tuberculata* (Bosc), which it resembles in its tuberculation [No. I, t. iii. p. 143. Bosc gives as a reference the *Flustra dentata* of O. F. Müller, Zool. Dan. iii. pp. 24, 25, pl. xcv. figs. 1, 2, but this is quite different]. But it differs from this in the greater thickness of the walls in *M. tuberculata* and in the presence in that species of a small front wall; in the new species, moreover, the zoœcia are more regularly hexagonal in form and are more elongated; there is also a small depressed area in the corners between the rims margining the opesia. From the recent *M. membranacea* (Linn.) it differs in the regularly alternate arrangement and rectangular shape of the zoœcia in that species; *M. tenuimuralis* also lacks the hollow marginal spines so characteristic of the recent species.

From *M. lacroixi* (Aud.) it differs in the presence of avicularia, and of the pair of tubercles or knobs; the form of the zoœcia is angular instead of oval, and the margins of the opesia are rarely crenulate. The comparison with *M. lacroixi* is especially necessary as Dr. Pergens makes *M. laxa*, Reuss [No. II, p. 252, pl. xxxvi. fig. 14], a synonym of this species; and *M. laxa* appears to be the closest ally of the London

Clay Bryozoan. *M. laxa* is a somewhat doubtful species; it has not been referred to by Mr. Waters [No. 12] in his recent revision. Reuss's figure may only represent a specimen in which the whole of the front wall is broken away and only the lateral walls are left; but if that is the case it is certainly not *M. lacroixi*, and in view of Pergens's conclusion it would not be safe to act on this view. Reuss's figure shows more regularly hexagonal zoœcia; the margins appear to be separated entirely by a narrow groove, and there are no tubercles. Hence it seems safest to make a new species for this London Clay form rather than to assert the existence of so doubtful a species as the North Italian Bartonian *M. laxa* in the Lower Eocene of the London Basin.

Species 5. Membranipora virguliformis, n. sp.

Diagnosis. Zoarium of elongate, cylindrical, solid shoots, somewhat resembling those of *Cellaria.*

Zoœcia in regular longitudinal series, elongate, rectangular. Opesia large, oval, surrounded by a thick raised and plain non-crenulate rim. A large depressed front wall below the area, often with a pair of triangular depressions.

Oœcia, none.

Avicularia single, prominent, lateral, on the upper left-hand margin of the zoœcia.

Distribution. London Clay, Highgate.

Type. Brit. Mus. No. 49658. Edwards Coll.

Figure. Pl. XXIX. fig. 8. Part of zoarium, × 25 diam.

Affinities. In its mode of growth this species resembles *M. sigillata* (Pourt.) [No. 1, p. 110; see also Smitt, No. 3, p. 8, pl. ii. figs. 64–68], but the zoœcia in that species are more irregular in form and distribution, while their general form is lozenge-shaped instead of rectangular. It also recalls to mind *M. monostachys*, Busk [No. 2, p. 31, pl. ii. fig. 2], but from this it differs by the somewhat pyriform shape of the zoœcia and the more curved instead of flattened front wall of that species.

Among the Lower Tertiary species, this most closely resembles *Membranipora macrostoma* (Reuss) [*Cellaria macrostoma*, Reuss, No. 1, p. 64, pl. viii. figs. 5, 6; *Biflustra macrostoma*, Reuss, No. 11, pp. 274, 275, pl. xxxiii. figs. 12, 13], but in that the subareal portion of the front wall is regularly rounded and has not the pair of triangular depressions seen in the new species.

Species 6. Membranipora disjuncta, n. sp.

Diagnosis. Zoarium forming a large encrusting surface; the zoœcia are arranged in disconnected rows, which are radially disposed; there are several centres of radiation in each zoarium.

Zoœcia elliptical; opesia large, surrounded by a prominent rim; the mouth opens at one end of the opesium; the rest is occupied by a thin calcareous lamina.

Avicularia and *oœcia* unknown.

Distribution. London Clay, Highgate.

Type. Brit. Mus. No. 69205. Wetherell Coll. Encrusting *Hippochrenes ampla.*

Figures. Pl. XXIX. figs. 9 *a*, *b*. Fig. 9 *a*, part of zoarium, magnified 4 diam., showing radial growths; fig. 9 *b*, × 12 diam.

Affinities. The mode of growth in loose disconnected rows resembles that often assumed by *M. catenularia* (Jameson) [No. I, p. 561, name only] (*Pyripora* of Macgillivray) [No. I, pt. xi. p. 24], but the much greater size of the opesia in this species is quite distinctive.

Genus LUNULITES, Lamarck, 1816.

[Lamarck, No. I, ii. p. 194.]

Diagnosis. A genus of Membraniporidæ with a unilaminate, conical, or cup-shaped zoarium. The zoœcia are arranged in radial rows; radial rows of vibracularia either separate the zoœcia or occur alternately.

Type species. *L. radiata*, Lamk. [No. I, p. 195].

Species 1. LUNULITES TRANSIENS [1], n. sp.

Syn. *Lunulites urceolata,* Lonsdale, 1850, in Dixon's Geol. Suss. pp. 159, 160, pl. i. fig. 8; 1878, do. ed. 2, pp. 201, 202, pl. i. fig. 8.

Lunulites ? radiata, Lonsdale, 1850, in Dixon's Geol. Suss. ed. 1, pl. i. fig. 8; 1878, do. ed. 2.

Diagnosis. Zoarium of medium size, depressed, circular, thin, cup-shaped; convex margin curved.

Zoœcia. Opesia with the aperture large, orbicular, elongate; a small lamina at the lower end. The lateral margins are steep; the inner margin slopes more gently. A pair of small tubercles occur on some of the margins between the two zoœcia.

Vibracularia large, aperture clithridiate; the radial series are connected by a groove; they increase in size towards the periphery, and gradually pass into normal zoœcia (whence the specific name). On the concave side the ridges are irregularly distributed and are separated by deep grooves; there are numerous large pores; on the narrower parts of the ridges there may be only a single line of pores.

Dimensions. Diameter ·5 mm.; height 1·25 mm. Taken from a small complete specimen. In some fragments the number of zoœcia is from 18–20; number of zoœcia in a radial series 10.

Distribution. Upper Eocene, Barton Beds, Barton. Middle Eocene, Bracklesham Beds, Bracklesham, Bramshaw, Brook, Whitecliff Bay.

Type. Brit. Mus. No. 49724. From Barton. Edwards Coll.

Figures. Pl. XXIX. fig. 13. Part of zoarium showing back, × 24 diam. Fig. 14. Several normal zoœcia, × 24 diam.—Pl. XXX. fig. 1. Another specimen, showing the

[1] Referring to the gradual passage from vibracularia to zoœcia.

ancestrula. Fig. 2. Part of zoarium from Bracklesham (B 4339), showing the front wall partly broken away. Fig. 3. Part of a worn specimen from Bracklesham, resembling *L. urceolata*.

Affinities. This species belongs to the *L. radiata*, Lamk., group, which the Marquis de Gregorio [No. 1, p. 248] has recently proposed to make into a new subgenus, *Demiclausa*; this, however, is against all rules, as *L. radiata* is clearly the type species of the genus. If, therefore, the separation is to be made, it is the other group that must be renamed and removed. *Demiclausa* is an absolute synonym of *Lunulites*.

This species was figured by Lonsdale as *Lunulites urceolata*, Lamk., but from the latter it widely differs in the fact that the vibracularia are connected by depressions into long radial lines; in *L. urceolata* they are disconnected.

From *Lunulites radiata*, Lamk., this differs by the gradual transition from the vibracularia to the normal zoœcia, and by the presence of a lamina and tubercles on the rim of the opesia. The species agrees most closely with *L. subplana*, Reuss [No. 3, p. 264, pl. xi. fig. 108], but the apertures in that species are not clithridiate, nor does there seem to be a gradual transition from vibracularia to zoœcia. It clearly differs from *Lunulites quadrata*, Reuss [*Cellepore quadrata*, Reuss, No. 1, p. 95, pl. xi. fig. 17; in the explanation of the better figure given in Reuss, No. 11, pl. xxviii. fig. 18, the species is called *Lepralia tetragona*], by the form of the aperture and the absence of the raised rim immediately around it. The original figure gives a suggestion of a similar passage from vibracularia to normal zoœcia.

In the main character of this species it resembles *Lunulites goldfussi*, Hag. [No. 2, p. 102, pl. xii. fig. 5], but that differs by the irregular distribution of the vibracularia.

Genus Biselenaria, nov. nom.

Syn. *Diplotaxis*, Reuss, 1867, *non* Kirby, 1837, Ueber Bry. deut. Unteroligocäns, Sitz. k. Ak. Wiss. Wien, Bd. lv. Abth. i. p. 231.

Diagnosis. A Membraniporid with a bilaminate zoarium, which is small and circular and discoid in form; typically the form is bun-shaped. The zoœcia of the upper layer have regular Membraniporidan apertures, with numerous normal vibracularia irregularly scattered, or one to each zoœcium. The zoœcia of the lower surface are much modified; the aperture is contracted by the great thickening of the peristome; in the zoœcia near the centre the aperture is sometimes completely closed or persists as a long narrow slit; the vibracularia are similarly modified; some of the peripheral zoœcia more nearly resemble those of the upper layer.

Type species. *Biselenaria placentula* (Reuss), op. cit.

Remarks on the Genus and its Affinities.—Reuss practically founded his genus *Diplotaxis* simply on the one character of its bilaminate zoarium; the species included in it are forms of much interest, and there seems to be no reason to question the validity of the genus, though it has been overlooked or merely mentioned by subsequent authors. Unfortunately, however, the name was preoccupied among Coleoptera by Kirby in 1837, and as it is still in use for that group the Bryozoan genus must be renamed. The nature of the zoœcia of the lower surface is somewhat puzzling; four explanations of their nature may be offered:—First: the zoarium may be fixed, probably in mud; in that case the peripheral zoœcia would be normal; but as they became more central by the growth of the colony they would gradually become aborted and their apertures closed; the distribution of the under zoœcia supports this view. Second: the zoarium may be free and the modified zoœcia of the lower surface may all be swimming vibracula instead of normal zoœcia; in that case the thickening of the peristome would be due to the necessity for greater muscular attachments. Third: the zoarium may be fixed by radical fibres or tubes given off from the modified zoœcia. And fourth: the zoarium may be free and the peculiar lower zoœcia may be gonœcia, as the thickened and contracted apertures resemble those of elements in other genera, such as *Teichopora*, which appear to be clearly gonœcia. So long as the genus remains known only by extinct species it may be impossible to decide between these views, but I am inclined to accept the first, though there are points that make for the second.

The genus differs from the rest of the group by its bilaminate nature and the structure of the inferior zoœcia. It is possible that it ought to be subdivided, one branch including the type species and all the rest of those in which there is a vibracularium to every zoœcium.

Species 1. Biselenaria offa [1], n. sp.

Diagnosis. Zoarium: a small circular disk, thickest in the middle and tapering towards the periphery.

Zoœcia irregular in form and distribution; a group of small ones occurs in the centre; the largest are in a circle at a little distance from the margin. The opesia are large and elliptical, surrounded by a thickened margin; some of the opesia are slightly trigonal. The vibracularia are very irregular in distribution; they resemble the normal zoœcia in general form, but the rim is thicker in proportion to their size.

The zoœcia of the lower side vary from being identical with those of the upper side to being quite closed; all intermediate forms occur, but a spathulate form with the aperture remaining as a slit or small pore is the commonest. Some of the vibracularia have the very typical auriculate appearance.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49759. Edwards Coll.

Figures. Pl. XXX. fig. 4. Zoarium of type specimen: upper surface. Fig. 4 *a*. Part of another specimen: under surface. Fig. 5. Upper surface of another zoarium.

[1] *Offa*, a bun.

Affinities. This species differs from the type species, *Biselenaria placentula* (Reuss), in several important respects; the most striking is that in the type there is a vibracularium to every zoœcium, situated just at the apex. This is practically the main character used in the separation of *Cupularia* and *Selenaria*; as in this case it is therefore generic, it might be thought that the two species ought to be separated into two genera, one including *B. placentula*, corresponding to *Cupularia*, and one including *B. offa*, corresponding to *Selenaria*. The two species, however, agree so closely that it would appear to be unnecessary to make a new genus upon this character alone. In merely specific points, the concavo-convex form of *B. placentula*, its more irregular opesia, and the larger size and smaller number of its inferior zoœcia all distinguish it from *B. offa*.

Family CRIBRILINIDÆ.

Genus Cribrilina, Gray, 1848.

Diagnosis. Hincks, No. 2, p. 184.

Species 1. Cribrilina vinei, n. sp.

Syn. *Membraniporella nitida,* Johnst. var. *eocena,* G. R. Vine, Notes on Brit. Eoc. Polyzoa, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pt. ii. pp. 161–2, pl. v. fig. 6.

Diagnosis. Zoarium encrusting.

Zoœcia large, quincuncially arranged; globose. Orifice large, orbicular; elongated transversely. Margin of the orifice raised, thin and plain.

The front walls of the zoœcia are traversed by 9 or 10 pairs of furrows; the upper 5 or 6 pairs of these are horizontal; the lowest 3 or 4 pairs in a radial fan. There are two or three pores in each furrow. The furrows do not reach the middle line of the front wall, and upon this there is a varying number of fairly large pores.

Avicularia large: a pair on each side of the orifice.

Oœcia large: very globose, often covering the lower part of the adjoining zoœcium. Perforated by numerous, fairly large pores.

Distribution. London Clay, Sheppey.

Type. Brit. Mus. No. Ḃ 4514. Vine Coll.

Figures. Pl. XXX. fig. 8. Part of the zoarium, × 55 diam.

Affinities. This species was regarded by Mr. Vine as only a variety of the recent *Membraniporella nitida*; he remarked the presence of a series of small pores in the furrows, and that Mr. Hincks did not mention them in his diagnosis of that species. But the existence of these pores is the generic character that separates *Cribrilina* from *Membraniporella*, and into the former genus this species must necessarily go. From the species to which Mr. Vine referred it, it differs also in the presence of the pores on the oœcia, in that the lower furrows are radial instead of them all being horizontal, and in other features. From the common and widely distributed *C. radiata* [Moll, No. 1, p. 63, pl. iv. fig. 17] this species differs by its larger orifice and by the furrows being more numerous and differently arranged. Among recent species it most closely resembles *C. philomela*, Busk [No. 8, pp. 132–3, pl. xvii. fig. 6, pl. xxii. fig. 7], to which it is allied by the large size of the orifice and the big globose oœcia; it differs, however, in the oœcia being plain in the recent species, and also in having more pores on the furrows and none in the middle line.

Probably the nearest ally to this species is *Cribrilina manzonii* [*Lepralia manzonii*, Reuss, No. 14, p. 171, pl. i. fig. 6], from Mödling, near Vienna, which agrees with it in the large size of the orifice and the arrangement of the furrows: Reuss does not figure any oœcia, and consequently this important character cannot be used for comparison; but the absence of the pair of large lateral avicularia and the greater number both of pores and furrows in *C. manzonii* are sufficient to distinguish the two.

The species belongs to *Cribrilina*, even restricted as narrowly as is done by Dr. Jullien [No. 3, 604].

Family MICROPORIDÆ.

Genus Micropora.

Diagnosis. Hincks, No. 8, pt. i. p. 161.

Species 1. Micropora cribriformis, n. sp.

Syn. *Membranipora holostoma*, Busk, var. *perforata*, G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. vol. xii. p. 60.

Diagnosis. Zoarium encrusting.

Zoœcia oval, sometimes tapering below. The lower part of the front wall is very tumid and rises above the raised margin. The aperture is small; the upper margin is regularly curved, the lower margin sinuous. The front wall is crowded with maculæ, which are very irregular in form and numbers. There is usually a pair of narrow slit-like opesiulæ situated at the extreme margin of the oœcia, just below the corners of the aperture.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. B 4583.

Figures. Pl. XXX. fig. 6. Part of zoarium. In one of the zoœcia the front wall has been broken away and shows the absence of internal partitions.

Affinities. This species is very clearly marked by the sinuous lower border of the aperture and the cribriform aspect of the whole front wall. Both characters, as well as the form of the zoœcia and other less important points, separate it from *M. holostoma* (Busk) [No. 6, p. 36, pl. iii. fig. 11], from the Crag.

Probably the most nearly allied species is *M. gracilis* (Münst.) [*Cellepora gracilis*, Münster, in Goldfuss, No. I, i. p. 102, pl. xxxvi. fig. 13], of which Reuss [No. II, p. 291, pl. xxix. fig. 13] has given a good figure; from this it is distinguished by the form of the orifice, the absence of a ridge on the lower side of the aperture, and the much greater coarseness of the maculæ. Waters [No. 12, p. 13] includes the Crosara species as a synonym of *M. coriacea* (Esper). The same characters separate it from *M. münsteri* (Reuss) [No. 6, p. 30, pl. x. fig. 2], which is very nearly allied to *M. gracilis*.

As in the new species some of the zoœcia and the opesiulæ are replaced by large pores, while in others these are no larger than some of the maculæ, it is evident that Mr. Hincks is fully justified in refusing to regard the presence of these opesiulæ as an essential character of the genus.

Genus Onychocella, Jullien, 1881.

Diagnosis. Microporidæ with large vicarious avicularia scattered over the zoœcia [Jullien, No. I, p. 277].

Species 1. Onychocella magnoaperta, n. sp.

Diagnosis. Zoarium encrusting, forming a large compact crust.

Zoœcia usually hexagonal, occasionally becoming rounded at the edges and oval where they are less crowded. Apertures slightly clithridiate, very large, occupying nearly the whole front of the cell; the aperture is restricted by a small lamina at the lower side of the zoœcium. The margins of the zoœcia are raised, plain, and non-crenulate.

Avicularia: large vicarious cells, long and tapering; irregularly scattered over the zoarium.

Distribution. Brockenhurst Beds (Mid. Headon), Brockenhurst.

Type. Brit. Mus. No. 49738. Edwards Coll.

Figures. Pl. XXX. fig. 7. Part of zoarium, $\times \frac{55}{\frac{3}{4}}$ diam., including one of the large tapering vicarious avicularia.

Remarks. The subdivision of the great genus *Membranipora* to which Jullien [No. I, p. 277] gave the name *Onychocella* appears to be based on more reliable characters than most of the genera which that author has proposed, and it seems to be now generally accepted [see Waters, No. 12, pp. 8, 9]. The nature of the avicularian cells of this new species shows that it belongs to this group. Its nearest ally is *O. angulosa* (Reuss) [No. I, p. 93, pl. xi. fig. 10], from which it differs in the much smaller size of the aperture in that species. If, as Waters suggests, *Rhagasostoma hexagonum*, Kosch. [No. I. p. 30, pl. v. figs. 5–7], is only a synonym of *O. angulosa*, it will be unnecessary to compare them further; but if, as appears probable, it is a distinct species, the structure of the aperture will clearly distinguish it from the Brockenhurst form.

O. magnoaperta is closely allied to some Upper Cretaceous species; of these *O. cyclostoma* (Goldf.) [*Eschara cyclostoma*, Goldfuss, 'Petrefacta Germaniæ,' Th. i. 1826, p. 23, pl. viii. fig. 9] appears to be about the nearest; the evidence for referring it to *Onychocella* is given by von Hagenow's figures [No. 2, p. 75, pl. ix. figs. 7, 8, pl. xii. fig. 3]; from this, which is biflustrine in habit, it may be distinguished by its clithridiate aperture; the avicularian cells agree in general character. From *O. koninckiana* (Hag.) *Cellepora* (*Discopora*) *koninckiana*, Hag. *ib.* p. 95, pl. xi. figs. 10, 11] it differs in the ovate shape of the avicularian cells, which in the Maastricht species are lanceolate. *O. santonensis*, D'Orb. [*Eschara santonensis*, D'Orbigny, No. 2, p. 109, pl. 673. fig. 4], agrees with it in the large size of the aperture and the shape of the avicularia; but the oœcia in that species are pyriform, the lamina larger, and the lower side of the mouth straight. *O. drya*, D'Orb. [*Eschara drya*, ib. p. 168, pl. 677. figs. 7–9], has also a large aperture, but this is much wider and not clithridiate; the zoœcia are also different in shape. D'Orbigny has figured amongst his Escharas a large series of species which must be referred to *Onychocella*, though many of them may be reduced to synonyms. rom most of them, such as *O. allica* (D'Orb.), *O. archosia* (D'Orb.), *O. charonia* (D'Orb.), *O. clito* (D'Orb.), and *O. cressida* (D'Orb.), the new species may be distinguished by its large aperture.

The occurrence of the genus *Onychocella* in Cretaceous rocks has been frequently pointed out; the British Museum Collection contains a specimen from the *Calcaire à polypiers* (Bathonian) of Ranville, that must be referred to this genus.

Suborder SCHIZOTHYRIATA.

Family SCHIZOPORELLIDÆ. (*Myriozoidæ* of Hincks.)

Genus Schizoporella, Hincks.

Diagnosis. See Hincks, No. 2, p. 237.

Species 1. Schizoporella magnoaperta, n. sp.

Diagnosis. *Zoarium*, a foliaceous expansion.

Zoœcia somewhat irregularly arranged, though with a tendency towards quincuncial. In shape they are pyriform, well rounded above, tapering below. The front wall is tumid, forming a raised triangular area. A raised lip around the orifice, which is oval; the sinus is median, small but distinct. The zoœcia are separated by a depressed flat margin, around which is a row of large deep areolæ.

Avicularia one on each zoœcium, beside and below the orifice; they have raised, elliptic borders.

Oœcia —— ?

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49733. Edwards Coll.

Figures. Pl. XXX. fig. 9. Part of a zoarium from London Clay, Sheppey; Brit. Mus. No. B 4514, $\times \frac{55}{\frac{2}{3}}$ diam.

Affinities. This species belongs to the group of which the common *Schizoporella unicornis*, Johnst., is a good representative; it agrees with the latter in its umbo, suborbicular mouth, and small sinus. From that species, however, it clearly differs in the much larger size of the aperture and the pyriform shape of the zoœcia in the new species, in which also the umbo is lower down, and there is one lateral avicularium instead of the pair usually present in *S. unicornis*; the areolæ are also limited to a single series. The large size of the aperture at once distinguishes this from most of the Continental Miocene and Lower Cainozoic species, such as *S. goniostoma* [*Cellepora goniostoma*, Reuss, No. 1, p. 87, pl. x. fig. 18; for better figures see Reuss, No. 14, p. 176, pl. ii. fig. 6, pl. iii. fig. 3] and *S. rugulosa* [Reuss, No. 14, p. 169, pl. iii. fig. 2]. *S. dunkeri* [Reuss, No. 1, p. 90, pl. x. fig. 27] agrees in some respects, *e. g.* the single lateral avicularium, the large mouth, and blunt umbo; it is probably the nearest ally of this species. Reuss's species may be distinguished by its higher umbo, marginal avicularia, and shorter and more rectangular zoœcia. Among recent species it agrees closely with *S. simplex* D'Orb. [*Eschara simplex*, D'Orbigny, No. 1, p. 13, pl. v. figs. 5–8], from which it differs in the pyriform shape of the zoœcia.

In the general form of the zoœcia this species agrees strikingly with *Microporella membranacea* (Reuss) [*Eschara membranacea*, Reuss, No. 6, p. 32, pl. v. fig. 6], from Oberburg; the possession of a sinus instead of a trypa, of course, distinguishes it from that species.

Species 2. Schizoporella magnoincisa, n. sp.

Diagnosis. Zoarium foliaceous.

Zoœcia narrow and elongated; peristome raised and almost subtubular. Aperture large and with a very large sinus; the angles of the peristome above the sinus vary considerably in prominence, but never meet. One line of areolæ. Front wall smooth and evenly convex.

Avicularia: one on each zoœcium, just below the aperture; lateral in position; mandible pointing upwards to the angle between the aperture and sinus.

Oœcia (none ?).

Distribution. London Clay, Copenhagen Fields.

Type. Brit. Mus. No. B 4515. Fragment enclosed in a septarian nodule.

Figure. Pl. XXX. fig. 10, × 30 diam.

Affinities. The large size of the sinus of this species would necessitate its inclusion in *Gemellipora* if that genus of Smitt's [No. 3, p. 35] be accepted. Its nearest ally appears to be *Schizoporella gonversi* (Reuss) [No. 14, p. 159, pl. vii. fig. 7], from Rauchstallbrunn, but in that species the zoœcia are shorter and broader, the areolæ, fewer, and there is a pair of avicularia above the aperture.

The large size of the sinus allies this species to *Schizoporella beyrichi*, Stol., but it differs in that the zoœcia are elongate and rectangular instead of hexagonal, they are not quincuncially arranged, and the zoarium is not Cellarian (*Cellaria beyrichi*, Stoliczka, No. 1, p. 83, pl. i. fig. 10).

Schizoporella insignis, Hincks [No. 4, pt. 5, p. 134, pl. v. fig. 10], differs in the quincuncial arrangement of the zoœcia, the central umbo, and the raised line at a little distance from the margins of the zoœcia. The shape of the zoœcia and the absence of the tubercles above the aperture distinguish this new species from *S. pauper* (Reuss) [*Lepralia pauper*, Reuss, No. 14, p. 164, pl. v. fig. 4], which has a large sinus. The last two species with which it is necessary to compare this are *S. variabilis* (Reuss) [*Hemeschara variabilis*, Reuss, No. 12, p. 508, pl. i. figs. 1–5] and *S. unicornis* (Johnst.) [*Lepralia unicornis*, Johnston, No. 2, p. 320], which both belong to the same group. From the former the London Clay species is mainly to be distinguished by the size of the sinus. The latter differs by its umbo, the absence of maculæ, and the smaller aperture; the zoœcia, however, agree in general form.

IV. *a. The Systematic Position of the* Adeonellidæ.

The genus *Adeona* was established by Lamouroux [No. 1, pp. 478–482, pl. xix. fig. 2] in 1816 for some Bryozoa with short jointed stems and reticulate zoaria; he took an Australian species, *A. grisea*, as his type: this species has also been made by Macgillivray the type of a genus *Dictyopora*, which is therefore necessarily a synonym. Enlarged figures of the zoœcia have been given by Kirchenpauer [No. 1, pl. i. fig. 8, pl. ii. fig. 10] and Macgillivray [No. 1, pl. 66], and these show that it possesses a trypa or zoœcial pore and a simple holostomatous orifice, and must therefore be referred to the Microporellidæ. But this genus and its allies have long given much trouble to systematists and the classification is still unsettled. Busk's 'Challenger' Report must certainly be held responsible for much of the confusion, as he there founded a genus *Adeonella* based wholly on zoarial characters; in consequence he included in it a miscellaneous series of species that must be divided among the several genera. Thus his *Adeonella distoma* has a trypa and is one of the Microporellidæ, while others, such as *A. polymorpha*, have no such pore and must belong to a different genus and family.

The subject has been attacked by Messrs. Hincks, Waters, and Macgillivray, and each of these has advocated very different conclusions. Mr. Hincks [No. 8, pt. i. pp. 150–158, especially 155 & 157] has discussed the matter at length with the following results: he maintains (1) that as *Adeonella* is based only on zoarial characters it is not distinct from *Adeona*; (2) the latter genus he places among the Microporellidæ, distinguished from *Microporella* by the substitution of gonœcia for external oœcia; (3) as he regards *Adeonellopsis* as based only on the possession of a peristomial pore he declines to accept it.

Mr. Waters's conclusions [No. 6, p. 294, and No. 10, pp. 3, 32, 33] are very different; he abandons *Adeona* as a synonym of *Microporella*, and speaks of the type species as *Microporella grisea*, form *Adeona*; in his last essay he accepts *Adeonella* for forms without a trypa but with a peristomial pore, the latter a character of very doubtful value.

Mr. Macgillivray's conclusions [No. 2, pt. ix. p. 134] seem to me more, though not entirely, satisfactory. He accepts *Adeonella* in much the same sense as Mr. Waters; but he fully grasps the significance of the absence of the trypa and removes the genus to the *Mucronellineæ* (or Smittidæ). He agrees with Mr. Hincks and differs from Mr. Waters in separating *Adeona* from *Microporella* owing to the absence of external oœcia in the former; finally, he founds the genus *Adeonellopsis* for forms resembling *Adeonella*, but without a peristomial pore.

Before proceeding to discuss these views I must again express my thanks to my colleague Mr. Kirkpatrick for allowing me constant access to the recent species, and especially to Busk's type specimens, and also for the opportunity of frequent discussion of all the points involved.

The first point to be decided is what are the true affinities of *Adeonella*. The first species described by Busk was *A. polymorpha*, and this he seems to have regarded as his type; Mr. Waters certainly includes it in the genus as restricted by him. Mr. Hincks [No. 4, pt. xiii. pp. 294–296] has quoted Busk's remark [No. 8, p. 183] that "as regards the general zoœcial characters there is no difference whatever between *Adeona* and *Adeonella*." This remark seems to me quite inexplicable. *Adeonella polymorpha* has no trypa, which seems to be generally regarded as implying a difference in family. *A. polymorpha* is therefore not one of the Microporellidæ at all, and cannot be synonynous with *Adeona*, which has a trypa *. Macgillivray has clearly recognized this, and has removed *Adeonella* to his Escharidæ. But this seems to me to be going rather too far; in *Adeonella polymorpha* and all the species which seem to be congeneric with it, the primary orifice is always schizostomatous, and therefore the genus cannot enter the holostomatous group: its true affinities appear to me to belong to the Schizothyriata allied to the Schizoporellidæ; the secondary orifice appears to distinguish it from both the Schizoporellidæ and the Microporellidæ; the presence of gonœcia instead of external oœcia still further separates it from the Schizoporellidæ, but allies it to its old associates of the *Adeoninæ*. Its true position therefore appears to be as a distinct family intermediate between the Schizoporellidæ and the Microporellidæ, with one link attaching it to each.

* Macgillivray's figures of *Adeona* (*Dictyopora*) *cellulosa* show an occasional absence of the trypa [Macgillivray, No. 1, dec. v. pl. 47. fig. 1 *a*, *b*]. A dissection of a specimen with the same feature shows that it is due simply to the trypa being overgrown and concealed by the avicularium.

In regard to *Adeonellopsis*, it seems to me absolutely necessary to accept that or Busk's [No. 8, p. 178] *Reptadeonella*, as it is going rather far to place such a species as "*Lepralia*" *violacea*, Johnst., in *Adeona* or *Microporella*. *Reptadeonella* is prior by two years, but it was based only on zoarial characters and was never properly diagnosed, and I therefore prefer to accept Macgillivray's better defined genus [No. 2, pt. ix. p. 134, and No. 3, p. 210].

Reuss has described another species which it is necessary to consider in connection with the Microporellidæ, as it possesses both a trypa and an oral sinus. The species which shows this feature is of such interest in connection with the evolution of this group that it is advisable here to diagnose the new genus necessary for its reception.

SCHISMOPORELLA[1], n. g.

Diagnosis. *Zoarium* lepralian or escharine.

Zoœcia elongate, oblong (in known species). Aperture orbicular, with a large sinus. The front wall has a zoœcial pore.

Oœcia external, globose.

Type species. *Schismoporella schizogaster* (Reuss)[2], 1847, Helvetian, Austria.

This genus may at first throw doubt upon the assumed homology of the sinus and trypa, the latter being regarded as the more specialized. The occurrence of *Schismoporella* may, however, be explained by a repeated formation of a sinus after the zoœcial pore has travelled well away from the peristome: or else the division of the trypa into two or more pores has very frequently taken place, and there seems no improbability in one of these parts persisting as a sinus. If neither of these explanations is correct, then *Schismoporella* is probably a primitive form uniting characters now divided between two families.

The following synopsis summarizes the classification of this group that is here proposed:—

- *Schizothyriata.*
  - *Schizoporellidæ*: schizostomatous. External oœcia.
  - *Adeonellidæ*: primary aperture schizostomatous. Gonœcia.
    - *Adeoninæ*: with gonœcia.
      - Zoarium fenestrate, &c. *Adeona.*
      - ,, foliaceous or encrusting. *Adeonellopsis.*
  - *Microporellidæ*: trypa present.
    - *Microporellineæ*: external marsupia. = *Microporella, Tessarodoma*, &c.
    - *Schismoporellinæ*: with trypa and sinus. = *Schismoporella.*

[1] From σχίσμα, a slit, and πόρος, a pore.

[2] *Cellepora schizogaster*, Reuss, 1847, No. 1, p. 84, pl. x. fig. 9; *Mollia schizogaster*, D'Orbigny, No. 2, p. 388; *Lepralia schizogaster*, Reuss, No. 14, p. 161, pl. iii. fig. 10.

It may be objected that the genera of the *Adeoninæ* are based on zoarial characters; but these are of such a marked description, and lead to such modifications and dimorphism of some of the zoœcia, that they seem certainly of generic value. In regard to *Adeona* and *Adeonellopsis* there is the further difference of the presence of a peristomial pore in the latter.

It seems also advisable to rediagnose *Adeonella* in accordance with this scheme, and consider what species should be included in it. But at present the diagnosis of the genus is the same as that of the family, as I am at present aware of only the one genus; the diagnosis is therefore: "Schizothyriata with a schizostomatous primary aperture and a secondary orifice variable in form. Gonœcia present, but no external marsupia." Before giving a list of the species I had better refer to the question of the value of the peristomial pore, as if Busk [No. 8, p. 167] and Ridley [No. 1, p. 47, pl. vi. fig. 6] are right in considering it of generic importance, then *Adeonella* must be subdivided. Since Mr. Kirkpatrick [No. 1, pp. 77, 78, pl. viii. fig. 5] has shown that this structure in "*Gigantopora*" *lyncoides*, Ridley [No. 1, p. 47, pl. vi. fig. 6], is only formed by the avicularia, little value has been attached to it. Messrs. Hincks [No. 6, pp. 268, 269] and Waters [No. 9, p. 192] also dismiss it as valueless, as the bridge is not always present in different zoœcia of the same zoarium of *Schizoporella biturrita*, Hincks (or *S. tuberosa*, Reuss).

List of Species of Adeonella.

Type. *Adeonella polymorpha*, Busk, No. 8, p. 183, pl.
Adeonella, cfr. *polymorpha*, Gioli, No. 1, pp. 261, 262, pl. xiv. fig. 8.
—— *platalea*, Busk, No. 8, p. 184.
—— *intricaria*, Busk, No. 8, p. 185.
—— *regularis*, Busk, No. 8, p. 186.
—— *atlantica*, Busk, No. 8, p. 186.
—— *pectinata*, Busk, No. 8, p. 189.
(This species has a large lyrula within the secondary orifice and hiding the primary aperture. Busk has not figured the operculum, but its shape shows that the primary aperture is schizostomatous. It ought, perhaps, to be separated as a subgenus.)
—— *polystomella* (Reuss), No. 1, p. 70, pl. viii. figs. 27, 28.
—— *pallasi* (Heller), No. 1, p. 115, pl. iii. figs. 1, 2 ? = *A. polystomella*.
—— *dispar* (Macgill.). For references *see* Jelly, No. 1, p. 259 (agrees with *Adeonella*, but has a sinus also in the secondary orifice).
—— *sulcata* (M.-Edw.), *Eschara sulcata*, M.-Edwards, No. 1, pp. 47–49, pl. v. fig. 2, non *Flustra sulcata*, Lamouroux, No. 3, p. 609, pl. 92. figs. 3, 4.
—— *fuegensis* (Busk), No. 3, p. 90.

List of Species that have been referred to Adeonella.

Adeonella distoma (Busk), No. 5, p. 127, pl. xviii. fig. 1 = *Adeonellopsis distoma.*
—— ——, var. *imperforata* (Busk), No. 8, p. 188 = *Adeonellopsis.*

(This form has a trypa, but it is covered over by the avicularian cell; by the kindness of Mr. Kirkpatrick I have been enabled to dissect off an avicularium, and thus demonstrate the presence of a trypa. The form is probably entitled to specific distinction, and I therefore record it as *Adeonellopsis imperforata.*)

Eschara pulchra, Stoliczka, No. 2, pp. 87, 88, pl. ii. fig. 10 = *Adeonellopsis.*
—— *coscinophora*, Reuss, No. 1, p. 67. = „
—— *mucronata* (Macgill.), No. 1, dec. v. p. 43. = „ (? *coscinophora*, Reuss).
Cellepora heckeli, Reuss, No. 1, p. 85. = „ *heckeli* (Reuss).
Lepralia violacea, Johnston, No. 2, p. 325. = „ (? *heckeli*, Reuss).
Eschara lichenoides, Lamk., No. 1, p. 176. = „
Microporella fissa, Hincks, No. 4, pt. ii. p. 381. = „
Adeonella japonica, Ortmann, No. 1, p. 54. = „
—— *sparassis*, Ortmann, No. 1, p. 54. = „
—— *tuberculata*, Ortmann, No. 1, pp. 53, 54. = „
{Ortmann does not figure the opercula, and the reference may be incorrect.}
Porina subsulcata, Smitt, No. 3, p. 29, pl. vi. figs. 136–140. = „
Eschara syringopora, Reuss, No. 1, p. 68, pl. viii. fig. 23. ? = *Teichopora.*
—— *ornatissima*, Stoliczka, No. 1, pl. ii. fig. 7. Probably a *Schismopora* with a peristomial pore.
—— *ciliata*, Pallas, Elenchus, p. 38. = *Microporella.*
Flustra sulcata, Lamx., No. 3, p. 609, pl. 92. figs. 3, 4. = ?
Cellepora imbricata, Lonsdale, No. 1, pp. 507, 508. = *Adeonellopsis.*

Family MICROPORELLIDÆ.

Subfamily Adeoninæ.

Genus Adeonellopsis, Macgillivray.

Species 1. Adeonellopsis wetherelli, n. sp.

Syn. *Flustra*, sp., Wetherell, 1837, Trans. Geol. Soc. (2) iv. pl. ix. fig. 22.
Microporella violacea, var. *fissa*, var. *b*, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 162, pl. v. fig. 7 *b*.
Microporella violacea, var. *fissa*, var. *a*, Vine, 1891, ibid. xii. p. 61.

Diagnosis. Zoarium erect: branching dichotomous; bilaminar and either flat or cylindrical branches.

Zoœcia tumid: usually pyriform; irregular in form; elongate and ovate or subhexagonal. Lower zoœcia immersed. The orifice is at the summit of a large raised head, the peristome being somewhat tubular; the orifice is oval, lunate, or semicircular in shape. The front wall contains an elongate, depressed areola, the floor of which is cribriform, being perforated by from 4 to 8 pores. A line of punctures runs around the margin of the zoœcia.

Avicularia large, pointing obliquely upwards: situated close below the peristome.

Gonœcia sparsely scattered, low; aperture smaller than in the normal zoœcia.

Distribution.[1] London Clay: Fareham (abundant); Highgate; Haverstock Hill; Sydenham; White Conduit House.

Figures. Pl. XXX. fig. 12. Part of a zoarium from the London Clay, Haverstock Hill, × 3 diam. Fig. 12 *b*. Several zoœcia from the upper part of the same specimen. Fig. 12 *c*. Zoœcia from lower in the same specimen. Fig. 13. Zoœcia from base of another specimen.—Pl. XXXI. fig. 1. Another specimen.

Type. Brit. Mus. No. 49756, Edwards Coll.; Highgate. Wetherell's figured specimen is B. M. No. B 4443.

Affinities. Wetherell found a minute fragment of this species in a well at Hampstead, and gave a good but small figure of it; this, however, seems to have escaped subsequent notice. Mr. Vine first described the species, and he regarded it as a variety of the well-known recent species *Adeonellopsis* (*Reptadeonella*, *Microporella*, &c.) *violacea* (Johnst.); from this, however, it differs very markedly in the nature of the avicularia, the cribriform area, the subtubular peristome, &c. The species to which it is most closely allied is *Adeonellopsis distoma* (Busk); from this the main difference is in the avicularian orifice, which is much smaller in proportion to the size of the peristomial orifice, and it is placed below the latter and not included within the rim, which includes both the avicularium and orifice. In the London Clay species the avicularia are always directed very obliquely upwards.

Busk has suggested that Reuss's *Eschara coscinophora* is synonymous with *A. distoma*; but agreeing with Mr. Waters [No. 6, p. 283, and No. 13, p. 162], who records the latter from the Italian Upper Eocenes, I prefer to keep them distinct. The London Clay species agree more with *A. distoma* than *A. coscinophora*. The specimens of the latter which agree most with our species are those from the Middle Oligocene of Söllingen in Prussia, figured by Reuss [No. 7, p. 186, pl. xi. figs. 1–4]: his figure 1 allows of a careful comparison of equivalent zoœcia. The differences between the species are that in *A. wetherelli* the avicularia are oblique or transverse and much larger, the cribriform plate is larger and has more regular pores, and the secondary aperture is more raised.

[1] There seems some confusion as to the localities and horizons of Mr. Vine's types of this species and the next; the specimen figured as var. *b* (*i. e.* fig. 7 *b*) is recorded as from the Bracklesham Beds of the Isle of Wight; the slide is, however, correctly labelled from the London Clay.

Species 2. ADEONELLOPSIS INCISA, n. sp.

Syn. *Microporella violacea,* var. *fissa,* var. *a,* Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 162, pl. v. figs. 7, 7 *a*.

Diagnosis. Zoarium erect, bilaminar, and forming thick, short, subcylindrical shoots.

Zoœcia elongate, lanceolate, quincuncially arranged. The orifice is oval or suborbicular; it opens on the sloping upper surface of the high tumid head, which also bears a large peristomial pore. A pair of large avicularia occur immediately below the orifice. The zoœcia are sharply defined by lines of depression marked by rows of areolæ. The trypa is a median narrow slit.

Gonœcia ——.

Distribution. London Clay: Haverstock Hill (? Bracklesham Beds, *fide* Vine).

Type. Brit. Mus. No. 49661.

Figure. Pl. XXX. fig. 11. Part of Mr. Vine's type.

Affinities. This species in its slit-like trypa closely resembles *Adeonellopsis perforata* (Reuss) [*Eschara perforata,* Reuss, No. 11, p. 231, pl. xxxiii. fig. 5], but the latter has no peristomial pore. It differs from *A. wetherelli,* Greg., by the pair of avicularia forming a peristomial pore, instead of having one median avicularium; the trypa is also different. The specimen figured by Reuss [No. 7, pl. xi. fig. 6] as *Eschara diplo stoma,* Phil., also belongs to this genus, but differs in the form of the trypa and of the orifice. The two other forms (figs. 5 and 7) associated with it by Reuss seem different, and that represented in fig. 7 is probably a second species of *Schismoporella.*

Suborder HOLOTHYRIATA.

Family LEPRALIIDÆ.

Subfamily LEPRALIINÆ.

Genus LEPRALIA, Hincks, 1880 (non Johnst. &c.).

Diagnosis. Hincks, No. 2, p. 297.

Species 1. LEPRALIA LONSDALEI.

Syn. *Eschara brongniarti,* pars, Lonsdale (non M.-Edw.), 1850, Dixon, Geol. Suss. pp. 161, 162, pl. i. fig. 9*.

Diagnosis. Zoarium thick, encrusting.

Zoœcia small, ovate; very irregularly distributed. Form irregular, varying from somewhat elongate to short and round. Aperture lepralian, very large: lower margin straight or curved outwards; the lateral constriction is, however, very slight. Surface granular. Zoœcia separated by deep depressions. A line of areolæ around the margin; these vary with the size of the zoœcia from 10 to 15 or 18.

Avicularia: usually one; lateral, placed close beside the orifice.

Distribution. Bracklesham Beds, Bracklesham Bay.

Type. Brit. Mus. No. 49734. Edwards Coll. (Encrusting.)

Figure. Pl. XXXI. fig. 2. × 55 diam.

Affinities. The shape of the orifice shows that this species is a true *Lepralia*, using that term, of course, in its modern restricted sense. It was figured by Lonsdale as *Eschara brongniarti*, a mistake due to his having failed to separate it from the Bryozoan on which it is encrusting. A comparison of his figure 9* with his figure 9 shows that he has included two different forms under one name.

Among the species of *Lepralia* it most resembles *Lepralia angiostoma*, Reuss [No. 11, pp. 291, 292, pl. xxx. fig. 3], but it may be distinguished by the smallness of the orifice in the Austrian species.

Genus Umbonula, Hincks.

Diagnosis. Hincks, No. 2, pp. 316 and cxxxviii.

Species 1. Umbonula bartonense, n. sp.

Diagnosis. Zoarium adnate, encrusting; forming a large and fairly thick crust over shells.

Zoœcia very crowded: quincuncially arranged; small, pyriform. Peristomial aperture semicircular or slightly clithridiate; lower margin straight; very large, sometimes occupying more than half the front of the zoœcium. The front wall is occupied by a large umbo, formed on an avicularian cell, the opening of which is just below the aperture and is hidden by the prominence of the umbo. Around the margin of the zoœcium runs a line of areolæ; those of the lower half are large, and from them furrows run some way up towards the umbo; the areolæ are small around the aperture.

Avicularia and external marsupia none.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49741.

Figure. Pl. XXXI. fig. 4. Portion of zoarium, × 55. diam.

Gottardi's *Eschara prominens* [No. 1, pp. 306, 307, pl. xiv. fig. 4] probably belongs to this genus, but the species is so diagrammatically figured that I cannot be quite sure. The genus is a convenient one, though, as Mr. Waters has pointed out, it is a very close ally of *Lepralia*, and perhaps ought not to be separated from it. The aperture in this species is typically lepralian.

Species 2. UMBONULA CALCARIFORMIS[1], n. sp.

Diagnosis. Zoarium, a thick encrusting mass.

Zoœcia roughly hexagonal in shape: short and thick. The front wall granular. The aperture is suborbicular, somewhat irregular on the lower margin from the ingrowth of the avicularia. The front wall is very tumid, and bears a large avicularian cell, this is attached to the front wall and continues over it as a pair of sharp pointed processes. The pore of the avicularium is raised and close beside the zoœcial aperture. The avicularium is always lateral and oblique.

Oœcia globose, low, and comparatively small.

Distribution. London Clay, Fareham.

Type. Brit. Mus. No. B 3831. (Growing on *Hornera.*)

Figure. Pl. XXXI. fig. 3. × 55 diam.

Affinities. The shape of the aperture, the tumid front wall, and the umbonate avicularium all agree with the genus *Umbonula.* Amongst the other species it probably is most nearly allied to *U. bartonense*, Greg., but from this it may be distinguished by its suborbicular aperture, the lateral position of the avicularia, and the pores of these being terminal instead of in the angle overhung by the umbo.

Subfamily TEICHOPORINÆ.

Genus TEICHOPORA[2], n. g.

Diagnosis. Zoarium foliaceous or encrusting: in large flat surfaces.

Zoœcia pyriform, much expanded above; elongate. Aperture large, holostomatous, orbicular; surrounded by a raised ring. Usually long sinuous lines of marginal areolæ continuous across successive zoœcia.

Gonœcia with the aperture contracted either marginally or by a bar or a central spot.

Species 1. TEICHOPORA CLAVATA.

Diagnosis. Zoarium in large foliaceous expansions.

Zoœcia clavate, the lower part being much restricted in width. Orifice very large; the surrounding ring is continuous with the ridge on the front wall of the zoœcia. Punctures large and numerous.

Avicularia: usually one, just below the orifice; lateral.

[1] From the spur-shape of the avicularian cell.

[2] From τεῖχος, the wall of a fortress.

Gonœcia irregularly scattered. Orifice much restricted, either at the margin or by the central calcareous plate, the knob of which has a small central pit.

Distribution. Barton Beds, Barton.

Type. Brit. Mus. No. 49733. Edwards Coll.

Figures. Pl. XXXI. fig. 5. Part of zoarium of the type. Fig. 6. Basal zoœcia. Fig. 7. Part of a large specimen (B. M. No. 49757) showing gonœcia.

Remarks on the Genus. This is a Lepralidan with a simple orbicular aperture and thickened peristome, and gonœcia instead of external marsupia. The last character as well as the form of the aperture distinguish it from *Lepralia*; the absence of a secondary orifice separates it from the Smittidæ.

Affinities of the Species. The nearest ally of *T. clavata* is a specimen from the German Oligocene, described by Stoliczka [No. 1, p. 87, pl. ii. fig. 8] as *Eschara crenatula,* from which it differs by its plain margin. *Eschara semitubulosa* (Reuss) [No. 11, p. 272, pl. xxxiii. fig. 3] probably also belongs to *Teichopora,* though in the absence of knowledge as to the oœcial characters one cannot be quite sure: the greater length of the zoœcia and the more uniform width of the Austrian species clearly distinguish it. Mr. Waters has suggested that *E. semitubulosa* is a synonym of Reuss's earlier species, *E. syringopora* [No. 1, p. 68, pl. viii. fig. 23, and No. 11, p. 269, pl. xxxii. fig. 1]; but in the latter the orifice is smaller, the zoœcia expanded below, and the front wall has a long furrow instead of being tumid and solid. Mr. Waters's own figures [No. 12, p. 20, pl. iii. figs. 2–4] more resemble the English species, though the different nature of the closure, the general form of the zoœcia, and the proportions of the orifice show them to be distinct.

Amongst other species that will probably prove to belong to this species are *Eschara stipitata* (Reuss, MS. Manzoni) [No. 3, p. 60, pl. xii. fig. 3], and *Eschara sulcimargo,* Reuss [No. 1, p. 58, pl. v. fig. 18].

Genus Meniscopora[1], n. g.

Diagnosis. A genus of Lepraliidæ with a simple primary orifice, usually biconvex in shape, with the lower margin a much flatter curve than the upper. Gonœcia and no external marsupia.

Affinities. This genus differs from *Teichopora* by the shape of the orifice and the form of the zoœcia. From most other Lepraliidæ it differs by the presence of gonœcia; when this cannot be determined, it may be distinguished from *Lepralia* (sensu stricto) by the form of the aperture, and from *Umbonula* by the absence of the umbo: these are the two genera which it most resembles in general aspect.

[1] From μηνίσκος, a lune, referring to the shape of the orifice.

Species 1. MENISCOPORA BIGIBBERA[1].

Syn. *Eschara brongniarti,* Lonsdale, 1850 (non M.-Edw.), in Dixon, Geol. Suss. pp. 161, 162, pl. i. fig. 9.

Diagnosis. Zoarium erect, bilaminar; forming large flat foliaceous expansions.

Zoœcia regularly quincuncial in arrangement. Surface plain. Shape pyriform. Aperture large, semicircular, but with the lower margin somewhat curved outward. The main part of the front wall is a raised triangular area; at the upper part are two prominent humps. The zoœcia are separated by depressed furrows; a line of large round punctures occurs along the margin.

Avicularia: one large marginal pair beside the lower corners of the aperture; mandible pointing outwards.

Distribution. Bracklesham Beds, Huntingbridge.

Type. Brit. Mus. No. 49732. Edwards Coll.

Figures. Pl. XXXI. fig. 8. Part of the type from Huntingbridge. Fig. 9. Fragment with gonœcium.

Affinities of the Species. As this species was identified by Lonsdale with M.-Edwards's *Eschara brongniarti* it is necessary to compare the two: the fact that the English species has the aperture wider than long, has two humps and a raised triangular area of front wall, is quite sufficient to distinguish them. M.-Edwards's figure [No. 2, p. 335, pl. xi. fig. 9] leaves the generic position of his species quite uncertain; but even should it prove to be a *Meniscopora,* which is not probable, there need be no confusion between the species.

This species has a certain resemblance in general aspect to the *Eschara fenestrata,* Reuss [No. 11, p. 290, pl. xxxii. fig. 5], which Waters [No. 12, pp. 18, 19] regards as a synonym of *Lepralia bisulca* (Reuss) [No. 11, pp. 270, 271, pl. xxxii. fig. 10]; but the latter has external oœcia.

Family CELLEPORIDÆ.

Genus CONESCHARELLINA, D'Orbigny, 1851.

[D'Orbigny, No 2, pp. 446, 447.]

Syn. *Batopora,* Reuss; *Fedora,* Jullien.

Diagnosis. A genus of Celleporidæ with a small, conical, hemispherical, or spherical free zoarium; uni- or multi-laminate. The zoœcia are holostomatous; the aperture is usually on the highest part of the front wall, and is generally orbicular or clithridiate. Oœcia large and globose; comparatively rare.

Distribution. Recent. S. Atlantic, Australia.—*Fossil.* Eocene: England. Oligocene: Germany, Austria, Italy. Miocene: Austria.

[1] *I. e.* two-humped, referring to the prominences on the front wall.

Species 1. CONESCHARELLINA CLITHRIDIATA, n. sp.

Syn. *Cellepora*, sp., Wetherell, 1837, Trans. Geol. Soc. ser. 2, vol. v. pl. ix. fig. 21; Busk, 1866, Geol. Mag. vol. iii. p. 301.

Cellepora sp. (*pumicosa*?), Vine, 1890, Proc. Yorks. Geol. & Polyt. Soc. xi. p. 164.

Diagnosis. *Zoarium* a small, thick, globular mass; base contracted (? attached).

Zoœcia few in number and irregularly distributed and not arranged around a central cell. The apertures of the zoœcia are clithridiate in shape; they are large and terminal. The zoœcia are tumid and generally hexagonal in outline; the front walls are granular and steep; the zoœcia are separated by deep depressions.

Oœcia very large in proportion to the size of the zoœcia; globose, tumid, overhanging the aperture. Only rare zoaria show them, but then they are numerous.

Distribution. London Clay: Highgate, Sydenham, &c.

Type. Brit. Mus. No. B 1357 (Wetherell's specimen, No. 69554).

Dimensions. The largest zoarium is 1 mm. in diameter.

Figures. Pl. XXXI. fig. 10. A zoarium from the London Clay, Hampstead; Brit. Mus. No. 69554.—Fig. 11. A zoarium from Sydenham with oœcia.

Affinities. A charming little figure of a specimen of this species has been given by Wetherell. The species, however, was not named and it has been missed by all subsequent workers. His specimen is in the British Museum collection, along with a great number from the London Clay at Sydenham. This species belongs to the group of which *Cellepora globularis*, Bronn [No. 2, p. 654], was the first described species; as Reuss [No. 9, pp. 113, 114] has, however, pointed out, several distinct forms have come in time to be included under this name. The specimen recently figured by Gioli [No. 1, pp. 263, 264, pl. xiv. fig. 9] appears to be quite distinct. Pergens's short synonymy [No. 4, p. xvi] shows much discrimination.

The nearest ally of this species, *C. scrobiculata* (Koschinsky) [No. 1, p. 63, pl. vi. figs. 2, 3], has a hemispherical or conical zoarium, the base being expanded instead of contracted as in all the English specimens; the aperture in the Bavarian species is also circular and surrounded by a rim. The new species differs from *C. multiradiata*, Reuss [No. 11, p. 265, pl. xxxi. figs. 1–4, and Waters, No. 12, pp. 32, 33], as in that the zoœcia are barrel-shaped, the apertures flush with the surface of the zoarium, and it is composed of several layers; the oœcia also are much larger. From the Miocene *Conescharellina rosula* (Reuss) [No. 1, p. 78, pl. ix. fig. 17, and Manzoni, No. 3, p. 54, pl. ii. fig. 6] the London species differs in its clithridiate aperture and the less elevated zoœcia. The same characters also separate it from *C. stoliczkai* (Reuss) [No. 10, pp. 223–226, pl. ii. figs. 2–4].

In agreement with the zoologists I accept the name *Conescharellina* in preference to Reuss's *Batopora*, which has been adopted by most palæontologists. There seems little room for doubt as to the identity of the two. D'Orbigny's genus was diagnosed exceptionally well for D'Orbigny, and its claims cannot be so quietly set aside as Reuss has done in the two lines in which he refers to it. *Batopora* is the better name, but that is of course a mere matter of detail.

Genus Orbitulipora, Stoliczka, 1862.

[Stoliczka, No. 1, p. 90.]

Type species. *O. haidingeri*, Stol. op. cit. p. 91, pl. iii. fig. 5.

Diagnosis. A Celleporidan with a bilaminar zoarium composed of a flat round disk supported laterally by a short stem. The zoœcia of the disk are usually arranged around a small central zoœcium. The zoœcia are holostomatous, with a large and typically orbicular aperture. The oœcia are narrow, but globose and elevated. Small avicularia and vibracula may or may not occur.

Species 1. Orbitulipora petiolus (Lonsdale), 1850.

Syn. *Cellepora ? petiolus*, Lonsdale, 1850, Dixon, Geol. Suss. p. 151, pl. i. fig. 10; Morris, 1854, Cat. Brit. Foss. ed. 2, p. 120; Mourlon, 1881, Geol. Belg. pp. 180, 191, 202; Vine, 1890, Proc. Yorks. Geol. & Polyt. Soc. xi. pp. 163, 164, pl. v. fig. 10; Reuss, 1867, Sitzb. k. Ak. Wiss. Wien, Bd. lv. Abth. 1, p. 217.

Diagnosis. Zoarium: disks rather large for this genus; thick at the margins and depressed in the centre. The stem is short and, so far as known, unjointed; when broken away it leaves a large round scar.

Zoœcia numerous; usually in fairly regular radial rows; the apertures are orbicular in the centre, but become elliptical at the margin; those adjoining oœcia have the margin nearest incurved owing to the overgrowth of the oœcium. Separated by interspaces which are often marked by punctures.

Oœcia very irregularly distributed; sometimes absent from the whole of one surface of a disk, at others there are a few irregularly scattered, at others nearly every zoœcium has one. They are globose, but narrow.

Distribution. Bracklesham Beds: Bracklesham, Bramshaw, Brook, Whitecliff Bay (common).—*Foreign.* Belgium: Bruxellien, Laekenien, Wemmelien, and Tongrien.

Type. Brit. Mus.

Figures. Pl. XXXI. fig. 12. Zoarium, ×4 diam. Fig. 12 *a*. Part of the same, ×18 diam., to show the oœcia. Fig. 13. Another specimen, to show the stem. Fig. 14. A young specimen in the Conescharellidan stage.

Affinities of the Species. This species differs from *O. haidingeri* mainly by the fact that the peripheral zoœcia open upwards instead of outwards, a point well seen in a comparison of Stoliczka's and Lonsdale's figures. *O. haidingeri* is the nearest ally of the English species; if the two species should prove to be identical, Lonsdale's name will have the prior claim to adoption.

Affinities of the Genus. The British Museum contains a large number of specimens of this species, and these well show its range. One of the smallest specimens, having a zoarium barely 1 mm. in diameter, is of interest as showing that this genus passes through a *Conescharellina* (or *Batopora*) stage; the small central zoœcium is surrounded by an irregular series of others having the tumid forms, granular walls, and terminal apertures of that genus. This therefore shows that *Conescharellina*, and especially such a species as *C. clithridiata*, is a more primitive form than *Orbitulipora* with its remarkably specialized zoarium.

The species is also clearly distinct from *O. lenticularis*, Reuss [No. 11, p. 289, pl. xxx. figs. 12–14], as to the generic position of which I do not feel able to express an opinion from Reuss's figures.

Family SMITTIDÆ.

Genus Mucronella, Hincks, 1880.

Diagnosis. Hincks, No. 2, p. 360.

Species 1. Mucronella angustoœcium, n. sp.

Syn. *Porella concinna*, var. *eocena*, G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. vol. xii. p. 61.

Diagnosis. Zoarium: unilaminar flat surfaces (? erect or encrusting algæ).

Zoœcia irregular, but with a tendency towards a disposition along radial branching lines. Shape approximately hexagonal. The zoœcia are tumid, rising from a flat surface. Orifice suborbicular: the peristome is high and thickened, especially on the lower margin; it here bears a small simple mucro. The thick bases of a pair of marginal spines occur on the lower angles of the orifice. The thick lower lip has a distinct median transverse depression. Surface granular. Zoœcia separated. About a dozen areolæ occur around the lower half of the zoœcia.

Oœcia numerous, granular, globose, but narrow. In one case there are two oœcia to one zoœcium.

Avicularia: none.

Distribution. Barton Beds, Barton; London Clay, Fareham.

Type. Brit. Mus. No. 49739. Edwards Coll. From Barton.

Figures. Pl. XXXI. fig. 15. Barton Beds. Brit. Mus. No. 49739. Fig. 16. Part of a zoarium from the London Clay, Fareham.

Affinities. This species reminds one at first sight of the common recent *Mucronella ventricosa* (Hass.), and it clearly belongs to the same group; it differs from that species, however, by the small simple mucro, the narrow instead of elongate oœcia, the position of the marginal spines, and in less important points. Probably its nearest ally is *M. hörnesi* (Reuss) [1], of the Middle Oligocene; the new species, however, may be distinguished by its low instead of elongate oœcia. In this character it most resembles

[1] *Lepralia hörnesi*, Reuss, No. 8, pp. 633, 634, pl. xiii. fig. 5, and No. 7, pp. 173, 174, pl. vii. fig. 12.

M. chilopora (Reuss)[1], but the general form of the zoœcia and the structure of the mucro are quite distinct in the two species.

Mr. A. Bell's collection of Fareham Bryozoa having recently passed into the possession of the British Museum, I am able to identify with this species the specimen referred to by Vine as *Porella concinna.*

Mr. Waters, in his 'Revision of the North Italian Bryozoa,' does not quote *Mucronella* from the Eocene deposits of that country. The genus occurs in the Austrian Leithakalk (Helvetian), as at least two species, *M. serrulata* (Reuss)[2] and *M. tenera* (Reuss)[3], seem referable to it.

Mr. Waters [No. 11, pp. 14, 15] has shown that under the name "mucro" several distinct structures have been confused together, and he has proposed the dismemberment of *Mucronella* and the incorporation of most of its species in *Smittia.* The generic value of variations in the secondary orifice and its peristomial tube certainly appears very doubtful, but there does seem sufficient difference between this group of species of *Mucronella* and normal *Smittiæ* to justify the limitation and retention of Mr. Hincks's too comprehensive genus.

Genus SMITTIA, Hincks, 1880.

Diagnosis. Hincks, No. 1, p. 340.

Species 1. SMITTIA TUBULARIS[4], n. sp.

Diagnosis. Zoarium erect; narrow cylindrical or shoot-like branches; branching dichotomous.

Zoœcia arranged alternately. Shape pyriform; ovate or elongate-ovate. Front wall tumid; surface granular. Secondary orifice orbicular or a distinct spout-like depression often shown on lower margin. Peristome thin. A row of large areolæ occurs around the margin.

Oœcia small, flattened, the lower side covered by the upper margin of the secondary orifice.

Avicularia large, lateral, on a prominent tubercle obliquely below the orifice.

Distribution. London Clay, White Conduit House.

Type. Brit. Mus. No. 49744. Edwards Coll.

Figures. Pl. XXXII. fig. 1 *a.* Zoarium, nat. size. Fig. 1 *b.* Several zoœcia, enlarged. Fig. 1 *c.* Basal zoœcia.

[1] *Cellepora chilopora*, Reuss, No. 1, p. 91, pl. xi. fig. 4, and No. 14, p. 168, pl. iv. fig. 1.

[2] *Cellepora serrulata*, Reuss, No. 1, p. 85, pl. x. fig. 12; and *Lepralia serrulata*, Reuss, No. 14, p. 167, pl. ii. figs. 2, 3 (? pl. iv. fig. 4).

[3] *Lepralia tenera*, Reuss, No. 14, p. 167, pl. ii. fig. 4, pl. iii. fig. 11.

[4] Referring to the subtubular orifice.

Affinities. This appears to be a very well-marked species, with its elevated peristome, its tumid front wall, and its large lateral avicularia and marginal punctures. The secondary orifice is so raised and subtubular that it first seemed that the species belonged to *Porella* (or *Tessarodoma*); but its secondary orifice and external avicularia show that the resemblance is superficial and that it is truly a *Smittia*. Its mode of growth, however, is exactly that of *Tubucellaria*; it lacks, however, the peristomial pore of that genus, and the peristome is not so raised. It is not improbable that some of the specimens figured as fossil forms of *T. opuntioides* (Pall.) may belong to this species. Such may be the specimen figured by Michelin [No. 1, pl. 46. fig. 21] as *Vincularia fragilis*, Defr., and some of Reuss's *Cellaria michelini*.

Smittia is well known in the Continental Upper Eocene and Oligocene[1], but none of the species with which I am acquainted sufficiently resemble this one to necessitate a comparison.

Order *CYCLOSTOMATA*.

Family IDMONEIDÆ.

Genus Idmonea, Lamouroux, 1821.

[Lamouroux, No. 2, p. 80.]

Diagnosis. Pergens, No. 3, p. 342.

Type species. *Idmonea triquetra*, Lamx. No. 2, p. 80, pl. 79. figs. 13–15.

Species 1. Idmonea giebeli, Stoliczka, 1862.

Syn. *Idmonea* (*Tubigera*) *giebeli*, F. Stoliczka, 1862, Olig. Bry. Latdf., Sitzb. k. Ak. Wiss. Wien, Bd. xlv. p. 81, pl. i. fig. 6; F. Schreiber, 1872, Bry. Mittelolig. Grünsand Magdeburg, Zeit. f. gesammt. Naturwiss. Bd. xxxix. p. 479.

Idmonea giebeliana, F. Stoliczka, 1865, Foss. Bry. Orakei Bay, Novara Reise, Geol. Theil, Bd. i. Abth. ii. Pal. p. 115, pl. xviii. figs. 4–6; F. W. Hutton, 1880, Man. New Zeal. Moll. Coll. Mus. Geol. Surv. N.Z. p. 196.

Diagnosis. Zoarium cylindrical, straight, erect branches; mode of branching unknown. The back of the zoarium is a full flat curve; the front is well raised.

Zoœcia in series of five; one forms a median row, on each side of which are two pairs placed on a line a little above the central zoœcium. The outermost zoœcia are the longest, but only slightly exceed the others. The walls are granular. Peristome entire, even.

Oœcia small, replacing one of the median zoœcia.

[1] See *e. g.* Waters, No. 12, pp. 21, 22.

Distribution. London Clay, Haverstock Hill.—*Foreign.* Oligocene: Latdorf, Magdeburg, &c., Germany. Palæogene: New Zealand.

Type. Brit. Mus. No. 49656.

Figures. Pl. XXXII. fig. 3 *a.* Part of zoarium, including an oœcium. Fig. 3 *b.* Transverse section.

Affinities. Busk has divided the genus *Idmonea* into two groups: in one the zoœcia all open in two lateral groups and the two innermost ones are the longest; in the second, corresponding to the genus *Tervia* of Jullien, the outermost are the longest and between the lateral series there are some zoœcia irregularly scattered. A third group may, however, be added, including species, such as the present, in which the outermost zoœcia are the longest, but in which there is only a single median row of zoœcia, and the lateral series are opposite.

I am aware of the existence of only six specimens of *Idmonea* from the London Clay; two of these are quite unrecognizable internal pyritous casts, one of which is identified by Mr. Vine as *Idmonea coronopus,* Defr., and the other as *I. gracillima.* A specimen which Mr. Vine tells me is that figured by him as the former is now in the British Museum Collection, but it is labelled, and correctly so, from the London Clay of Sheppey. Mr. Vine [B, p. 165, pl. v. fig. 12] has figured a third specimen also as *Idmonea gracillima,* Reuss, but it is an *Entalophora.* The remaining three small specimens belong one to each of these three groups of *Idmonea.* This helps one to realize that the British Eocene Bryozoan fauna was a singularly diversified one.

Lonsdale [No. 2, pl. ix. fig. 24] has also figured a specimen as *Idmonea coronopus,* but the figure is unrecognizable and I have not been able to find the specimen.

The only noticeable difference between the London Clay specimen and the type figure is in the greater length of the zoœcia in the former; but that may be only due to the fragments having come from a different position in the zoaria. The New Zealand specimen is more doubtful; Hutton quotes it, but Waters, in his paper on the New Zealand Cyclostomata [No. 8, pp. 337–350, pl. xviii.], does not refer to it. Miss Jelly [No. 1, pp. 118, 119] makes it a synonym of *I. milneana,* D'Orb., but I fail to see why it should be included with this rather than any other species of the genus.

Species 2. IDMONEA BIALTERNATA, n. sp.

Diagnosis. Zoarium sinuous, in thin elongated branches, evenly rounded in front, with a flattish curve at the back.

Zoœcia of medium length, thick, with large apertures; walls granular. They are arranged in two pairs; each pair open close together; the two pairs are placed alternately. Peristome thick, plain.

Oœcia: ? a small dilatation at base of the inner zoœcia.

Distribution. London Clay, Islington.

Type. Brit. Mus. No. 49662.

Figures. Pl. XXXII. figs. 2 *a*, 2 *b*. Zoarium and section.

Affinities. This species belongs to the first of the groups of *Idmonea*, including those with the zoœcia all in lateral series. It most closely resembles a specimen figured by Manzoni [No. 4, p. 5, pl. iii. fig. 10] as *I. carinata*?, Röm. A comparison with the figures both of Römer [No. I, p. 21, pl. v. fig. 20] and Reuss [No. I, pp. 44, 45, pl. vi. fig. 27] would seem to show that the query after the identification was very well founded; in the number of zoœcia, the shape and structure of cross-sections, and other points, Manzoni's figures markedly differ from those of the larger pluriserial triangular species figured by Römer from the North-German Chalk. From the typical *I. carinata* the London Clay species can be very readily distinguished.

Idmonea reticulata, Reuss [No. II, pp. 281, 282, pl. xxxiv. fig. 13], belongs to the same series, but differs in the smaller size and more regular arrangement of the zoœcia and apertures, which are grouped in triplets instead of pairs. The same characters also separate the new species from the *I. laticosta*, Mars. [No. I, p. 29, pl. ii. fig. 11], of Danian age, which belongs to the same group.

Species 3. IDMONEA SERIATOPORA, Reuss (?).

Syn. *Idmonea seriatopora*, Reuss, 1847, Foss. Polyp. Wiener Tertiärbeckens, p. 46, pl. vi. fig. 32; Manzoni, 1878, Brioz. foss. Mioc. Austr. Ungh., Denk. k. Ak. Wiss. Wien, Bd. xxxviii. Abth. 2, p. 6, pl. vi. fig. 12.

Diagnosis. Zoarium of thick irregular branches, composed of many zoœcia, well rounded at the back.

Zoœcia very irregularly arranged, the lateral ones the longest. There are no regular series arranged on either side of a medial line. Three zoœcia often open in an oblique line.

Peristome elliptic; border irregular.

Distribution. London Clay, Haverstock Hill.—*Foreign.* Leithakalk (Helvetian), Austria.

Type. Brit. Mus. No. B 4510.

Figures. Pl. XXXII. fig. 4 *a*. Part of a zoarium, × 18 diam. Fig. 4 *b*. Mouth, × 32 diam. Fig. 4 *c*. Transverse section, × 18 diam. Fig. 5. Back view of zoarium.

This species belongs to the subgenus *Tervia* of Jullien.

Affinities. The irregular distribution of the zoœcia of this species reminds one of *I. compressa*, Reuss [No. I, p. 46, pl. vi. fig. 22], but the zoarium is not so laterally compressed. Its closest ally is *Idmonea seriatopora*, Reuss, as figured by Manzoni [No. 4, pp. 6, 7, pl. ii. fig. 8, pl. v. fig. 17]; to the original and no doubt diagrammatic figure of Reuss it has a less decided resemblance. But the London Clay specimen is not sufficiently large to allow of a more definite comparison; hence I do not feel able positively to affirm the occurrence of the Austrian Miocene species in the

English Eocenes. Among the species which M. Jullien [No. 2, p. 501, pl. xvii. figs. 72, 73] has referred to his genus *Tervia* it most resembles *Tervia solidula.*

Species 4. IDMONEA CORONOPUS, Defrance, 1821.

Syn. *Idmonea coronopus,* Defrance, 1821, Dict. Sci. Nat. t. xxii. p. 565 (non Atlas, pl. xlvi. fig. 2, as stated by Bronn); Blainville, 1830, ibid. t. lx. p. 385; id. 1834, Man. d'Actinol. p. 420; Milne-Edwards, 1836, in Lamarck, Anim. sans Vert. ed. 2, t. ii. pp. 281, 282; id. 1838, Mém. Crisiées, Ann. Sci. Nat. Zool. sér. 2, t. ix. pp. 215, 216, pl. xii. fig. 3; Michelin, 1844, Icon. Zooph. p. 172, pl. xlvi. fig. 16; Bronn, 1848, Index Palæont. Nomencl. p. 606; Lonsdale, 1850, in Dixon, Geol. Sussex, pp. 153–155, pl. ix. fig. 24; Hagenow, 1851, Bryoz. Maastr. Kreidebild. p. 25; Lonsdale, 1878, in Dixon, Geol. Sussex, ed. 2, pp. 204–206, pl. ix. [10] fig. 24; Harris and Burrows, 1891, Eoc. and Oligoc. Paris Basin, p. 61.

Retepora trigona, Morren, 1828, Desc. Corall. foss. Belgio, Ann. Gron. p. 37, pl. x. figs. 1–3 (identification *fide* Michelin); Galeotti, 1838, Mém. Géogn. Brabant, p. 187, pl. iv. fig. 13; Nyst, 1844, Coq. et Polyp. foss. Terr. Tert. Belg., Mém. Cour. R. Ac. Belg. t. xvii. pp. 619, 620.

Chrysisina coronopus, Mourlon, 1881, Géol. Belgique, t. ii. p. 180.

Hornera flabelliformis, Vine (non Blainv.), Proc. Yorks. Geol. & Polyt. Soc. vol. xi. p. 166, pl. v. fig. 15; id. ibid. vol. xii. p. 53.

Diagnosis. Zoarium small, erect, rising from an encrusting, expanded base. The branches fork several times; they are triangular in section and well rounded behind; they end bluntly.

Zoœcia in short transverse series, alternately arranged. The zoœcia are single at the base, but rapidly increase to rows of four; this decreases to three above. The innermost zoœcia are the longest.

Peristome even, usually oblong with rounded angles; younger and isolated zoœcia have oval or even circular apertures.

Wall granular.

Distribution. British: Bracklesham Beds, Bracklesham (Brit. Mus., Dixon and Vine Collections).—*Foreign*: Calcaire grossier, Parnes, Grignon, Chaumont, &c.; Laekenien; Uccle (near Brussels), de Forêt, d'Assche.

Figures. Pl. XXXII. figs. 6 *a*, 6 *b*.

Affinities and Differences. As this species belongs to the typical group of *Idmonea* it clearly differs from *Idmonea* (*Tervia*) *seriatopora*, Reuss. As there is no median line of zoœcia it differs from *Idmonea giebeli*, Stol. From the third British Eocene species it may readily be distinguished, as in that the zoœcia are always in alternate pairs.

Genus HORNERA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 41.]

Diagnosis. Pergens, 1889, No. 3, p. 353.

Type species. *Hornera frondiculata* (Lamarck), 1816, No. 1, pp. 182, 183.

Species 1. HORNERA FAREHAMENSIS, n. sp.

Syn. *Hornera ramosa,* D'Orb., G. R. Vine, 1891, Proc. Yorks. Geol. & Polyt. Soc. xii. pp. 54–56.

Diagnosis. Zoarium thick, dichotomously branching tufts; the branches do not anastomose.

Zoœcia open somewhat regularly on the anterior side; the orbicular apertures form straight lines around the branches. In the middle line there is often an irregular and crowded series. The apertures are flush. The interzoœcial pores are of medium size, but not very abundant, numbering from twice to thrice as many as the zoœcia. The posterior side of the zoarium is deeply perforate, the punctures occurring in simple series, occasionally branching.

Distribution. London Clay, Fareham.

Type. Brit. Mus. No. B 3831.

Figures. Pl. XXXII. figs. 7–9.

Affinities. This species has been identified by Mr. Vine as *H. ramosa*, D'Orbigny [No. 2, pp. 937, 938, pl. 608. figs. 6–10, pl. 773. figs. 1–3]; from that species it appears to me to differ by the following characters: (1) the sections of the branches are round and not subtriangular; (2) the central series of zoœcial apertures are very irregularly distributed; (3) the species figured by D'Orbigny has the exceptional character of a series of tubular prominences probably zoœcial (see pl. 773. fig. 2); (4) the zoarium is irregularly branched and does not form the cupuliform structure shown by D'Orbigny (pl. 608. fig. 6).

The nearest ally of this species appears to me to be *Hornera concatenata*, Reuss (No. 11, pp. 71, 72, pl. xxxv. figs. 5, 6), but in that species the pores on the back are few and far between, the number of zoœcia in a transverse series is less, the pores on the front wall are much less numerous, and there is no irregular middle series.

Genus ENTALOPHORA, Lamouroux, 1821.

[Lamouroux, No. 2, p. 81.]

Diagnosis. Pergens, No. 3, p. 357.

Species 1. ENTALOPHORA TERGEMINA [1], n. sp.

Syn. *Idmonea gracillima?,* Reuss, Vine, 1889, Proc. Yorks. Geol. & Polyt. Soc. vol. xi. pp. 165, 166, pl. v. fig. 13.

Diagnosis. Zoarium thick, apparently short. In section it appears quadrangular, with the angles well rounded. Surface minutely pitted.

Zoœcia crowded, long, expanding above; series of three or four open together along a straight line; there are four such triplets at not quite the same level in a series around the zoarium. There are 12 or 13 in a complete series. The zoœcia are somewhat infundibuliform, and have a somewhat quadrangular aperture.

[1] *Tergeminus*, triple, referring to the apertures being usually in triplets.

Distribution. London Clay, Sheppey.

Type. Brit. Mus. No. B 4509.

Figures. Pl. XXXII. figs. 10 *a*, 10 *b*.

Affinities. The specimen which serves as the type of this species is that which Mr. Vine figured as *Idmonea gracillima*, Reuss, but as it belongs to a different family there is no necessity to compare it with that species. It reminds one, in the form of the zoarium, of *Entalophora clavula*, Reuss [1]; from this it differs in the serial arrangement of the apertures. The same character separates it from *Entalophora palmata*, Busk [2].

This species seems to me to be most allied to *Entalophora wanganuiensis*, Waters (No. 5, pp. 340, 341, pl. xviii. fig. 1): but the New Zealand species has only 10 zoœcia in a series; these are verticillate, and the zoœcia are not infundibuliform.

Family HETEROPORIDÆ.

Genus Heteropora, Blainville, 1830.

[Blainville, No. 1, p. 381.]

Diagnosis. Pergens, No. 3, p. 369.

Species 1. Heteropora glandiformis [3], n. sp.

Diagnosis. Zoarium very small, globular, free (the largest specimen is less than 3 millim. in diameter).

Zoœcia irregularly bent tubes. The orifice varies from orbicular to subhexagonal in shape; they are surrounded by a strong raised rim. The zoœcia are crowded, but interzoœcial spaces occur on the surface of the zoarium; these are, however, entirely filled in the interior. Secondary pores numerous, somewhat less in number than the normal zoœcia, irregularly scattered; they also have a thickened, slightly raised rim.

Distribution. Barton Beds, Barton (common). Bracklesham Beds, Bracklesham Bay. ? London Clay, Highgate. (One somewhat doubtful specimen: Brit. Mus. No. 49596.)

Type. Brit. Mus. No. B 4511. Edwards Coll.

Figures. Pl. XXXII. fig. 11. A zoarium from Barton; external view. Figs. 12 *a*, *b*. Fragments to show internal structure.

Affinities. In the form of the zoarium this species resembles most closely some specimens of *Heteropora conifera* (Lamx.) [No. 2, p. 87, pl. 83. figs. 6, 7; see Haime, No. 1, pp. 208, 209, pl. xi. figs. 1 *a–c*], figured by Haime, but the zoœcial characters are quite distinct. *H. stellulata*, Reuss (No. 1, p. 35, pl. v. figs. 21, 22; Manzoni, No. 4,

[1] *Pustulipora clavula*, Reuss, No. 1, p. 41, pl. vi. fig. 11. For later figures see Reuss, No. 1, p. 194, pl. ix. figs. 3, 4.

[2] *Pustulopora palmata*, Busk, No. 6, p. 108, pl. xviii. fig. 2; and Manzoni, No. 4, p. 11, pl. ix. fig. 34.

[3] From *glans*, a bullet.

p. 18, pl. xi. fig. 44), has certain affinities, but the raised triangular or oval zoœcia and numerous pores of that species are quite distinctive. *H. stipitata*, Reuss (No. I, p. 35, pl. v. fig. 19; Manzoni, No. 4, p. 19, pl. xi. fig. 45), has also more numerous cancellate pores and a greater thickness of wall. Most of the specimens are less than 2 millim. in diameter and are perfectly spherical; the largest is about 2·5 millim. in diameter, and is somewhat flattened and presents a slight resemblance to some specimens in the *Conescharellina* stage of *Orbitulipora*.

V. *Miscellaneous Records.*

As the Bryozoa are rare in the English Lower Tertiaries, the following records are inserted in the hope that they may lead to search in those horizons.

DIACHORIS INTERMEDIA, A. W. Waters, A, p. 224 (non Hincks); G. R. Vine, A, p. 673, B, p. 160, C, p. 54.

Distribution. Middle Eocene, Bournemouth.

The British Museum contains some specimens of Bryozoa from the same horizon, but they are quite indeterminable. Mr. Waters has also recorded *Lepralia*, sp., *Membranipora*, sp., and *Flustræ*, from the same horizon.

DITAXIA VARIABILIS, D'Orb., G. R. Vine, C, p. 58.

The specimen on which this identification was founded is now in the British Museum (B 4589), but it seems to me to be generically indeterminable. It came from the London Clay at Fareham.

CRIBRILINA RADIATA (Moll), A. W. Waters, 1883, in H. M. Klassen, A, p. 244; W. Whitaker, B, vol. i. p. 237.

Distribution. Woolwich and Reading Beds (Blackheath Beds); Park Hill, Croydon.

FLUSTRA CRASSA, Desm., J. Morris, No. I, p. 37; T. H. Huxley and R. Etheridge, A, p. 332; W. Whitaker, A, p. 594; G. R. Vine, A, p. 673; J. L. Lobley, A, p. 96.

Distribution. London Clay, Primrose Hill and London District.

FLUSTRA, sp., W. Whitaker, T. H. Huxley, and R. Etheridge, A, pp. 574, 577, 581; T. H. Huxley and E. T. Newton, B, p. 14; W. Whitaker, B, vol. i. p. 213.

Distribution. Thanet Beds, E. of Faversham. Woolwich and Reading Beds, Dulwich, Sundridge.

POLYZOA, indet., H. W. Bristow, A, p. 284.

Distribution. Bembridge Beds. (This is the only evidence known to me of the occurrence of Bryozoa in the British Upper Oligocene.)

HORNERA MINUTA, Vine, B, p. 166, C, p. 53. Bracklesham Beds.

The specimen appears to have been lost.

HORNERA ? FLABELLIFORMIS, Blainv., Vine, B, p. 166, pl. v. fig. 15, and C, p. 53.

The specimen upon which this record is founded is now in the British Museum; it is partly immersed, with the zoœcial orifices downwards, the basal portion alone being visible: it is likely to belong to *Idmonea*, and to be the same species as that figured by Lonsdale, No. 2, pl. ix. fig. 24, as *I. coronopus*, Defr.

LICHENOPORA MEDITERRANEA ?, Blainv., Vine, C, p. 60.

VI. *Stratigraphical Distribution.*

No.	Species.	Author.			London Clay.								Bracklesham.						Barton.	Headon.		
			Thanet Sands.	Woolwich & Reading Beds.	Copenhagen Fields.	Fareham.	Hampstead.	Highgate.	Islington.	Portsmouth.	Sheppey.	Sydenham.	Bracklesham.	Bramshaw.	Brook.	Huntingbridge.	Stubbington.	Isle of Wight.	Barton.	Colwell Bay.	Brockenhurst.	
1.	Notamia wetherelli	(Busk)						—														
2.	Membranipora eocena	(„)	—					—														
3.	—— buski	n. sp.																		—		
4.	—— crassomuralis	„											—						—			
5.	—— tenuimuralis	„				—	—	—		—												
6.	—— virguliformis	„						—														
7.	—— disjuncta	„						—														
8.	Lunulites transiens	„											—	—	—	—		—	—			
9.	Biselenaria offa	„																	—			
10.	Micropora cribriformis	„																	—			
11.	Onychocella magnoaperta	„																			—	
12.	Cribrilina vinei	„									—											
13.	Schizoporella magnoaperta	„																	—			
14.	—— magnoincisa	„			—		—															
15.	Adeonellopsis wetherelli	„				—	—	—				—										
16.	—— incisa	„					—															
17.	Lepralia lonsdalei	„											—									
18.	Umbonula bartonense	„																	—			
19.	—— calcariformis	„				—																
20.	Teichopora clavata	„																	—			
21.	Meniscopora bigibbera	„														—						
22.	Conescharellina clithridiata	„						—			—											
23.	Orbitulipora petiolus	Lonsd.											—	—	—		—	—				
24.	Mucronella angustoœcium	n. sp.				—													—			
25.	Smittia tubularis	„					—															
26.	Idmonea giebeli	Stol.					—															Oligocene, Germany. Palæogene, New Zealand.
27.	—— bialternata	n. sp.							—													
28.	—— seriatopora	Reuss					—															
29.	—— coronopus	Defr.										—										Calc. gross. France. Laekenien, Belgium
30.	Hornera farehamensis	n. sp.				—																
31.	Entalophora tergemina	„									—											
32.	Heteropora glandiformis	„						?					—						—			
33.	Lichenopora, sp.	„																	—			

VII. *Affinities of the Fauna.*

The preceding list shows that the Bryozoa included in the present paper belong to three fairly distinct faunas, but a comparison of the three shows that they possess certain features in common. In the first place, each of the three faunas is numerically small, both in species and individuals, in comparison with the wealth of forms that inhabited the contemporary seas of the Mediterranean basin.

The stunted and dwarfed aspect of the three faunas is apparently due mainly to climatic conditions. As has been pointed out in a recent revision of our Eocene Echinoids [1], the British seas of that period were confined to the south by a land barrier which stretched across France and Northern Germany. Hence to the south of this area the Bryozoa flourished under favourable conditions in a tropical and subtropical ocean, while on the other side the seas were open to the chilling influences of the northern ocean. The land barrier was breached in Middle Eocene times, but the conditions were not seriously modified till later: then, with the gradual change to the brackish and freshwater deposits of the Oligocene, the marine Bryozoa cease to be represented in the British Palæogene.

The Echinoids of the period belong to the same genera as their contemporaries in the Mediterranean basin, but their generally dwarfed aspect and rareness indicate that they lived under unfavourable conditions. The Bryozoa present exactly the same parallel.

An effort has been made to explain the paucity of Bryozoa in English deposits of this period as due simply to unfavourable lithological conditions of life and preservation. The prevalence of clay and sharp sand is quoted as unfavourable to the growth of Bryozoa. But this is hardly sufficient. The shelly sands of the Bracklesham, on the contrary, would seem to indicate the conditions that would be most favourable to the existence and preservation of Bryozoa. That the clay shores of the London Clay and Barton are wholly responsible for the rarity of the Bryozoa is not likely to be accepted by any one who has dredged on the great mud-flats off the Essex coasts, where it is often difficult to procure a shell not encrusted by them. In other districts, such as the Paris basin, Belgium, and North Germany, which were also to the north of this land barrier, and where the lithological characters of the sea-floors were quite different from those of England, the Bryozoa are equally rare and stunted.

Hence, it is to geographical questions rather than to the lithological conditions of the sea-floor that we must attribute the marked characters of our Palæogene Bryozoan fauna.

The singular diversity of the fauna is another feature which supports the view that it is to be regarded as a remnant or an offshoot from one that was much greater and richer. Mr. Waters [Nos. 12 & 13], in his revision of the Oligocene Bryozoa of North Italy, admits 88 species, representing 35 genera. But the British fauna contains only

[1] Gregory, Proc. Geol. Assoc. xii. 1891, pp. 51, 52.

25 species, belonging to 17 genera. If we take the case of the species of a single genus, we find the same point very instructively shown. Thus the genus *Idmonea* is represented by only five specimens, of which two from Mr. Vine's collection appear to me to be indeterminable; *Idmonea* may be conveniently divided into three groups or subgenera, and one of the three recognizable specimens belongs to each of these three groups. This consideration ought to stimulate the search for more material, as the specimens already known appear to represent but a fragment of the fauna.

The high proportion of peculiar species in this fauna would not excite surprise in any of the higher groups, except the Bryozoa; but when we consider the vast range both in space and time claimed for some species, a few words of explanation are required. In the first place, rare though the Bryozoa are in the English beds, they appear to have been even scarcer in contemporary deposits of other parts of the same basin; the meagre lists given by Stremme (No. 1), Marsson (No. 2), Michelin (No. 1), Milne-Edwards (No. 2), and Mourlon (No. 1) show the paucity of Bryozoa at this time in Northern France, Germany, and Belgium.

The great range in time usually accorded to species of Bryozoa raises the general question as to the value of species in this group; their growth in colonies is the main reason for the "lumping" tendencies of zoophytologists. In the Cheilostomata species are usually founded, if only on one specimen, yet on hundreds of zoœcia: in a colony of this size great variation is inevitable; many of the polypites are crushed out by growth-pressure, and their zoœcia are malformed or aborted; the older zoœcia become immersed and lose their characters; the younger zoœcia at the tips of the branches are immature. Hence it is easy to pick out two zoœcia in a zoarium which differ far more markedly than do two zoœcia taken from different species; but that no more proves that the two species should be merged than that two species of frogs are identical because they resemble one another more closely than they do the tadpoles from which they have developed.

Dr. Waagen—'Pal. Indica' (xiii.), 'Salt Range Fossils,' iv. pt. 2, 'Geol. Results,' 1891, pp. 235, 236—has recently pointed out the disastrous effects that have been wrought by palæontologists "lumping" species and neglecting slight but definite differences; and one worker on Bryozoa has recently expressed his doubts as to the accuracy of the identification of recent and Cretaceous species. With this opinion I feel strongly disposed to concur, but will here only say that, so far, I have seen no Cretaceous species of Cheilostomata identical with a living one. If there are such constant differences, it seems certainly advisable to recognize them by name, whether we call them species, forms (Smitt), or mutations (Waagen). Unless this be done, if we accept species as ranging from the Jurassic to the present, then we must abandon all hope of deriving from the Bryozoa any assistance in the study of the geographical distribution of the past, though the group presents characters that should give its evidence great value.

VIII. *Bibliography.*

(Including only works referred to.)

A. *General.*

AUDOUIN, VICTOR.

No. 1.—1826. Explication sommaire des planches de Zoophytes de l'Egypte et de la Syrie . . . offrant un exposé des caractères naturels des genres avec la distinction des espèces. In 'Description de l'Egypte.' Histoire Naturelle, i. 1809, Polypes, pp. 225–244, pl. 14. Fol. *Paris.*

BLAINVILLE, H. M. D. DE.

No. 1.—1830. Zoophytes. Dict. Sci. Nat. lx. pp. 1–546, pls. 67, 68.

No. 2.—1834. Manuel d'Actinologie ou de Zoophytologie. 8vo. *Paris.* 2 vols.

BOSC, L. A. G.

No. 1.—1830. Histoire naturelle des Vers. Ed. 2. 12mo. *Paris.*

BRONGNIART, ALEX., and CUVIER, G.

No. 1.—1822. Description géologique des Couches des environs de Paris parmi lesquelles se trouvent les gypes à ossemens. In Cuvier, Oss. foss. ed. 2. t. ii. pt. 2, 4to, pp. 239–648; 15 pls. & maps.

BRONN, H. G.

No. 1.—1825. System der urweltlichen Pflanzenthiere. Fol. *Heidelberg.* iv+47 pp. 7 pls.

No. 2.—1831. Uebersicht der fossilen Ueberreste in den tertiären subapenninischen Gebirgen. In Ergebnisse meiner naturhistorisch-ökonomischen Reise. Th. ii. Skizzen und Ausarbeitungen über Italien. *Heidelberg.* 8vo. Bd. ii. pp. 505–646. pl. iii.

No. 3.—1848. Handbuch der Geschichte der Natur. Bd. iii. Index palæontologicus. A. Nomenclator palæontologicus. 8vo. *Stuttgart,* 1848. Pp. lxxxiv+1381.

BUSK, G.

No. 1.—1852. An account of the Polyzoa and Sertularian Zoophytes collected in the Voyage of the 'Rattlesnake' on the coasts of Australia and the Louisiade Archipelago. In J. Macgillivray, Narrative of the Voyage of H.M.S. 'Rattlesnake.' 8vo. *London,* 1852. Vol. i., App. No. iv. pp. 343–402, pl. 1.

No. 2.—1852. British Museum Catalogues. Catalogue of Marine Polyzoa. Pt. I. Cheilostomata. Pp. viii+vi+54, pl. 68.

No. 3.—1854. Ditto. Pt. II. Cheilostomata. Pp. viii+55–120, pls. 69–124.

No. 4.—1875. Ditto. Pt. III. Cyclostomata. Pp. viii+41, pl. 34.

No. 5.—1858. Zoophytology [9th part]. Quart. Journ. Micr. Sci. vi. pp. 124–130, pls. xviii. & xix.

No. 6.—1859. A Monograph of the Fossil Polyzoa of the Crag. Palæont. Soc. Pp. xiii+136, pl. 22.

No. 7.—1866. Description of three new Species of Polyzoa from the London Clay at Highgate, in the collection of N. T. Wetherell, Esq., F.G.S. Geol. Mag. iii. pp. 298–302, pl. xii.

No. 8.—1884. Report on the Polyzoa collected by H.M.S. 'Challenger' during the years 1873–1876. Part I. The Cheilostomata. Chall. Exp., Zool. vol. x. (pt. xxx.), pp. xxiv + 216, pls. 36.

No. 9.—1886. Ditto. Part II. The Cyclostomata, Ctenostomata, and Pedicellinea. Ibid. vol. xvii. pp. viii + 47, pls. 10.

Deslongchamps, Eug.

No. 1.—1824. In Encyclopédie Méthodique. Histoire Naturelle des Zoophytes ou Animaux rayonnés. 4to. *Paris.*

Dollfus, G. F.

No. 1.—1889. Bryozoaires. Ann. géol. univ. v. (1888) pp. 1159–1170.

Edwards, H. Milne-.

No. 1.—1836. Recherches anatomiques, physiologiques et zoologiques sur les Eschares. Ann. Sci. Nat., Zool. (2) vi. pp. 5–53, pls. i.–v.

No. 2.—1836. Observations sur les polypiers fossiles du genre Eschare. Ibid. pp. 321–345, pls. ix.–xi.

Fleming, John.

No. 1.—1828. A History of British Animals. 8vo. *Edinburgh.* Pp. xxiii + 565.

Gabb, W. M., and Horn, G. H.

No. 1.—1862. Monograph of the Fossil Polyzoa of the Secondary and Tertiary Formations of North America. Journ. Acad. Nat. Sci. Phil. v. pp. 111–179.

Gioli, G.

No. 1.—1889. Briozoi neogenici dell' isola di Pianosa nel Mar Tirreno. Atti Soc. Tosc. Sci. Nat. x. pp. 251–267, pl. xiv.

Goldfuss, Aug.

No. 1.—1827. Petrefacta Germaniæ. Fol. *Düsseldorf* (1827–1833). Vol. I. Bryozoa, pp. 23–41, pls. viii.–xii.

Gottardi, G. B.

No. 1.—1886. Briozoi fossili di Montecchio Maggiore. Atti Soc. Veneto-Trentina, ix. fs. ii. *Padova* (1885), pp. 297–308, pl. xiv.

Gregorio, Marquis Antonio de.

No. 1.—1890. Monographie de la Faune Eocénique de l'Alabama et surtout de celle de Claiborne de l'Etage Parisien. Ann. Géol. livr. vii., viii. 4to. *Palermo.* 316 pp. 46 pls.

Hagenow, Fr. von.

No. 1.—1839. Monographie der Rügenschen Kreide Versteinerungen. Abt. I. Phytolithen und Polyparien. N. Jahrb. 1839, pp. 252–296, pls. iv., v.

No. 2.—1851. Die Bryozoen der Maastrichter Kreidebildung. *Cassel.* Pp. xi + 111, pls. 12.

HAIME, JULES.

No. 1.—1854. Description des Bryozoaires fossiles de la formation Jurassique. Mém. Soc. Géol. France, (2) v. pp. 156–218, pls. vi.–xi.

HELLER, CAM.

No. 1.—1867. Die Bryozoën des adriatischen Meeres. Verh. k. k. zool.-bot. Ges. Wien, xvii. Abh. pp. 77–136, pls. i.–vi.

HINCKS, T.

No. 1.—1878. Notes on the Genus *Retepora,* with descriptions of new Species. Ann. Mag. Nat. Hist. (5) i. pp. 353–365, pls. xviii., xix.

No. 2.—1880. A History of the British Marine Polyzoa. 2 vols. 8vo. *London.* Pp. clxi + 601, pls. 83.

No. 3.—1880. On new Hydroida and Polyzoa from Barents Sea. Ann. Mag. Nat. Hist. (5) vi. pp. 277–286, pl. xv.

No. 4.—1880–1891. Contributions towards a General History of the Marine Polyzoa:—

Part I. 1880. Ann. Mag. Nat. Hist. (5) vi. pp. 69–92, pls. ix.–xi.
II. 1880. „ vii. pp. 376–384, pls. xvi., xvii.
III. 1881. „ vii. pp. 147–161, pls. viii.–x.
IV. 1881. „ viii. pp. 1–14.
V. 1881. „ viii. pp. 122–136, pls. i.–v.
VI. 1882. „ ix. pp. 116–127, pl. v.
VII. 1882. „ x. pp. 160–170, pls. vii., viii.
VIII. 1883. „ xi. pp. 193–202, pls. vi., vii.
IX. 1884. „ xiii. pp. 265–267.
X. 1884. „ xiii. pp. 356–369, pls. xiii., xiv.
XI. 1884. „ xiv. pp. 276–285, pls. viii., ix.
XII. 1885. „ xv. pp. 244–257, pls. vii.–ix.
XIII. 1891. „ (6) vii. pp. 285–298, pls. vi., vii.

No. 5.—1891–1892. Ditto. Appendix:—

Part I. 1891. Ann. Mag. Nat. Hist. (6) viii. pp. 86–93.
II. 1891. „ viii. pp. 169–176.
III. 1891. „ viii. pp. 471–480.
IV. 1892. „ ix. pp. 327–334.

No. 6.—1886. The Polyzoa of the Adriatic: a supplement to Prof. Heller's 'Die Bryozoën des adriatischen Meeres,' 1867. Ann. Mag. Nat. Hist. (5) xvii. pp. 254–271, pls. ix., x.

No. 7.—1887. On the Polyzoa and Hydroida of the Mergui Archipelago collected . . . . by Dr. J. Anderson . . . . Journ. Linn. Soc., Zool. xxi. pp. 121–135, pl. xii.

No. 8.—1887. Critical Notes on the Polyzoa:—

Part I. 1887. Ann. Mag. Nat. Hist. (5) xix. pp. 150–164.
II. 1890. „ (6) v. pp. 83–103.

HUTTON, F. W.

No. 1.—1880. Manual of the New Zealand Mollusca. Misc. Public. Col. Mus. Geol. Surv. N. Zeal. No. xii. 8vo. *Wellington.* Pp. xvi + iv + 224. Bry. pp. 178–199.

Jameson, R.

No. 1.—1811. Catalogue of Animals of the Class Vermes found in the Frith of Forth and other parts of Scotland. Mem. Wern. Soc. i. pp. 556–565.

Jelly, E. C.

No. 1.—1889. A Synonymic Catalogue of the Recent Marine Bryozoa, including Fossil Synonyms. 8vo. *London.* Pp. xv + 322.

Johnston, George.

No. 1.—1838. A History of British Zoophytes. 8vo. *London.* Pp. xii + 333, pls. 44.

No. 2.—1847. Ditto. Ed. 2. 2 vols. Pp. xvi + 488, pls. 74.

Jullien, Jules.

No. 1.—1882. Note sur une nouvelle Division des Bryozoaires Cheilostomiens. Bull. Soc. Zool. France, vi. pp. 271–285.

No. 2.—1883. Dragages du 'Travailleur.' Bryozoaires, espèces draguées dans l'Océan Atlantique en 1881. Ibid. vii. pp. 497–529, pls. xiii.–xvii.

No. 3.—1886. Les Costulidées, nouvelle famille de Bryozoaires. Ib. xi. pp. 601–620, pls. xvii.–xx.

No. 4.—1888. Bryozoaires. Mission Scientifique du Cap Horn, 1882–1883. Zool. vi. 4to. 92 pp., 15 pls.

Kirchenpauer, G. H.

No. 1.—1880. Ueber die Bryozoen-Gattung *Adeona.* Abh. Naturwiss. Ver. Hamburg, vii. pp. 1–24, pls. i.–iii.

Kirkpatrick, R.

No. 1.—1888. Polyzoa of Mauritus. Ann. Mag. Nat. Hist. (6) i. pp. 72–85, pls. vii.–x.

No. 2.—1890. Report on the Zoological Collections made in Torres Straits by Prof. A. C. Haddon, 1888–1889.—Hydroida and Polyzoa. Sci. Proc. Roy. Dublin Soc. new ser. vi. pp. 603–626, pls. xiv.–xvii.

Klöden, K. F.

No. 1.—1834. Die Versteinerungen der Mark Brandenburg, insonderheit diejenigen welche sich in den Rollsteinen und Blöcken der südbaltische Ebene finden. 8vo. *Berlin.* Pp. x + 378, pls. 10.

Koschinsky, C.

No. 1.—1885. Ein Beitrag zur Kenntniss der Bryozoenfauna der älteren Tertiärschichten des südlichen Bayerns. I. Chilostomata. Palaeontogr. xxxii. 1885, pp. 1–73, pls. i.–vii.

Lamarck, J. B.

No. 1.—1816. Histoire naturelle des Animaux sans Vertèbres, t. ii. 8vo. *Paris.*

Lamouroux, J. V. F.

No. 1.—1816. Histoire des Polypiers Coralligènes flexibles, vulgairement nommés Zoophytes. 8vo. *Caen.* Pp. lxxxiv + 560, pls. 19.

No. 2.—1821. Exposition méthodique des genres de l'ordre des Polypiers. 4to. *Paris,* 1821. Pp. viii + 115, pls. 84.

No. 3.—1824. In Quoy & Gaimard, Voyage autour du Monde . . . . . exécuté sur les corvettes de S. M. 'l'Uranie' et 'la Physicienne' pendant les années 1817, 1818, 1819, et 1820. 4to. *Paris.* Pp. 604–641, pls. 89–95.

LIENENKLAUS, E.

No. 1.—1891. Die Ober-Oligocän Fauna des Doberges. Jahresber. Naturwiss. Ver. Osnabrück, viii. pp. 43–178, pls. i., ii.

LONSDALE, WM.

No. 1.—1845. Account of the species of Polyparia obtained from the Miocene Tertiary formations of North America. Quart. Journ. Geol. Soc. i. pp. 495–509.

No. 2.—1850. In F. Dixon, The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex. 4to. Pp. xvi + xvi + 433, 40 pls.

No. 3.—1878. Ditto. Ed. 2.

MACGILLIVRAY, P. H.

No. 1.—1879–1890. In McCoy, Prodromus of the Zoology of Victoria.

Dec. III.	pls. 24–26.	1879.	Dec. IX.	pls. 89–90.	1884.	Dec. XV.	pls. 146–148.	1887.
IV.	35–38.	„	X.	94–99.	1885.	XVI.	156–158.	1888.
V.	45–49.	1880.	XI.	105–108.	„	XVII.	165–168.	„
VI.	57–60.	1881.	XII.	116–118.	1886.	XVIII.	175–178.	1889.
VII.	66–68.	1882.	XIII.	126–128.	„	XIX.	185–187.	„
VIII.	78.	1883.	XIV.	136–138.	1887.	XX.	195–196.	1890.

No. 2.—1882–1891. Descriptions of new or little-known Polyzoa. Trans. Roy. Soc. Victoria.

Pt. I.	1882, xviii.	pp. 115–121, 1 pl.	Pt. VIII.	1885,	xxi.	pp. 106–119, 5 pls.
II.	1883, xix.	pp. 130–138, 3 pls.	IX.	1886,	xxii.	pp. 128–139.
III.	„ „	pp. 191–195, 2 „	X.	1887,	xxiii.	pp. 34–38, 2 pls.
IV.	„ „	pp. 287–293, 2 „	XI.	„	„	pp. 64–72, 3 pls.
V.	1884, xx.	pp. 103–113, 3 „	XII.	„	„	pp. 179–186.
VI.	„	pp. 126–128, 1 pl.	XIII.	1890, (new ser.)	ii.	pp. 106–110, pls. iv., v.
VII.	1885, xxi.	pp. 92–99, 3 pls.	XIV.	1891, „	iii.	pp. 78–83, pl. ix., x.

No. 3.—1887. A Catalogue of the Marine Polyzoa of Victoria. Trans. and Proc. Roy. Soc. Vict. xxiii. pp. 187–224.

No. 4.—1889. On some South Australian Polyzoa. Trans. and Proc. Roy. Soc. S. Austr. xii. pp. 24–30, pl. ii.

No. 5.—1890. An additional List of South Australian Polyzoa. Trans. Roy. Soc. S. Austr. xiii. pt. 1, pp. 1–7, pl. 1.

MANZONI, A.

No. 1.—1869. Briozoi pliocenici Italiani. Pt. I. Sitzb. k. Ak. Wiss. Wien, lix. Abt. i. pp. 17–28, 2 plates.

No. 2.—1869–1870. Briozoi fossili Italiani. Pt. II.–IV. Ibid. lix. Abt. i. pp. 512–523, 2 plates; lx. Abt. pp. 930–944, 4 plates; lxi. Abt. pp. 323–349, 6 plates.

No. 3.—1877. I Briozoi fossili del Miocene d'Austria ed Ungheria. Parte II. Celleporidea, Escharidea, Vincularidea, Selenaridea. Denk. k. Akad. Wiss. Wien, xxxvii. Abt. ii. pp. 49–78, pls. i.–xvii.

No. 4.—1878. Ditto. Parte III. Crisidea, Idmoneidea, Entalophoridea, Tubuliporidea, Diastoporidea, Cerioporidea. Ibid. xxxviii. Abt. ii. pp. 1–24, pls. i.–xviii.

Marsson, Th.

No. 1.—1887. Die Bryozoen der weissen Schreibkreide der Insel Rügen. Pal. Abh. iv. Heft i. pp. 112, pls. 10.

No. 2.—1888. In Fr. Noetling, Die Fauna des samlandischen Tertiärs. Th. ii. Lf. v. Bryozoa. Abh. geol. Specialk. Preuss. vi. Heft 4, pp. 555–560.

Meunier, A., & Pergens, Ed.

No. 1.—1886. Les Bryozoaires du Système Montien. 8vo. *Louvain.* Pp. 15, pls. 3.

No. 2.—1886. Nouveaux Bryozoaires du crétacé supérieur. Ann. Soc. Malacol. Belg. xx. Mém. pp. 32–37, pl. ii.

No. 3.—1887. La faune des Bryozoaires garumniens de Faxe. Ibid. xxi. (1886) Mém. pp. 187–242, pls. ix.–xiii.

Michelin, Hardouin.

No. 1.—1840–1847. Iconographie Zoophytologique : description par localités et terrains des Polypiers fossiles de France et pays environnants. Groupe Supracrétacé, pp. 149–178, pls. 43–46. 1844.

Moll, J. P. C.

No. 1.—1803. Eschara ex Zoophytorum seu Phytozoorum ordine pulcherrimum ac . . . . . . 4to. *Vindobonæ.* 70 pp., 4 pls.

Morren, C. F. A.

No. 1.—1828. Descriptio coralliorum fossilium in Belgio repertorum. Ann. Ac. Groning. 4to. 76 pp., 7 pls.

Morris, J.

No. 1.—1843. Catalogue of British Fossils. 8vo. *London.* Pp. x + 222.

No. 2.—1854. Ditto. Ed. 2. Ditto. Pp. viii + 372.

Mourlon, Michel.

No. 1.—1881. Géologie de la Belgique. 8vo. *Bruxelles.* T. ii. pp. xvi + 392.

Müller, O. F.

No. 1.—1788–1806. Zoologia Danica, seu Animalium Daniæ et Norvegiæ rariorum ac minus notorum Descriptiones et Historia. Fol. *Havniæ.* Vols. i. 1788, 52 pp.; ii. 1788, 56 pp.; iii. 1789, 71 pp.; iv. 1806, 46 pp.

Münster, von.

No. 1.—1835. Bemerkungen über einige tertiäre Meerwasser-Gebilde in nordwestlichen Deutschland zwischen Osnabrück und Cassel. N. Jahrb. 1835, pp. 420–451.

Novák, Ottomar.

No. 1.—1877. Beitrag zur Kenntniss der Bryozoen der böhmischen Kreideformation. Denk. k. Ak. Wiss. Wien, xxxvii. Abt. ii. pp. 79–118, pls. i.–x.

D'ORBIGNY, ALCIDE.

No. 1.—1839 & 1846. Voyage dans l'Amérique méridionale. v. pt. 4. Zoophytes. 4to. *Paris.* 28 pp., 13 pls.

No. 2.—1850–1852. Bryozoaires. Pal. Franç. Terr. Crét. v. 8vo. *Paris.* 1192 pp., pls. 600–800.

ORTMANN, A.

No. 1.—1890. Die Japanische Bryozoenfauna. Arch. f. Nat. 1890, I. Heft i. pp. 1–74, pls. i.–iv.

PERGENS, ED. (See also MEUNIER & PERGENS.)

No. 1.—1887. Pliocäne Bryozoën von Rhodos. Ann. k. k. Naturh. Hofmus. Wien, ii. pp. 1–34, pl. i.

No. 2.—1889. Zur fossilen Bryozoenfauna von Wola Lu'zanska. Ann. Soc. Géol. Belg. Mém., Hydr. iii. pp. 59–72.

No. 3.—1889. Revision des bryozoaires du Crétacé figurés par d'Orbigny. I. Cyclostomata. Ibid. iii. pp. 305–400, pls. xi.–xiii.

No. 4.—1889. Les Bryozoaires du Tasmajdan à Belgrade. Ann. Soc. Malac. Belg. xxii. (1887) Bull. pp. xii–xxviii.

No. 5.—1889. Note supplémentaire sur ditto. Ibid. pp. lix–lx.

No. 6.—1889. Note préliminaire sur les Bryozoaires fossiles des environs de Kolosvar. Ibid. pp. xxxiii–xxxvii.

No. 7.—1889. Untersuchungen an Seebryozoen. Zool. Anz. xii. pp. 504–510, 526–533.

No. 8.—1890. Notes succinctes sur les Bryozoaires. Ann. Soc. Mal. Belg. xxiv. Bull. pp. xx–xxiv.

PHILIPPI, R. A.

No. 1.—1844. Beiträge zur Kenntniss der Tertiärversteinerungen des nordwestlichen Deutschlands. 4to. *Kassel* (1843). 87 pp., 5 pls.

POURTALÈS, L. F. DE.

No. 1.—1868–1869. Contributions to the Fauna of the Gulf Stream at great depths (1867–8). Bull. Mus. Comp. Zool. i. pp. 103–120, 121–142.

REUSS, A. E. VON.

No. 1.—1847. Die fossilen Polyparien des Wiener Tertiärbeckens. Ein monographischer Versuch. Haidinger's Naturwiss. Abh. ii. S. i. *Wien.* 4to. 109 pp., 11 pls.

No. 2.—1851. Ein Beitrag zur Paläontologie der Tertiärschichten Oberschlesiens. Zeit. deut. geol. Ges. iii. pp. 149–184, pls. viii., ix.

No. 3.—1855. Beiträge zur Charakteristik der Tertiärschichten des nördlichen und mittleren Deutschlands. Sitzb. k. Ak. Wiss. Wien, xviii. Abt. i. pp. 197–273, 12 pls.

No. 4.—1864. Bemerkungen über die Bryozoengattung *Cumulipora,* v. M. Jahrb. k. k. geol. Reichs. xiv. Verh. pp. 21, 22.

No. 5.—1864. Ueber Anthozoen und Bryozoen des Mainzer Tertiärbeckens. Sitzb. k. Ak. Wiss. Wien, l. Abt. i. pp. 197–210, pls. i., ii.

No. 6.—1864. Die fossilen Foraminiferen, Anthozoen und Bryozoen von Oberburg in Steiermark. Denk. k. Ak. Wiss. Wien, xxiii. pp. 1–38, pls. i.–x.

No. 7.—1865. Die Foraminiferen, Anthozoen und Bryozoen des deutschen Septarienthones. Ein Beitrag zur Fauna der mitteloligocänen Tertiärschichten. Ibid. xxv. pp. 117–214, pls. i.–xi.

No. 8.—1865. Zur Fauna des deutschen Oberoligocäns. Sitzb. k. Ak. Wiss. Wien, l. Abt. i. pp. 614–691, pls. vi.–xv.

No. 9.—1867. Die fossile Fauna der Steinsalzablagerungen von Wieliczka in Galizien. Ibid. lv. Abt. i. pp. 17–182, pls. i.–viii.

No. 10.—1867. Ueber einige Bryozoen aus dem deutschen Unteroligocän. Ibid. pp. 216–234, pls. i.–iii.

No. 11.—1869. Paläontologische Studien über die älteren Tertiärschichten der Alpen. Th. ii. Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosara. Denk. k. Ak. Wiss. Wien, xxix. pp. 215–298, pls. xvii.–xxxvi.

No. 12.—1870. Ueber tertiäre Bryozoen von Kischenew in Bessarabia. Sitzb. k. Ak. Wiss. Wien, lx. Abt. i. pp. 505–513, pls. i., ii.

No. 13.—1872. Die Bryozoen und Foraminiferen des unteren Pläners. In H. B. Geinitz, Das Elbthalgebirge in Sachsen. IV. Palaeontogr. xx. pp. 97–144, pls. xxiv.–xxxiii.

No. 14.—1874. Die fossilen Bryozoen des österreichisch-ungarischen Miöcans. Abt. i. Salicornaridea, Cellularidea, Membraniporidea. Denk. k. Ak. Wiss. Wien, xxxiii. pp. 141–190, pls. i.–xii.

Ridley, S. O.

No. 1.—1881. Account of the Polyzoa collected during the Survey of H.M.S. 'Alert' in the Straits of Magellan and on the Coast of Patagonia. Proc. Zool. Soc. 1881, pp. 44–61, pl. vi.

Römer, F. A.

No. 1.—1840. Die Versteinerungen des norddeutschen Kreidegebirges. 4to. *Hannover*. Bryozoen in Lf. i. pp. 11–25, pl. v.

No. 2.—1863. Beschreibung der norddeutschen tertiären Polyparien. Palaeontogr. ix. pp. 199–246, pls. xxxv.–xxxix.

Schreiber, A.

No. 1.—1872. Die Bryozoen des mitteloligocänen Grünsandes bei Magdeburg. Zeit. f. gesammt. Naturwiss. xxxix. pp. 475–481, pls. iv., v.

Smitt, F. A.

No. 1.—1867. Bryozoa marina in regionibus arcticis et borealibus viventia recensuit. Öfver. K. Vet.-Akad. Förh. Stockholm, xxiv. pp. 443–487.

No. 2.—1872. Floridan Bryozoa collected by Count L. F. de Pourtalès. Pt. I. Handl. K. Svens. Vet.-Akad. x. No. 11. 20 pp., 5 pls.

No. 3.—1873. Ditto. Pt. II. Ibid. xi. No. 4. 83 pp., 13 pls.

Speyer, Oscar.

No. 1.—1864. Die Tertiärfauna von Söllingen bei Jerxheim im Herzogthum Braunschweig. Palaeontagr. ix. pp. 247–337, pls. xl.–xlii.

Stoliczka, Ferd.

No. 1.—1862. Oligocäne Bryozoen von Latdorf in Bernburg. Sitzb. k. Ak. Wiss. Wien, xlv. Abt. i. pp. 71–94, pls. i–iii.

No. 2.—1862. Ueber heteromorphe Zellenbildungen bei Bryozoen, *Coelophyma,* Reuss. Verh. k. k. zool.-bot. Ges. Wien, xii. Abh. pp. 101–104.

No. 3.—1864. Kritische Bemerkungen zu Herrn Fr. A. Römer's Beschreibung der norddeutschen tertiären Polyparien. N. Jahrb. 1864, pp. 340–347.

No. 4.—1865. Fossile Bryozoen aus dem tertiären Grünsandsteine der Orakei-Bay bei Auckland. 'Novara' Reise, Geol. Th. i. Abt. ii. Pal. pp. 87–158, pls. xvii.–xx.

Stremme, E.

No. 1.—1888. Beitrag zur Kenntniss der tertiären Ablagerungen zwischen Cassel und Detmold, nebst einer Besprechung der norddeutschen Pecten Arten. Zeit. deut. geol. Ges. xl. pp. 310–354, pls. xx.–xxi.

Waters, A. W.

No. 1.—1881. On fossil Chilostomatous Bryozoa from South-west Victoria, Australia. Quart. Journ. Geol. Soc. xxxvii. pp. 309–347, pls. xiv.–xviii.

No. 2.—1882. On fossil Chilostomatous Bryozoa from Mount Gambier, South Australia. Quart. Journ. Geol. Soc. xxxviii. pp. 257–276, pls. vii.–ix.

No. 3.—1882. On Chilostomatous Bryozoa from Bairnsdale, Gippsland. Ibid. pp. 502–513, pl. xxii.

No. 4.—1883. Fossil Chilostomatous Bryozoa from Muddy Creek, Victoria. Ibid. xxxix. pp. 423–443, pl. xii.

No. 5.—1884. Fossil Cyclostomatous Bryozoa from Australia. Ibid. xl. pp. 674–697, pls. xxx., xxxi.

No. 6.—1885. Chilostomatous Bryozoa from Aldinga and the River Murray Cliffs, South Australia. Ibid. xli. pp. 279–310, pl. vii.

No. 7.—1887. On Tertiary Chilostomatous Bryozoa from New Zealand. Ibid. xliii. pp. 40–72, pls. vi.–viii.

No. 8.—1887. On Tertiary Cyclostomatous Bryozoa from New Zealand. Ibid. xliii. pp. 337–350, pl. xviii.

No. 9.—1887. Bryozoa from New South Wales, North Australia, &c. Pt. I. Ann. Mag. Nat. Hist. (5) xx. pp. 81–95, pl. iv. Pt. II. Ibid. pp. 181–203, pls. v., vi. Pt. III. pp. 253–265, pl. vii.

No. 10.—1888. Supplementary Report on the Polyzoa collected by H.M.S. 'Challenger' during the years 1873–1876. Chall. Exp., Zool. xxxi. (pt. lxxix.). 4to. 41 pp., 3 pls.

No. 11.—1889. Bryozoa from New South Wales. Ann. Mag. Nat. Hist. (6) iv. pp. 1–24, pls. i.–iii.

No. 12.—1891. North Italian Bryozoa. Pt. I. Cheilostomata. Quart. Journ. Geol. Soc. xlvii. pp. 1–34, pls. i.–iv.

No. 13.—1892. Ditto. Pt. II. Cyclostomata. Ibid. xlviii. pp. 153–162, pl. iii.

Whitelegge, T.

No. 1.—1887. Notes on some Australian Polyzoa. Proc. Linn. Soc. N. S. Wales (2) ii. pp. 337–347. [Reprinted 1888, Ann. Mag. Nat. Hist. (6) i. pp. 13–22.]

B. *Works bearing on the Distribution of the British Eocene Bryozoa.*

BRISTOW, H. W.

A.—1889. Geology of the Isle of Wight. Ed. 2.

HUXLEY, T. H., and ETHERIDGE, R.

A.—1865. A Catalogue of the Collection of Fossils in the Museum of Practical Geology. 8vo. Pp. lxxixx + 381.

Ditto, and NEWTON, E. T.

B.—1878. A Catalogue of the Tertiary and Post-Tertiary Fossils of the Museum of Practical Geology. 8vo. 90 pp.

JUDD, J. W.

A.—1883. The Oligocene Strata of the Hampshire Basin. Geol. Mag. (2) x. pp. 525–527.

KLAASSEN, H. M.

A.—1883. On a section of the Lower London Tertiaries at Park Hill, Croydon. Proc. Geol. Assoc. viii. pp. 226–249.

LOBLEY, J. LOGAN.

A.—1887. The Geology of the Parish of Hampstead. Trans. Middlesex Nat. Hist. Sci. Soc. pp. 64–102.

VINE, G. R.

A.—1886. Report on Recent Polyzoa. Rep. Brit. Assoc. 1885, pp. 481–680.

B.—1889. Notes on British Eocene Polyzoa. Proc. Yorks. Geol. & Polyt. Soc. xi. pt. i. pp. 154–169, pl. v.

C.—1892. Notes on some new or little-known Eocene Polyzoa from localities. Ibid. xii. pt. i. pp. 52–61.

WATERS, A. W.

A.—1879. In Gardner, J. S., Description and Correlation of the Bournemouth Beds. Pt. I. Upper Marine Series. Quart. Journ. Geol. Soc. xxxv. pp. 224–225.

WETHERELL, N. T.

A.—1837. Observations on a well dug on the south side of Hampstead Heath. Trans. Geol. Soc. (2) v. pp. 131–135, pl. ix.

WHITAKER, W.

A.—1872. The Geology of the London Basin. Pt. I. Mem. Geol. Surv. iv. pt. i.

B.—1889. The Geology of London and of part of the Thames Valley. Mem. Geol. Surv. 2 vols.

IX. EXPLANATION OF THE PLATES.

PLATE XXIX.

Fig. 1. *Notamia wetherelli* (Busk), p. 226. Fig. 1 *a*, front view; 1 *b*, lateral view. London Clay, Highgate. Brit. Mus. No. 49731. × 37 diam.

Fig. 2. *Membranipora eocena* (Busk), p. 228. London Clay, Highgate. Brit. Mus. No. 49729. × 16 diam.

Fig. 3. *Membranipora eocena* (Busk). View of the back of the zoarium. London Clay, Highgate. Brit. Mus. No. 6330. × 12 diam.

Fig. 4. *Membranipora eocena* (Busk). Woolwich and Reading Beds, Croydon. Brit. Mus. $\times \frac{55}{2}$ diam.

Fig. 5. *Membranipora tenuimuralis*, n. sp., p. 231. London Clay, Highgate. Brit. Mus. No. 49736 (part of one of Busk's types of *M. lacroixi*). $\times \frac{55}{2}$ diam.

Fig. 6. *Membranipora tenuimuralis*, n. sp. London Clay, Highgate. Brit. Mus. No. 49736. $\times \frac{55}{2}$ diam.

Fig. 7. *Membranipora tenuimuralis*, n. sp. London Clay, Highgate. Brit. Mus. No. B 4331. × 55 diam.

Fig. 8. *Membranipora virguliformis*, n. sp., p. 232. London Clay, Highgate. Brit. Mus. No. 49658. × 25 diam.

Fig. 9. *Membranipora disjuncta*, n. sp., p. 232. London Clay, Highgate. Brit. Mus. No. 69205. Fig. 9 *a*. × 4 diam., to show general arrangement of the zoarium. Fig. 9 *b*. × 12 diam., to show structure of the zoœcia.

Fig. 10 *a*. *Membranipora crassomuralis*, n. sp., p. 229. Barton Clay, Barton. Brit. Mus. No. 49741. × 32 diam.

Fig. 10 *b*. *Membranipora crassomuralis*, n. sp. Barton Clay, Barton. Brit. Mus. No. 49740. × 32 diam. Another specimen growing on a strongly ribbed *Pecten*.

Fig. 11. *Membranipora buski*, n. sp., p. 229. Headon Beds, Colwell Bay. Brit. Mus. No. B 4625. × 55 diam.

Fig. 12. *Membranipora buski*, n. sp. Headon Beds, Colwell Bay. Mus. Pract. Geol. Specimen with numerous oœcia. × 55 diam.

Fig. 13. *Lunulites transiens*, n. sp., p. 233. Barton Beds, Barton. Brit. Mus. No. 49724. × 24 diam. View of the external layer of the zoarium.

Fig. 14. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 4339. × 24 diam.

PLATE XXX.

Fig. 1. *Lunulites transiens*, n. sp., p. 233. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 49724. $\times \frac{\frac{55}{3}}{4}$ diam. The centre of a zoarium, with the " ancestrula."

Fig. 2. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. B 4339. × 18 diam. In the lower part the front wall has been broken away.

Fig. 3. *Lunulites transiens*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49723. $\times \frac{\frac{55}{3}}{4}$ diam. Part of a worn zoarium resembling *L. urceolata*, Lamk.

Fig. 4. *Biselenaria offa*, n. sp., p. 235. Barton Beds, Barton. Brit. Mus. No. 49766. Upper surface of the zoarium. × 18 diam. Fig. 4 *a*. A fragment of another zoarium showing the zoœcia of the under surface. Brit. Mus. No. 49766. × 18 diam.

Fig. 5. *Biselenaria offa*, n. sp. Barton Beds, Barton. Another specimen: upper surface. Brit. Mus. No. 49759. $\times \frac{26}{2}$ diam.

Fig. 6. *Micropora cribriformis*, n. sp., p. 236. Barton Beds, Barton. Brit. Mus. No. B 4583. × 55 diam.

Fig. 7. *Onychocella magnoaperta*, n. sp., p. 237. Brockenhurst Beds (Mid. Headon), Brockenhurst. Brit. Mus. No. 49738. $\times \frac{\frac{55}{3}}{4}$ diam.

Fig. 8. *Cribrilina vinei*, n. sp., p. 238. London Clay, Sheppey. Brit. Mus. No. B 4514. (Vine's type of *Membraniporella nitida*.)

Fig. 9. *Schizoporella magnoaperta*, n. sp., p. 239. Barton Beds, Barton. Brit. Mus. No. 49733. $\times \frac{\frac{55}{2}}{3}$ diam.

Fig. 10. *Schizoporella magnoincisa*, n. sp., p. 240. London Clay, Hampstead. Brit. Mus. No. B 4515. × 30 diam.

Fig. 11. *Adeonellopsis incisa*, n. sp., p. 247. London Clay, Haverstock Hill. Brit. Mus. No. 49661. × 55 diam.

Figs. 12 & 13. *Adeonellopsis wetherelli*, n. sp., p. 245. London Clay, Haverstock Hill. Brit. Mus. No. 49756. Fig. 12 *a*. A zoarium, × 3 diam. Fig. 12 *b*. Upper zoœcia of the same, × 55 diam. Fig. 12 *c*. Lower zoœcia of the same, × 18 diam. Fig. 13. Basal zoœcia : No. B 3832 ; × 18 diam

PLATE XXXI.

Fig. 1. *Adeonellopsis wetherelli*, n. sp., p. 245. London Clay, Fareham. Basal zoœcia. Brit. Mus. No. B 4623. × 55 diam.

Fig. 2. *Lepralia lonsdalei*, n. sp., p. 247. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49734. × 55 diam.

Fig. 3. *Umbonula calcariformis*, n. sp., p. 249. London Clay, Fareham. Brit. Mus. No. B 3831. × 55 diam.

Fig. 4. *Umbonula bartonense*, n. sp., p. 248. Barton Beds, Barton. Brit. Mus. No. 49741. × 55 diam.

Figs. 5–7. *Teichopora clavata*, n. sp., p. 249. Barton Beds, Barton. Brit. Mus. No. 49733. × 55 diam. Fig. 5. Normal zoœcia. Fig. 6. Basal zoœcia: No. 49757. Fig. 7. Part with a gonœcium: No. 49659. × 55 diam.

Fig. 8. *Meniscopora bigibbera*, n. sp., p. 251. Bracklesham Beds, Huntingbridge. Brit. Mus. No. 49732. × 55 diam.

Fig. 9. *Meniscopora bigibbera*, n. sp. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49734. × 55 diam. Fragment with gonœcium.

Fig. 10. *Conescharellina clithridiata*, n. sp., p. 252. London Clay, Hampstead. Brit. Mus. No. 69554. × 18 diam.

Fig. 11. *Conescharellina clithridiata*, n. sp. London Clay, Sydenham. Brit. Mus. No. B 1357. × 18 diam. Another zoarium with oœcia.

Fig. 12. *Orbitulipora petiolus* (Lonsd.), p. 253. Bracklesham Beds, Bracklesham. Brit. Mus. No. 49760. Fig. 12. Zoarium, × 4 diam. Fig. 12 *a*. Zoœcia, × 18 diam.

Fig. 13. *Orbitulipora petiolus* (Lonsd.). Bracklesham Beds, Bramshaw. Brit. Mus. No. B 4349. × 12. Zoarium with stem.

Fig. 14. *Orbitulipora petiolus* (Lonsd.). Whitecliff Bay. Specimen in *Conescharellina* stage. Brit. Mus. No. B 4347.

Fig. 15. *Mucronella angustoœcium*, n. sp., p. 254. Barton Beds, Barton. Brit. Mus. No. 49739.

Fig. 16. *Mucronella angustoœcium*, n. sp. Brit. Mus. No. B 4579. × 55 diam.

PLATE XXXII.

Fig. 1. *Smittia tubularis*, n. sp., p. 255. London Clay, White Conduit House. Brit. Mus. No. 49744. × 55 diam. Fig. 1 *a*. Nat. size. Fig. 1 *b*. Upper zoœcia, × 55 diam. Fig. 1 *c*. Basal zoœcia, × 55 diam.

Fig. 2. *Idmonea bialternata*, n. sp., p. 257. London Clay, Islington. Brit. Mus. No. 49662. Fig. 2. Part of zoarium with oœcium. Fig. 2 *b*. Section.

Fig. 3. *Idmonea giebeli*, Stol., p. 256. London Clay, Haverstock Hill. Brit. Mus. No. 49656. × 55 diam. Fig. 3 *a*. Part of zoarium including an oœcium. Fig. 3 *b*. Transverse section.

Fig. 4. *Idmonea* aff. *seriatopora*, Reuss, p. 258. London Clay, Haverstock Hill. Brit. Mus. No. B 4510. Fig. 4 *a*. Part of zoarium, × 18 diam. Fig. 4 *b*. Mouth, × 32 diam. Fig. 4 *c*. Transverse section, × 18 diam.

Fig. 5. *Idmonea* aff. *seriatopora*. Back view of a zoarium, × 55 diam.

Fig. 6. *Idmonea coronopus*, Defr., p. 259. Calcaire grossier, Parnes. Brit. Mus. Fig. 6 *a*. Nat. size. Fig. 6 *b*. An entire colony, × 18 diam.

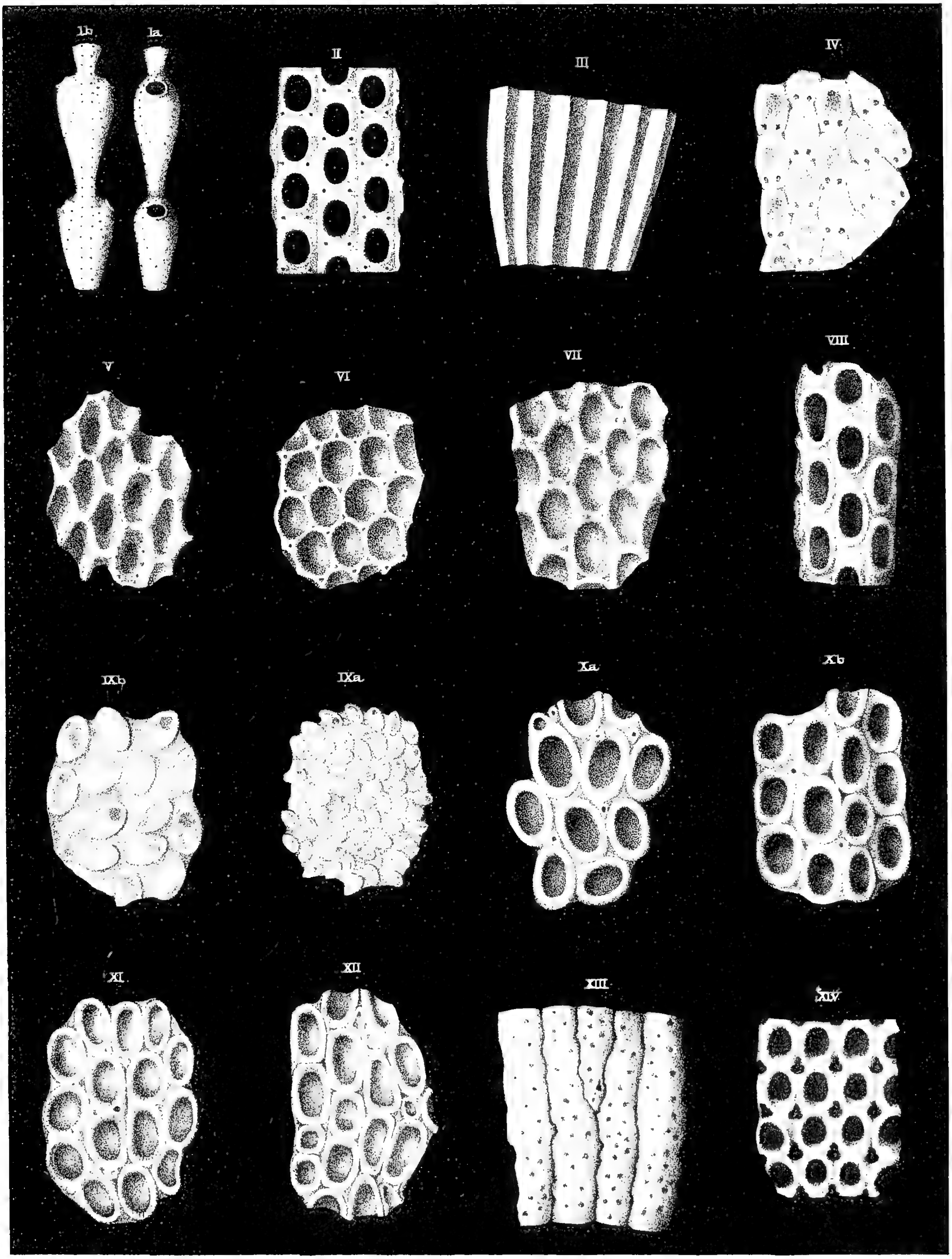
Figs. 7–9. *Hornera farehamensis*, n. sp., p. 260. London Clay, Fareham. Brit. Mus. No. B 3831. Fig. 7 *a*. A zoarium, nat. size. Fig. 7 *b*. View of back, × 18 diam. Fig. 8. Part of another zoarium, × 18 diam. Fig. 9. Basal zoœcia of another specimen, × 18 diam.

Fig. 10. *Entalophora tergemina*, n. sp., p. 260. London Clay, Sheppey Brit. Mus. No. B 4509. Figs. 10 *a* & 10 *b*. Two views of the same specimen, × 55 diam.

Figs. 11 & 12. *Heteropora glandiformis*, n. sp., p. 261. Barton Beds, Barton. Brit. Mus. No. B 4511. Fig. 11. An entire zoarium, × 18 diam. Figs. 12 *a* & 12 *b*. Broken transverse sections showing internal structure. No. B 4512. × 18 diam.

Fig. 13. *Lichenopora*, sp. Barton Beds, Barton. Brit. Mus. No. B 4583. × 10 diam.

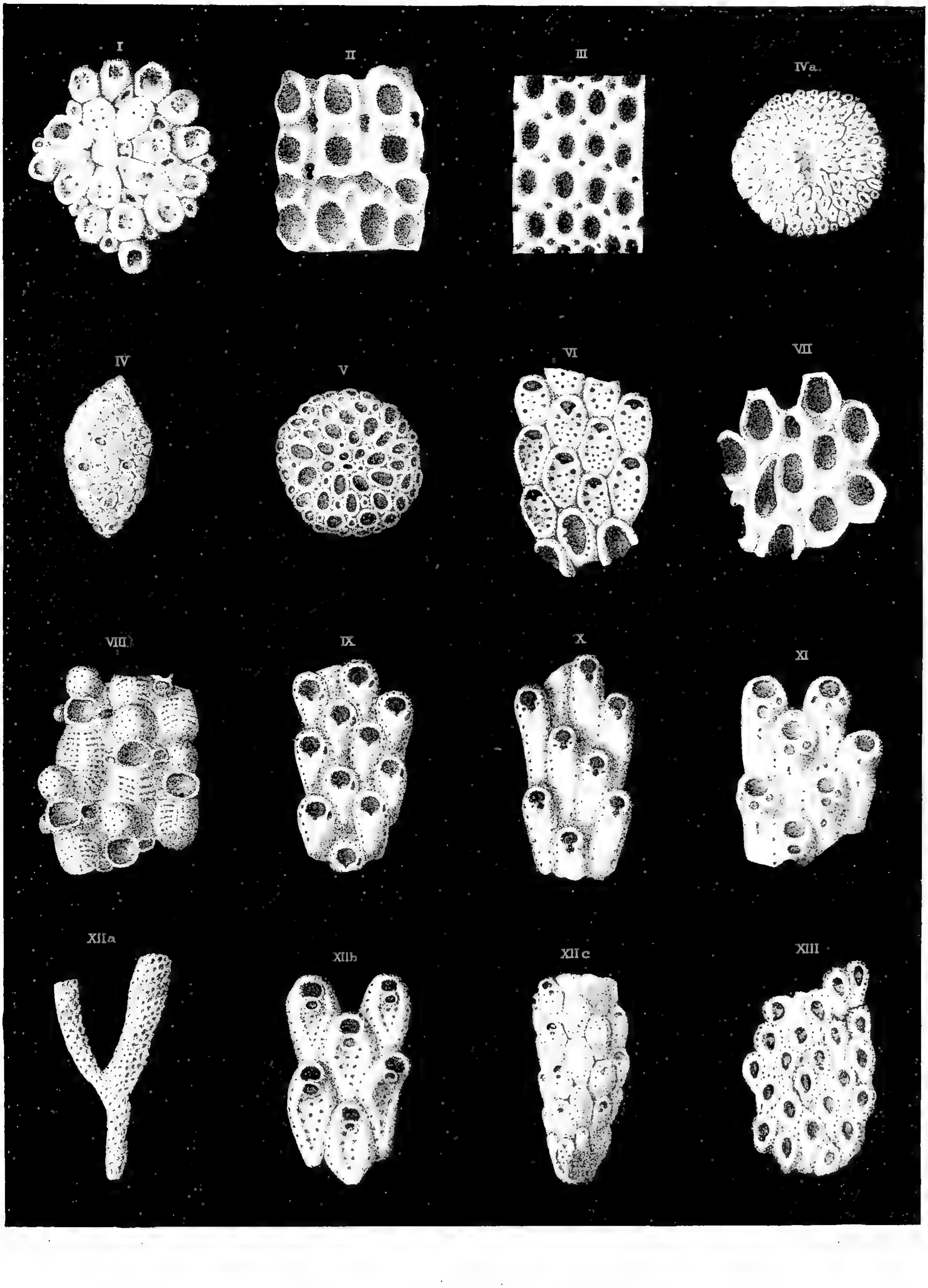
The numerator of the magnifying-power 'fractions' represents the original magnification, and the denominator the reduction from the size of the field of the microscope.

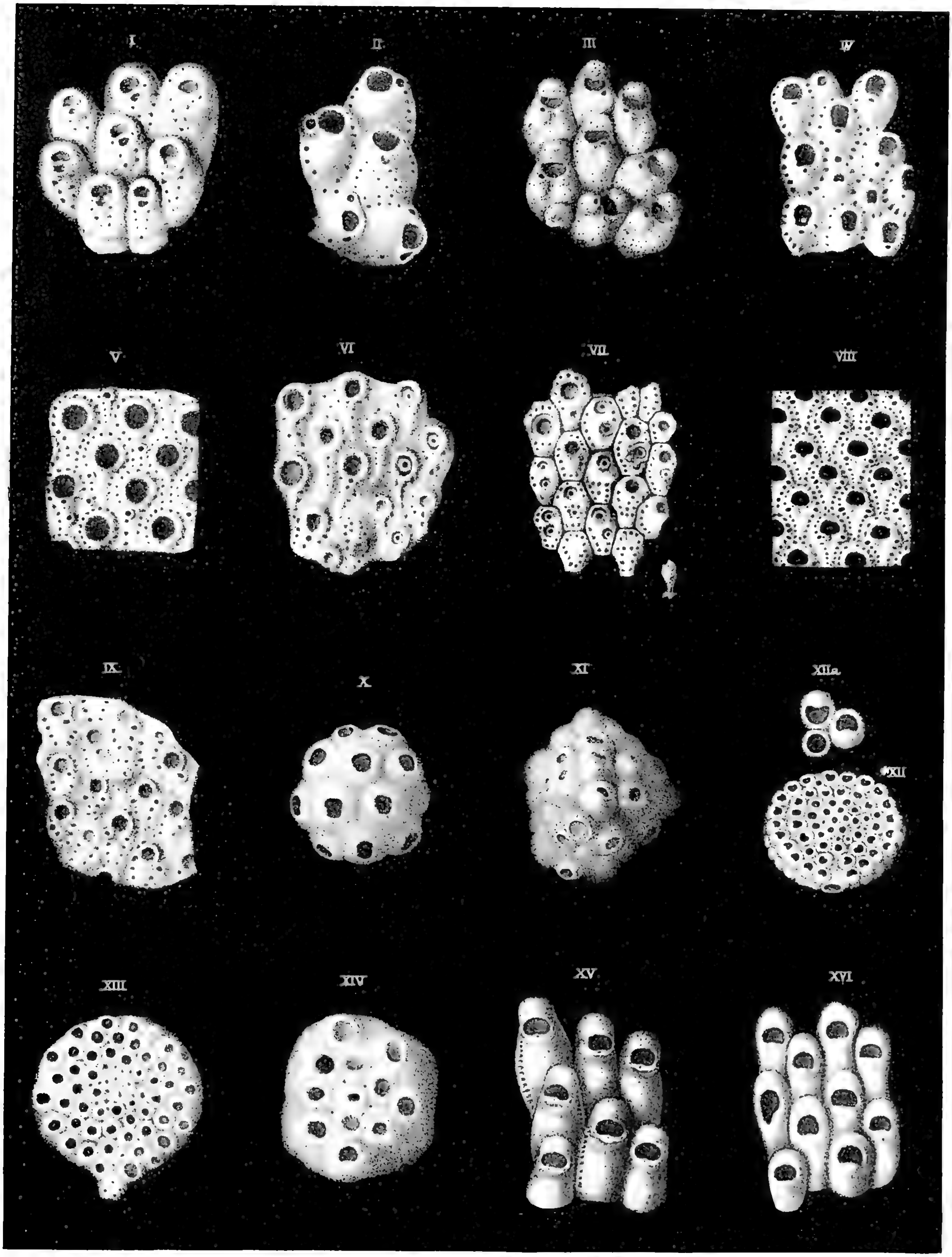


E.C. & M. Woodward del et lith.

West, Newman imp.

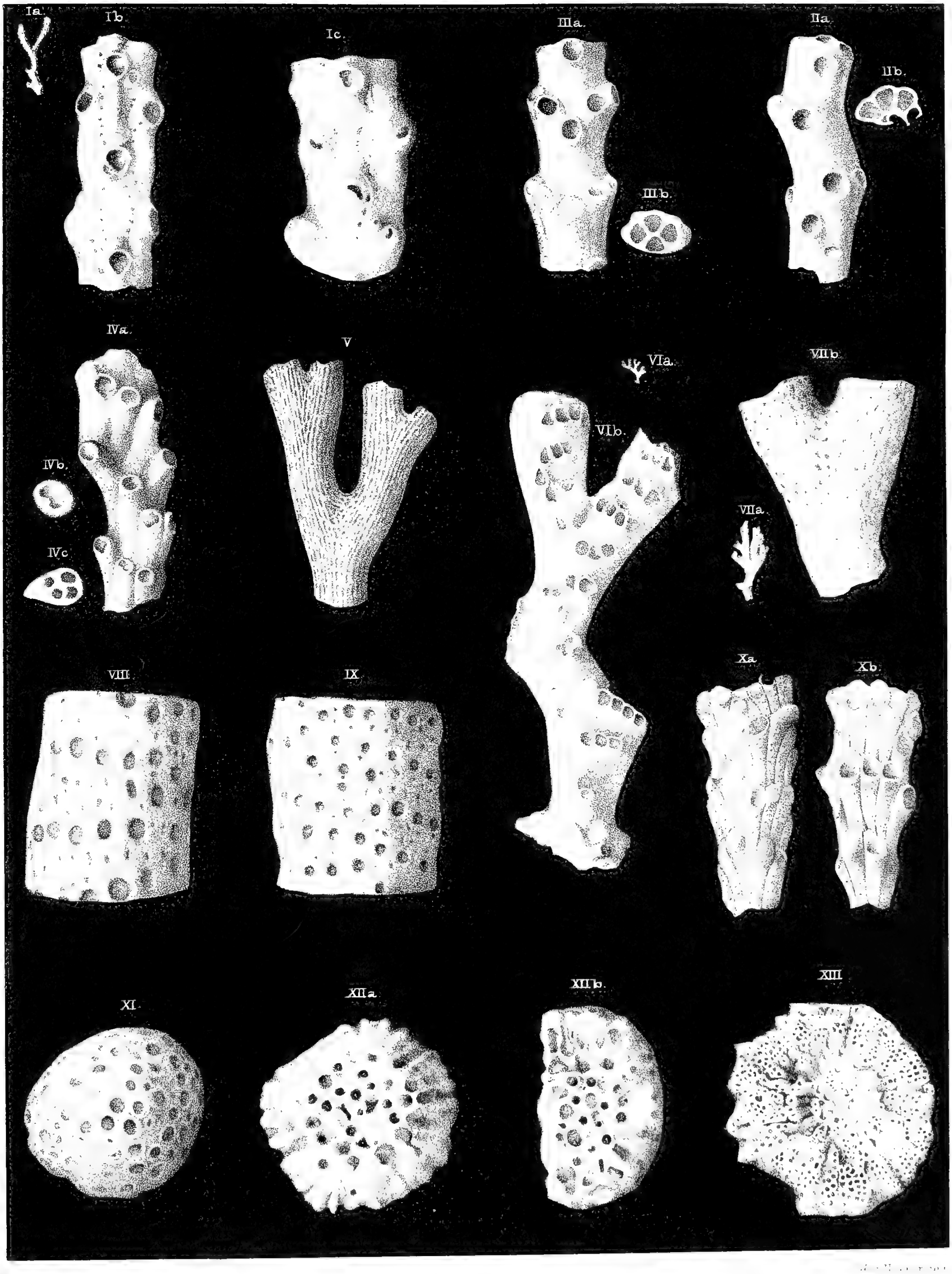
BRITISH PALÆOGENE BRYOZOA.


I
II
III
IVa.
IV
V
VI
VII
VIII
IX
X
XI
XIIa
XIIb
XIIc
XIII



E.C. & J.M. Woodward del. et lith. West Newman imp.

BRITISH PALAEOZOIC BRYOZOA


Ia.
Ib.
Ic.
IIIa.
IIa.
IIb.
IIIb.
IVa.
V.
VIa.
VIIb.
IVb.
VIb.
IVc.
VIIa.
VIII.
IX.
Xa.
Xb.
XI.
XIIa.
XIIb.
XIII.

IX. *On additional Bones of the Dodo and other Extinct Birds of Mauritius obtained by* Mr. Théodore Sauzier. *By* Sir Edward Newton, *K.C.M.G., F.L.S., C.M.Z.S., and* Hans Gadow, *Ph.D., M.A., F.R.S., F.Z.S.*

Received October 31st, 1892, read November 1st, 1892.

[Plates XXXIII.–XXXVII.]

In 1889 the Government of Mauritius appointed a Commission to enquire into the "Souvenirs Historiques" of that island; and in furtherance of their object, at the instance and under the able direction of their President, Mr. Théodore Sauzier, they continued the exploration of the Mare aux Songes—the marsh in which the late Mr. George Clark, upwards of five-and-twenty years ago, made the discovery of a vast deposit of bones of the Dodo [1] and other animals, mostly now extinct, and the only locality in Mauritius where remains of the Dodo have been found in any quantity [2].

This exploration has been very successful, for not only have many Dodos' bones, some of them new and others represented only by imperfect specimens, been recovered, but also a considerable number of the bones of other birds, materially adding to our knowledge of those which had been but partially described, and proving the former existence in Mauritius of species either vaguely indicated by old voyagers or wholly unsuspected to have been members of its fauna. Besides these there have been found many remains of the large extinct Lizard, *Didosaurus mauritianus* [3], and several carapaces, more or less entire, though none absolutely perfect, belonging to one or other of the extirpated Tortoises.

Nearly the whole of these specimens have been sent by Mr. Sauzier, on behalf of the Commission over which he presided, to the Museum at Cambridge, with a view to their determination and to the description of such as are new, and this task has been undertaken by the present writers.

Before proceeding to its execution, it may be as well to recall the fact that up to the present time, beside bones of *Didus ineptus*, those of the following birds have been obtained from this marsh and described as under:—

Lophopsittacus mauritianus (Owen).	Lower Jaw. R. Owen, Ibis, 1866, pp. 168 *et seqq.*
	Tibia. A. Milne-Edwards, Ann. Sc. Nat. sér. 5, vi. pp. 91 *et seqq.* (1866).

[1] Ibis, 1866, pp. 141 *et seqq.*
[2] Proceedings of the Zoological Society, 1890, pp. 402 *et seqq.*
[3] Günther, Journal of the Linnean Society, Zoology, xiii. pp. 322 *et seqq.*

Astur, sp. indet.	Metatarsus. *Id. op. cit.* xix. art. 3 (1874).
Ardea garzetta, Linnæus.	Tibia. *Id. loc. cit.*
Aphanapteryx broecki (Schlegel).	Lower Jaw, Tibia, Metatarsus. *Id. op. cit.* x. pp. 325 *et seqq.* (1868).
Fulica newtoni, A. Milne-Edwards.	Pelvis, Tibia, Metatarsus. *Id. op. cit.* viii. pp. 195 *et seqq.* (1867).

All these are species which no longer occur in the island.

Bones of a species of *Phœnicopterus* have also been found (G. Clark, Ibis, 1866, p. 144, and A. Milne-Edwards, Ann. Sc. Nat. sér. 5, xix. art. 3).

The present collection contains not only bones of the above-named birds, but also those of a Finch (?), an Owl, four other species of Heron, a Bittern, a Darter, a Gannet, a Goose, a Duck, a Grebe, two species of Pigeon, one of which is probably the extinct *Funingus (Alectorœnas) nitidissimus*, a Water-hen, and two Petrels, of which we proceed to describe and characterize as new:—

Strix sauzieri,
Astur alphonsi,
Butorides mauritianus,
Plotus nanus,
Sarcidiornis mauritianus, and
Anas theodori.

In naming these species we wish by the first and last to commemorate the services to science of Mr. Sauzier; while the *Astur*, being in all probability identical with that recognized but left unnamed by Professor Milne-Edwards, may be appropriately dedicated to him.

Of birds previously distinguished we have now for the first time the following parts:—

Didus ineptus.—Atlas, Prepelvic or "intermediate" (18th) Vertebra, complete Pubic Bones, and Metacarpals.

Lophopsittacus mauritianus.—Sternum (?), Femur, Metatarsus, beside Lower Jaw far larger than that first described.

Aphanapteryx broecki.—Upper Jaw, third Cervical Vertebra, Pelvis, Humerus, Femur[1].

Fulica newtoni.—Cervical vertebræ (third and ninth or tenth), Sternum, Sacrum, Humerus, Ulna, and Femur[1].

[1] There is a large series of tibiæ (39 right and 50 left), which must belong to one or the other of these two species, but except in a few cases it is impossible to distinguish between them.

One specimen at least of each of the bones now first described has been kindly presented by Mr. Sauzier, on behalf of the Commission of which he is President, to the Museum of the University of Cambridge, as well as a series of other bones in proportion to the extent of the collection. The remainder, including a magnificent skeleton, which has been mounted in that Museum and is doubtless the most complete in the world, of *Didus ineptus,* will be ultimately deposited in the Museum of Mauritius at Port Louis.

1. Lophopsittacus mauritianus. (Plate XXXIII. figs. 1–8.)

A complete tibia obtained previously from Mauritius and having been assigned, although not described, by M. Milne-Edwards to *Lophopsittacus mauritianus,* made it easy to recognize 46 other tibiæ taken from the Mare aux Songes as belonging to the same species of Parrot.

Several femora, varying from 58 to 63 mm. in length, are likewise easily referable to the same species.

There is also a left tarso-metatarsus of 35 mm. in length, typically flattened and broadened out, with the outer condyle turned backwards and outwards in accordance with the reversed fourth toe. The plantar tuberculum near the proximal end of the bone is partly broken off, but sufficiently preserved to show the two canals lying side by side, through which the tendons of the deep flexors of the hallux and other three digits passed. Near the inner or tibial margin of the second metatarsal is a deep impression, caused by the insertion of the tendon of the m. tibialis anticus. The position of this insertion, near the inner side of the second metatarsal, instead of near the middle of the third metatarsal, is typical of Parrots. Above this impression is a deep oblique groove, in which lodged the tendon of the m. extensor digitorum in its oblique course from under the bony tibial bridge to the inner side of the foot. This peculiar groove exists also in *Necropsittacus rodericanus, Calyptorhynchus funereus, Cacatua galerita, Licmetis tenuirostris,* and *Macrocercus macao,* but apparently not in *Stringops, Domicella,* or *Trichoglossus,* although the tendons run in precisely the same direction, passing over the tarsus without leaving any impression upon the bone. The erratic occurrence of this groove, intensified by age, but absent in a fully adult *Stringops,* detracts from its taxonomic value.

The following measurements show that the relative lengths of the femur, tibia, and metatarsus from Mauritius are so similar to those of other Old-World Parrots that the bones in question can without doubt be referred to one species only. The measurements show also that this species was considerably larger than *Necropsittacus rodericanus,* agreeing in the length of its hinder extremity with *Cacatua galerita.*

	Necropsittacus rodericanus.	*Lophopsittacus mauritianus.*	*Calyptorhynchus funereus.*	*Cacatua galerita.*	*Palæornis alexandri.*
	mm.	mm.	mm.	mm.	mm.
Femur	46–49	58, 61, 63	55	60	37
Tibia	59–63	{ 88, 93 (type specimen), 99 }	74	86	50
Metatarsus	22	35	25	27	18
Total length of hind limb	127–134	181–197	154	173	105
Width of sternum at level of 1st rib	20·0	27·5	....	32	
Distance from spina externa to height of crista sterni	20·0	22·0	....	32	
Distance from spina interna to subclavian ridge	13·5	16·0	....	20	
Greatest length of mandibles	57	65, 71, 78	....	53	
Greatest width of mandibles	50	65	....	41	

The most interesting part of this Parrot is the enormous underjaw. One pair of underjaws is absolutely complete but for a few particles of bone being broken off from the anterior margin. The left mandibles of two other specimens are nearly complete. A fourth specimen is represented by the posterior half of the left mandible only. These four jaws vary somewhat in size. The distance from the posterior angle (*p* in fig. 5, Plate XXXIII.) to the anterior end of the complete symphysis is in the largest and best preserved specimen 78 mm., in the next 71, in the third only 65 mm. The smallest specimen of the extinct Mauritian Parrot is consequently still 8 mm. larger than that of *Necropsittacus rodericanus.* The width of the mandibles shows the same proportions. Each underjaw has a distinct additional articulating facet, about 7 mm. in length, for the ventral surface of the outer process of the quadrate, which carries the jugal bone. Such an additional facet, besides the usual one at the ventral end of the quadrate, is indicated in *Cacatua galerita*, broad and well developed in *Stringops*, *Calyptorhynchus*, and *Ara*: in fact, in many Parrots with powerful and broad underjaws.

It seems rather improbable that such an enormous jaw should be associated with a Cockatoo of moderate size; but, curiously enough, the comparison of the greatest length of the mandibles with the total length of the hinder extremity shows that *Necropsittacus rodericanus* had actually a proportionately larger jaw than the species of Mauritius, because the length of the jaw should not be more than 50 or 51, while it is in fact 57 mm. Of course it is hardly necessary to observe that there can scarcely be any correlation between the length of the whole leg and the size of the bill and head in a Parrot; but, having to deal with scanty remains of birds whose anatomical structure is otherwise unknown, we have to be grateful for small mercies. At any rate, we find that the Parrots from Mauritius and from Rodriguez not only resemble each other in the proportions of the bones of their hinder extremities, but also in the enormous development of their jaws, a feature which makes them unlike any other Parrots. Moreover, these considerations enable us to discuss with some amount of certainty, or at least probability, the only other bone of a Parrot which has been found in the Mare aux Songes: to wit, the sternum.

The sternum is preserved only in its anterior part. The large spina externa agrees in shape and direction exactly with that of *N. rodericanus*, and excludes any possibility of this sternum belonging to any other bird but a Parrot. The ventral margin of part of the keel is broken off, but the line of the m. subclavius is well marked; the whole of the anterior margin and the articulating facets for several ribs are likewise uninjured. This sternum appears at the first glance undoubtedly far too small for *L. mauritianus*, but if we measure its width in level of the first pair of ribs, the height of the keel, the distance from the middle of the anterior margin of the sternum (at the place where the spina interna would be if it existed in these Parrots) to the highest curve of the keel, or to the muscular ridge at the point (Plate XXXIII. fig. 7, *S*), we find that this fragmentary sternum by all its dimensions indicates that it belonged to a larger bird than *N. rodericanus.* In fact, the size of this sternum would fit one of the smaller specimens of *L. mauritianus*; and this is corroborated by the following calculation, which gives a result which we should not have expected:—Average of total length of hind limb of *N. rodericanus* (130): width of its sternum (20)=Length of hind limb of smallest *L. mauritianus* (181): width of its sternum would be 27·8, while our single sternum from Mauritius actually measures 27·5 mm. across!

There can be no doubt that the extinct Mauritian Parrot was a larger but otherwise nearly allied form of the Parrot from Rodriguez; it is, however, questionable whether both might not be included in the same genus *Necropsittacus*, for while we know from old drawings that the Mauritian form had a sort of ornamental crest, we know nothing to the contrary of *N. rodericanus.*

2. Astur alphonsi, sp. nov. (Plate XXXIII. figs. 9, 10.)

Amongst numerous Asturine remains a pair of tibiæ, a pair of metatarsals, and the metacarpals of the left side are probably referable to one individual bird of prey. The two metatarsals, with a length of 81 mm., agree perfectly with that figured by M. Milne-Edwards (plate 33. fig. 2). He rightly referred them to the genus *Astur*, and remarked that they belonged to a bird which was undescribed and unknown, unless it was identical with *A. melanoleucus* from the Cape of Good Hope. We have been able to measure the length of the tarso-metatarsus of an *A. melanoleucus*, and have found that it agrees in this respect with the two bones in question. It would therefore seem reasonable to assign these bones to *A. melanoleucus*, unless the absence of this South-African species from Madagascar, and the numerous instances of insular forms or species of Hawks, be deemed arguments sufficiently strong to distinguish the bird to which these bones belonged as *Astur alphonsi.*

The greatest length of the two tibiæ is 117 mm., which agrees proportionately with that of the two metatarsi, so as to justify us in connecting them with each other as those of the same Hawk, a view which is corroborated by the tibial and metatarsal articulating facets fitting well upon each other. The bony bridge for the m. flexor digitorum communis is very strong, the fibula reaches far down the tibia, the peroneal crest is straight and long, the cnemial crest slants gradually into the anterior inner edge of the shaft of the tibia.

It is of course impossible to state with certainty whether the metacarpal bones, the total length of which is 55 mm., belong to the same individual; that they belong to the same species is more than probable, and that they are those of a diurnal bird of prey of the size of *Astur melanoleucus* is unquestionable. All the facets, tendinous impressions and processes, and the sharp, blade-like, deeply scooped-out third metacarpal bone mark the specimen.

3. Strix sauzieri, sp. nov. (Plate XXXIII. figs. 11–18.)

The Owls are generally classified according to cranial, sternal, and various purely external characters. None of these points will serve our purpose, because the only bones of Owls in the present collection are those of the humerus, tibia, and metatarsus.

There is one character, namely the relative length of the tibia to that of the metatarsus, which is not only very constant but also very characteristic of the various families and even genera of Owls. From the quotient resulting from the division of the length of the tibia by that of the metatarsus we have come to the conclusion that the majority of the bones in question, namely four metatarsals, three tibiæ, and, by inference, two humeri, belonged to a member of the long-footed Owls, of which *Strix flammea* and its allies is the most pronounced type, while *Heliodilus soumagnii* from Madagascar closely approaches it, to the exclusion of *Carine murivora* from Rodriguez, *Scops*, *Sceloglaux novæ-zealandiæ*, *Spiloglaux*, *Gymnoscops*, *Asio*, and *Bubo* as examples of the several subfamilies and principal genera of the so-called *Bubonidæ*.

We have much pleasure in distinguishing this new Owl from Mauritius as *Strix sauzieri*, referring it to the genus *Strix*, and not to *Heliodilus*, on the strength of most of those very characters which induced M. A. Milne-Edwards to establish the new genus *Heliodilus*[1]. These characters are, first, the relative length of the tibia

[1] It will be convenient to mention here at least those characters which could be tested with the material at our disposal:—

"L'Héliodile est un Strigide à pattes robustes, à ailes plus courtes et à tête plus large que les Effraies (*Strix*). Le tibia est plus long et les proportions en sont différentes, car l'extrémité inférieure est plus robuste et le corps de l'os est aussi grêle; la crête péronnière est courte et le péroné ne se prolonge pas autant que chez les Chouettes et les Hiboux. Si l'os de la jambe est plus long que celui de l'Effraie, celui du pied est au contraire plus court; mais ses caractères sont à peu près les mêmes que dans ce dernier genre."—A. Milne-Edwards, Comptes Rendus (1878), vol. 85, p. 1282.

and metatarsus; secondly, the length of the "péroné" or fibula, which, at least in the two larger specimens, is continued far beyond the level of the tubercle of the hallux attachment, as far down as the epicondyle; thirdly, the relatively greater length of the peroneal crest, which in our specimens extends to the end of the upper third of the tibia, while in *Heliodilus* it ends a little below the upper fourth; the actual peroneal connexion, *i. e.* the ridge of the tibia which touches the fibula, is absolutely and relatively larger in our specimens than on the tibia figured by M. Milne-Edwards (Grandidier, Ois. de Madagascar, plate 36 *c*, fig. 8).

On the other hand, there are differences, notably the longer and higher cnemial process of the tibia and the shortness of the humerus, sufficient to justify the specific distinction of this Mauritian Owl from *Strix flammea*, with its numerous varieties.

	Humerus.	Tibia.	Metatarsus.	Quotient. Tibia./Metatarsus.	
	mm.	mm.	mm.	mm.	
Strix sauzieri	71	90, 92, 93	63, 63, 64, 64, 66	1·42	↑ Longest Metatarsus.
——, sp.	..	..	56 pair.		
—— flammea	84	85	60	1·42	
Heliodilus soumagnii	72	87	57–60	1·52	
Athene murivora	64–69	69–76	41–46	1·65–1·70	
Asio capensis	..	95	56	1·70	
Scops rutilus	47	50	28	1·80	
Sceloglaux novæ-zealandiæ	58	64	35	1·83	
Bubo virginianus	163	146	75	1·94	
—— madagascariensis	80	82	41	2·0	↓ Shortest Metatarsus.

The pair of metatarsi measuring 56 mm. in length are at the same time much more slender than the other five metatarsi. We do not feel justified in explaining this considerable difference in size and strength by difference of age, because the bones are fully ossified and show all the characteristic markings in the same pronounced degree. Only the bony bridge over the tendon of the m. tibialis anticus is broken, and was moreover certainly incomplete in both of the smaller metatarsi. We naturally tried to fit the shortest tibia of 90 mm. length on to the metatarsus of the corresponding side, but the tibial condylar facets are a little too large. If they fitted, the quotient of this shortest tibia with the shortest metatarsus being 1·61 would indicate an Owl different from any of those which are mentioned in our list. *Asio capensis* cannot be thought of, because its metatarsus is several times stronger than the two in question, nor do we feel inclined to explain the shortness and slender shape of these two bones by sexual difference of *Strix sauzieri*. Unless we assume, what is unlikely, that the island of Mauritius possessed two different species of *Strix*, we have to conclude that the short pair of metatarsals belonged to a small individual of *Strix* *sauzieri*, although it is rather improbable that this species, restricted to a small island, varied as much as British specimens of *Strix flammea*, of which latter the British Museum Catalogue records the length of the "tarsus" as 2·2 inches, *i. e.* 55 mm., while the measurements taken from an English specimen in the Cambridge Museum give the length of this bone as 60 mm.

4. Plotus nanus, sp. nov. (Plate XXXIV. figs. 1–5.)

The humerus, pelvis with sacrum, and tibia of the genus *Plotus* possess so many diagnostic characters that the three bones figured on Plate XXXIV. can easily be recognized as belonging to this genus of *Steganopodes.*

The *Humerus* shows the following characteristic points:—The sulcus transversus is very deep and strongly marked, extending from the tuberculum mediale halfway across the head of the humerus as a groove of equal width and depth. The crista superior is straight, and shows well-marked impressions of the insertions of the great pectoral muscle. The supracoracoidean or subclavian muscle has an inserting surface upon the corner where the caput humeri meets the proximal end of the crista superior. The tuberculum inferius s. medianum is a very prominent knob, serving on its dorsal and ventral surfaces for the attachments of the m. coraco-brachialis posterior and m. biceps humeri respectively. The pneumatic foramen lies at the bottom of a wide and deep recess. The dorsal lip of this recess is sharply marked by an oval impression from the tendon of the m. scapuli-humeralis posterior (m. infraspinatus, m. teres major, of other anatomists); from this impression the low but sharp ridge for the m. latissimus dorsi is continued down the middle of the ventral or inner surface of the humerus. The two grooves above and upon the ventral surface of the outer and inner condyles are produced by the origins of the pronator and short flexor muscles of the forearm. The m. brachialis inferior s. internus arises from a strongly marked impression on the dorsal or outer surface of the distal part of the shaft of the humerus.

The *Pelvis* and *Sacrum* are easily referred to the genus *Plotus* by the deeply notched or curved lateral margin of the pre-acetabular part of the ilium, the prominent and sharp antitrochanter, the sharp ventral ridge springing from the three anterior sacral vertebræ, and by the position of the single primary sacral vertebra closely behind the acetabular axis. The individual peculiarity of the specimen described is the lopsided position of the two halves of the pelvis with reference to the sacrum.

The *Tibia* is much flattened anteriorly; its anterior or cnemial crests are high, but not anchylosed with the patella; the peroneal crest for the attachment of the fibula is long and straight. The condylar portion of the tibia is turned considerably inwards, and the bridged-over groove for the passage of the tendon of the m. extensor digitorum communis is very deep and placed obliquely.

There remains the question of the specific differences of the bones before us. They all belong, to judge from their appearance, to one adult individual, but their small size excludes at once the possibility of their being referable to any of the species hitherto known, as the following measurements will show. We distinguish it, on account of its small size, as *Plotus nanus.*

	Plotus nanus.	*P. anhinga.*	*P. melanogaster.*	*P. nov.-holland.*
	mm.	mm.	mm.	mm.
Left humerus	89	112	132	120
Left tibia	61	77	86	78–95
Distance from acetabular axis to anterior end of sacrum	30	35		
Distance between ventral inner margins of the acetabula	14·5	15		

5. PODICEPES, sp. inc.

The proof of the former existence of Grebes in the Mare aux Songes rests upon one single bone only, the right ulna; but the latter agrees in all the essential points with the corresponding bone of the genus *Podicepes*, notably the configuration of the proximal and the distal articulations, and the existence of a sharply marked groove at the upper outer distal condyle for the passage of the tendons of the extensor muscles, and differs in all these characters from the corresponding bones of any other birds which might otherwise possibly be taken into consideration, that doubts are excluded. The total length of this ulna is 82 mm. It is consequently far too long and strong for *P. pelzelni*, *P. minor*, or *P. philippensis.* On the other hand, it is much too short for *P. cristatus* and by 10 mm. shorter than that of *P. ruficollis.* It is, however, slightly longer than the ulna of either *P. cornutus* or *P. auritus*, so that it probably belonged to an insular form of one of these last-named species.

6. BUTORIDES MAURITIANUS, sp. nov. (Plate XXXIV. figs. 6–8.)

It is surprising that of all the Ardeine bones, referable to at least twelve individuals of five different species, none belong to *Ardea* (*Butorides*) *nigricollis*, the only species of Heron at present existing in Mauritius, while a pair of ulnæ, one radius, four metatarsi, and one coracoid must be considered as belonging to a species of short-footed Heron hitherto unknown. The bones in question are all considerably shorter than the corresponding bones of *A.* (*Nycticorax*) *megacephala.* The metatarsi agree otherwise in every detail with those of the latter species; this relative stoutness indicates that they belonged to a Night-Heron or Bittern like *A. megacephala.* The two ulnæ cannot, unfortunately, be compared with those of *A. megacephala*; their length, 110 mm., compared with the length of the humerus of *A. megacephala*, 119 mm., shows, however, likewise that they were those of a considerably smaller bird.

The single left coracoid agrees in all the features of its dorsal or scapular half with *A. megacephala*, but its ventral or sternal half differs considerably, first by the much more strongly marked ridge of the linea intermuscularis on its ventral surface, secondly by the almost straight instead of inwardly curved margin between the processus lateralis and the lateral distal corner of the sternal articulation, thirdly by a very low but very distinct and sharp ridge which arises from the median margin of the coracoid a little above its median articulating corner. This roughness or prominent ridge is entirely absent in *A. megacephala* and in all other Herons which we have been able to examine, but at least a slight indication of it occurs in an individually varying degree in *Nycticorax* and in *Botaurus*. That this coracoid bone belonged, however, to an Ardeine bird is clearly indicated by its whole configuration, notably by the shape and position of the precoracoid process, the various articulating facets at the dorsal end, and the prominent lip on the visceral or internal surface of the median portion of the sternal articulating facet.

	Butorides mauritianus.	*Nycticorax megacephala.*
	mm.	mm.
Length of ulna	111–112	..
Length of metatarsus	81–87	96
Length of coracoid	48	55

7. Sarcidiornis mauritianus, sp. nov. (Plate XXXIV. figs. 9, 10.)

The most tangible proof of the former existence of this form in the island of Mauritius rests at present upon one specimen of left metacarpal bones. However, this solitary specimen is sufficiently well preserved to show its affinities by various well-marked characters. It agrees in size with the corresponding combination of bones of *Bernicla brenta*, while it is considerably smaller than those of the common domesticated *Anser cinereus*, and too large for the Madagascar and East-African *Sarcidiornis africanus* and the Indian *S. melanonotus*.

The generically diagnostic feature of the bones of the middle hand of *Sarcidiornis* is the very prominent process which arises from the side of the first metacarpal, proximally from the articulating facet of the pollex. The apex of this process is covered in *Sarcidiornis* by a skin, which, although thickened and bare of feathers, is not transformed into a horny callosity or spur. The same peculiar feature exists in the bone before us; the apex is rough and irregularly shaped, and since this part of the process never serves for the origin or insertion of muscles or tendons, its roughness plainly indicates the same purpose as that of the Madagascar species of *Sarcidiornis*, namely its use as a fighting knuckle, although in an either arrested or incipient state. Such a weapon, furnished with a sharp and long horny spur with bony core, carried by the first metacarpal bone, is fully developed in *Chauna*. This American genus can of course not be compared with the bird from Mauritius except by analogy. The only truly "spurred Goose" of the Ethiopian region is *Plectropterus*; but the spur is carried by the radial carpal bone and therefore is at once removed from comparison with our specimen, which belonged to a rather large-sized species of *Sarcidiornis*, and, having probably been restricted to the island of Mauritius, may be distinguished as *S. mauritianus*.

Another part of this bird consists of the somewhat incomplete left half of the pelvis; it agrees in size with that of *Bernicla brenta*, consequently by inference with *Sarcidiornis*, measuring 70 mm. from the anterior brim of the acetabulum to the posterior end of the os ischii. The few characters which are preserved in this portion of a pelvis agree with those of *Anas* and *Anser* and other Lamellirostres.

8. Anas theodori, sp. nov. (Plate XXXIV. figs. 11–17.)

The fragment of a sternum, a pair of coracoids, eight humeri, and a pair of metatarsi are referable to a Duck which was considerably larger than *Nettapus auritus*, *Anas bernieri*, and *Dendrocygna*, but smaller than *Anas melleri*, of which we have a skin and breast-bone with shoulder-girdle for comparison.

Of the sternum only the anterior portion is preserved, which is, however, sufficient to show its affinities. Its width between the two lateral muscular ridges of the sternum is 28 mm., *i. e.* slightly less than in *Anas melleri* and agreeing with *Dendrocygna arcuata*; the sternum differs, however, from that of *Dendrocygna* by its well-developed, although broken-off spina externa, by its lower keel, and lastly by the much smaller and shallower entrance to the pneumatic foramen; it differs also from that of *A. melleri* by the lesser height of the keel, moreover by the shape and direction of the anterior margin of the latter.

The single left coracoid is in a perfect state of preservation and fits well into the sternal fragment, so that it might belong to the same species, although certainly not to the same individual. This coracoid differs from that of *Dendrocygna* by its greater length, by the shape of its sternal end, and by its very smooth, almost plain ventral surface. *Nettapus* and *Anas bernieri* are to be excluded on account of their much smaller and shorter coracoids. The coracoid in question is much shorter than that of *A. melleri*, but it agrees closely with the latter by its shape, and especially by the almost plain ridgeless ventral surface of the shaft.

The seven humeri are much like each other, but vary from 70 to 78 mm. in their greatest length; they are exactly of the same shape and size as those of different specimens of *Anas punctata*, *i. e.* of a much smaller Duck than *A. melleri*.

The two metatarsi are in a bad condition; the right one measures 42 mm. in length, indicating a bird much more short-footed than *A. melleri*.

	A. theodori.	*A. melleri.*
	mm.	mm.
Width between pectoral ridges	28	30
Distance from spina interna to top of crest	20	25
Length of coracoid	42	52
Length of humerus	70–78	89
Length of metatarsus	42	41

The result of our investigations is that the bones figured (Plate XXXIV. figs. 11–17) belong to a Duck which differs from any of those found in Madagascar, while it agrees more closely with *A. melleri* but for its dimensions, which are so much smaller that they cannot well be accounted for by individual variation. It is moreover the only Duck of which remains have hitherto been found in Mauritius; we distinguish it therefore as *Anas theodori*, in honour of Mr. Théodore Sauzier.

9. Fulica newtoni. (Plate XXXV. figs. 1–11.)

The remains of this large Coot are numerous. The femur, sternum, humerus, and four cervical vertebræ are new and hitherto not described, while the whole pelvis and sacrum, the tibia, and the metatarsus have been described by M. Milne-Edwards. The bones belonged to at least 24 different individuals, and show accordingly a considerable amount of variation in their dimensions.

The smallest thigh-bone is 76, the longest 90 mm. long. The latter is larger in all its dimensions, otherwise alike the others. The outer or superior trochanteric crest is high and curved inwards; the two principal arms of the tendinous loop for the m. biceps cruris have left two very distinct impressions on the lateral surface of the distal end of the shaft and near the popliteal region. The external condyle has a deep and smooth notch for the reception of the head of the fibula.

The pelvis agrees with that of *Fulica* proper and with that of *Tribonyx* because of the peculiar dip of the dorsal margin of the pre-acetabular ilium, which does not reach up to the level of the dorsal spinous processes, leaving a long groove through which passed the tendons of the usually obliterated dorsal spinal muscles. In the possession of this groove and in its elongated and laterally contracted shape this pelvis agrees with that of a typical *Fulica*, and it differs much from that of *Aphanapteryx* and *Ocydromus*, while the pelvis of *Porphyrio melanonotus* and that of *Tribonyx* are less contracted than in *Fulica* and *Gallinula*.

The sternum of *F. newtoni* resembles in several points that of *Aphanapteryx*, *Erythromachus*, and *Ocydromus*, and differs from *Tribonyx*, *Fulica* proper, and *Porphyrio*, first in the configuration of the whole anterior margin of the sternum, especially in the double or basally divided spina externa, which is moreover broad and flat, while in the other genera this spine is single and furnished with a ventral longitudinal sharp ridge; secondly, by the receding and broad anterior margin of the keel, which, however, is well developed, although less than in *Tribonyx* and *Fulica atra*, but the tendency towards a reduction of the keel is apparent.

The shortest humerus is 8·5, the longest 92 mm. in length. They all differ from that of *Aphanapteryx* by being far less curved, stronger throughout, and furnished with a large pneumatic foramen; the sulcus transversus upon the head of the humerus is deeper, but the tuberculum medium is lower.

The cervical vertebræ of the Rallidæ can be easily recognized by their shape and by the numerous articulating facets, processes, and median crests. On the whole, these vertebræ of *F. newtoni* resemble more closely those of *Porphyrio* and *Ocydromus* than those of *Fulica* proper. Dorsal spinous processes are absent in the 9th and 10th vertebræ, they are rather low in the 6th and 5th, sharp and high in the 4th. Ventral median processes are absent in the 10th to 5th, high in the 4th and 3rd. The latter two vertebræ are marked by a deep round notch on each side, this notch being often turned into a complete foramen. Most of the lower and middle vertebræ of the neck are very broad in comparison with their length.

In conclusion, we feel inclined to think that the *Fulica newtoni* combines important characters of the true genus *Fulica* with those of *Porphyrio*, *Tribonyx*, and *Ocydromus*, and that on the whole it more resembles these last three than the true Waterhens.

10. Aphanapteryx broecki. (Plate XXXV. figs. 12–20.)

Only the tibia, tarso-metatarsus, and underjaw were hitherto known, described and figured by M. Milne-Edwards. Besides the tibiæ and tarso-metatarsi of many individuals, we have now before us the pelvis with sacrum, femora, and humeri; one sternum, one third cervical vertebra, and one nearly complete premaxilla, together with fragments of the upper and lower jaws. It has been comparatively easy to determine most of these new bones because of their close resemblance to the corresponding parts of *Erythromachus.*

The pelvis, with the sacrum, of one specimen is extremely well preserved. It is much more compact, stouter, shorter, and broader than that of *Fulica newtoni*; the dorsal margin of the pre-acetabular part of the ilium reaches up to the dorsal spinous crest of the anchylosed presacral vertebræ, as is also the case in *Ocydromus* and *Porphyrio.* In their general configuration the pelvis and sacrum of *Aphanapteryx* agree with *Erythromachus.*

The femur, essentially similar to that of *Fulica*, *Porphyrio*, and other allied Rails, can be distinguished from that of *Fulica newtoni* by its smaller dimensions.

The tibia and metatarsus, having been described and figured previously, need not be commented upon, beyond stating that they, especially the metatarsus, are relatively stouter than those of *Fulica.*

The sternum and humerus are of particular interest, because of their small size, and because of the absence of any large pneumatic foramina, indicating that this bird was devoid of the power of flight. The sternum is not complete, its posterior portion being absent. Its width across the level of the first rib behind the anterior lateral process is only 25 mm.; the keel is very much suppressed, with its anterior margin broadened out and deeply grooved, as in *Erythromachus*. There is no trace of a spina interna; the feet of the coracoids, as indicated by their facets, were separated from each other by a smooth groove of 9 mm. in length. The spina externa is represented by two projections from the ventral lips of the median corner of the coracoid articulation. In this respect *Aphanapteryx* agrees with *Erythromachus*, and also with *Fulica newtoni*.

The humerus is very short and slender for so large a bird; its typically Ralline characters are, however, obvious enough to recognize it as belonging to *Aphanapteryx*, while it differs by its far greater length and strength from the humerus of *Gallinula*, and by its much smaller dimensions from that of *Fulica*. A very interesting feature is the absence of the usually wide and deep pneumatic foramen, which is indicated only by a shallow depression which is smaller than even in *Gallinula chloropus*.

The third cervical vertebra could easily be recognized as such by its numerous Ralline characters, which in these birds are strongly pronounced; its dimensions remove it from either *Fulica* or *Gallinula*, *i. e.* from the only other Ralline birds hitherto known to have occurred in Mauritius.

The premaxilla fits well upon the several fragments of underjaws, and still better upon the underjaw figured by M. Milne-Edwards. The great length and the shape of these bones closely resemble those of *Erythromachus* (Phil. Trans. vol. 168, pl. xliii. fig. A). The Mauritian bird is, in fact, nothing but a larger species of the same genus.

A number of measurements are given in the subjoined Table in order to aid the comparison of the Mauritian Ralline birds with each other and with some of their allies.

	Fulica newtoni.	*Aphanapteryx broecki.*	*Porphyrio melanonotus.*	*Ocydromus australis.*
	mm.	mm.	mm.	mm.
Length of pelvis	80	60		
Distance between pectineal processes	23·0	28·5		
Distance across lat. dorsal iliac process	28	44		
Distance across antitrochanters	32	38		
Length of femur	76, 78, 81, 90	69, 70, 71	83	82
Length of tibia	120, 127, 130, 133	98, 102, 108, 112, 115	140	111
Length of tarso-metatarsus	82–84	79	98	62
Length of humerus	85, 88, 90, 92	60–66	88	57
Length of ulna	74			
Total length of sternum	70	incomplete	68	55
Width of sternum from *a* to *a*	29·5–30	25	22	20
Distance between coracoids at sternal articulation	5	9	2·5	
Greatest length of 9th cervical vertebra	17–21			
Greatest width of 3rd cervical vertebra	15	9·5		
Greatest length of 3rd cervical vertebra	16	12·5		

11. Trocaza meyeri.

Five fractured breastbones can easily be recognized as Columbine by the combination of the following characters:—The very high and at the same time slender or thin crista; the presence of a well-developed spina interna, which is broad at its base, ending anteriorly obtuse and slightly bifurcated, while the spina externa is by far less developed; lastly, the deep and regular grooves for the articulation with the coracoids, which do not meet each other, but are separated by a smooth, scarcely prominent, median ridge.

In order to determine the species we have compared the bones with those of *Turtur picturatus*, *Vinago australis*, *Funingus madagascariensis*, and *Trocaza meyeri*. The bones of the first three are figured by M. Milne-Edwards, of the last two the Cambridge Museum possesses skeletons. The result of this comparison showed that four breastbones belong to *Trocaza meyeri*.

In this species there exists a small but distinctly prominent tubercle on the labium internum of the anterior margin of the sternum, midway between the anterior end of the spina interna and the base of the lateral anterior process of the sternum; it serves for the attachment of the inner accessory sterno-coracoidal ligament. This tubercle is well developed in the four breastbones, as in *Trocaza*, very small in *Funingus*, and absent in *Turtur* and *Vinago*.

A second specific character is afforded by the spina externa of the sternum, which is well developed in *Trocaza* and *Vinago*, small in *Turtur*, absent in *Funingus*.

The measurements on the following page show, moreover, additional characters, which led to the determination of the species to which the breastbones belong.

Three tarso-metatarsal bones likewise are referable to *Trocaza meyeri*, because of their length and the configuration of the bony ridges and furrows on the posterior side of the proximal end of the tarso-metatarsus, serving for the passage of the various long flexor muscles of the toes. In this respect *Trocaza* agrees, but for the length of the bones, with *Turtur*, and differs considerably from *Funingus*.

12. Funingus, sp. inc.

One sternum, unfortunately very incomplete, consisting only of the anterior end, with the anterior margin of the sternum and the anterior margin of the keel, may possibly belong to *Funingus*, chiefly on account of the absence of the lateral tubercles of the spina interna, and because of several of its dimensions as given in the following Table, in which this specimen is marked M.S.=Mare aux Songes, while E.N. indicates obtained in the flesh by Sir Edward Newton, and M.E. that the specimen has been figured by M. Milne-Edwards.

	Vinago.	*Turtur.*	*Funingus.*			*Trocaza.*					
	M.E.	M.E.	E.N.	M.E.	M.S.	E.N. ♀	M.S.				
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Distance *a b* from anterior end of spina interna to pneumatic foramen	7·5	8·0	8	10·5	10·0	8	11	10·5	10	9	9
Distance *c c* across the sternum in level of the 2nd thoracic ribs	20·5	18	18	20	broken	21	26	26	25	incomplete	
Distance *a f* from anterior end of spina interna to anterior ventral curve of crista sterni	..	..	22	..	29	28	31	34	...31...	28·5	incomplete
Length of tarso-metatarsus	23	26·5	..	24	..	..	34	34	..	28·5	

There are also five ulnæ of a Pigeon, which could not, however, be further determined except that they belong to either *Trocaza* or *Funingus.*

13. Didus ineptus. (Plates XXXVI., XXXVII.)

The new material of bones of the Dodo has enabled us to add to the restoration of the skeleton the following parts which have hitherto not been known :—

1. The median distal portion of the *furcula* appears to be devoid of an "apophyse médiane" or hypocleidium, this region being rounded off. This may, however, be a case of individual variation, considering that in the male specimen of the Cambridge *Pezophaps* there is likewise no apophysis, while there is one, although small, in the female specimen. Hence, Professor Owen's restored drawing of this part in the British Museum specimen of *Didus* cannot be pronounced to be incorrect.

2. Metacarpal bones of the right and left side, and the first phalanx of the second finger. These bones present no remarkable features, and agree in their small size with the much reduced state of the other bones of the wings. There is, moreover, no evidence of the existence of those peculiar exostoses on the distal end of the radius and on the first metacarpal that are so characteristic of the male Solitaire, which probably used them as fighting-knuckles.

3. The distal third of the pubic bones.

4. Phalanges of the toes (hitherto known from the Oxford specimen only).

5. The atlas or first cervical vertebra.

The most interesting result of the examination of the bones entrusted to us by Mr. Sauzier is the determination of the number of vertebræ and ribs which belong to the various regions of the skeletal axis.

Hitherto our knowledge of these parts has rested upon the mounted specimen in the

British Museum (and the restored drawings by Professor Owen in the Trans. Zool. Soc. vi. and vii.), which is faulty, and upon the Cambridge skeleton, which was incomplete. Hence all the references to the number of vertebræ and ribs are also at fault (*cf.* Fuerbringer's 'Untersuchungen für Morphologie und Systematik der Vögel,' tabb. xxi. & xxii. pp. 778–781; and Bronn's 'Thier-Reich, Vögel,' p. 950).

The vertebræ examined by us belong to an unknown number of individuals. Moreover, it is not possible to pick out a complete series from the atlas to the pelvis, which without doubt belonged to one and the same individual. Lastly, it is a curious mishap that only a single specimen has been found of that vertebra which fits into the gap between the last of the three anchylosed thoracic vertebræ and the first vertebra which is overlapped by and fused with the pelvis.

The determination of the number of vertebræ composing the various regions of the vertebral column has consequently to rest upon circumstantial evidence. An unbiased collection of facts from other Pigeons reveals certain correlations of number and shape of vertebræ and ribs, and the results thus gained can be applied to the restoration of the Dodo's skeleton with a considerable amount of probability.

It seems to be the rule in normal (not domesticated) Pigeons that:—

1. The 15th, 16th, and 17th vertebræ are anchylosed together.

2. The 18th vertebra is free, articulating in front with the 17th, and behind with the 19th vertebra, which latter in all cases is overlapped by, and partly fused with, the pelvis. For the sake of convenience the 18th may be called the intermediate vertebra.

3. The 14th and 13th vertebræ each possess a spinous process which is hook-shaped.

4. Complete ribs, *i. e.* such as articulate with the sternum, vary from 3 to 4 in number, and are restricted to the 15th to 19th vertebræ, while the 16th to 18th always carry complete sternal ribs.

5. Cervico-dorsal vertebræ are those which carry movable short ribs; the dorsal portion of such a rib articulates by a typical capitulum and tuberculum with one vertebra, while the ventral or distal half of the rib is lost. As a rule, at least, the last of these short ribs carries an uncinate process. The number of cervico-dorsal vertebræ is two, rarely three.

6. The other neck-vertebræ are true cervical vertebræ; with the exception of the atlas and the epistropheus, they all possess a transverse foramen and immovable rib-rudiments.

7. In recent Pigeons the last or hindmost pair of complete sternal ribs is frequently followed by one pair of ribs which, attached to the 19th, or 1st pelvic, vertebra, almost reaches the sternum: in rare cases there is present even a second, although much shorter pair, which then belongs to the 2nd pelvic or 20th vertebra.

The following Table will show these modifications:—

C indicates the last true cervical vertebra.
h ,, a hooked spinous process.
r ,, a short rib.
st indicates a sternal rib.
u ,, an uncinate process (not mentioned on the sternal ribs).

Serial number of vertebræ	12	13	14	15 (anchylosed)	16 (anchylosed)	17 (anchylosed)	18 intermediate.	19 1st pelvic.	20 2nd pelvic.
Columba livia	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	*st*	almost sternal	no rib
Phaps chalcoptera	C	*h*, *r*	*h*, *r*, *u*	*st*	*st*	*st*	*st*	,,	long rib
Didunculus strigirostris	C	*h*, *r*	*h*, *r*	*st*	*st*	*st*	*st*	,,	no rib
Treron olax	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	,,	
Carpophaga pacifica	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	,,	no rib
Goura coronata	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	,,	
Pezophaps solitaria, ♂	..	C, *h*	*h*, *r*, *u*	*r*, *u*	*st*	*st*	*st*	*st*	short rib
——— ———, ♀	..	C, *h*	*h*, *r*	*r*, *u*	*st*	*st*	*st*	*st*	,,
Didus ineptus, properly restored, Cambridge and Mauritius Museums	..	C, *h*	*h*, *r*	*r*, *u*?	*st*	*st*	*st*	*st*	no rib
Didus, British Museum, figured by Sir Richard Owen, Trans. Zool. Soc.	C	*r*	*r*, *u*	*st*	*st*	*st*	*st*	*st*	almost sternal

Didus agrees with *Pezophaps* in possessing 13 cervical vertebræ, 2 short ribs, 4 sternal ribs, the last being carried by the first pelvic vertebra.

Treron, *Carpophaga*, and *Goura* agree with each other in having 13 true cervical vertebræ, 2 short, 2 sternal, and 1 almost sternal pairs of ribs. They differ from *Didus* and *Pezophaps* in the latter pair of ribs being withdrawn from the articulation with the sternum.

Columba, *Phaps*, and *Didunculus* differ from the others in having only 12 true cervical vertebræ, 2 short, 4 sternal, and 1 almost sternal pair of ribs, because their 15th or first anchylosed vertebra (instead of the 16th or 2nd anchylosed vertebra) carries the first pair of sternal ribs.

The restoration in the Trans. Zool. Soc. vi. pl. 15 contains one pair of sternal ribs and one vertebra (the 15th in the figure) too many.

In conclusion we wish to say that, beside the Birds' bones here described, the explorations of Mr. Sauzier have produced very many bones of Reptiles, which will be treated of by one of us in a subsequent paper, together with a considerable number of shells of Mollusks, portions of Crustacean integument, and a few pieces of Coral. The presence of these marine forms in the soil of the Mare aux Songes may be, it is believed, attributed to the action of Land-Crabs, for there is no reason to think that the sea has ever had access to the lake, from which it is separated by a ridge of some height, while it is known to be the habit of those creatures to convey animal remains a long distance inland from the shore. Nevertheless it may be as well to name the shells as determined by Mr. A. H. Cooke, Honorary Curator of Conchology in the Cambridge Museum. They are as follows:—Land Mollusca, *Gibbulina sulcata*, Lam., *Pachystyla inversicolor*, Fér., *Cyclostoma carinatum*, Lam.: Marine Mollusca, *Cypræa caput-serpentis*, L., *Nerita polita*, L., *Turbo sp. incert.* (fragment). In addition to the foregoing the seeds of several plants have also been found, but these appear not to need enumeration; nor do the specimens of the soil collected by Mr. Sauzier (though all are carefully preserved in the Museum) seem to call for any particular remark on the present occasion.

EXPLANATION OF THE PLATES.

PLATE XXXIII.

Figs. 1–8. *Lophopsittacus mauritianus* (p. 283).

Fig. 1. Left tibia, front view. *l*, attachments of the transverse ligament across the long extensor tendons.

Fig. 2. Right femur, posterior view.

Fig. 3. Left metatarsus, plantar surface.

Fig. 4. Left metatarsus, dorsal surface. *g*, groove for the tendon of the musc. extensor digitorum; *i*, insertion of the tendon of the m. tibialis anticus.

Fig. 5. Dorsal view of the underjaw. *p*, posterior angle; *f*, facet for the quadrate; *f i*, additional facet for the jugal process of the quadrate.

Fig. 6. Lateral view of the right jaw.

Fig. 7. Ventral view of sternum. *Sp.e.*, spina externa sterni; *p.l.a.*, anterior lateral process; *S*, lateral line of m. subclavius.

Fig. 8. Right lateral view of sternum. *Sp.i.*, spina externa sterni; *S*, median line of m. subclavius.

Figs. 9 and 10. *Astur alphonsi* (p. 285).

Fig. 9. Left tibia, front view. *f*, rest of fibula; *b*, bony bridge over the tendon of the m. extensor digitorum; *p*, peroneal crest.

Fig. 10. Left metacarpals, lateral view. *p*, articular facet of the pollex; m_3, metacarpale III.

Figs. 11–18. *Strix sauzieri* (p. 286).

Figs. 11, 12. Inner and outer views of humerus. *f*, pneumatic foramen.

Fig. 13. Left tibia, front view. *p*, peroneal crest; *f*, distal portion of fibula; *l*, attachment of transverse ligament.

Figs. 14, 15. Posterior and anterior views of right tarso-metatarsus. *b*, bony bridge across the tendon of the m. tibialis anticus; *h*, facet for the hallux's metatarsal; *i*, insertion of the m. tibialis anticus.

Fig. 16. Proximal end of the tarsus.

Figs. 17, 18. Posterior and anterior views of the small pair of tarso-metatarsals.

PLATE XXXIV.

Figs. 1–5. *Plotus nanus* (p. 288).

Figs. 1, 2. Dorsal and ventral views of pelvis. *I*, first vertebra fused with sacrum; *T.I*, primary sacral vertebra; *pb*, os pubis; *at*, antitrochanter.

Fig. 3. Inner or median view of left humerus.

Fig. 4. Outer or lateral view of left humerus. *C.s*, crista superior; *S.t*, sulcus for the humero-coracoid ligament; *T.s*, tuberculum superius s. externum; *s.a.l*, sulcus anconæi lateralis; *s.a.m*, sulcus anconæi medialis; *b.i*, origin of the m. brachialis inferior.

Fig. 5. Anterior view of left tibia. *p*, peroneal crest; *l.c*, lateral cnemial crest.

Figs. 6–8. *Butorides mauritianus* (p. 289).

Figs. 6, 7. Dorsal and ventral views of left coracoid. *l.i*, linea intermuscularis; *p.l*, prominent lip; *pr*, precoracoid process; *r*, rough ridge.

Fig. 8. Posterior plantar view of right tarso-metatarsus. *h*, attachment of metatarsale I.

Figs. 9 and 10. *Sarcidiornis mauritianus* (p. 290).

Fig. 9. Lateral view of metacarpals of left wing.

Fig. 10. Median or ventral view. *M.I*, rough knob of first metacarpal; *P*, articulation of pollex; *f*, facet for the os carpale ulnare.

Figs. 11–17. *Anas theodori* (p. 291).

Fig. 11. Left lateral view of sternum. *Sp.e*, spina externa; *l*, lateral line of m. subclavius.

Fig. 12. Anterior margin of sternum. *K*, keel.

Fig. 13. Ventral view of left coracoid.

Figs. 14, 15. Right humerus. *s*, sulcus for ligament. humero-scapulare; *C.s*, crista superior; *b.i*, origin of m. brachialis inferior.

Fig. 16. Posterior or plantar view of right tarso-metatarsus.

Fig. 17. Proximal end of the same.

PLATE XXXV.

Figs. 1–11. *Fulica newtoni* (p. 292).

Fig. 1. Dorsal view of premaxilla.
Fig. 2. Dorsal view of third cervical vertebra.
Fig. 3. Dorsal view of either ninth or tenth cervical vertebra.
Fig. 4. Ventral view of either ninth or tenth cervical vertebra.
Fig. 5. Sternum from the right side. *p.l.a*, anterior lateral process; *Sp.e*, spina externa; *s*, ridge of m. subclavius.
Fig. 6. Sternum from the ventral side. *a a*, distance of 30 mm.
Fig. 7. Sternum from the dorsal side. *C.s*, attachment of ligament between sternum and coracoid.
Fig. 8. Lateral view of left humerus. *S.t*, sulcus transversus.
Fig. 9. Median view of left humerus. *C.s*, crista superior; *t.m*, tuberculum medium.
Figs. 10, 11. Anterior and posterior views of left femur. *B*, attachment of sling of biceps muscle; *F*, facet for the fibula.

Figs. 12–20. *Aphanapteryx broecki* (p. 293).

Fig. 12. Premaxilla and mandible; lateral view.
Fig. 13. Dorsal and ventral views of third cervical vertebra. *p.t*, posterior zygapophysis.
Figs. 14, 15, 16. Ventral, dorsal, and lateral views of sternum. *T*, tubercle for attachment of sterno-coracoid ligament; *K*, anterior end of keel.
Fig. 17. Lateral view of left humerus. *t.m*, tuberculum medium, much higher than in *Fulica*.
Fig. 18. Median view of left humerus.
Fig. 19. Ventral view of pelvis and sacrum. *p.p*, pectineal process; S_1, primary sacral vertebra.
Fig. 20. Right lateral view of pelvis. *A*, antitrochanter; *p.i*, posterior lateral dorsal process of ilium; *P*, os pubis.

PLATE XXXVI.

Didus ineptus (p. 296).

Fig. 1. The first correctly restored and properly mounted skeleton of the Dodo. The specimen belongs to the Government Museum of Mauritius. The left wing and ribs have not been drawn, in order to keep the drawing clearer. The 18th vertebra has been cross-shaded, because it was still unknown when the skeleton was restored.

Figs. 2, 3, 4. Anterior, posterior, and lateral views of the atlas. Nat. size.

Fig. 5. Dorsal and ventral views of the metacarpals and of the first phalanx of the index.

PLATE XXXVII.

Didus ineptus (p. 296).

Figs. 1 A, B. Dorsal and lateral views of the posterior portion of the pelvis. Nat. size.

Figs. 2 A, B, C. Lateral, anterior, and posterior views of the 18th vertebra. Nat. size. Only one single specimen of this 18th vertebra was found amongst the hundreds of other vertebræ of the Dodo which have passed through our hands. This specimen is unique. The corresponding vertebra of the mounted skeleton in the British Museum is a cleverly executed artificial substitute.

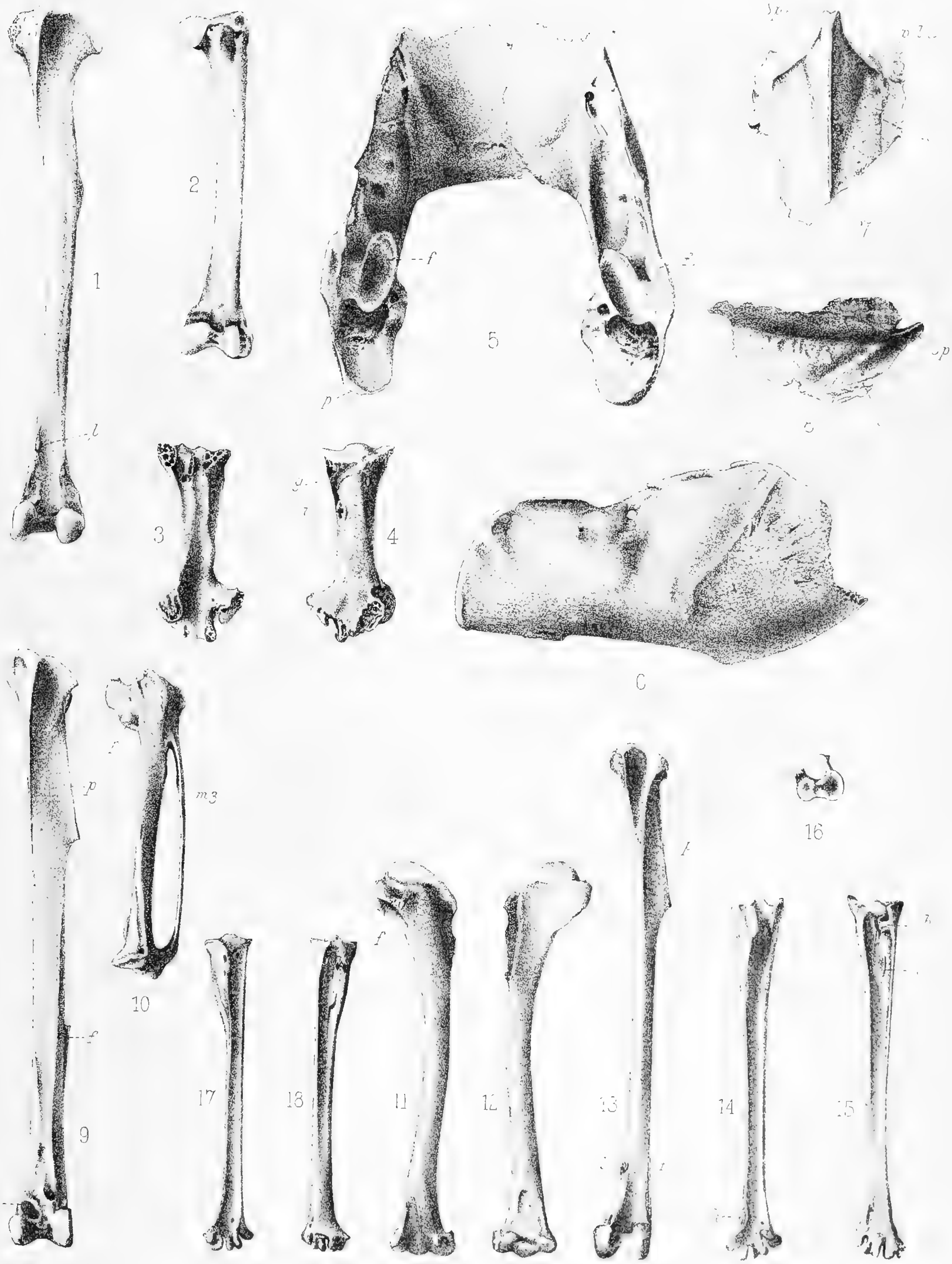


FIG. 1-8 LOPHOPSITTACUS MAURITIANUS. FIG. 9-10 ASTUR [illegible]
FIG. 11-18 STRIX SAUZIERI

Cambridge Engraving Company

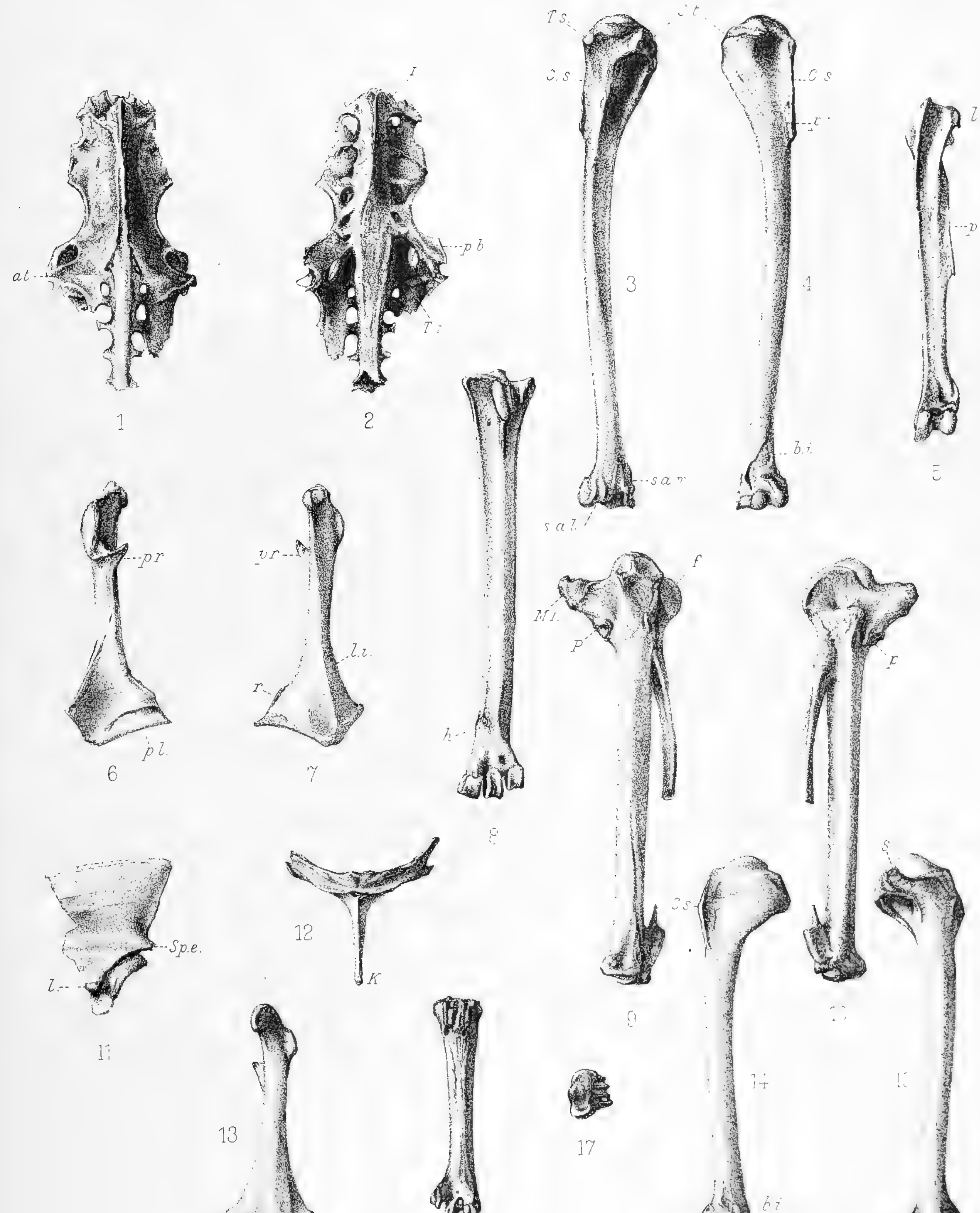


FIG 1-5 PLOTUS NANUS. FIG 6-8 BUTORIDES MAURITIANUS. FIG. 9-10 SAR[illegible] MAURITIANA.
FIG. 11-17 ANAS THEODORI.

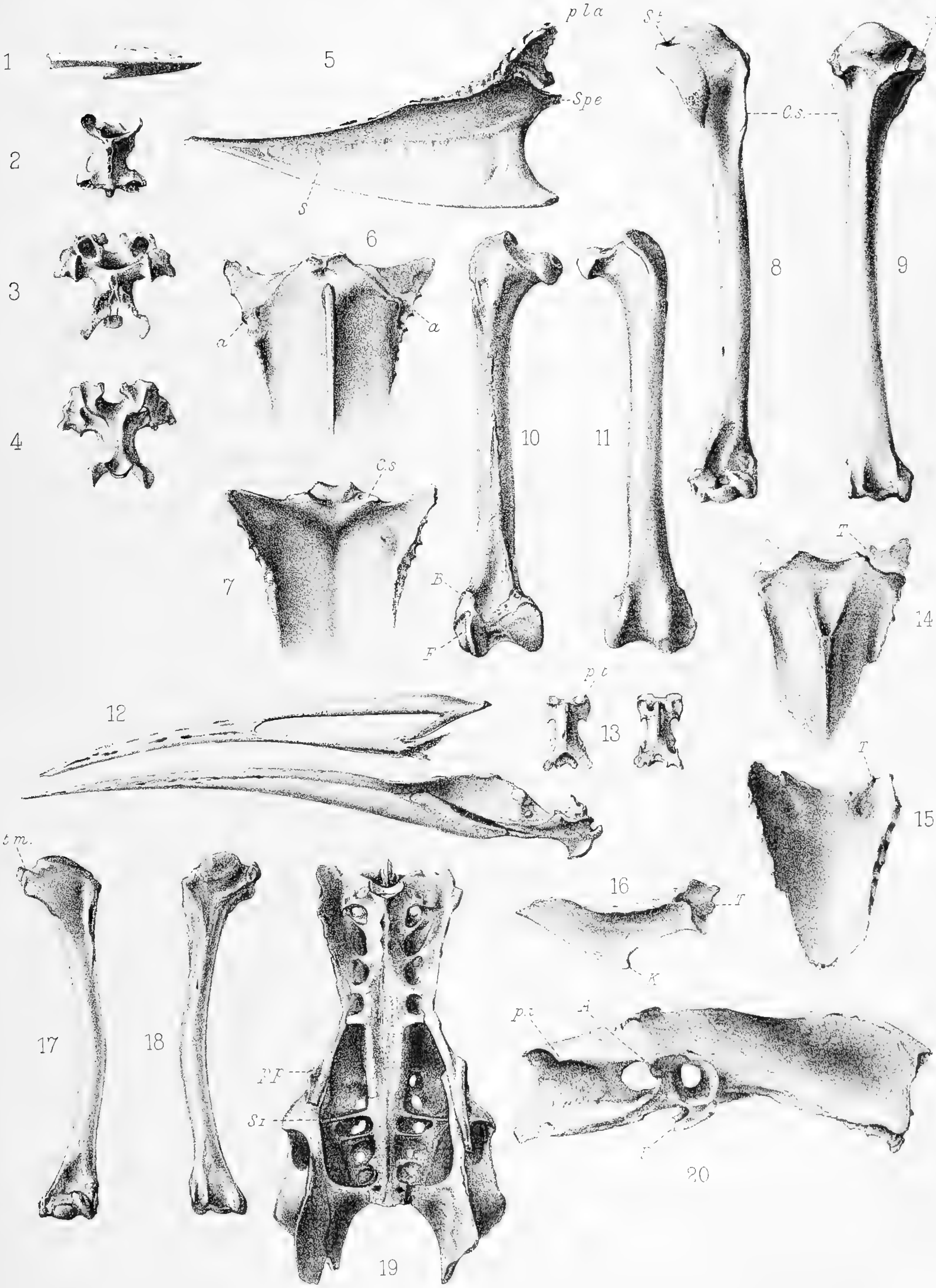


FIG 1-11 FULICA NEWTONI [illegible]

[illegible]

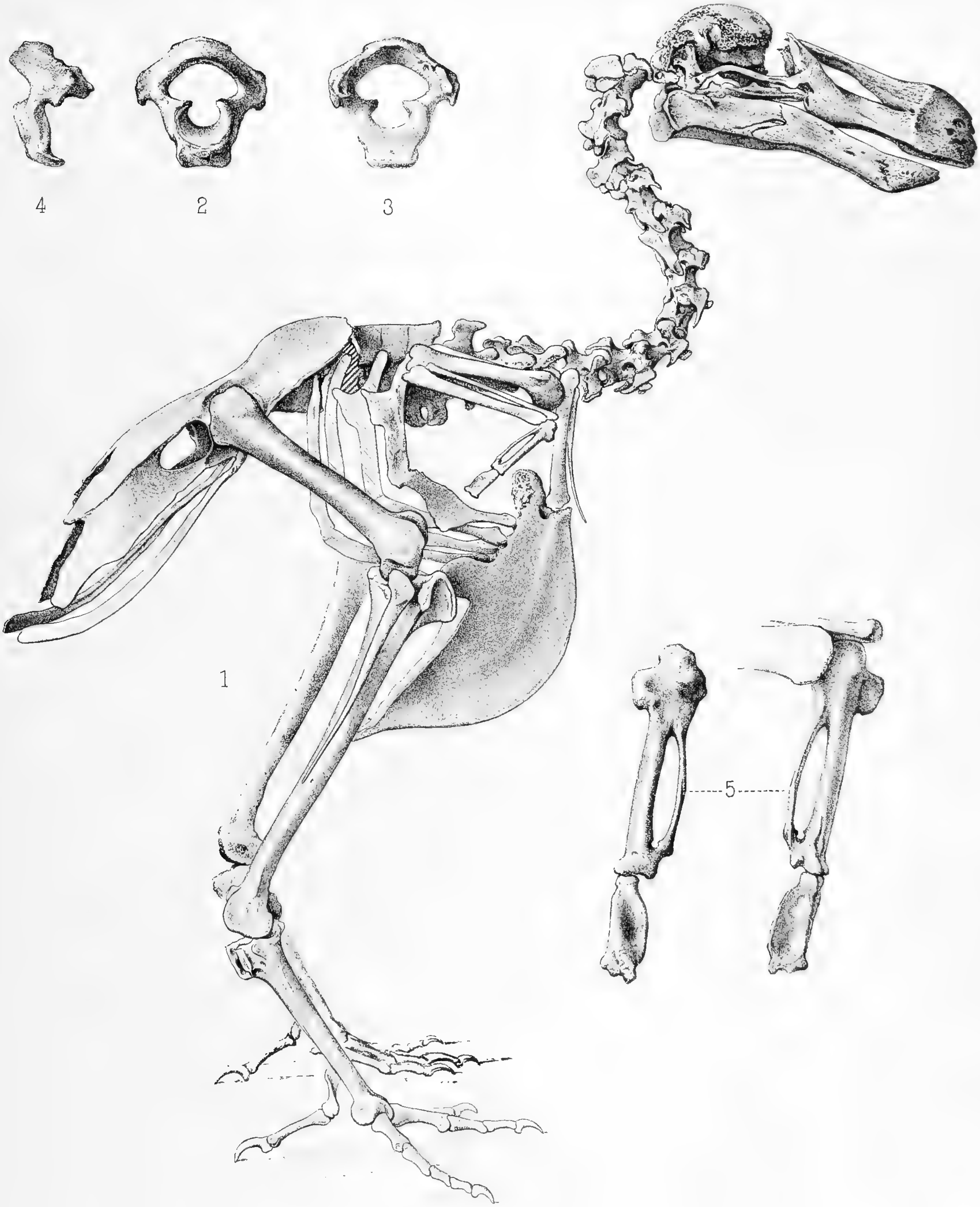


FIG. 1–5 DIDUS INEPTUS

Cambridge Engraving Company

Fig. 1.A.

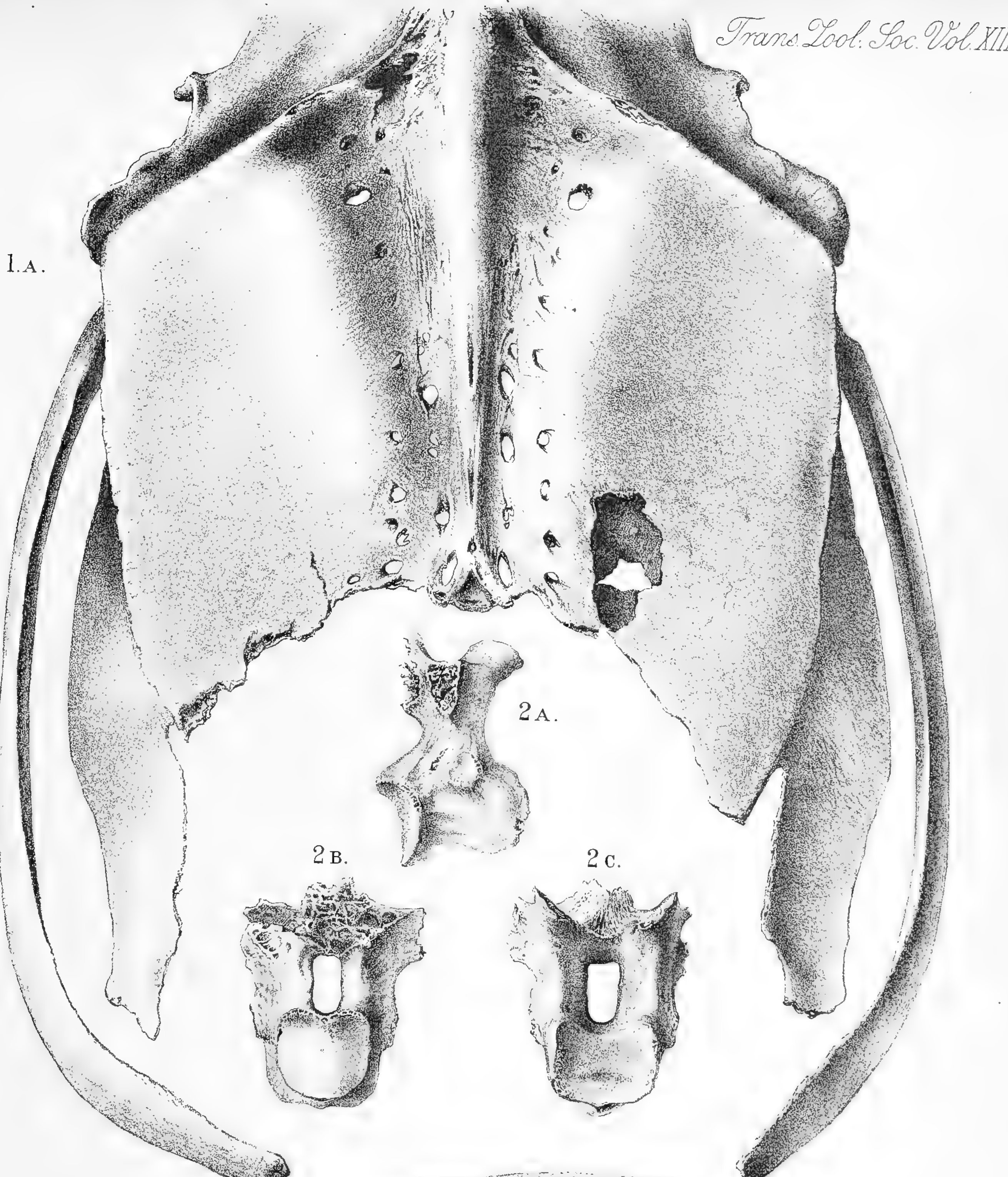
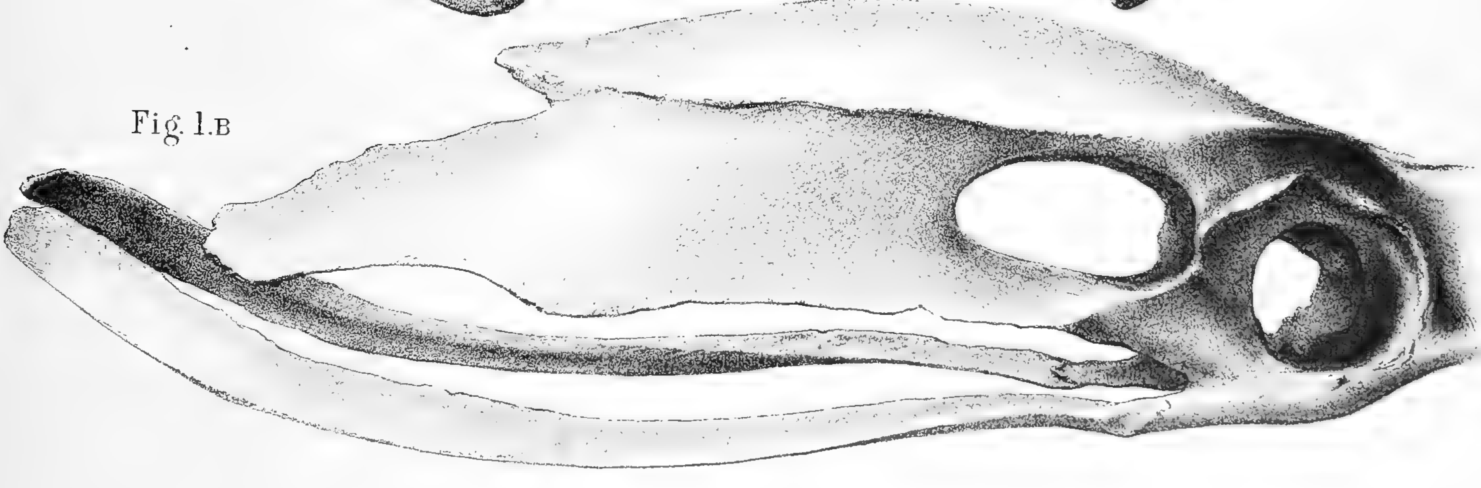


Fig. 1.B



Cambridge Engraving Company.

DIDUS INEPTUS

X. *Description of a remarkable new Sea-urchin of the Genus* Cidaris *from Mauritius.*

By F. Jeffrey Bell, *M.A., Sec.R.M.S., Professor of Comparative Anatomy and Zoology in King's College.*

Received September 12th, 1892, read November 1st, 1892.

[Plate XXXVIII.]

A FEW months since the Trustees of the British Museum obtained from M. de Robillard, of Mauritius, another of those rarities in the collection of which he has so much distinguished himself [1]. The specimen is unique, and its general facies would be so much altered by the removal of a fifth of the spinulation that I propose, on this occasion, to limit myself to a description of the external appearance of the most remarkable *Cidaris* it has ever been my good fortune to see. In the hope that further examples might be discovered I have delayed, longer perhaps than I should, the publication of a notice of this extraordinary specimen.

The primary spines are exceedingly long, some of them being more than 150 millim. in length, or about three times the diameter of the test. They are, however, most remarkable for being curved, slightly indeed, but yet distinctly curved in an upward direction. The base of the spine is flattened on its lower side; there are two sharp edges, and the upper side is formed of two halves set at a wide angle to each other, and ending in a distinct ridge. This ridge may be dentate and ornamented with a few minute tubercles. At a distance of about 20 millim. from its base the upper ridge disappears, and the spine becomes flat above as well as below. At about this point most of the spines become completely altered in colour (in the dry specimen), for while the basal part is creamy yellow, the rest of the large spine is of a reddish-brown colour. In many, near the tip, there are a few bands of brown and pale yellow. Where the brown colour begins a distinct striation also commences, and there are ten striæ on both the upper and the lower surfaces. The spine is widest at its base, and as it narrows very regularly the whole has the form of a greatly elongated triangle. Gradually and almost imperceptibly, the form of the spines in cross section alters, and instead of being depressed and flattened it becomes almost regularly circular.

The spines just described are arranged very regularly in pairs in each interambulacrum; only one or two are more than 150 millim. long; in each interambulacrum there are seven or eight primary spines, and the shortest are, as usual,

[1] I cannot let pass this opportunity of putting on record the regret with which all who are interested in marine zoology have heard of the recent death of this distinguished collector.

those nearest the mouth. It is usual for all to have the form and coloration already described; but those nearest the mouth are more spatulate in form than the rest.

The secondary spines are crowded in great quantities round the bases of the primaries and in the ambulacral areas; they are sharply pointed, and creamy or yellowish in colour. The apical area is very extensive and about half the diameter of the corona.

With regard to the affinities of this species it is not possible to say much. The amount of ostracum seen in transverse sections of the spines is slight, and there are no swellings, transverse crowns, or ridges, and no parasitic deposits. The long simple spines with striæ appear to be most like those members of the genus which have been distinguished as *Dorocidaris*.

A number of, as I think, very unnecessary genera have been founded for various examples of *Cidaris*[1]. To *Cidaris* in a wide sense there is no doubt that the present specimen belongs, and I do not expect that the investigation of the denuded test will lead to the establishment of any new generic division for it. From the characteristic shape of the spines I propose to call it *Cidaris curvatispinis*.

EXPLANATION OF PLATE XXXVIII.

Cidaris curvatispinis, from a photograph, reduced to two-thirds of the natural size.

[1] *Cf.* Catal. Brit. Echinoderms Brit. Mus. (1892), p. 139.

Hanhart imp

CIDARIS CURVATISPINIS

XI. *On Remains of an Extinct Gigantic Tortoise from Madagascar* (Testudo grandidieri, *Vaillant*). *By* G. A. Boulenger.

Received October 25th, 1892, read November 15th, 1892.

[Plates XXXIX.-XLI.]

On the 14th December, 1868, Prof. H. Milne-Edwards announced to the French Academy of Sciences[1] the discovery by M. Grandidier of remains of some gigantic Tortoises in Madagascar, contemporaries of *Æpyornis* and *Hippopotamus lemerlii.* These bones were referred to two species, named *Testudo abrupta* and *Emys gigantea* by Grandidier, without, however, any descriptions being given by means of which some idea could be obtained of their affinities. So matters stood until 1885, when Prof. L. Vaillant published some notes on these remains[2], which had in the meantime been restored for exhibition in the Palæontological Gallery of the Paris Museum, at the same time showing that both species belong to the genus *Testudo.* The name *gigantea* being twice preoccupied in that genus, Grandidier's *Emys gigantea* was renamed *Testudo grandidieri.* It is, however, not impossible that Grandidier's tortoise will ultimately have to be regarded as a form of the true *Testudo gigantea* of Schweigger. To *T. grandidieri* belong the remains the description of which has been kindly entrusted to me by Dr. H. Woodward. They consist of two nearly perfect shells, skilfully restored by Mr. Barlow, fragments of others, an imperfect skull, and numerous bones belonging to several individuals, found by Mr. Last in South-west Madagascar, and now preserved in the Geological Department of the British Museum.

Mr. Last writes, from Nossi Vey, as follows about the specimens:—"They were found in large caves in the rocks some two miles from the beach. These caves were formed by the sea long ago, when either the sea was higher or the land lower than it is at present. The Tortoises are found in pairs partly bedded in the fine loose sand of the caves, and, owing to the fact that they are only partly buried, many of the small bones get lost, the natives making use of these caves as hiding-places for themselves in time of war, and for their goods in time of peace. In one case, where the shell of one animal was completely underground, though broken all to pieces, I have sifted the soil and found nearly all the small bones and a head, which seems to me very small for so large an animal."

Unfortunately, Mr. Last did not keep apart the bones which he secured in connexion with the shell, but sent them home mixed up with those of several other individuals. This has necessitated considerable labour on my part in identifying them, and in several

[1] Comptes Rendus, lxvii. 1868 p. 1165.

[2] Comptes Rendus c. 1885, p. 874.

cases caused some uncertainty; in dealing with the smaller carpal and tarsal bones and phalanges I had to give up the attempt at sorting out the bones according to specimens. The material, though thus inadequate for the complete restoration of any single specimen, yet affords information on almost every portion of the skeleton, and is therefore of the greatest value in fixing the characters of this extinct tortoise, our knowledge of which was still very imperfect.

1. *Shell.*—In addition to fragmentary remains of several specimens, we have two nearly perfect shells, referable to male and female. The former measures 116 centim. in a straight line and 150 over the curve, thus agreeing very closely in size with the type specimen in Paris, which measures 121 and 152. In the characteristic flatness of the vertebral region, together with the sinuous protuberances and the deep grooves separating the epidermal scutes, it agrees entirely with the original, as I am informed by Prof. Vaillant, to whom I showed the specimens during a recent visit he made to the Natural History Museum. The figures (Plate XXXIX.) appended to this paper relieve me from giving a description of the shape of the carapace, which, after all, differs but slightly from that of the existing Aldabra forms, *Testudo elephantina* and allies. Its width is 85 centim. and its height 49. The anterior margin is feebly notched in the middle and turned outwards on the sides, with notches between the marginal scutes; the posterior sides are likewise expanded, and the pygal incurved. The nuchal shield is very small, as long as broad; the vertebral shields are broader than long, a little broader than the costals; the supracaudal is single.

The plastron agrees with that of *T. gigantea* and *T. hololissa*. Its length is 92 centim.; its front lobe 27 long and 33 broad at the base, 12 at the apex, which is truncate. The bridge measures 44. The hind lobe is rounded, without anal notch, 19 centim. long and 47 broad. The gular shield is divided; the suture between the humerals three and a half times as long as that between the gulars; pectorals very short; abdominals as long as pectorals; femorals three-fifths of pectorals; anals as long as gulars.

The second specimen, which is a female, differs from the preceding in its less deeply excavated plastron, its greater thickness, the dorsal plates being about $1\frac{1}{4}$ inch thick, whereas in the larger male their thickness is only $\frac{3}{4}$ to 1 inch; the anterior and posterior borders are not spread out nor notched; the sutures between the bones are almost obsolete; and the nuchal is larger and a little longer than broad. The carapace measures 97 centim. in a straight line, 120 over curve; width 73; height 44. The plastron is imperfect, wanting the anterior lobe. The bridge measures 40 centim.

In the characters of its shell, *T. grandidieri* clearly pertains to the section known as "Aldabra Tortoises"[1]. Aldabra being a group of small islands north-west of Madagascar, this section of the genus would, with our present extended knowledge of its distribution, more properly be termed the "Madagascar Gigantic Tortoises." On referring to the synopsis of the species as given by me[2], it will be seen that an analysis of the characters

[1] Günther, 'Gigantic Land-Tortoises,' p. 10.

[2] Cat. Chelon. &c. p. 153.

of the carapace and plastron in the tortoise now described leads to *T. hololissa*, which differs from *T. elephantina* in the smaller plastron not notched behind; from *T. gigantea* in the undivided supracaudal shield; and from *T. daudini* in the wider plastral bridge. *T. grandidieri* may be distinguished from *T. elephantina, hololissa*, and *gigantea* by the greater depression of the carapace.

2. *Skull.*—The remains on which *Testudo grandidieri* was established did not include any portion of the skull. It is therefore highly gratifying to find among the bones secured by Mr. Last a nearly complete skull, 15 centim. long (to the extremity of the supraoccipital crest), wanting merely the zygomatic arch and the right quadrate. This skull was associated with the female shell noticed above. The mandible of this specimen is also present, together with a symphysial fragment of another.

The structure of the skull fully confirms the conclusion arrived at by Prof. Vaillant, from the study of the shell, as to the close affinity of *T. grandidieri* to the Aldabra Tortoises. The differences, in fact, are rather slight and, in some respects, show an exaggeration of the features which differentiate the Aldabra forms from their congeners.

The naso-frontal region is moderately convex, with the nasal fossa extremely large and produced to between the anterior portion of the orbits, sloping obliquely downwards, and longer than broad. When the skull is viewed from above, the anterior portions of the choanæ, separated by a narrow septum, are visible through the nasal fossa, whilst the præmaxillaries terminate on a line with the anterior borders of the orbits. The interorbital region is formed entirely by the præfrontal bones, the upper surface of which is much more developed than that of the frontals. The postorbital arch is slender and the parietal bones narrow. The præfrontals form a broad suture with the postfrontals, and the frontals are enclosed between these two elements and the parietals. The præfrontals are longer than broad, and their median suture measures two-fifths that between the frontals; the latter are very slightly longer than broad, and measure half the greatest length of the parietals. The diameter of the tympanic cavity equals that of the orbit.

The lower aspect of the skull presents this peculiarity, that the pterygoids do not meet on the middle line, being separated by the basisphenoid, as I have recently described in *T. microtympanum*[1]. The vomer is produced posteriorly far beyond the line of the postorbital arch, and its length equals nearly four times that of the choanæ; it bears a feeble median keel, which is continued on the anterior half of the basisphenoid; the palatines extend but little beyond the vomer. The suture between the præmaxillaries and the vomer falls a considerable distance behind the inner angle of the alveolar edges of the maxillaries. The alveolar surface of the maxillary is broad, with a strong denticulate median ridge, which is equally distant from the likewise denticulate inner and outer margins. The occipital condyle is tripartite, and the posterior margin of the opisthotic is not excised.

[1] Proc. Zool. Soc. 1891, p. 5, figs. 1, 2, 3.

The mandible has a double denticulate ridge, between which the alveolar surface is deeply concave; its outer surface slopes outwards and is concave; the symphysis is short and without a backward dilatation of the lower margin.

3. *Cervical Vertebræ.*—Among the remains mentioned by Vaillant was a third biconvex cervical vertebra, thus affording a valuable diagnostic character confirming the deductions arrived at from the examination of other bones. Our material is, unfortunately, very scanty, consisting merely of two second vertebræ, one sixth, one seventh, and three eighth, one of the latter being reduced to the arch. I have therefore no special remarks to offer on this part of the skeleton.

4. *Sacral and Caudal Vertebræ.*—A great number of vertebræ were collected, which I have been able to sort out and refer to three specimens, as follows:—

A. The largest specimen: 7 vertebræ, referable to the 3rd, 4th, 6th, 10th, 11th, 12th, and 13th caudals. In all these the arch is anchylosed to the centrum, and so are the costoids to the vertebræ. I regard this specimen as a male.

B. A smaller specimen, with centrum and arch and costoids likewise anchylosed, but the arch less elevated and less produced posteriorly; the series consists of a sacral and 11 caudal vertebræ, viz. 1st and 2nd, 4th and 5th, and 7th to 13th. I regard this specimen as a female, probably the same as yielded the shell and skull which were found associated.

C. This specimen, which agrees nearly is size with the preceding, differs in having the centra thicker and joined by suture to the arches, which in some of the vertebræ have even become detached; the costoids were also loosely attached and have been lost. These vertebræ form a complete series from the 2nd to the 18th.

The bones in specimens A and B agree so well with those of *T. elephantina*, male and female respectively, that I have no doubt they belong to the same form as yielded the skull described above. As regards specimen C, there are, on the other hand, several differences, so that I have to consider whether they are referable to the same species. These differences consist chiefly in the greater vertical diameter of the centrum, the lesser excavation of the articular cavity, the persistent suture between arch and centrum in the anterior vertebræ, 8th inclusive, and the autogenous costoids throughout.

Owing to the fact that the vertebræ are nearly equal in size in specimens B and C it would seem, at first, that age cannot be made to account for the differences. However, we must bear in mind that the tail differs so much in size according to the sexes in these Tortoises that it may be as large in a half-grown male as in a full-grown female of the same species; and how great the differences in the shape of the bones are may be gathered from a perusal of Günther's descriptions on pp. 29 and 37 of his memoir, which deal with what I regard as male and female of one and the same species. I have therefore carefully compared the caudal vertebræ of the adult male *T. elephantina* with those of the female of the same species (I regret to have no half-grown or young male skeleton with which to compare), and have come to the conclusion that the differences between specimens B and C may, provisionally at least, be ascribed to both age and sex. On comparing the caudal vertebræ of a young Galapagos tortoise (*T. elephantopus*) with those of an adult of a closely allied form (*T. vicina*) I find the articular facets to be nearly plane in the former, whereas the cup-and-ball system is strongly developed in the latter. As to the anchylosis or non-anchylosis of the costoids, I think the examination of more material would reveal a great amount of individual differences on this point, irrespective of age or sex. Both specimens of *T. elephantina* show no trace of suture, but I find a great amount of individual variation in other species. In the adult specimen of *T. vicina* most of the costoids show a distinct suture with the centrum, whilst those of the 6th vertebra, the right one of the 10th, the left of the 16th and 17th, and the right of the 18th and 19th are more or less completely united with the centrum.

After describing the tail of the adult male *T. elephantina*, Dr. Günther adds:—"Nearly always the animal carries it [the tail] bent sidewards under the carapace, generally towards the left side; and therefore I anticipated to find a want of symmetry in some portion of the root of the tail; however, nothing of the kind can be observed." This statement is not quite correct. Since the above lines were written, Dr. G. Smets[1] has pointed out that the basal caudal vertebræ of *T. sulcata* and other Land-Tortoises are characterized by a remarkable asymmetry, especially with regard to the zygapophyses, and I find his statement borne out by the gigantic species as well. Smets remarks of *T. sulcata* that the right postzygapophysis of the first sacral vertebra is obliterated, whilst the left is well developed; on the second sacral the left zygapophysis is more developed than the right; likewise on the first caudal. On the second caudal the right postzygapophysis is slightly more massive than the left, but its articular facet is smaller; in the 3rd, 4th, and 5th the right postzygapophysis is more developed than the left, whilst in the 6th to 8th it is the reverse. The first and second caudal vertebræ have the diapophyses more developed than the left; on the third vertebra the left diapophysis is less massive but a little longer than the right; fourth and fifth with the left, seventh with the right, diapophysis longest. From the ninth vertebra any striking asymmetry ceases.

In the large male specimen described by Günther[2] the second sacral vertebra has but one prezygapophysis, the left; the facet of the right postzygapophysis of the first caudal is much larger than that of the left, but little larger in the second; in the third vertebra the left postzygapophysis is the largest, and in the fourth it is the right. In the female specimen the asymmetry is much less marked.

In the 3rd and 4th vertebræ of specimen A of *T. grandidieri* the right postzygapophysis is more developed than the left, in the 6th the left.

In specimen B the left postzygapophysial facet of the second sacral is much higher

[1] Muséon, 1887, p. 394. [2] *Op. cit.* p. 29.

up than the right; the right postzygapophysis of the first caudal vertebra is abortive, its facet being sessile and directed upwards; that of the second vertebra is less developed than the left; the other vertebræ being nearly symmetrical.

In specimen C the right postzygapophysis is the more developed on the second caudal vertebra, the left on the third and fourth.

It is therefore clear that in these Tortoises the asymmetry of the caudal vertebræ is subject to much individual variation, and that the identification of single vertebræ cannot be attempted by means of this character.

5. *Pectoral arch.*—The complete pectoral arch of a specimen which, judging from the size of the bones, must be the one of which Mr. Last states he found most of the bones, that is to say, the female previously noticed, is preserved. The coracoid is free from the scapula, which measures (from the proximal extremity of the suture with the coracoid) $17\frac{1}{2}$ centim., the acromial process (so-called precoracoid) measuring (likewise from the suture with the coracoid) 9 centim. Length of coracoid 11 centim., greatest width 9. These proportions agree very closely with those of *T. elephantina.*

Besides these bones, a smaller right coracoid is preserved.

6. *Pelvis.*—This is represented by the ischia of a large specimen, and the ilia and left pubis and ischium of a smaller specimen, no doubt the female of which shell and bones were found associated. In general configuration, and especially in the narrow bridge, they agree with *T. elephantina.* The surface of the ilium which articulates with the sacrum is directed more upwards than inwards, thus differing from the specimen of *T. elephantina* with which I have compared it, and approaching the arrangement described by Vaillant.

7. *Limb-bones.*—Numerous carpal and tarsal bones and phalangeals and long bones belonging to at least six specimens:—

A. The largest (femur measuring 20 centim.): left femur, right tibia, and left fibula.

B. A smaller specimen, probably the female (femur $16\frac{1}{2}$ centim.): right humerus, right and left radius, and right ulna; right and left femur and right tibia and fibula.

C–F. Right radius; two right tibiæ; four left tibiæ; one right and one left fibula.

There are also a few bones, apparently dermal ossifications from the limbs, which I am unable to determine with precision, having been unsuccessful in finding anything similar with which to compare them.

Now that most of the bones have been identified, it will perhaps be possible to mount the skeleton of the female specimen found undisturbed by Mr. Last, and to exhibit it in that condition in the Geological Galleries of the British Museum. The neck will, however, have to be omitted.

EXPLANATION OF THE PLATES.

PLATE XXXIX.

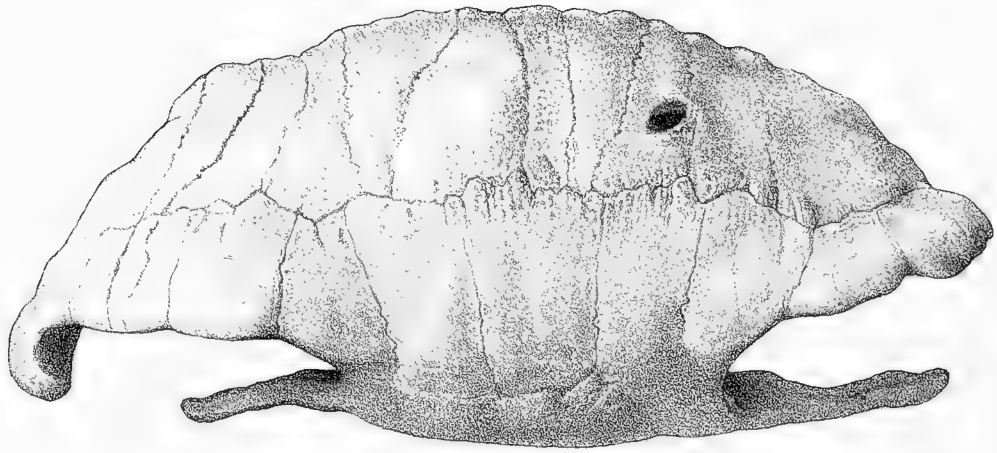
Shell of male (*Testudo grandidieri*), $\frac{1}{9}$ nat. size. Upper, lower, and side views.

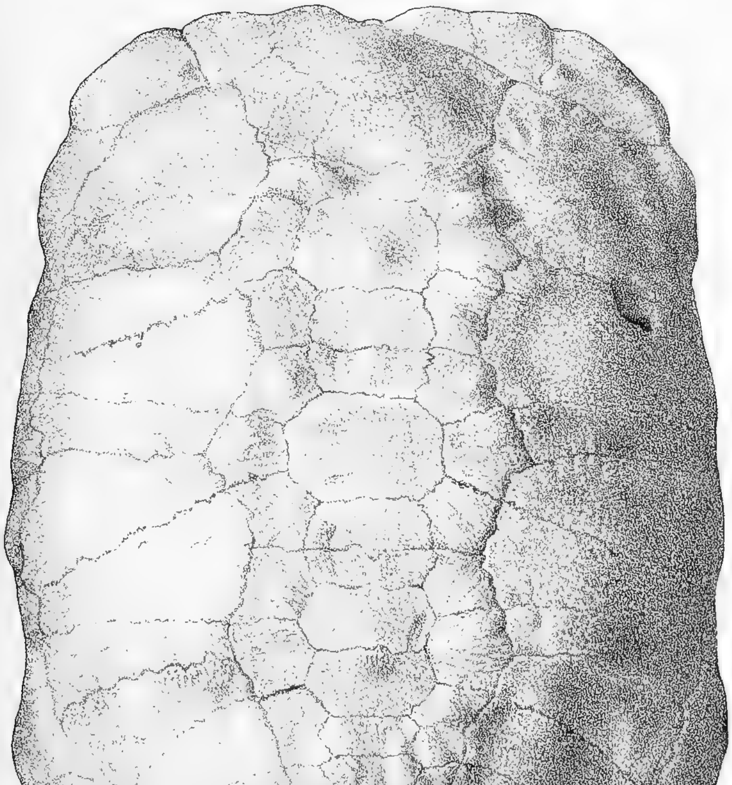
PLATE XL.

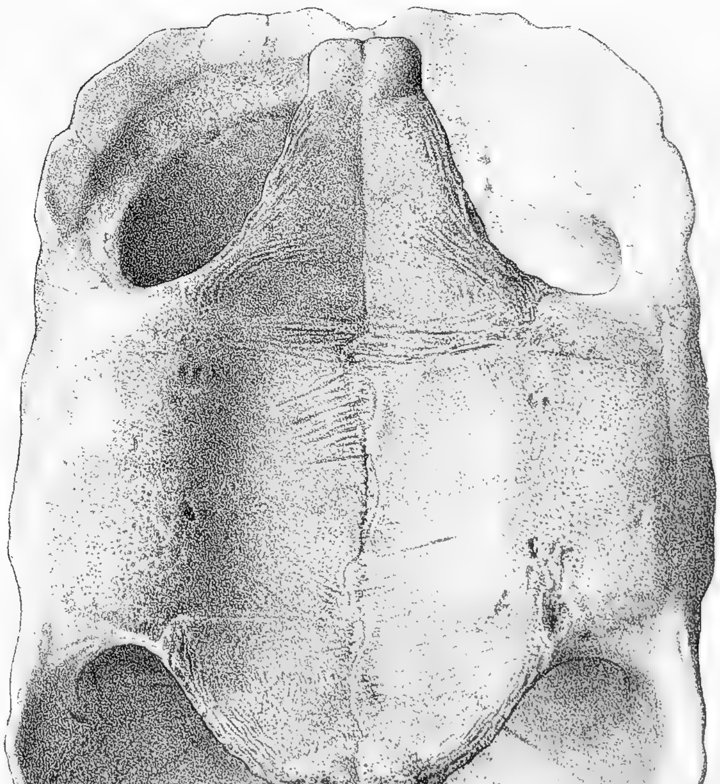
Shell of female, $\frac{1}{8}$ nat. size. Upper, lower, and side views.

PLATE XLI.

Skull of female, nat. size. Upper, lower, and side views, and upper view of symphysial portion of mandible.







E.C. & G.M. Woodward. del. et lith.

West, Newman imp.

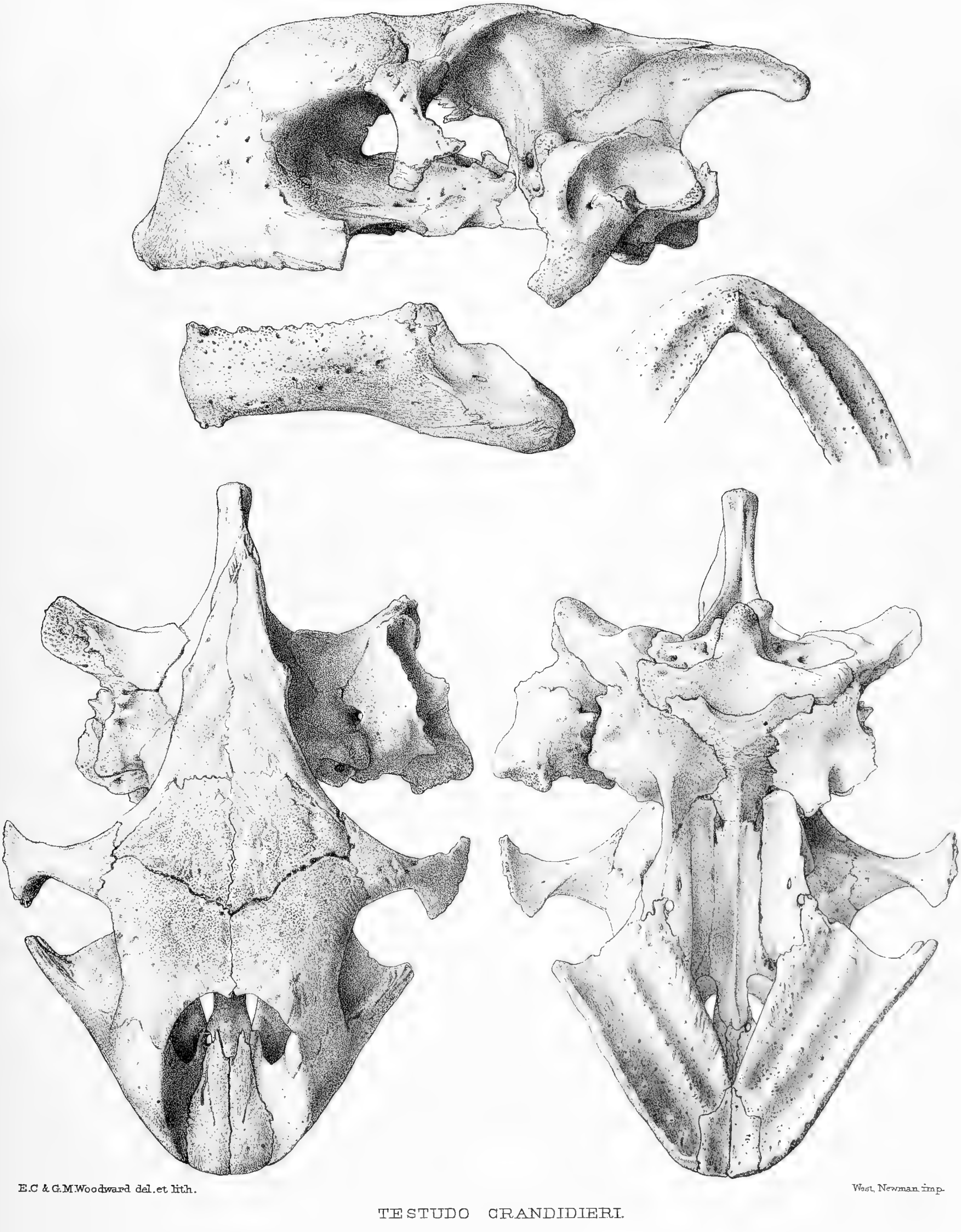
TESTUDO GRANDIDIERI.

Trans. Zool. Soc. Vol. XIII. Pl. XI.

E.C & G.M. Woodward del. et lith.

West, Newman imp.

TESTUDO GRANDIDIERI.



E.C & G.M.Woodward del. et lith.

West, Newman imp.

TESTUDO GRANDIDIERI.

XII. *On the Remains of some Gigantic Land-Tortoises, and of an extinct Lizard, recently discovered in Mauritius.* *By* HANS GADOW, *Ph.D., M.A., F.R.S., Lecturer on Advanced Morphology of Vertebrata, and Strickland Curator, University of Cambridge.*

Received November 29th, 1892, read December 20th, 1892.

[PLATES XLII.–XLIV.]

THE collection of bones of birds from the Mare aux Songes, in Mauritius (described in Trans. Zool. Soc. vol. xiii. (1893) p. 281), was accompanied by an equally interesting collection of reptilian remains from the same locality. Mr. Théodore Sauzier, as President of the Commission des Souvenirs Historiques, made the stipulation that a typical selection of these bones should be given to the University Museum of Zoology, provided the whole of the material was worked out in Cambridge. This task has been entrusted to me, and I now take the opportunity of thanking Mr. Sauzier for his generous liberality.

Considering that a great portion of the collection has to be returned to Mauritius, it is necessary to figure most of the important specimens.

Dr. Günther's Monograph, 'The Gigantic Land-Tortoises, living and extinct,' London, 1877, naturally forms the basis of the following descriptions. By having distinguished several species, notably *Testudo triserrata* and *T. inepta*, when studying previous collections from the Mare aux Songes, and by having, moreover, assigned names to the numerous disconnected skulls, carapaces, plastra, pelves, and shoulder-girdles, he has established a case of precedence which naturally has to be acknowledged as potentially correct, until at some future time complete specimens, with all their bones associated, shall be found, and either corroborate or correct his identifications.

I follow his plan of distinguishing by different names at least some of the most obviously differing carapaces and plastra, referring, however, to many of the other bones by letters and numbers only. The same letters and numbers, with references to this paper, having been attached to all the specimens, recognition has been secured.

There remains the question of the specific value of these names. It is immaterial to the descriptive purpose of this paper, whether they be considered as indicating species, subspecies, varieties, or races. So long as we knew that Mauritius was inhabited at the utmost by three species, namely *T. triserrata* and *T. inepta*—*T. indica* s. *perraulti* being only supposed to have come from Mauritius, and since the name *T. leptocnemis* was suggested only on account of the femur, pelvis, and scapula—this view was to be accepted as possible, considering that the island of Aldabra has yielded, according to Dr. Günther, five living species, which Mr. Boulenger has reduced to four.

But now, through this last collection, there have come to light so many different forms of Tortoises that, proceeding upon the old lines, at least the following forms have to be distinguished:—

T. INDICA, provided carapace No. V. belongs to this form.

T. TRISERRATA.

T. INEPTA.

T. SAUZIERI.

T. SUMEIREI, *i. e.* the name given by Mr. Sauzier to the specimen which is still living in the court of the Artillery Barracks at Port Louis.

Lastly, T. LEPTOCNEMIS, if need be.

This makes five or six different forms, and to suppose that these represent as many species reduces the idea of a species to absurdity, unless the very presence of these Tortoises on this little island (and the same applies to Aldabra) be explained by the thrilling assumption that during the supposed process of subsidence of the surrounding country—now the Indian Ocean—the Tortoises fled to the highest districts, now the islands of Madagascar, Aldabra, Mascarenes, &c. This assumption implies the supposition, equally gratuitous, that South-western "Lemuria" was inhabited by at least 11 to 14 different species of gigantic Tortoises, namely 5 or 6 now in Mauritius, 4 or 5 now in Aldabra, 1 in Rodriguez, and 1 or 2 in Madagascar, not counting the species which possibly never reached these islands.

How these islands ever received their Tortoises is a mystery, but this is quite another question.

The five or six forms of Galapagos Tortoises were, or are, to a certain extent peculiar to different islands, and this isolation is in favour of their specific value, but five of the Mauritian forms were all found in the same swamp [1]. With plenty of food, a congenial climate, and without formidable enemies, they grew to a gigantic size, could interbreed to their hearts' content, for all we know to the contrary, and variation within harmless bounds received no check from natural selection. The very thinness of the shells of some of these gigantic Tortoises, especially *T. vosmaeri* of Rodriguez and several Galapagos forms, seems to indicate that strength of the dermal armour was no longer required in these Elysia of Tortoises.

[1] I do not suggest that different genera, and even different species of one genus, do not inhabit the same locality. In the marismas of Andalucia I have found, in the Laguna de los Patos, *Emys europæa* and *Clemmys sigris* s. *leprosa* in equal numbers, a somewhat unexpected fact, because *Emys* is the almost exclusive Tortoise in North Portugal, while *Clemmys* is extremely abundant in the Alemtejo, where *Emys* is very rare.

THE CARAPACES. (Plate XLII.)

Carapace No. I.—*Testudo sauzieri.* The whole shell, together with the plastron, is complete, with the exception of the second, third, and fourth vertebral plates. The dorsal profile differs from that of the typical *T. inepta* by the shape of the hump of the fifth vertebral plate, the much steeper hump of the fourth plate, and the apparently much steeper hump of the first vertebral.

The marginals are likewise different; the first is in broad contact with the first costal, even more so than in *T. triserrata*, while in *T. inepta* the first marginal and first costal do not touch each other. The last marginal or caudal is much thicker than in *T. inepta*, measuring 10 by 3·3 cm., with a thickness of 2·3 cm.; instead of being concave ventrally, it is decidedly convex.

The total length of carapace no. I. is 51·5 cm.; its greatest breadth across the inguinal region is 36 cm.

The plastron, 36 cm. long, resembles that of *T. triserrata* (that of *T. inepta* is still unknown), but the pectorals are wider than in the plastron figured by Dr. Günther, while the markings of the shields in the axillary region agree with it. However, there is another male plastron in the Cambridge Museum, determined by Dr. Günther as belonging to *T. triserrata*, in which the pectorals are just as wide as in *T. sauzieri*, while the axillary impressions are different.

The whole shell is rather thick, like that of *T. inepta*; the sides are steep and as decidedly convex as in *T. inepta.*

Carapace No. II.—*T. inepta.* Fragment of posterior two-thirds, typical *T. inepta.*

Carapace No. III.—*T. triserrata.* Fragment, consisting of the posterior six marginals, with portions of the adjoining right and left fourth costals, and the fifth vertebral plates.

Carapace No. IV.—*T. triserrata.* Fragment, a little more complete than no. III.

Both specimens are easily recognized as belonging to the typical *T. triserrata*, because of the large, ventrally concave caudal plate, which is thin, strongly curved, and measures 17·5 cm. in greatest width, 10 cm. in height.

Carapace No. V.—*T. indica.* This fragment consists of the complete first, second, third, and portion of the fourth vertebral plates; portions of the right and left first marginals, portions of the right and left first, second, and third costals. Greatest length of fragment 43 cm.

Its dorsal longitudinal profile is almost a straight line, only with a slight concavity across the middle of the first vertebral plate. All the vertebrals are nearly flat, and there is no indication of a swelling or hump on the fourth plate.

The first marginals are likewise in the same flat dorsal level. Apparently the first marginal scutes did not touch the costal plates.

The anterior margin of this carapace is very peculiar (*cf.* Pl. XLII. fig. 10).

1st. The two marginals form a straight line, instead of being curved as in *T. inepta*, *T. triserrata*, and *T. sauzieri*.

2nd. The median notch is very slight dorsally; absolutely wanting on the ventral margin.

3rd. Ventrally the two marginals are strongly concave, forming a sharp and very prominent ridge.

Dr. Günther, Monograph, p. 43, remarks that "a carapace with so straight a vertebral profile as that delineated and described of *T. perraulti* is not represented among the specimens collected by Messrs. Bouton and Newton." Moreover, none of the species described in his Monograph possess such a flat carapace. Our carapace no. V., in its flatness and almost straight profile, agrees rather well with the figure given by Perrault of his male Grande Tortue des Indes ('Mémoires pour servir à l'Histoire des Animaux et des Plantes,' Amsterdam, 1736, p. 395), but the anterior marginals are very different. This may, however, be due to the inexactness of the drawing, which also exhibits the curious anomaly of showing only four instead of the usual five vertebral plates.

Perrault remarks that the length of the shell was 3 feet, the tail 14 inches long, and ending in a point "garni d'un bout semblable à une corne de bœuf." The length of this horny spur is not mentioned; judging from the figure, it would scarcely amount to half an inch.

Duméril et Bibron, 'Erpétologie Générale,' vol. ii. p. 126, mention among other points "la suscaudale simple, très élargie; la dernière de la rangée vertébrale bombée." If this implies that only the last vertebral plate possesses a hump, then this specimen differs from both *T. triserrata* and *T. inepta*, because in the former all the vertebrals are humped and in the latter the fourth and fifth; on the other hand, *T. indica* s. *perraulti* agrees by the large caudal plate with *T. triserrata*, and differs from *T. inepta* and *T. sauzieri*.

It is very probable that carapace no. V. belongs to a *T. indica*, and in this case there can be no longer any doubt that Perrault's specimen came from Mauritius, a corroboration of Dr. Günther's surmise.

The Plastra. (Plate XLII.)

Plastron A.—Intermediate between *T. triserrata* and *T. sauzieri*. This plastron is complete. Its greatest length is 39 cm., its greatest breadth 35·5 cm., indicating a much broader Tortoise than *T. sauzieri*. It agrees in its ventral impressions with that of *T. sauzieri*, but differs from the latter as follows:—

1. The markings or shield-impressions in the inguinal region are more like those of *T. triserrata*.

2. The posterior margin of the plastron is decidedly and sharply curved upwards, instead of showing a slight triangular swelling; more like *T. triserrata*.

3. The fourth to seventh marginals, which connected the plastron with the three middle costal plates, are very much steeper, and almost flat vertically instead of being convex.

Plastron B. *T. triserrata.* Typical. Represented by the two disconnected anterior and posterior two-fifths of a male specimen.

Plastron C. *T. triserrata.* The anterior half of a large male plastron; greatest width of fragment 42 cm.

Plastra D, E, F, G. *T. sumeirei.* When Dr. Günther wrote his Monograph he could state categorically :—

1. That the specimens with a nuchal plate, and with a double gular, came from Aldabra.

2. That the specimens without nuchal, and with a single gular, came from the Mascarenes.

3. That the specimens without nuchal, and with a double gular, are Galapagos Tortoises.

Now this statement cannot be upheld any longer, because among the materials brought by Mr. Sauzier from the Mare aux Songes are the anterior portions of four very large plastra, which differ from all the others previously received from Mauritius and Rodriguez in the following points [1] :—

1. The anterior lobe of the plastron is very much elongated.

2. It ends in a fork instead of being rounded off.

3. There were two gular shields, a right and a left, as indicated by the deep impressions left upon the bones.

Another difference is exhibited by the posterior portion of the plastron (Pl. XLII. fig. 8), which, from its size, thickness, and colour, I suppose to belong to the same Tortoise as the anterior portion of the plastron (fig. 6).

The posterior margin of this specimen ends ventrally in a much swollen and rugose tuberosity; dorsally it possesses a somewhat triangular, very strong tuberosity, which seems to have fitted upon the ischiadic symphysial tuberosity of the pelvis, and which, to judge from its roughness, seems partly to have been anchylosed with the pelvis. None of the Mauritian specimens, hitherto known, show any such tuberosities; but they exist in some of the Aldabran forms, namely in *T. elephantina*, *T. daudini*, and *T. hololissa*, not, however, in *T. ponderosa*, which latter has, by the way, been recognized by Boulenger as the female of *T. elephantina*.

In the configuration of the pectoral impressions, and in the whole shape of the anterior lobe, the plastra D, E, F, G agree mostly with *T. daudini*.

[1] There are also five precisely similar specimens of anterior plastral portions in the Cambridge Museum, which had probably been received together with those Tortoise-remains from Mauritius which Professor Haddon has catalogued and described in Trans. Linn. Soc. ser. ii., Zoology, vol. ii. (1879) pp. 155–163, pl. 13. They have, however, remained undetermined and do not seem to have been mentioned.

All these specimens are extremely thick and heavy, in every respect different from the plastra of *T. triserrata* and *T. sauzieri*. The greatest width of fragment E is 38 cm. The fact that they have been found in the Mare aux Songes, together with the other Tortoise material, excludes the possibility of their having been introduced by Man.

Tabular Comparison of the Forked Plastra D, E, F, G of Mauritius with Plastra of Aldabra Tortoises. (+ means agreement, — means difference.)

	T. elephantina.	*T. ponderosa.*	*T. daudini.*	*T. hololissa.*
Anterior end of plastron	+	+, most.	—	—
Double gulars	+	+	+	+
Pectoral impressions	+	+, most.	—	—
Posterior plastral tuberosity ..	+	—	+	+

T. sumeirei (Pl. XLIV.).—The indigenous existence in Mauritius of Tortoises with a double gular and with a long forked plastron having been proved, it is quite within the range of probability that the solitary specimen which is still living in that island is a native and not an imported creature.

Mr. Sauzier has given a description, with photographic views, of this specimen in 'La Nature,' no. 1016, 19 novembre, 1892, pp. 395–398, and he has distinguished it as *Testudo sumeirei*, in honour of M. Camille Sumeire, of Mauritius. Mr. Sauzier has presented to us several of the original photographs of this Tortoise, accompanied by the following notes:—

"Lors de la conquête de l'Ile de France (Maurice), le 3 décembre 1810, il existait dans la cour des casernes de l'Artillerie, à Port Louis, une gigantesque tortue de terre, qui a fait partie du matériel laissé aux Anglais.

"Cette bête vit encore dans cette même cour, dont les bâtiments ont été convertis en mess pour les officiers.

"Il est facile de voir, par son aspect général, qu'elle doit être d'un grand âge. Si, en 1810, d'après les plus anciens habitants, elle avait attenue sa taille actuelle, ou peu après, elle aurait pour moins deux siècles—ce qui ne l'empèche pas, bien qu'aveugle depuis quelques années, de porter avec aisance sur sa carapace deux hommes représentants ensemble le poids de 150 kilos.

"Il est à regretter que l'absence d'échelle [in the side-view photograph], ou mieux encore, d'un objet de comparaison, dans la photographie, ne permette pas d'apprécier exactement la taille de cette gigantesque tortue, dont on ne connaît pas le lieu d'origine."

When walking this Tortoise stands 63·5 cm. high, leaving 15·5 cm. between the ground and the plastron; its carapace is grey and measures in its "grande circonférence" 259 cm. = 8 feet 6 inches, and 213 cm. "de circonférence en largeur." The fore legs are 45, the hind legs 30 cm. long; neck and head 39·5 cm., tail 30·5 cm. in length.

The back view shows a very large, broad, and sharply-curved caudal shield, which strongly resembles that of *T. triserrata*, and differs from that of any Aldabran or Galapagos specimens. Front and side views show that there is no nuchal shield whatever.

The under view shows a slightly forked projection of the anterior end of the plastron, with two gular shields, indicating two gular bony plates as in the forked plastra D, E, F, G.

The first marginal shield is very large and in broad contact with the first costal, agreeing in this respect with Aldabran specimens.

The profile of the carapace, the scarcely serrated marginals, and the markings of the vertebral and costal shields most resemble the corresponding parts of *T. ponderosa* = female of *T. elephantina*.

The anterior portion of the plastron, which is well shown in the photograph, agrees in length, narrowness, and forked termination with *T. daudini*.

According to Boulenger's Key, pp. 153–154, Cat. Chelonians, British Museum, this specimen would come nearest to *T. nigrita* and *T. nigra* s. *elephantopus* (nuchal absent, gulars distinct, shields of carapace concentrically striated in the adult, profile of carapace declivous in front). But *T. nigrita* differs considerably in the shape of the anterior end of the plastron, the profile of the distinctly humped vertebral shields, and the serrated marginals. *T. elephantopus* differs likewise in the shape of its plastron. Both *T. elephantopus* and *T. nigrita*, moreover, differ in the shape of their much smaller caudal shield, and above all in the shape of the head. The head of the photographed specimen, *T. sumeirei*, agrees much more with that of the Aldabran type, while *T. triserrata* and *T. inepta* appear to have resembled the Galapagos types.

There remains the question whether the forked plastra D, E, F, G belong to the same race of Tortoises as *T. sumeirei*.

This question is difficult to settle; we do not know the carapaces which belonged to the plastra D, E, F, G.

However, this much is certain—(1) that the plastra D, E, F, G cannot have belonged to Galapagos Tortoises, because of the double gulars and because of their locality; (2) that the type of *T. sumeirei* cannot be a specimen introduced from the Galapagos Islands, because of the shape of its head, plastron, and double gulars; (3) that *T. sumeirei* cannot be one of the true Aldabran species, because it has no nuchal shield and because of its different caudal shield; (4) *T. sumeirei* exhibits quite a new combination of characters, namely double gulars, without nuchal, and is indigenous in Mauritius. At any rate, we have here a Mauritian Tortoise which is fundamentally of the Aldabran type, but combines with Aldabran features several peculiarities which are characteristic of the Mauritian *T. indica*, *T. triserrata*, and *T. inepta*, and also resembling in several points some of the Galapagos species [1].

Complexes of terminal Caudal Vertebræ (Plate XLIII. figs. 1, 2, 3).—Until proof to the contrary is forthcoming, I assign two completely preserved specimens of anchylosed terminal vertebræ to the species which possesses the cleft or forked plastron, namely *T. sumeirei.* The largest of these curious specimens measures 12 cm. in length, with an anterior concave, almost saddle-shaped, articulating facet of 5·3 cm. in width. The anterior half of this vertebral complex consists clearly of three or four anchylosed vertebræ, while the posterior half, strongly curved downwards and tapering to a blunt point, shows by its surface-mouldings that it was covered with a horny sheath which completely surrounded the terminal half like a spur. The length of this spur was at least 6 cm., to which, of course, the probably considerable thickness of the horn itself has to be added.

Dr. Günther says in his description of *T. elephantina* (Monograph, p. 30) that "the last seven vertebræ are quite rudimentary and coalesced into a single bone." The total number of caudal vertebræ of *T. elephantina* is 25, *i. e.* 18 free vertebræ besides the coalesced complex; the shell of the large stuffed male specimen in the Natural History Museum is not less than 49 inches long, but the caudal complex is far less completely anchylosed, and its anterior articulating facet is one third smaller than is the case with the two specimens in Mr. Sauzier's collection. They either belonged to a Tortoise of gigantic dimensions (as indicated by the large plastron E), or the caudal spurred complex is relatively larger than in any of the Aldabran races. According to Perrault's description, *T. indica* likewise possessed a distinct horny spur. Dr. Günther continues as follows:—"In individuals of the male sex the tail plays a very important part as an external prehensile or, rather, steadying organ, which also differs externally from that of the female in its greater length and by being provided with a large terminal claw. Nearly always the animal carries it bent sidewards under the carapace, generally towards the left side, and therefore I anticipated to find a want of symmetry in some portion of the root of the tail; however, nothing of the kind can be observed."

I have much pleasure in corroborating the sagacious anticipation of Dr. Günther concerning an asymmetrical development, not, however, of the root of the tail, but of the terminal half of the anchylosed complex, which shows a distinct deviation towards the left side (see figure of dorsal view, Plate XLIII.).

Among gigantic Land-Tortoises such an anchylosis has hitherto been observed only in specimens from Aldabra, Mauritius, and, to a lesser extent, from the Galapagos. In one specimen of *T. elephantopus* the vertebræ are, according to Günther, "irregular, and asymmetrically confluent towards the end of the tail."

[1] Should the post-mortem of the solitary surviving type of *T. sumeirei* reveal that it differs in its plastron from those referred to as D, E, F, G, I herewith reserve to myself the claim of distinguishing these forked plastra as belonging to a *Testudo guentheri.*

Adult specimens of *Chelone midas* have a similar, although much smaller, caudal claw; in a large male specimen in the Cambridge Museum the horny claw or spur is about 2 cm. in length, and covers about three vertebræ, two anchylosed and one free.

None of the textbooks of zoology, comparative anatomy, and herpetology written since 1877 have as yet condescended to mention this important instance of an anchylosed terminal caudal vertebral complex in the class of Reptiles.

Cervical Vertebræ (Pl. XLIV. figs. 20–25).—Three atlas vertebræ, representing two different types, one with slightly joined neural arches and with a ring-shaped perforated body, the others with a completely solid unperforated body—differences which cannot be explained away by age. Although the atlas of the various families of Tortoises exhibits many modifications, the specimen A, with the solid body, is peculiar; its body does not contain the odontoid process, because the latter has left the three typical articulating facets or impressions upon the body of the atlas. Specimens B and C agree more with the atlas vertebræ figured by Dr. Günther.

Pelves.—Five nearly complete specimens, numbered I. to V. (Pl. XLIII. figs. 4 & 5).

Pelvis No. I. has to be assigned to *T. triserrata* according to Dr. Günther's definition. It is the largest known, measuring 23 cm. in height and 23 cm. in width. The bridge between the obturator foramina is very broad, namely 3·8 cm. Unfortunately, the tuberosity of the ischiadic symphysis, resting upon the plastron, is lost. The ventral ridge of the ischiadic symphysis is very prominent.

Pelvis No. II. belongs to a smaller specimen, its measurements being 17 and 15·5 cm. The obturator foramina are wide, the bridge consequently narrow, resembling that of Aldabran Tortoises. The lateral ridge or crest of the shaft of the ilium is very prominent, more so than in *T. triserrata.* This pelvis differs markedly in two peculiarities from those which have been determined as belonging to *T. triserrata* and *T. inepta.* First, the longitudinal ridge on the ventral side of the ischiadic symphysis is very low, instead of being very prominent. Secondly, the ischiadic tuberosity has a deep cavity on its ventral surface, and is rough instead of being smooth, suggesting that it fitted upon and was partly fused with a corresponding tuberosity of the posterior end of the plastron. Such a plastron is that which I have distinguished as belonging to *T. sumeirei.*

Pelves III., IV., and V. resemble each other, and those of *T. inepta* more than other species; but it has to be noted that they exhibit a certain amount of variation in the extent of the lateral iliac ridge—in fact, that they are intermediate between the typical specimens of *T. triserrata* and *T. inepta.* They may belong to *T. leptocnemis,* the pelvis of which is diagnosed as resembling that of *T. triserrata*, but with a narrower ilium.

Scapulæ and Coracoids.—The four specimens are all different. Two are more like those of *T. inepta*; one more like that of *T. triserrata*; the fourth has a very flat scapular shaft, resembling in its transverse configuration that of *T. triserrata* and still more in general the Aldabran species. I feel inclined to associate this specimen with the other remains of *T. sumeirei.*

It has to be borne in mind, however, that the bones of the shoulder-girdle of all these extinct Tortoises are subject to a very great amount of variation in size and shape [1]. It would not be difficult to select out of the extensive material at our disposal at least half a dozen different types, provided the intermediate forms were neglected or suppressed.

Phalanges.—Three large terminal and seven middle and proximal phalanges.

Skulls (Pl. XLIII. figs. 6 *a*–8).—Mr. Sauzier's collection contains 19 skulls and two mandibles. Two of these skulls and one pair of underjaws belong to *T. triserrata* according to Dr. Günther's definition. Six skulls and the other pair of underjaws agree with those of *T. inepta.* The remaining eleven skulls differ from those of *T. triserrata* and *T. inepta* chiefly in the shape of the ventral surface of the long supra-occipital crest. This surface is broad, triangular, and concave, while it is narrow and ridge-like in *T. inepta,* narrow and doubly ridged (or, in other words, with a narrow longitudinal groove) in *T. triserrata.*

However, all these skulls exhibit a considerable amount of individual variation in their general aspect, slope and size of the crest, relative strength of the various parts of the skull, naso-frontal profile, &c. Most of them approach to a slight extent the Aldabran skulls by the convexity of their frontal region, and, according to Dr. Günther, the "posterior margin of the paroccipital crest is deeply excised" in *T. daudini.* Whether these variations are due to age or sex, or are of specific or subspecific value, cannot be determined. It has to be borne in mind that we have no criterion whatever by which we can associate any of these numerous skulls with any particular form of carapace, plastron, or limb-girdle. It is quite possible that the typical skulls of *T. triserrata* belong to the carapaces which have been distinguished as those of *T. inepta,* or to *T. sumeirei,* or *vice versâ,* and the same remark applies with equal force to the various sorts of pelves.

Unfortunately, this uncertainty is inevitable, because, owing to the circumstance that many of the bones from the Mare aux Songes had to be fished out of a morass just as the labourers happened to come across them, no record of the juxtaposition of the various bones could be, or at any rate has been, made. Until, by happy chance or by a much more careful and extensive mode of research, all the principal parts of one unquestionable individual are found, the association of these bones will be a matter of speculation without any valid basis.

"Habt alle die Theile in der Hand,
Fehlt leider nur das geistige Band."

---

[1] See A. C. Haddon, Trans. Linn. Soc. ser. ii., Zoology, vol. ii. (1879) pp. 156–158.

Didosaurus mauritianus. (Plate XLIV. figs. 1–16.)

A short fragment, with three teeth, of the maxilla, five fragments of the mandible, seven more or less perfect femora, and portions of three humeri have been described and figured (with the exception of the maxillary fragment) by Dr. Günther in the 'Journal of the Linnean Society,' Zoology, vol. xiii. (1878) pp. 322–324. All these bones had been collected in the Mare aux Songes.

Mr. Sauzier has obtained many more specimens in the same locality:—4 complete left mandibles; 4 complete right mandibles; 10 right and 9 left mandibular dentals: 14 right and 14 left proximal halves of mandibles; 3 complete frontals, of two large specimens and one small; 3 bases cranii; 1 atlas vertebra; 3 thoracic vertebræ, two of which are successive and belong to one individual; 4 lumbal vertebræ of a smaller specimen; 1 lumbal rib; 1 sacrum; 2 fused vertebræ; 4 post-sacral vertebræ (first, second, third?, and fourth?); 4 right humeri; 4 left humeri; 4 ulnæ; 3 right femora; 7 left femora; and 3 left ossa innominata or pelvic halves, one of which indicates a small specimen.

The largest of the complete underjaws measures 76 mm. in length.

As was to be expected, the number of teeth is variable, namely 22, 23, 24, 24, 25 in the five most complete left dentals, and 20, 22, 23, 26 in the right dentals.

The shape and proportions of the underjaws, of the frontal bone, and of the basis cranii indicate that in the shape of the skull *Didosaurus* resembled the genus *Cyclodus*.

The largest humerus measures 42 mm. in length, the smallest 35 mm.; all the specimens possess a distinct entepicondylar foramen.

The ulnæ vary from 30·5 to 32 mm. in length.

The largest femur measures 49 mm., the shortest 43 mm.

P.S.—Since this paper was read, Mr. Sauzier has published a memoir, which contains not only numerous historical accounts, but also several excellent woodcuts, representing side and back views of the large Tortoise living at St. Louis. It is entitled 'Les Tortues de terre gigantesques des Mascareignes et de certaines autres iles de la mer des Indes.' 8vo. Paris, 1893. 32 pp.

EXPLANATION OF THE PLATES.

PLATE XLII.

Fig. 1. Type of *Testudo sauzieri*. Carapace No. I.
Fig. 2. Carapace No. I.; posterior view.
Fig. 3. Longitudinal vertical section through type-specimen of *T. sauzieri*.
Fig. 4. *T. sauzieri*; ventral view.
Fig. 5. Plastron A.
Fig. 6. Plastron F. Dorsal view, posterior portion, *T. sumeirei*.
Fig. 7. Plastron F. Profile section through posterior portion.
Fig. 8. Plastron F. Ventral view, posterior portion, *T. sumeirei*.
Fig. 9. Carapace No. V. Probably *T. indica* of Perrault.

Fig. 10. Profile section through the anterior portion of carapace no. V., in level of the arrow.

Fig. 11. Profile section through corresponding part of *T. triserrata.*

Fig. 12. Plastron E. Dorsal view. *T. sumeirei.*

Fig. 13. Plastron E. Ventral view. *T. sumeirei.*

PLATE XLIII.

Figs. 1–3. Dorsal, anterior, and ventral views of complex of terminal caudal vertebræ, referred to *Testudo sumeirei.* Nat. size.

Fig. 4. Pelvis No. II. Ventral view. Probably *T. sumeirei.*

Fig. 5. Pelvis No. II. Dorsal and anterior view.

Fig. 6 *a*. Cranium of *Testudo*, sp. ?

Fig. 6 *b*. View of the "posterior margin of the paroccipital crest."

Fig. 7. Cranium and posterior view of paroccipital crest of *T. inepta.*

Fig. 8. ,, ,, ,, ,, *T. triserrata.*

(Figs. 6, 7, 8 are drawn to the same scale, namely about $\frac{6}{10}$ nat. size. The paroccipital crests are drawn of the natural size.)

PLATE XLIV.

Figs. 1–16. *Didosaurus mauritianus.* Nat. size.

Figs. 1, 2. Inner and outer view of left mandible.

Fig. 3. Dorsal view of frontal bone.

Fig. 4. Ventral view of basis cranii.

Fig. 5. Upper figure: dorsal view of atlas.

Fig. 5. Lower figure: side view of a thoracic vertebra.

Figs. 6 & 7. Dorsal and ventral views of two successive thoracic vertebræ.

Fig. 8. Dorsal and ventral views of sacrum.

Fig. 9. Dorsal view of first post-sacral vertebra.

Fig. 10. Dorsal view of second post-sacral vertebra.

Fig. 11. Dorsal view of third ? or fourth ? post-sacral vertebra.

Fig. 12. Left outer view of pelvis.

Fig. 13. Posterior view of femur.

Figs. 14 & 15. Anterior and posterior view of humerus.

Fig. 16. Left ulna.

Fig. 17. *Testudo sumeirei*; the type specimen living at Port Louis, Mauritius.

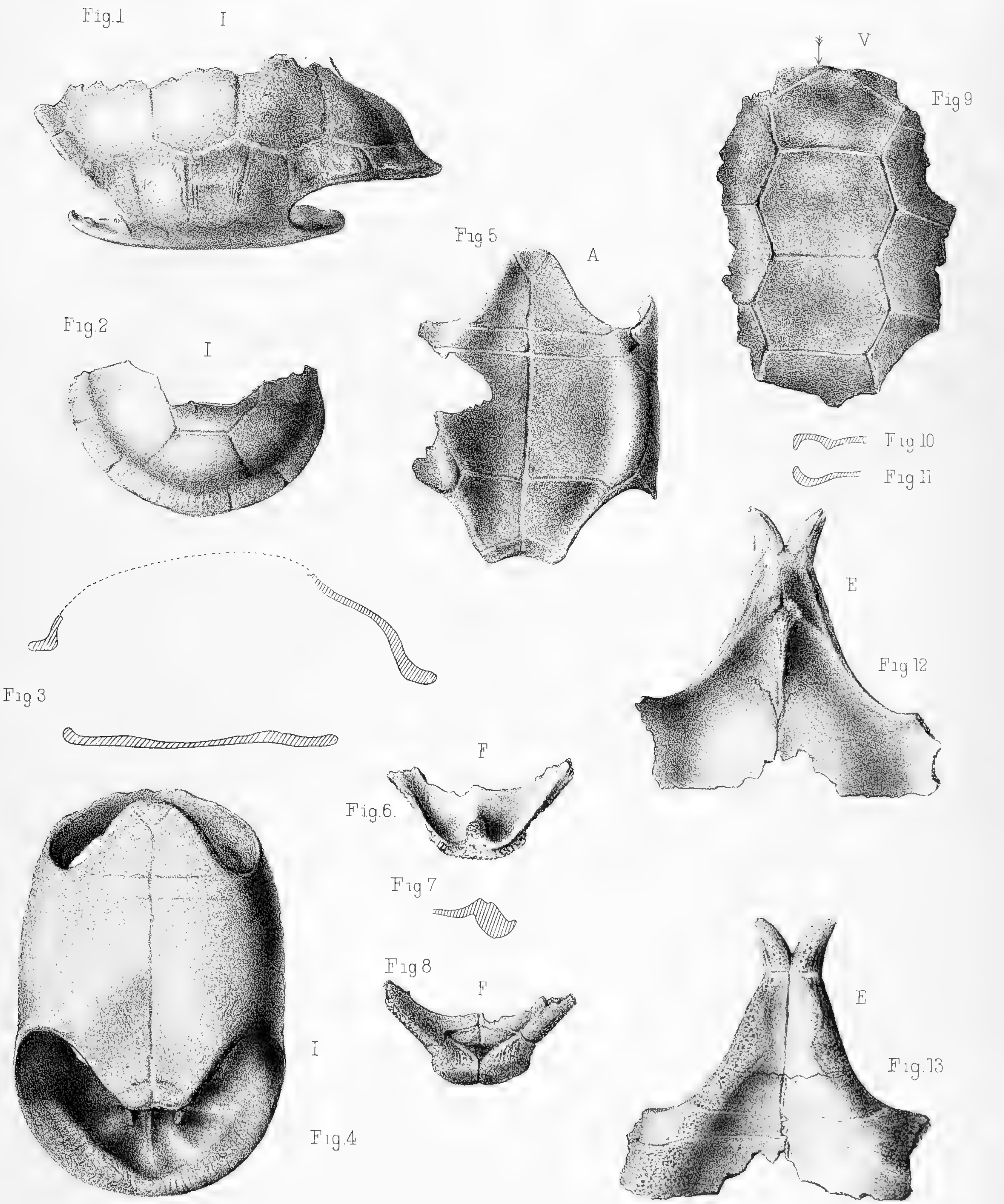
Fig. 18. Ventral view of plastron of the same specimen.

Fig. 19. Side view of the same specimen.

(Figs. 17–19 after photographs procured through the kindness of Mr. Th. Sauzier.)

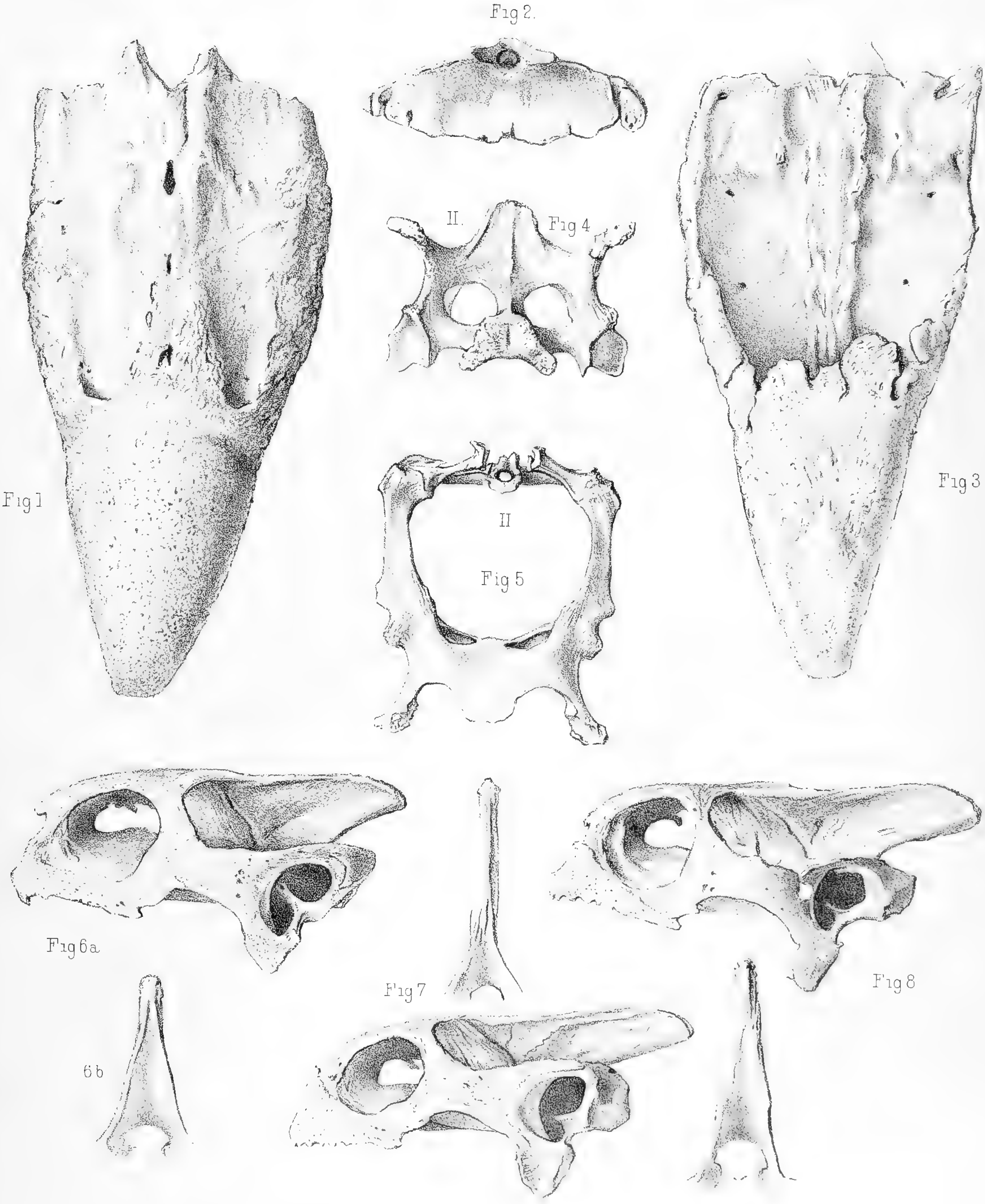
Figs. 20, 21, 22. Lateral, anterior, and posterior views of atlas A. Nat. size.

Figs. 23, 24, 25. Anterior, lateral, and posterior views of atlas B. Nat. size.



MAURITIAN LAND-TORTOISES.

Edwin Wilson Cambridge



MAURITIAN LAND-TORTOISES

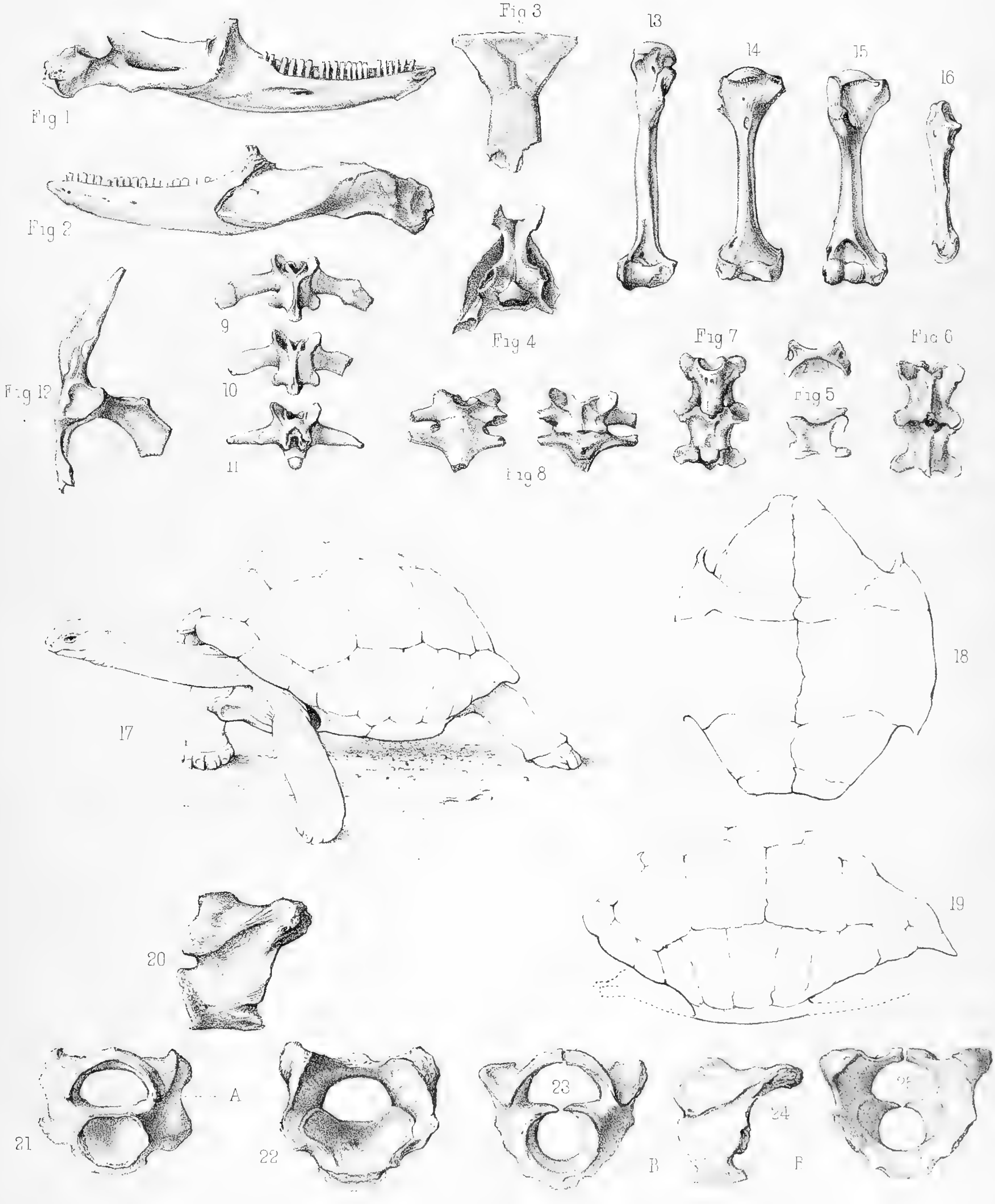


FIG. 1-16 DIDOSAURUS MAURITIANUS
FIG. 17-19 TESTUDO SUMEIREI
FIG. 20-25 „ SP. ATLAS A AND B

Edwin Wilson Cambridge

XIII. *A Revision of the Genera of the Alcyonaria Stolonifera, with a Description of one new Genus and several new Species.* *By* SYDNEY J. HICKSON, *M.A. Cantab., D.Sc. Lond., F.Z.S., Fellow of Downing College, Cambridge.*

Received October 13th, 1892, read December 6th, 1892.

[PLATES XLV.–L.]

IN a communication made to the Royal Society in 1883 (8) I pointed out the advisability of separating those Alcyonarians in which the polypes spring independently from a basal stolon into a special suborder, for which I proposed the term Stolonifera. As my suggestions have not been very generally accepted by continental writers on this group, it is necessary to preface my remarks by a short defence of the position I now take in retaining this suborder.

No very serious argument has yet been brought forward against the retention of the Stolonifera. Von Koch (19), in his monograph of the Gorgonidæ of Naples, refers to my paper in a footnote only, and does not attempt either to describe or criticize my classification. I cannot allow this opportunity to pass without reference to the extraordinary and perfectly unjustifiable attack that he has made upon me in this footnote.

He says, in the first place, that I have quite falsely quoted his paper on the "Skelet der Alcyonarien." The sentence to which he probably objects will be found on page 699. It runs as follows:—"Recently von Koch has suggested a classification that is based on the varieties of the skeleton, but it seems to me that the Pennatulidæ and Gorgonidæ are not so closely related as to justify their position in the same division of the same group (Axifera)." The word Axifera, it is true, at the end of this sentence was allowed to remain in this position in the text by an oversight, and for that I apologize; but the general statement is perfectly true, for on p. 474, in describing his third "Hauptgruppe," he says "Zu der letzten Abtheilung gehören die beiden Familien der Pennatuliden (VII.) . . . . . . und die der Axifera (VIII.)" (*i. e.* the true Gorgonidæ).

In the second place, he says that I did not investigate a single true Gorgonid (Axifera); but, as a matter of fact, I not only did make and examine several series of sections through the polypes of *Primnoa*, which von Koch himself includes in his family Gorgonidæ, but I actually gave and described a careful drawing of one of these sections. I was induced to make the statement that the siphonoglyphe is probably absent in the Gorgonidæ, partly because I could find no such structure in the two forms I investigated myself, and partly because von Koch himself did not describe any such structure in any of the numerous Gorgonidæ he had examined (*Isis, Gorgonia, Sclerogorgia*, &c.); but I was wrong in placing too much reliance on von Koch's work, as he failed to note in a monograph on the anatomy of the genus the well-marked siphonoglyphe of *Tubipora*. Ever since the publication of my paper in the 'Philosophical Transactions' von Koch has not brought forward one word of criticism upon my system of classification that requires an answer, and I can only say now that I am exceedingly sorry that he should have thought it necessary to make such a personal attack upon me.

Viguier (35), in a valuable paper on a very remarkable Alcyonarian, *Fascicularia edwardsi*, in which a number of small *Alcyonium*-like colonies are connected together by expansions of the cœnenchym, remarks:—"Je ne parlerai pas, au cours de cette discussion, de la classification proposée par Hickson, dans le mémoire cité plus haut. En voulant séparer d'une manière aussi absolue les types où la multiplication se fait par bourgeons naissant directement sur les polypes, de ceux où elle se fait par l'intermédiaire de stolons, cette classification, justement critiquée par Koch à un autre point de vue, avait déjà, au moment où elle a été proposée, l'inconvénient de laisser en dehors le Paralcyonium, où les deux modes se trouvent réunis."

Viguier's argument would be perfectly conclusive if my group Stolonifera were based entirely on the mode of origin of the young polypes. I was probably wrong in assuming that there was sufficient evidence to lead us to believe that in the *majority* of Alcyonaria they are formed by budding directly from the first-formed polypes; in fact, it seems to be more probable now that in all the Alcyonaria, except, perhaps, the Pennatulida, the buds are formed in the cœnosarcal canals, which connect the cœlentera of the older polypes. The essential feature of the Stolonifera, a feature in which the genera of the group differ from all the other Alcyonaria, is that the polypes arise independently from a creeping basal stolon or (in *Tubipora*, in *Clavularia viridis*, and the fossil *Syringopora*) also from horizontal platforms or connecting-tubes; and their walls never become fused or cemented together by a growth of the mesoderm during the whole life of the colony.

The growth of the colony of a Stoloniferan usually takes place at the periphery of the stolon, that is to say it increases in size horizontally; the only exceptions to this rule being found in the forms just mentioned, where there is a very considerable vertical growth, and new polypes are formed above the plane of the stolon. In all the other Alcyonaria there is, after the youngest stages, very little basal horizontal growth, but a very considerable distal vertical growth and multiplication by gemmation from peripheral canals.

The important differences of the mode of growth of the five suborders of the Alcyonaria may be seen at a glance by reference to the diagrammatic figures here given.

It was naturally expected that the authors of the volume on the Alcyonaria of the 'Challenger' expedition (30) would take the trouble to consider and discuss the

Fig. 2.

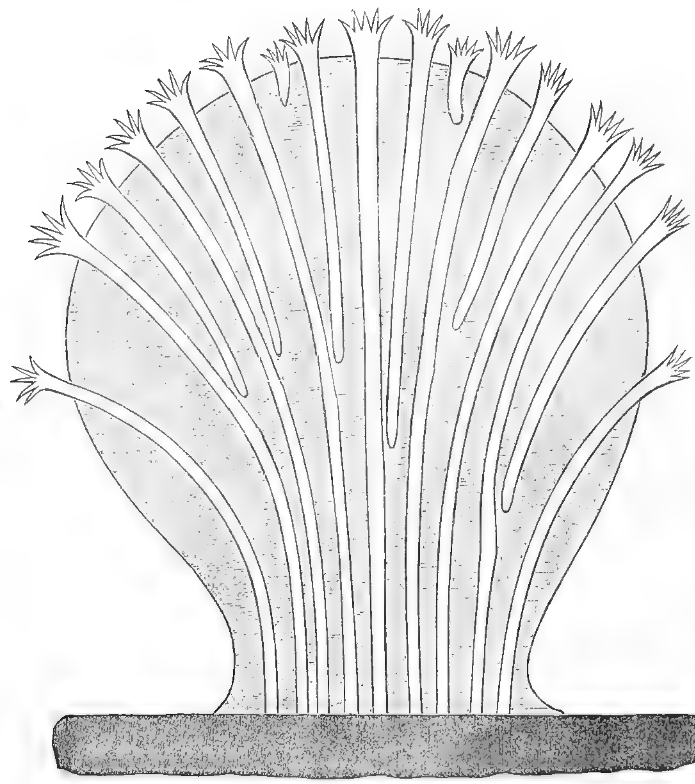


Fig. 1.

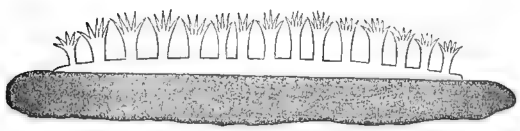


Fig. 3.

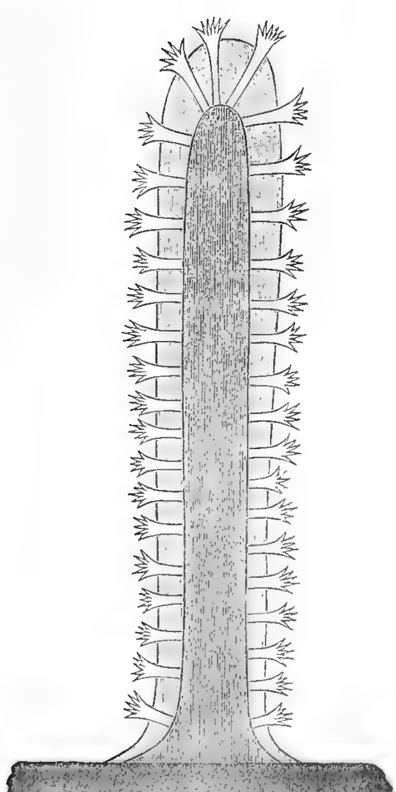


Fig. 4.

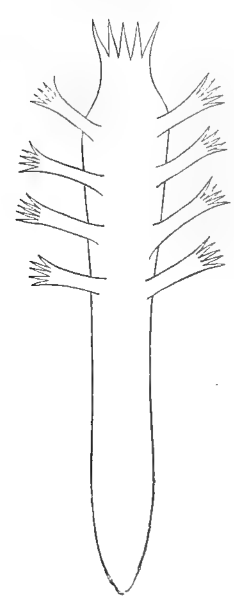


Fig. 1. Schematic section through a Stoloniferan.
Fig. 2. Schematic section through an Alcyonid.

Fig. 3. Schematic section through a Gorgonid.
Fig. 4. Schematic section through a Pennatulid.

value of classifications that have been seriously put forward in easily accessible publications; but not only is my group, the Stolonifera, passed over in silence, but the name is actually employed for a division of the genus *Clavularia*, without one word of comment or apology. Anyone who is not well acquainted with the literature of the group might quite easily infer, on reading the 'Challenger' report, that the term "Stolonifera" is used for the first time by these authors. It is quite in keeping with such work as this that no attempt is made in the volume cited to discuss the value of the genera of the family Cornulariidæ (Clavulariidæ), which have recently been proposed without sufficient reason or description; that the peculiar mode of budding of *Clavularia viridis* is not referred to[1]; and that, in a word, the whole group remains in the same state of confusion that it was in before the publication of that colossal memoir.

Classification of the Alcyonaria.

The Order Alcyonaria may be conveniently divided into the following five Sub-orders:—

1. PROTOALCYONARIA .	*Haimeia, Hartea.*
2. STOLONIFERA	Fam. 1. *Clavulariidæ.* ,, 2. *Tubiporidæ.*
3. ALCYONACEA.........	Fam. 1. *Alcyonidæ.* ,, 2. *Helioporidæ.* etc. etc.
4. GORGONACEA.........	Section I. *Scleraxonia.* ,, II. *Holaxonia.*
5. PENNATULACEA	Fam. *Pennatulidæ.*

The principal points by which this classification differs from those put forward in recent times by other authors are the separation of the Protoalcyonaria and Stolonifera from the rest of the Alcyonaria as separate suborders, and the grouping together into one suborder the Tubiporidæ and the Clavulariidæ.

The value of a system of classification rests upon the correctness of the conception of the relative values of the characters presented by the animals that are being classified. A good classification is not necessarily the one in which the different groups contain an approximately equal number of families or genera. It is generally recognized now, for example, that it is not reasonable to include *Amphioxus* in the Class Pisces, but that it is reasonable and far more correct to place this remarkable form in a group by itself, the Acrania, which is to be considered of equal value to the whole

[1] To illustrate the importance of this point, I may be allowed to quote some remarks of the late Professor Moseley (10):—"The existence of transverse communicating canals in *Clavularia*, extending between the vertical tubes at successive heights above the stolon-tubes, as in *Syringopora*, is apparently a new fact, and one of great interest."

of the Chordata, with the exception of the Tunicata—the Craniata. Now the genera *Haimeia*, *Hartea*, and *Monoxenia* differ from all the other Alcyonaria in the remarkable character that they remain solitary—they do not, in fact, form compound colonies by gemmation.

This feature surely, by itself, is quite sufficient to justify their separation into a suborder. It is true there are many points in their anatomy and life-history that require further investigation, but it is only misleading to group them, even temporarily, with the Alcyonidæ, Helioporidæ, and other families with complicated growth and gemmation.

The Stolonifera, again, must be placed in a separate suborder, because in their mode of budding and in their general anatomy they differ widely from the other Alcyonaria. Anyone with the smallest experience of the group could distinguish almost at a glance one of the Stolonifera. He could recognize it as such as easily as he could recognize an Alcyonian, a Pennatulid, or a Gorgonian. There are, of course, in all these suborders some genera that present difficulties, but the majority of them may be quite easily located.

I have very little to add to the remarks I made in two former papers in favour of my proposition to classify *Tubipora* with the Stolonifera. I was not by any means the first to point out the relations between this genus and *Clavularia* and *Cornularia*. In 1834, de Blainville (1) placed these three genera together in one family, "Les tubipores;" and von Koch many years ago regarded *Tubipora* as a very primitive form, closely related to the Cornulariidæ. The formation of new buds in *Clavularia viridis*, from tubes connecting the polypes, similar to the condition which existed in the fossil *Syringopora*, is a point which brings the genus *Clavularia* closer to *Tubipora*, and this may be used as an additional argument in favour of my method of classification.

The Stolonifera.

The Suborder Stolonifera may be defined as follows:—Colonial Alcyonaria, with a membranous or ribbon-like stolon. Mesoglœa poorly developed. Polypes either entirely free from one another, excepting at their bases, or connected by horizontal platforms (*Tubipora*) or connecting-tubes (*Clavularia viridis*). Skeleton composed of calcareous spicules, which may be joined together to form firm tubes (*Tubipora*), free from one another, or absent. In some cases the body-wall supported by a horny secretion.

The Stolonifera contain two families, the Tubiporidæ and the Clavulariidæ. To the former belongs the genus *Tubipora* alone, distinguished from all the other Stolonifera by the fact that the spicules join together to form a firm skeleton, and by the presence of horizontal connecting platforms. To the latter belong four living genera, namely *Clavularia*, *Cornularia*, *Stereosoma*, and *Sympodium*, and probably the fossil genus *Syringopora*.

The family Clavulariidæ is practically the same as the Cornulariidæ of other writers, but there are very good reasons for changing the name and adopting the one that I have proposed.

The genus *Cornularia* is distinguished from the other genera by the absence of spicules and the presence of a considerable horny secretion on the polype-walls and stolon. If this genus contained a large number of species, and it were at all a common thing for the species of the other genera to have horny walls and be devoid of spicules, *Cornularia* might be taken as the type of the family. But it is not so. *Clavularia* is the genus with the largest number of species, and the absence of spicules and the presence of a horny substance strengthening the walls of the polypes are phenomena not very frequently met with in the family. It is better, then, to take *Clavularia* as the typical genus.

At the time of the appearance of the famous 'Histoire Naturelle des Coralliaires,' by MM. Milne-Edwards and Haime, seven genera were recognized, and they were arranged as follows:—

Cornulariés
- Simples, à polypiéroïde tubulaire et à polype rétractile . . . . *Haimeia.*
- Agrégées, portées sur
  - des stolons radiciformes. Polypiéroïdes
    - tubuliformes. Polypes
      - rétractiles. Murailles
        - ni costulées ni spiculifères: *Cornularia.*
        - costulées et spiculifères: *Clavularia.*
      - non rétractiles. *Rhizoxenia.*
    - verruciformes . . . . *Sarcodictyon.*
  - une expansion membraniforme. Polypes
    - rétractiles . . *Sympodium.*
    - non rétractiles *Anthelia.*

If subsequent naturalists had followed closely the characters here given by the French naturalists, we might have been preserved from the extraordinary state of confusion into which the group has now fallen; but new species have been included in the old genera without reference to the characters here given, new genera have been created without any reason, adequate or otherwise, given in the text, and the figures, in some cases, have been hopelessly at variance with the descriptions. To give here just one example of the many I have come across:—The genus *Rhizoxenia* was established by Ehrenberg (5) to include a species that he found in the Red Sea, characterized by the fact that the polypes are not retractile, and Milne-Edwards and Haime rely upon this as the one and only character separating this genus from *Clavularia* and *Cornularia*. "Genre IV. RHIZOXENIA. Polypiéroïdes comme dans les genres précédents, mais polypes non rétractiles."

Notwithstanding this fact, Sars (26) described a new species as *Rhizoxenia filiformis* with completely retractile polypes, and von Koch (17), in describing Dana's old species, *Rhizoxenia rosea*, says the polypes are extraordinarily contractile.

Without giving more examples illustrating the fearful state of confusion of the group at the present time, I will merely express my opinion that all the old classifications must now be definitely abandoned, and a new one be formed to take their place. In order to do this it is necessary to criticize the genera as they now stand.

Since the publication of the 'Histoire Naturelle des Coralliaires,' several genera have been added, so that we have now thirteen genera in all (omitting the non-colonial forms *Haimeia*, *Hartea*, and *Monoxenia*).

The Genera of the Stolonifera.

In the report on the Alcyonaria of H.M.S. 'Challenger,' Studer and Perceval Wright (30) include the following sixteen genera in the family Cornulariidæ:—

1. *Cornularia,* Lamarck.
2. *Rhizoxenia,* Ehrenberg.
3. *Clavularia,* Quoy & Gaimard.
4. *Sarcodictyon,* Forbes.
5. *Anthelia,* Savigny.
6. *Gymnosarca,* Saville Kent.
7. *Cornulariella,* Verrill.
8. *Telesto,* Lamouroux.
9. *Cœlogorgia,* Milne-Edwards.
10. *Cyathopodium,* Verrill.
11. *Scleranthelia,* Studer.
12. *Anthopodium,* Verrill.
13. *Sympodium,* Ehrenberg.
14. *Erythropodium,* Kölliker.
15. *Callipodium,* Verrill.
16. *Pseudogorgia,* Kölliker.

These sixteen genera fall into three groups:—

(1) Those that have been thoroughly well described and figured, and can be readily identified as separate genera belonging to the Stolonifera, namely: *Cornularia*, *Clavularia*, and *Sympodium*.

(2) Those that have been only imperfectly described, and had better be incorporated in the other genera: *Rhizoxenia*, *Sarcodictyon*, *Anthelia*, *Gymnosarca*, *Cornulariella*, and *Cyathopodium*.

(3) Those that do not come within the limits of my definition of the Stolonifera, and should be placed in other suborders: *Telesto*, *Cœlogorgia*, *Scleranthelia*, *Erythropodium*, *Pseudogorgia*, *Anthopodium*, and *Callipodium*.

The three genera *Rhizoxenia*, *Sarcodictyon*, and *Anthelia* have been established for many years, and I feel some hesitation in proposing that they should now be abolished. Increased knowledge of the varieties of the species of *Clavularia*, however, shows that it is a matter of impossibility to draw any hard-and-fast lines between the forms described under these generic names and some of the species of *Clavularia*.

The genus *Rhizoxenia* was established by Ehrenberg (5) in 1834 for those forms allied to *Cornularia* and *Clavularia*, but differing from them in the non-retractility of their polypes. Since Ehrenberg's time new species have been named *Rhizoxenia* with perfectly retractile polypes, so that the original character of the genus has been lost. Thus von Koch (17) in a recent paper says that *Rhizoxenia rosea* (von Koch) differs from *Clavularia* in the fact that the tentacles are partially invaginated in retraction as in *Corallium rubrum*; but this is not a character that can be raised to the value of a specific distinction. I have myself noticed in some species of *Clavularia* that the base of the tentacle is, to a certain extent, invaginated, and I have always considered that this feature depends upon the presence or absence of a dense deposit of spicules at the basal part of the tentacles. In those Clavularias with very thick-walled polypes there is no invagination of the tentacles—they are simply withdrawn; but in those whose polypes are thin-walled a partial invagination takes place. Even if there were any value in this character it is not one, I think, that should be very readily adopted, as it is not very easy to determine the mode of retraction of the tentacles with certainty without making a series of sections through a large number of polypes, and it would consequently be a character of great inconvenience to the systematic zoologist. Until some other character has been described, the genus *Rhizoxenia* must go, and consequently

Rhizoxenia rosea, Dana (3), becomes *Clavularia danæ.*[1]
Rhizoxenia primula, Dana (3), becomes *Clavularia primula.*
Rhizoxenia thalassantha, Ehrenberg (5), becomes *Clavularia thalassantha.*
Rhizoxenia filiformis, Sars (26), becomes *Clavularia filiformis.*

The genus *Sarcodictyon* was established by Forbes (12) for a delicate little form with very thin-walled polypes, which may be completely withdrawn into a thin ramifying stolon of ribbon-like bands.

There can be no doubt that the *Rhizoxenia filiformis* of Sars is closely related to *Sarcodictyon catenata* of Forbes; but it was hardly fair of Sars to criticize Forbes's action in not including it in the genus *Rhizoxenia.* Surely it was Sars who was at fault in placing his species with perfectly retractile polypes in a genus whose main character was that the polypes were not retractile!

However, I agree with Sars that *Sarcodictyon* must be given up, and consequently

Sarcodictyon catenata of Forbes becomes *Clavularia catenata.*

It is difficult, too, to find any very definite character by which to distinguish the genus *Anthelia* from *Clavularia.* The stolon is a membranous expansion, the polypes are not retractile as a whole, though their tentacles are, and there are numerous spicules. All of these characters are to be seen in some Clavularias.

Dana says, "The *Antheliæ* cover the rocks or any solid support at hand with thin fleshy plates, which consist of an aggregation of polypes united by their bases. They differ from the *Xeniæ* in budding only at the base, which gradually spreads outward by the process, producing finally the encrusting plate."

[1] The name *Clavularia rosea* has been given to a species from Kerguelen by Studer (28).

Anthelia glauca, Savigny,	=	*Clavularia glauca.*
Anthelia strumosa, Dana (3),	=	*Clavularia strumosa.*
Anthelia purpurascens, Dana (3),	=	*Clavularia purpurascens.*
Anthelia desjardiniana, Templeton,	=	*Clavularia desjardiniana.*
Anthelia capensis, Studer (28),	=	*Clavularia capensis.*
Anthelia filippii, Kölliker (20),	=	*Clavularia filippii.*

The name *Gymnosarca* was given by Saville Kent (13) to a form that exhibits numerous creeping stolon-like thick expansions, which anastomose and give rise to *free cylindrical stolons* on which the polypes are found. It may be that *Gymnosarca* should more correctly be placed with *Telesto* among the Alcyonida, but the determination of this point must rest upon some future microscopic examination of the "free cylindrical stolons." If they are really "stolons" (that is to say, if they are not mainly composed of the fused body-walls of the polypes), there is no reason for separating this form from the genus *Clavularia.* Whatever view we take, *Gymnosarca* as a separate genus must disappear from the Clavulariidæ.

The genus *Cornulariella* was described by Verrill (31) in 1874 in a footnote to a list of specimens caught in a dredging-expedition on the coast of New England.

The chief point of importance in this form is the presence of large fusiform spicules with sharp conical projections, which thicken and stiffen the walls of the polype-bodies. The actual size of these spicules is not given.

It seems to me to be a mistake to place a species in a separate genus on the character of the spicules alone. The spicules vary enormously in size, in number, and in distribution in the various species of *Clavularia.* Sometimes they are very large, as in *Clavularia viridis* (Plate L. fig. 16), sometimes very small, as in *C. garciæ*, and sometimes altogether absent, as in one variety of *C. australiensis*, *C. celebensis*, &c.

If there were any other distinctive character of this form, it might be well to consider it a separate genus; but it seems to me, from the very meagre description that is given (without any figure), that it is nothing more than a species of *Clavularia* with large and peculiar spicules. In what respects it is allied to "*Cornularia* and *Telesto*" we have no information.

It seems to me, then, that *Cornulariella modesta* should become *Clavularia modesta.*

The name *Cyathopodium* was given by Verrill (33) to a species formerly described by Dana as *Aulopora tenuis.* (It is obvious that in Verrill's paper *Allopora* is a misprint for *Aulopora.*) Verrill says, "It is, in fact, a *Tubipora*-like polyp with short cup-shaped cells, connected by narrow calcareous stolons, which correspond to the transverse plates of *Tubipora*, and from which the polyps spring."

I must confess that I fail to see that we have any evidence for supposing that this form is allied to *Tubipora.* We have no figure nor description of the polypes, and we have no figure nor description of the microscopic appearance of the calcareous stolon.

Moreover, the narrow calcareous stolons of *Cyathopodium* do not correspond in any way with the transverse plates of *Tubipora.* They are homologous with the stolons of *Tubipora*, and there is nothing like the horizontal platforms in this form. From the beautiful drawing given by Dana (3) it appears to be very similar macroscopically to Forbes's *Sarcodictyon*, a genus which, as I have pointed out, must now be abandoned.

Aulopora tenuis (Dana) = *Cyathopodium tenue* (Verrill) = *Clavularia tenuis*.

The genera *Telesto*, *Cœlogorgia*, *Scleranthelia*, and *Pseudogorgia* seem to me to be very remotely allied to the Stolonifera, and I do not think it is necessary to discuss their relations here. They all belong to the Alcyonida.

The genus *Erythropodium* was established by Kölliker (20) for the *Xenia carybæorum* of Duchassaing and Michelotti (4). From the description and figures given by the Italian observers, and the very brief description of the species given by Kölliker, it is quite unreasonable to accept without further comment the genus *Erythropodium*. It seems to me to be highly probable that Duchassaing and Michelotti were perfectly correct in their identification of the specimen they examined as a *Xenia*.

The genus *Callipodium*, established by Verrill (32) in 1869, would probably be more correctly placed among the Alcyonidæ than the Clavulariidæ. "The polyps are rather large and situated at the tops or summits of round-topped verrucæ, which are more or less elevated above the surface of the cœnenchyma, and either distantly scattered or closely crowded together; in the latter case often united laterally nearly to their summits." These points seem to indicate, as Verrill remarks, that it is "more nearly allied to the Briareidæ than to the Cornularidæ (Clavulariidæ, mihi), and I am therefore inclined to regard it as an encrusting genus of the former family, since even the typical species of the genus *Briareum* is sometimes found growing in broad encrusting sheets on stones, or parasitically covering the dead axes of many species of Gorgonidæ.

The genus *Anthopodium*, also established by Verrill (34), seems to be closely related to *Callipodium* on the one hand, and *Telesto* on the other. There is no reason whatever for retaining it in the suborder Stolonifera.

Genus Cornularia, Lamarck (24).

Without spicules. Stolons with a simple cavity. The basal parts of the polypes and stolons protected by a horny secretion.

Cornularia cornucopiæ. Naples. von Koch (16) = *Tubularia cornucopiæ*, Pallas, Elenchus.
Cornularia aurantiaca. China. Stimpson (27).

The species given by Quoy and Gaimard, *Cornularia multipinnata* and *Cornularia subviridis*, belong properly to the genus *Xenia*.

A further and more detailed account of the anatomy of this genus is a desideratum.

Genus Clavularia, Quoy & Gaimard (25).

The definition of this genus given by the French naturalists runs as follows:—

"Animaux cylindriques à huit tentacules pinnés continus dans des claviformes, coriaces, striés, subpédicules fixes et agglomérés."

This definition holds good in its entirety for the one species *Clavularia viridis* only. The limits of the genus must be considerably expanded to include the species that have been described since the return of the 'Astrolabe.'

The genus *Clavularia* includes those Clavulariidæ that possess a membranous or retiform creeping stolon into which the polypes cannot be completely retracted. Spicules are usually present. No horny secretion of the ectoderm formed.

In order to render the task of identifying the species of *Clavularia* an easier one, it is necessary to give detailed lists of some of the principal characters of all the species that have now been described.

The species of *Clavularia* arranged approximately in the order in which they have been described.

Name of Species.	Locality and depth.	Length of polypes.	Authority.
Clavularia viridis	Vanikoro, shore (?).	50 mm. and over.	Quoy and Gaimard (25).
C. violacea	Vanikoro, shore (?).	Only a few lines.	Quoy and Gaimard (25).
C. rusei	St. Thomas.	?	Duchassaing and Michelotti (4).
C. rosea	Kerguelen, 120 fath.	9 mm.	Studer (28).
C. magelhænica	Straits of Magellan, 42 fath.	5 mm.	Studer (28).
C. ochracea	Mediterranean.	10 mm.	von Koch (15).
C. crassa = *Cornularia crassa* (M.-E. & H.)	Mediterranean, shallow water.	5 mm.	Marion and Kowalewsky (23).
C. petricola	Mediterranean, shallow water.	6 mm.	Marion and Kowalewsky (23).
C. arctica	Vadsö, 50–60 fath. [150 fath., Grieg (6)].	12–14 mm.	Koren and Danielssen (21).
C. borealis	Throndhjemsfjord.	10–12 mm.	Koren and Danielssen (21).
C. stormi	Throndhjemsfjord.	5 mm.	Koren and Danielssen (21).
C. frigida	Off Spitzbergen, 260 fath.	3 mm.	Koren and Danielssen (22).
C. tubaria	Sombrero, W. Indies, 450 fath.	18 mm.	Perceval Wright and Studer (30).
C. elongata	Off Azores, 1000 fath.	13 mm.	Perceval Wright and Studer (30).
C. cylindrica	Off Tristan da Cunha, 100–150 fath.	5 mm.	Perceval Wright and Studer (30).
C. marioni	Mediterranean.	10 mm.	von Koch (16).
C. concreta	46° N. lat., 49° E. long., 1267 fath.	....	Studer (29).
C. australiensis	Port Jackson, Australia, shallow water.	About 3 mm.	Hickson, present monograph.
C. ramosa	Port Jackson, Australia, shallow water.	About 4 mm.	Hickson, present monograph.
C. flava	Port Jackson, Australia, shallow water.	About 8 mm.	Hickson, present monograph.
C. garciæ	Diego Garcia, shallow water.	9–10 mm.	Hickson, present monograph.
C. reptans	N. Celebes, 5–10 fath.	?	Hickson, present monograph.
C. celebensis	N. Celebes, 10 fath.	8 mm.	Hickson, present monograph.

To these must be added the species of those genera that I have shown can no longer be separated from *Clavularia*:—

Name of Species.	Locality and depth.	Length of polypes.	Authority.
Clavularia desjardiniana = *Anthelia desjardiniana.*	Ile de France.	?	Dana (3).
C. strumosa=*A. strumosa*	Red Sea.	1 inch.	Ehrenberg (5).
C. glauca=*A. glauca*	Red Sea.	?	Savigny's figure in de Blainville (1).
C. purpurascens=*A. purpurascens*	Red Sea.	?	Ehrenberg (5).
C. capensis=*A. capensis*	Cape of Good Hope, 50 fath.	9–10 mm.	Studer (28).
C. filippii=*A. filippii*	?	?	Kölliker (20).
C. danæ=*Rhizoxenia rosea*	Mediterranean.	2 lines.	Dana (3).
C. primula=*R. primula*	Fiji Islands.	4–5 lines.	Dana (3).
C. thalassantha=*R. thalassantha* .	Moluccas.	?	Ehrenberg (5).
C. filiformis=*R. filiformis*	Coasts of Norway, 30–40 fath.	?	Sars (26).
C. catenata=*Sarcodictyon catenata.*	British, deep water.	....	Forbes (12).
C. colinabum=*S. colinabum*	Scotland.	?	Forbes (?).
C. bathybius= *Gymnosarca bathybius.*	Cezimbra, Portugal.	....	Saville Kent (13).
C. modesta= *Cornulariella modesta.*	Gulf of St. Lawrence, 80–100 fath.	6–18 mm.	Verrill (31).

To these must be added two species, *Rhizoxenia alba* and *Sympodium margaritaceum*, described by James Grieg from the coasts of Norway, both of them being undoubtedly species of *Clavularia* :—

Name of Species.	Locality and depth.	Length of polypes.	Authority.
Clavularia alba=*Rhizoxenia alba*	68° N. long., 9° 44′ E. lat., 634 fath.	....	Grieg (6).
C. margaritaceum=*Sympodium margaritaceum.*	63° N. long., 5° E. lat., 237 fath.		

The following species have been too imperfectly described to enter into any modern system:—*Anthelia rubra* of delle Chiaje, *Anthelia olivi* and *Anthelia domuncula* of de Blainville.

Genus Sympodium (Ehrenberg).

Some doubt has been thrown upon the stability of this genus by the recent investigations of von Koch (18) upon *Sympodium coralloides*, who has shown that this form is a true Alcyonid adapted to live on a *Gorgonia* stem, and proposes that its name should be changed to *Alcyonium coralloides*. It is possible that, when they are properly examined histologically, the other species attributed to *Sympodium* may turn out to be after all true Alcyonians with a modified habit. For the present, however, it may be allowed to stand provisionally, and the reader may be referred to the excellent account of the genus in the 'Challenger' volume for the species that have been hitherto described.

The genus includes those Clavulariidæ with a thick plate-like stolon into which the polypes may be completely retracted.

Description of a new Genus (Stereosoma), *and of new Species of* Clavularia.

Stereosoma, gen. nov.

Stereosoma celebense. (Plate XLV.)

The only specimen of this interesting new genus known to me is one that I found growing on the reefs of Talisse Island in North Celebes. It does not occur in great abundance on any of the reefs that I visited; in fact the only specimen I found after months of reef-wading in search of specimens was a small colony bearing five or six polypes attached to a piece of water-logged wood.

The genus can be at once recognized by two important characters, the first being that it shows no power of retracting either its body-wall or tentacles, and the second that the pinnæ of the tentacles are separated from one another by very considerable intervals.

The absence of contractility is a remarkable feature.

Many Alcyonaria are usually described as not contractile, but the description is seldom perfectly accurate.

Polypes that possess a great number of densely-packed spicules take a long time to contract, and they may be removed from their habitat, placed in ordinary spirit, and be preserved without showing very much contraction. Again, many Alcyonarians that do not exhibit any considerable power of contracting their body-walls may contract their tentacles.

Now *Stereosoma* possesses no spicules, and the tentacles show no more power of contracting than the body-wall.

The illustration given (Plate XLV.) is a faithful representation of the specimen as it reached England on my return from Celebes, the colour alone having been added from notes that I made at the time of its discovery.

On making a series of transverse sections through one of the polypes I found that the ectoderm is remarkably thick, and presents a very vacuolated appearance.

Between the vacuoles and the ectoderm covering the body there may be seen a number of isolated cells, islets of cells, and strings of cells (Plate L. fig. 1). These are undoubtedly derived from the ectoderm, and probably secrete the tough, vacuolated, homogeneous substance that surrounds them and lies between them and the mesoglœa. I have had no means of ascertaining what is the precise chemical nature of this substance, but it is undoubtedly of a horny consistency. It stains deeply in borax carmine, and can be readily distinguished from the true mesoglœa which lies below it. It is a point of some importance, in comparing this genus with *Cornularia*, that in

Stereosoma the horny substance that is formed lies inside the ectoderm, whereas in *Cornularia* it is outside it.

The mesenteries present well-marked muscle-ridges and muscular bands. The muscles are used for producing the graceful swaying and bending movements that I noticed in the living condition.

There is a small and not very well-defined siphonoglyphe (Plate L. fig. 2), and the walls of the stomodæum in preserved specimens are slightly folded.

There are no spicules in the body-walls, tentacles, or stolon.

The stolon is a moderately thick plate-like structure containing numerous ramifying canals.

The tentacles are long and delicate, and present the remarkable feature of possessing only a few small teat-like pinnæ, separated from one another by considerable intervals. In this feature *Stereosoma* presents a character that seems to separate it from all the other Stolonifera. In all the species of *Clavularia* that I have examined the pinnæ are exceedingly numerous and very closely set, so that the tentacle has a considerable resemblance to the vexillum of a feather. The tentacle of *Stereosoma* has no resemblance whatever to a feather.

The elongated slit-shape mouth is situated on the top of a prominent conical hypostome.

There are no external ridges or other markings on the body-walls.

The genus may be defined as follows:—

Clavulariidæ forming small colonies, consisting of stiff non-retractile polypes situated at considerable intervals from each other on a thick plate-like stolon. Tentacles non-retractile. Pinnæ few and widely separated. Spicules absent.

One species, *Stereosoma celebense.* Polypes 15 mm. long, 3 mm. in diameter; tentacles 10 mm. long, with from 5 to 10 pinnæ on each side. Colour pale brown.

Locality. Shore reefs on southern part of Talisse Island, North Celebes.

Genus Clavularia.

Clavularia australiensis, Hickson (11), Variety A. (Plate L. fig. 3.)

Specimen 1. Stolon thin and membranous, forming in some places sympodial plates, in others broad and narrow strands.

Polypes partially retracted into the stolon, forming protuberances on its surface, 0·5 mm. in diameter, 1·0 to 1·5 mm. in height, and about 2 mm. apart.

Spicules numerous, simple, multituberculate, 0·14 to 0·18 mm. long (Plate L. fig. 4).

Colour in spirit white.

The specimen sent to me is parasitic on a piece of sponge.

An interesting point in connection with this specimen is the enormous number of zooxanthellæ in the intermesenterial spaces (Plate L. fig. 5).

I am convinced, from an examination of a large number of specimens of Alcyonarians, that the number of the zooxanthellæ in the cœlenteron cannot be used for purposes of classification, since polypes of the same species, and even of the same colony, show very great variation in this respect. Generally speaking, shallow-water polypes possess more than those that live in deeper water, the zooxanthellæ being probably dependent for their growth and multiplication upon the intensity of the daylight. But whether this is the only cause or not does not seem certain. At any rate we can say that it is highly probable that the conditions favourable for the growth and multiplication of the zooxanthellæ are not precisely the same as those favourable for the growth and multiplication of the Alcyonarian colonies, and thus the variations in the number of these symbiotic algæ in the polypes may be accounted for.

Specimen 2. The stolon is somewhat thicker in the central part of its area than in Specimen 1. It is membranous, but becomes divided at the edges into broad and narrow strands. The polypes are densely crowded on the central parts of the stolon, but scattered at the edges.

The polypes are partially retracted, but not to such an extent as in Specimen 1, the adpressed tentacles remaining visible in more than fifty per cent. of the polypes.

The average height of the partially retracted polypes is 3 mm., and their diameter 1·5 mm.

The walls of the polypes are thicker than they are in the first specimen, with dark brown corrugated outer surfaces.

Spicules resemble those in Specimen 1, but the tubercles are slightly longer and less numerous. Average length 0·15 mm. (Plate L. fig. 6).

The colony is parastic on a piece of sponge.

Clavularia australiensis, Variety B. (Plate L. fig. 7.)

The three specimens that I have grouped together as Variety B of this species are distinguished from the others by the absence of spicules. This fact in itself might be considered by some naturalists to be sufficient reason for the establishment of a new species, or even a new genus, for their reception; but after a careful examination of the anatomy of the specimens, their mode of growth, structure of the tentacles, and general anatomy, I am convinced that we are not justified in separating into different species those forms that differ mainly in the presence or absence of spicules. I believe that it is quite possible that in some localities, where there is but little lime in the water and an abundance of sand, the *Clavularias* do not develop spicules. This is sufficient to constitute a separate local variety, but not a species.

Associated with the absence of spicules in this variety there may be noticed a difference in the character of the ectoderm from that of Variety A (Plate L. fig. 8).

The ectoderm of Variety A is over the great part of ts surface smooth and columnar, each cell being marked off from its neighbours by very definite cell-outlines. In

Variety B, on the other hand, the ectoderm is highly vacuolated and its surface irregular. The cells have branched processes which anastomose with one another, and it is impossible to determine, in most cases, where one cell ends or another begins. I believe that this vacuolated ectoderm is considerably stiffer or firmer than the simple columnar ectoderm of Variety A, and that it is formed for the support of the body-wall in the absence of spicules.

In Specimen 1 of this variety the stolon is thin and membranous, dividing into ribbon-like pieces at the edges. The polypes are partially retracted and densely crowded on the parts of the colony with a membranous stolon, but fully expanded and widely separated from one another at the edges.

The colour is brownish yellow, due to a considerable deposit of sand.

The colony is parasitic on an Ascidian test.

Specimens 2 and 3 are probably young examples of the above. The stolon is very thin and composed of a number of anastomosing bands or ribbons. Most of the polypes are fully expanded. They are both parasitic on mussel-shells.

Locality. Coast of Victoria, shallow water.

CLAVULARIA RAMOSA, Hickson (11). (Plate L. figs. 9 & 10.)

Stolon composed of a number of thin branching strands clinging to the branches of a seaweed. The strands of the stolon are usually about $\frac{1}{2}$ mm. in breadth, but never exceed 1 mm.; they do not fuse to form membranous or plate-like expansions.

The polypes spring from the branches of the stolon singly at intervals of 3 mm. The youngest polypes are found at the ends of the youngest branches.

New polypes apparently never arise between the older polypes, but each polype is formed in succession at the end of the growing branch of the stolon.

The ramifications are formed by a simple bifurcation of the growing point of a branch, and they are produced quite independently of the position of the youngest polypes. Sometimes a polype may be seen springing from the angle of a bifurcation, but more frequently there is no polype in this position.

Judging from spirit-specimens only, the polypes are not capable of complete retraction into the branches of the stolon. In the retracted condition they are funnel-shaped. The broad rounded distal extremity, 1·5 mm. in diameter, contains the retracted calyx. The narrow proximal extremity at the point of attachment to the stolon is ·5 mm. in diameter.

The distal extremity is marked by eight deep furrows.

The spicules are numerous, both in the stolon and the polype-walls; they are double clubs 0·1 to 0·15 mm. long. In the tentacles there are a few elongated lancet-shaped spicules with irregular dentate projections (Plate L. fig. 11).

In spirit the specimens are dirty yellowish white in colour.

Locality. Coast of Victoria, shallow water.

Clavularia flava, Hickson (11). (Plate L. fig. 12.)

The stolon is thin and ribbon-like, not coalescing into membranous plates. There are comparatively few polypes situated on the stolon at intervals of 4 to 6 mm. At the edges of the stolon there are frequently to be seen considerable areas devoid of polypes.

The polypes have in all cases their crowns retracted, and the tracts of insertion of the mesenteries are not indicated externally by longitudinal grooves or lines. This feature, connected probably with the denseness of the mesoglœa and the great number of spicules, is quite sufficient in itself to distinguish this species from *C. australiensis.*

The length of the polypes, as they are seen in spirit with their tentacles retracted, is 4–6 mm., the diameter 1·5 mm.

The spicules are of a bright yellow colour, and form a dense armature for the polypes and stolon. On slicing off a piece of the body-wall and examining it with the microscope the spicules appear to be locked together to form a compact skeleton.

The spicules are 0·1 to 0·15 mm. in length, and are of three kinds:—(*a*) short and broad double cones with numerous blunt tubercles, found in great number in the mesoglœa of the body-walls of the polypes and the stolon; (*b*) elongated style-like spicules, with very few short and pointed tubercles, found principally in the tentacles; (*c*) a few spicules of irregular shape that I have never seen *in situ* (Plate L. fig. 13).

The colour of the specimens in spirit is orange. They are situated on fragments of an old lamellibranch (oyster?) shell.

Locality. Coast of Victoria, shallow water.

Clavularia garciæ, sp. nov. (Plate XLVI.)

The stolon is in the form of a thin membranous plate about 1 mm. in thickness.

The polypes are evenly distributed over the stolon, and separated from one another by short intervals. When looking down upon a spirit-specimen it appears as if the polypes were densely crowded, on account of the long tentacles and pinnæ, but on carefully separating the polypes with needles it is clear that there are considerable intervals between their bases.

The polypes have remarkably thin and transparent walls containing a number of very small scattered (not crowded) spicules; the mouth is very small and situated at the extremity of a teat-like papilla in the centre of the oral disk. Each polype is from 9–10 mm. in length.

The tentacles are about 5 mm. in length, very thin-walled, and bear on each side about 30 long hollow pinnæ. The great length and number of the pinnæ give the species a very fluffy or downy appearance quite peculiar to it.

Neither the polypes nor the tentacles show any signs in the spirit-specimens of a power of contraction.

Every polype is fully expanded. This is a noteworthy feature in a species with such thin-walled tentacles and polypes. It must be noted that it is highly improbable that in the natural condition the polypes can retract, for there are no spaces in the basal stolon that could contain them.

Another very remarkable feature of the species is the minuteness of the spicules. They are a great deal smaller than the spicules of any species of *Clavularia* I have yet examined (Plate L. fig. 15). They are all of one kind, namely, rhombic in shape, with the angles rounded off, and they show a number of extremely minute thorn-like projections. Each spicule measured 0·05 mm. in length and 0·003 mm. in breadth.

The specimen now in my possession was kindly given to me by Mr. G. C. Bourne, who found it in shallow water on the reefs of Diego Garcia, in the Chargos Archipelago.

Clavularia reptans, sp. nov. (Plate XLVII.)

This species of *Clavularia* is quite different in habit from any species yet described. The stolon consists of thin strands creeping over pieces of dead branched coral, in many cases stretching across the spaces between the branches, forming bridges on which polypes may arise. The important point about this form of stolon, and one upon which I was inclined to lay special stress, is the extraordinary area over which each colony extends, and the absence of any special point of concentration. When dredging off the coast of Talisse I often fished up bits of coral, much too large for my collecting-jars, that had this species of *Clavularia* growing over it in a form that reminded me of a very wide-meshed net. The whole colony grows, in fact, like a Canariensis creeper, clinging to any projecting branch that may be in its vicinity.

The breadth of the stolons averages 1 mm., the diameter of the contracted polypes 2 mm., and the length of the expanded polypes 7 to 10 mm.

It should be noted here that it is very rarely the case in *Clavularia* that the diameter of the retracted polype is actually greater than the average breadth of the stolon from which the polype springs. This character, then, is one which helps us to distinguish *Clavularia reptans* from other species of the genus.

The tentacles of this species are rather short and provided with numerous densely packed pinnæ, resembling somewhat the tentacles of *Clavularia garciæ*. Spicules absent.

Locality. I have only found this species at depths of 5 to 20 fathoms in the Banka Straits, North Celebes.

Clavularia celebensis, sp. nov. (Plate XLVIII.)

I have established this species for a small specimen of *Clavularia* I found off Talisse Island in 10 fathoms of water on an old water-worn branch of a madrepore.

In habit it is very similar to *Clavularia viridis*, but differs from it in several important points of structure.

The stolon is composed of thin strands varying from 1 to 3 mm. across, which coalesce at intervals to form small plate-like expansions. The polypes are of various sizes, the largest I have measured being 8 mm. long, with a maximum of 2·5 mm. in breadth. They have very thick walls, due to an extreme development of the mesoglœa. No grooves or lines of any kind mark externally the insertion of the mesenteries. The tentacles are long and pointed in life, and provided with numerous densely crowded pinnæ. The polypes are not capable of any very great contraction, but the crown of tentacles can be introverted into the anterior part of the polype-walls.

As I have had at my disposal such a small specimen I have not made as complete a study of the anatomy of this species as I should wish, but in the fragments of the stolon and polypes I have examined with the microscope I have not been able to find any trace of spicules. It is possible that they exist, for I find that it is never safe to state that there are no spicules in any species unless several polypes and a large piece of the stolon have been boiled in potash and the residue examined with the microscope.

The colour of the stolon and body-walls is the usual dull olive-brown, but the pinnæ of the tentacles are bright green.

When examined alive with the polypes expanded this species is one of the most beautiful, delicate, and graceful Alcyonarians I have ever seen.

Locality. Talisse Island, N. Celebes; shallow water.

CLAVULARIA VIRIDIS, Quoy & Gaimard. (Plate XLIX.)

I published, in the 'Proceedings' of the Royal Society, 1886 (10), a preliminary account of some observations on this species that I made when I was resident in Celebes. I then pointed out the existence of the remarkable tubes connecting the polypes, and the similarity of the expanded polypes, both in form and colour, to those of *Tubipora*.

Since my return to England I have made a few more observations upon its anatomy.

The species may be found in abundance on most of the coral-reefs of North Celebes, and probably occurs on the shores of nearly all the islands of the Malay Archipelago.

Quoy and Gaimard, who originally described the species, found it at Vanikoro, and Wallace obtained some specimens, which are now in the British Museum, from the Aru Islands.

Its usual habitat is, like *Tubipora*, on the shore side of the reef, where it is left exposed to the air at low water of spring tides. It occurs either in large clumps five or six inches in height and over a foot in diameter, or in small creeping colonies clinging to dead water-worn coral branches.

When dried in the sun it leaves a firm but brittle skeleton, composed of a plexus of irregular branching fibres, which fuse into a continuous sheath in the lower parts. This skeleton retains the original form of the contracted colony.

In colour the expanded polypes are either olive-brown or green, or any of the intermediate colours between the two.

The length of the polypes varies according to the size of the colony and the mode of growth. The longest tube I have measured is four inches, but the average length is not more than one or two inches.

When the tide goes down the crown and neck of the polypes are slowly but completely retracted within the firm walls of the lower part of the polype-tubes. In this firmly retracted condition they retain a considerable quantity of sea-water in their cœlentera, and they are able, in consequence, to withstand exposure to the air and sun for an hour or two.

The stolon consists of a network of tubes and strands clinging to the supporting coral blocks. In some places these strands are somewhat expanded, but I have never found any very extensive membranous plates in this species.

There are no spicules in the tentacles nor in the crown and neck, but in the lower parts of the body-walls of the polypes there are a few very large calcareous spicules. They are long spindles beset with numerous small spines and tubercles. Their average size is 2·3 mm. long by 0·14 mm. broad (Plate L. fig. 16).

A series of sections through the polypes shows that the muscular ridges on the mesenteries are very numerous and long (fig. 17); in fact the mesenterial muscles of *Clavularia viridis* are stronger than any I have met with in the Alcyonaria, excepting perhaps *Tubipora* (9).

The mesoglœa is very thick for a Stoloniferan, both in the tentacles and body-wall.

The spicules are situated in the mesoglœa, and in transverse sections of decalcified specimens empty spaces may be seen, indicating the places that they formerly occupied.

The horny skeleton is formed by some modification of the mesoglœa. It occurs in the form of a number of very dense fibres, which are figured in transverse sections in Plate L. fig. 18 *h.f.* They appear in the form of deeply stained cores situated in the centres of wide lacunæ in the homogeneous mesoglœa.

It is difficult to determine the exact chemical nature of this horny skeleton, but it is apparently closely related to keratin.

It is insoluble in weak and strong nitric and hydrochloric acid. It is partially soluble in strong hot sulphuric acid. It is not digested by pepsin and ·2 per cent. hydrochloric acid, nor by solution of pancreatin.

On burning it gives a pungent and somewhat aromatic odour.

In origin it differs from the horny skeleton of *Cornularia* and *Stereosoma* in being a product of the mesoglœa. There is nothing that resembles it in any other species of the genus.

List of the Literature referred to.

1. DE BLAINVILLE.—Manuel d'Actinologie.
2. DELLE CHIAJE.—Descriz. e anotom. degli Anim. inv. della Sicilia Citer. t. v. p. 160, fig. 5.
3. DANA, J. D.—United States Exploring Expedition. Zoophytes. 1848.

4. Duchassaing and Michelotti.—Sur les Coralliaires des Antilles. Mem. della R. Accad. d. Torin. ii. tom. xix. 1860.
5. Ehrenberg, C. G.—Corallenthiere d. rothen Meeres. 1834.
Forbes, *vide* Johnston.
6. Grieg, James A.—To nye Cornularier fra den Norske kyst. Bergens Museum, No. 3, 1887.
7. Herdman, W. A.—On the Structure of *Sarcodictyon*. Proceedings Roy. Soc. Edinb. viii. p. 31.
8. Hickson, S. J.—On the Ciliated Groove (Siphonoglyphe) in the Stomodæum of the Alcyonarians. Phil. Tr. 1883.
9. Hickson, S. J.—The Structure and Relations of *Tubipora*. Q. J. Micr. Sci. 1883.
10. Hickson, S. J.—Preliminary Notes on certain Zoological Observations. P. R. S. 1886.
11. Hickson, S. J.—Preliminary Report on a Collection of Alcyonaria and Zoantharia from Port Phillip. P. R. Soc. Vict. 1890.
12. Johnston, G.—History of British Zoophytes. 2nd ed. 1847.
13. Kent, W. Saville.—Two new Genera of Alcyonoid Corals. Q. J. Micr. Sci. vol. x. p. 397, pl. xxi.
14. Klunzinger, C. B.—Die Korallthiere des rothen Meeres. 1877.
15. von Koch, G.—Anatomie der *Clavularia prolifera*, n. sp., nebst einigen vergleichenden Bemerkungen. Morph. Jahrb. vol. vii. p. 467. 1882.
16. von Koch, G.—Die *Alcyonacea* des Golfes von Neapel. Mittheil. a. d. zool. Stat. Neapel, vol. ix. p. 652. 1891.
17. von Koch, G.—Kleinere Mittheilungen über Anthozoen. Morph. Jahrb. xvi. 1890.
18. von Koch, G.—Die systematische Stellung von *Sympodium corálloides*. Zool. Jahrb. v. Heft 1, pp. 76–92.
19. von Koch, G.—Die Gorgoniden des Golfes von Neapel. 1887.
20. Kölliker, A.—Icones Histiologicæ. 1864.
21. Koren and Danielssen.—Nye Alcyonider, Gorgonider og Pennatulider tilhörendes Norges Fauna. Bergens Museum, 1883.
22. Koren and Danielssen.—Norske Nordhavs-Expedition. Alcyonida. 1887.
23. Kowalewsky, A., and Marion, A. F.—Documents pour l'histoire embryogénique des Alcyonaires. Annales du Musée de Marseille, vol. i. Mémoire 4. 1883.
24. Lamarck.—Hist. des Animaux sans Vertèbres. 1816.
25. Quoy and Gaimard.—Voyage de l'Astrolabe. 1834.
26. Sars, M.—Fauna littoralis norvegicæ. Part II. 1856.
27. Stimpson, W.—Descriptions of some of the new Marine Invertebrata from the Chinese and Japanese Seas. Proc. Acad. Philad. Nat. Sci., May and June, 1855.
28. Studer, T.—Alcyonaria der Gazelle. Monats. d. k. preuss. Akad. d. Wiss. Berlin, October 1878, p. 632.
29. Studer, T.—Note préliminaire sur les Alcyonaires provenant des Campagnes du yacht l'Hirondelle, 1886, 1887, 1888. Part 2. *Alcyonacea* and *Pennatulacea*. Mém. Soc. Zool. iv. pt. 2, pp. 86–95.
30. Wright, P., and Studer, T.—Report on the Alcyonaria collected by H.M.S. 'Challenger.' Zoology, xxxi. 1889.
31. Verrill, A. E.—Results of recent Dredging Expeditions on the Coast of New England. Am. J. Sci. 1874, ser. 3, vol. vii. p. 40.

32. Verrill, A. E.—Notes on Radiata. Trans. Connecticut Acad. vol. i. 1868, pt. 2, no. 6, p. 455.
33. Verrill, A. E.—Critical Remarks on the Halcyonoid Polyps in the Museum of Yale College. Am. J. Sci. 1868.
34. Verrill, A. E.—Radiata from the Coast of North Carolina. Am. J. Sci. 1872.
35. Viguier, C.—Un nouveau type d'Anthozoaire (*Fascicularia edwardsi*). Arch. Zool. Expér. 2e série, vol. vi.

EXPLANATION OF THE PLATES.

PLATE XLV.

Stereosoma celebense, p. 337.

PLATE XLVI.

Clavularia garciæ, p. 341.

PLATE XLVII.

Clavularia reptans, p. 342.

PLATE XLVIII.

Clavularia celebensis, p. 342.

PLATE XLIX.

Clavularia viridis, p. 343.

PLATE L.

Structure of *Stereosoma* and *Clavularia*.

Fig. 1. Transverse section through a portion of the body-wall and one mesentery of *Stereosoma celebense*, showing the thick vacuolated ectoderm, consisting of an outer layer of cells and a subjacent dense homogeneous substance containing a number of isolated cells, rods of cells, and cell islets (*Ect.'*), as well as the vacuoles or lacunæ. The mesoglœa is sharply defined and is not vacuolated. A considerable number of zooxanthellæ may be seen adhering to the endoderm.

Fig. 2. Outline drawing of a transverse section through *Stereosoma celebense* in the region of the stomodæum, showing the small but prominent muscular ridges and the siphonoglyphe.

Fig. 3. A small specimen of *Clavularia australiensis*, Variety A.

Fig. 4. Two forms of the spicules of *Clavularia australiensis*, Variety A.

Fig. 5. Transverse section through a polype of *Clavularia australiensis*, Variety A, showing the enormous number of zooxanthellæ adhering to the endoderm, and the simple columnar form of the ectoderm.

Fig. 6. Two forms of spicules found in another specimen of *Clavularia australiensis*, Variety A.

Fig. 7. A specimen of *Clavularia australiensis*, Variety B, showing the ribbon-like character of the stolon at the edges. One of the polypes is fully expanded, but all the others are in different stages of retraction.

Fig. 8. Transverse section of a polype of *Clavularia australiensis*, Variety B, showing that there are only a few zooxanthellæ adhering to the endoderm (compare *C. australiensis*, Variety A, fig. 5). The ectoderm is thick and vacuolated, the cells being irregular in shape. The siphonoglyphe is large and well-defined.

Fig. 9. A small portion of a colony of *Clavularia ramosa*, growing on a ramifying sponge.

Fig. 10. The growing point of a colony of *Clavularia ramosa*, showing two young polypes.

Fig. 11. Three forms of spicules found in *Clavularia ramosa*: *a*, a spicule from the body-wall; *b*, two spicules from the tentacles.

Fig. 12. A specimen of *Clavularia flava* growing on a piece of oyster-shell.

Fig. 13. Three forms of spicules found in *Clavularia flava*.

Fig. 14. Transverse section through a portion of the stolon of *Clavularia flava*, showing four endodermic canals in section.

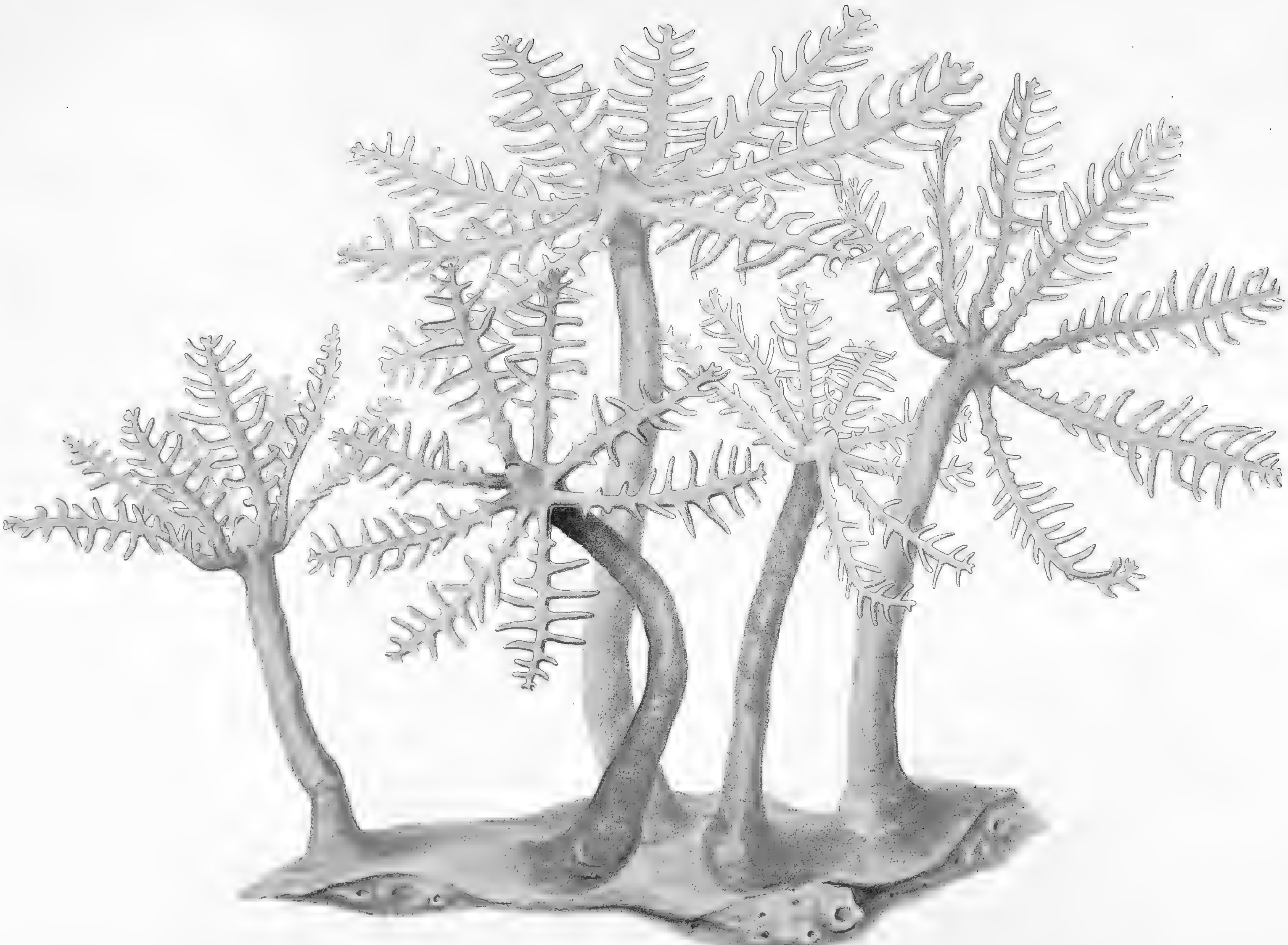
Fig. 15. Spicule of *Clavularia garciæ*.

Fig. 16. A spicule of *Clavularia viridis*.

Fig. 17. Outline sketch of a transverse section through a polype of *Clavularia viridis*, to show the large and deep muscular ridges on the mesenteries.

Fig. 18. Transverse section through a portion of the body-wall of *Clavularia viridis*, showing the horny fibres, *h.f.*, and the lacunæ left after the solution of the calcareous spicules in the mesoglœa.

Reference letters used in all the figures:—*Ect.* Ectoderm; *End.* Endoderm; *Lac.* Lacunæ; *Mes.* Mesoglœa; *Musc.* Muscular ridges; *Siph.* Siphonoglyphe; *Stom.* Stomodæum; *Zx.* Zooxanthellæ.



L. R. King del.
M. P. Parker lith.

STEREOSOMA CELEBENSE

West, Newman imp.

L. B. King del.
M. P. Parker chromo.

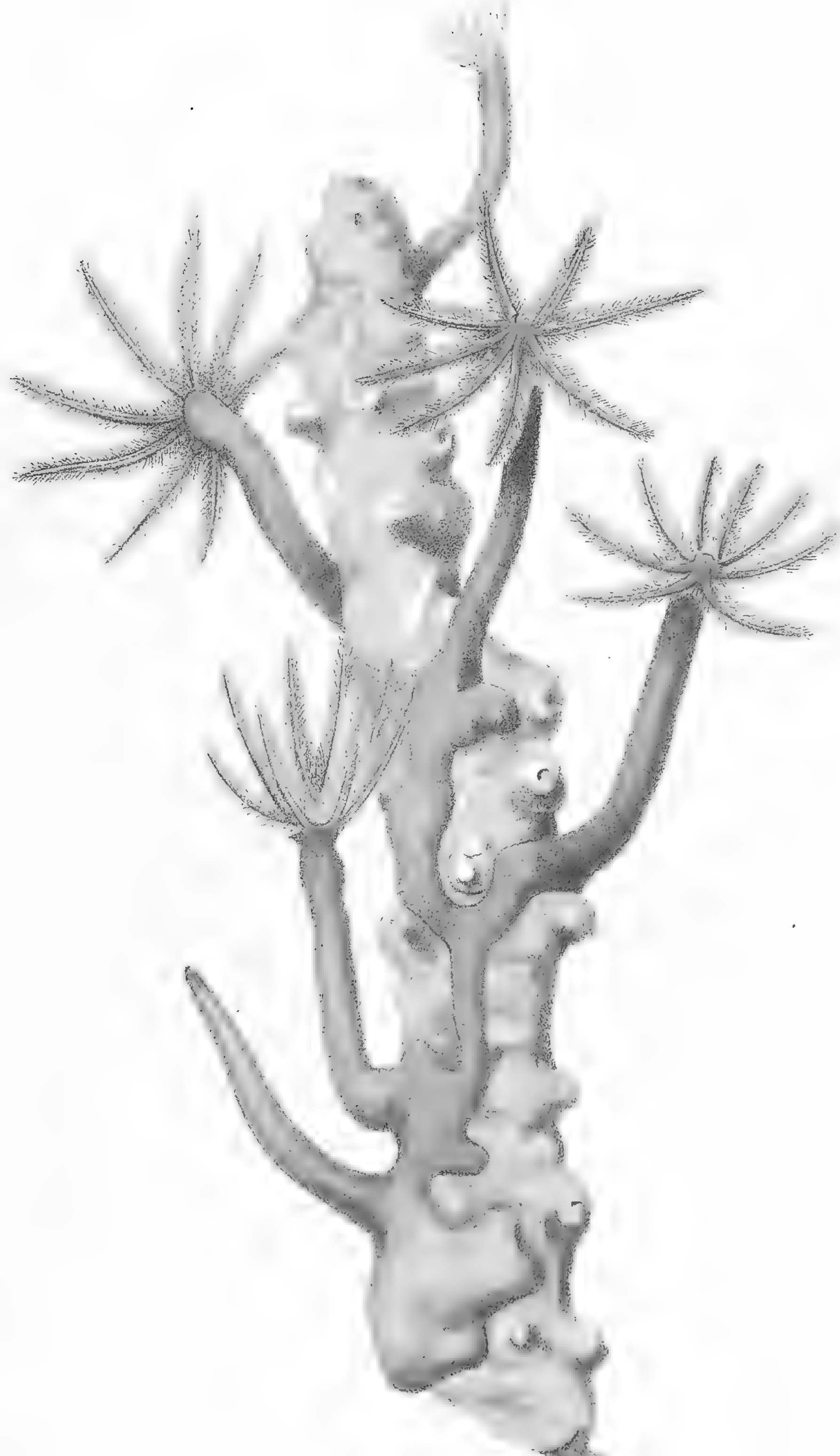
West, Newman imp.

CLAVULARIA GARCIÆ.

M.P. Parker chromo.
L.B. King del.

West, Newman imp.

CLAVULARIA REPTANS.



L.B. King del.
M.P. Parker chromo.

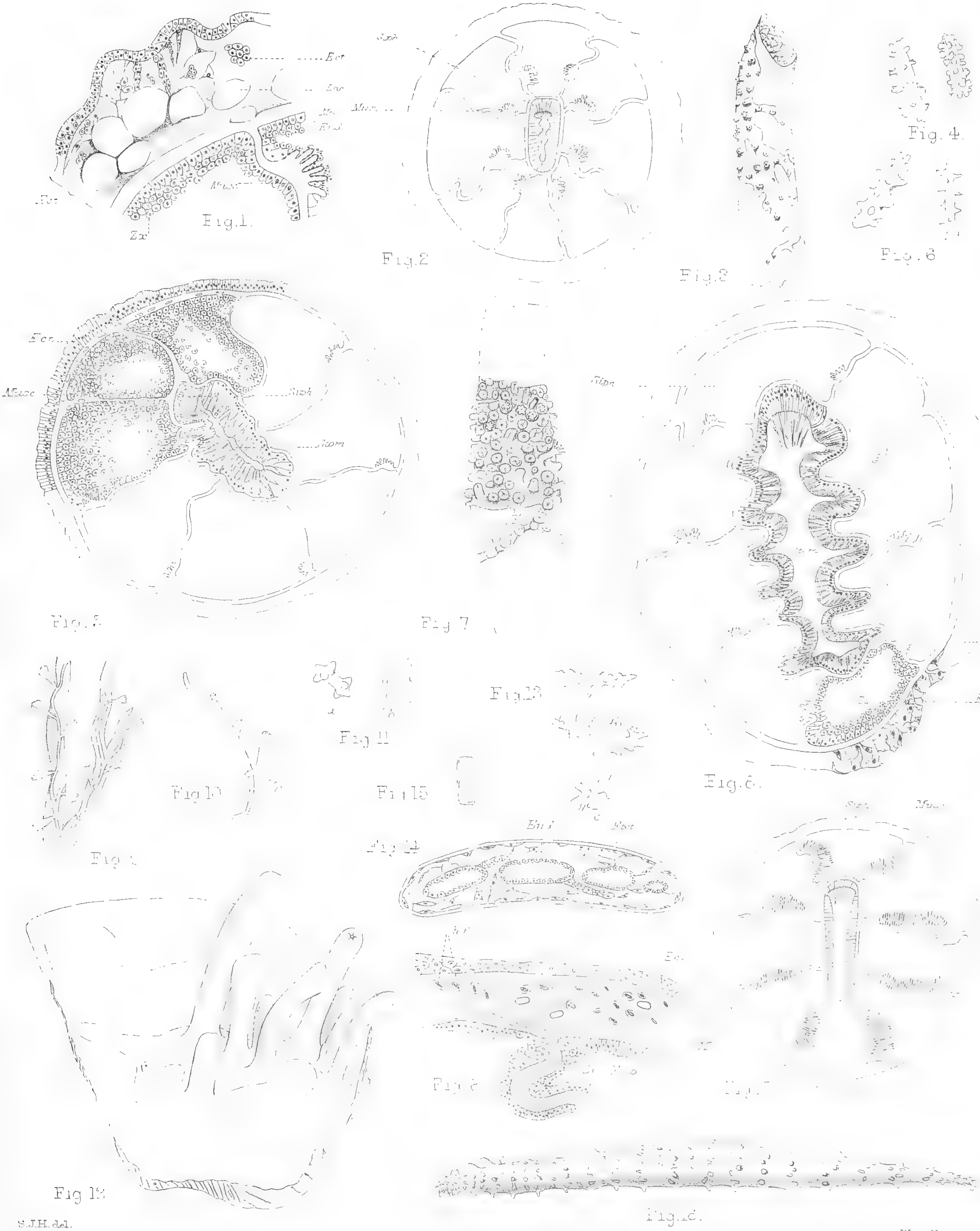
West, Newman imp.

CLAVULARIA CELEBENSIS.

A.W. Hickson del.
M.P. Parker chromo.

West, Newman imp.

CLAVULARIA VIRIDIS.



S.J.H. del.
M.P. Parker lith.

West, Newman imp.

STRUCTURE OF STEREOSOMA AND CLAVULARIA.

XIV. *Descriptions of nine new Species of Amphipodous Crustaceans from the Tropical Atlantic.* *By the Rev.* THOMAS R. R. STEBBING, *M.A.*

Received November 1st, 1892, read December 20th, 1892.

[PLATES LI.–LV.]

THE specimens described in this paper were obtained by Mr. John Rattray, during the expedition of the 'Buccaneer,' the telegraph-ship belonging to the Silvertown Company, when engaged in surveying for the laying of cables on the West Coast of Africa. The scientific investigations made during the expedition were arranged for, and the expenses met by, Dr. John Murray, the Director of the 'Challenger' Commission, and Mr. J. Y. Buchanan, the latter of whom accompanied the ship.

Tribe *HYPERIDEA.*

Family SCINIDÆ, Stebbing, 1888.

The head is small, of less width than the peræon. The eyes are small. The first antennæ are large, straight, generally (perhaps always) three-jointed, attached at the front corners of the head. The second antennæ are attached to the underside of the head; they are rudimentary in the female, but in the male become long and slender, after being at an early stage short and curved one over the other. The mandibles are without palp. Both pairs of maxillæ are well developed. The maxillipeds have a small inner plate, and two large outer plates which are distally narrowed. Both first and second gnathopods are simple. Of the peræopods the third are generally the longest, the fifth always the shortest. The pleon is narrower than the peræon. The fifth and sixth segments are generally (perhaps always) coalesced. In the uropods only the outer branch is free. The telson is small.

Definitions of this family have been given recently by Dr. Bovallius, Professor Chun, and Professor Sars. With all of these the above substantially agrees. Chun includes the character that the body is not compressed, which will not apply to the new species *Scina stenopus*, and is rather vague in its application to other species. Sars speaks of the first antennæ as divergent, an epithet which is unsuitable, since, though capable of great divergence, they can lie with the inner margins perfectly parallel, and one may even suspect that this is their natural position when at rest. Both Bovallius and Sars speak of the second antennæ in the male as angularly bent. This angulation, it may be remarked, is distinct from the zigzag folding familiar in several other Hyperid genera. As Streets has explained, it merely refers to a single bend at one point of the long slender flagellum, when that, not being in use, is laid for security beneath the animal's body. For the two species which Dana named *Clydonia gracilis* and *Clydonia longipes*, Bovallius accepts from Dana a division between the fifth and six segments of the pleon. Streets, in describing what he regarded as a specimen of *Clydonia longipes*, says that the fifth and sixth segments in question are apparently consolidated. Since in all the species which have been recently examined these two segments are coalesced, it is most probable that their separation was not observed by Dana, but taken for granted, contrary to the actual fact, although according to what is normal in the Gammaridea, to which he assigned the genus *Clydonia*.

Genus Scina, Prestandrea, 1833.

1833. *Scina,* Prestandrea, Effemeridi scientifiche e letterarie per la Sicilia, t. vi. p. 10.
1840. *Tyro,* Milne-Edwards, Hist. Nat. des Crustacés, t. iii. p. 80.
1849. *Clydonia,* Dana, American Journal Sci. and Arts, vol. viii. no. 22, p. 140.
1885. *Tyro,* Bovallius, On some forgotten Genera among Amph. Crust. p. 12.
1887. ,, Bovallius, Monogr. Amph. Hyperiidea, K. Svensk. Vet.-Akad. Handl. Bd. xxi. no. 5, p. 5.
1888. *Scina,* Stebbing, Challenger Amphipoda, pp. 151, 1271, &c.
1889. *Fortunata,* Chun, Akad. der Wissenschaften zu Berlin, Math. u. naturwiss. Mitth. p. 342.
1889. *Scina,* Chun, Zoologischer Anzeiger, Jahrg. xii. no. 308, p. 286.
1890. ,, G. O. Sars, Crustacea of Norway, vol. i. pt. 1, p. 18.

The other references will be found in the Monograph of the Hyperidea by Bovallius and in the Report on the 'Challenger' Amphipoda. The genus at present stands by itself, and may therefore be content with the character of the family. Nevertheless, Bovallius and Sars have drawn out separate generic descriptions. Bovallius in his definition speaks of the third peræopods as "transformed into jumping-legs." For such a function they do not seem particularly well suited. The long and strong second joint is directed forward and upward, and is prolonged into a spine-like process at the apex of the front margin. According to Professor Chun, by aid of these processes, the animal attaches itself to a free-swimming hydrozoon, and floats about without exertion after the fashion of *Phronima* and various other Hyperidea. Sars states that the third peræopods are the longest, which is indeed usually a conspicuous feature; but the *Scina bovallii* of Chun is said to have the fourth peræopods somewhat longer than the third, and *Scina clausi* (Bovallius) to have the fourth as long as or a little longer than the third. Of the uropods Sars declares the first and second pairs to be "simple, with the peduncle not defined." Yet both in his own species, *Scina borealis*, and in all the other known species, with one or two doubtful exceptions, the extent of the peduncle is defined in all the uropods by the presence of a free outer branch, albeit that branch is sometimes extremely small and spine-like. There are more or less conspicuous gland-cells in the limbs of the peræon and the uropods. The pleopods are provided with a couple of serrate coupling-hooks on each peduncle, and a single cleft spine on the first joint of the inner ramus. At least in general there are fewer joints to the inner than to the outer ramus.

The species belonging to this genus are now numerous. Those earliest described remain, and will probably for ever remain, involved in much obscurity. *Astacus crassicornis*, Fabricius, 1775, *Tyro cornigera*, Milne-Edwards, 1840, and *Tyro sarsi*, Bovallius, 1885, all with large upper antennæ, may very likely be one and the same species, which I am disposed to call *Scina cornigera*, rejecting the earlier *crassicornis* on the ground of the too uncertain identity. The *Scina ensicorne*, Prestandrea, 1833, from the Mediterranean, may yet be identified, but the *Clydonia gracilis* and *Clydonia longipes* of Dana are so figured that, in the absence of the type specimens and with our present knowledge of the genus, I do not think they will ever be reconciled with any actual species. Professor Chun recognizes that his *Scina lepisma* stands near to the Mediterranean *Scina marginata* of Bovallius, but considers it distinct because the upper antennæ are shorter, with strikingly strong armature of filaments, and because it has four pairs of branchial vesicles instead of six. There does not, however, appear to be really any difference in the armature of the antennæ, and the difference in length is not by any means considerable. As for the branchial vesicles, in *Scina marginata* these are said to be found on all the limbs of the peræon from the second to the seventh, but in *Scina lepisma* only from the fourth to the seventh. This would constitute a very important distinction, but the fact stands in need of confirmation. These vesicles are very easily detached and lost in the handling of a specimen, and there is a great improbability that a species should be without them on the second and third pairs of limbs, and yet have them on the seventh pair. Thus the validity of the species *lepisma* is left in some doubt. Of his other species, *Scina bovallii*, Professor Chun says that it has four pairs of branchial vesicles, " between the third to the seventh pairs of trunk-limbs ; " and this he considers one of its chief distinctions from *Scina borealis*, Sars, and *Scina clausi* (Bovallius), both of which have the normal set of branchial vesicles extending from the second gnathopods to the fourth peræopods. Sars is rather inclined to regard *Scina clausi* as a synonym of *Scina borealis*, but both *clausi* and *bovallii* may be distinguished from *borealis* by different proportions in some of the limbs.

Arithmetic shows that a pack of fifty-two cards may be dealt out in a bewildering number of ways. It may be noticed, therefore, that in the genus *Scina* the animals have on the peræon seven pairs of limbs, each limb having six free joints, and that they have also a pair of antennæ consisting of peduncle and flagellum, and three pairs of uropods, each uropod having one branch free from the peduncle. Thus there are fifty-two pieces to be played with, each of which may be relatively long or short, broad or narrow, simple or variously armed. Relatively also to each other these eleven pairs of appendages may go through any number of variations of size. Without taking into account other features, such as the eyes and the telson, or the general shape and armature of the body, it may be left to the arithmetician to calculate, if he can, how many species may be framed from the given conditions. Some praise should be allowed to the moderation of nature and of naturalists, in that, with such facilities at command, they have been contented as yet with creating only twenty-one species in the genus, including in that number all the doubtful names and seven new species instituted in the present paper. Probably not more than fifteen of the twenty-one can be sustained. Of these there are some which can only be distinguished from one another by close comparison of various details, but *Scina marginata* (Bovallius) is at once marked out by having the apex of the hands in the gnathopods produced. No other species, unless *Scina lepisma* be distinct from *Scina marginata*, shares this peculiarity. *Scina acanthodes*, n. sp., is unique in the dentate armature of the peræon and pleon. *Scina stenopus*, n. sp., is unique in the enormous elongation of the peduncles of the uropods, only the otherwise very different *Scina acanthodes* making any approach to it in this respect. Bovallius considers the *Scina cornigera* of Milne-Edwards uniquely devoid of outer branches to the third uropods; but in that case I take it for granted that they were present though not observed, such an oversight easily occurring when the more striking features of the animal were attracting attention by their novelty. *Scina uncipes*, n. sp., is unique in the blunt-ended finger of its fifth peræopods, though it agrees more or less with *Scina marginata* in the unwonted thickness of those limbs. The species at large may be roughly divided into two groups —one in which, as in *Scina cornigera*, the first antennæ are of very great length, the other in which, as in *Scina borealis*, they are of much more moderate extent. In the determination of species it is useful also to note whether the second joint of the third peræopods is dentate on both sides or only on one, and whether the finger of the fifth peræopods is hooked or simple. The serrature or denticulation of the margins of the uropods varies in different species, but the details are often microscopic. The number of species is at present rather surprisingly large compared with the number of specimens known. They have been instituted on the supposition that the proportional sizes of the antennæ, of the joints of the limbs, and of the uropods are fairly constant for each species. Should this supposition prove unsound, a further revision would doubtless be required. As the list at present stands, if it be right to cancel for different reasons the names *crassicornis*, *gracilis*, *longipes*, *sarsi*, *lepisma*, and to leave *ensicorne* in suspense, the species remaining will be *cornigera*, Milne-Edwards, *borealis*, *atlantica*, *clausi*, *marginata*, *tullbergi*, and *pacifica* of Bovallius, *bovallii* of Chun, and *acanthodes*, *stenopus*, *œdicarpus*, *rattrayi*, *concors*, *similis*, and *uncipes* of the present paper.

Scina acanthodes, n. sp. (Plate LI.)

The head in front is deeply emarginate, forming two blunt lobes, behind which it is dorsally traversed by a curved line. The peræon increases in width to the fourth segment. The boundary between the first and second segments is rather indistinct. All the segments, except the first, have on the hind margin a strongly projecting median tooth. The pleon is much narrower than the peræon, but similarly armed with a median tooth on each of the first three segments, of which the postero-lateral angles appear to be acute. The fourth segment is short, with a thin semicircular shield arising from near the front margin and covering the chief part of the segment. The coalesced fifth and sixth segments are together not longer than the fourth. The small telson is broader than long, distally truncate, not narrowed, with a setule on either side of the centre of the distal margin; folded under is a thin curved lobe about half the length of the telson. That the fold is natural and not accidental is evident from the uninterrupted double marginal lines running round the sides and end of the other portion. No eyes were perceived.

The first antennæ are longer than the head and peræon together. The long first joint of the flagellum has serrate edges, with numerous hyaline bacilli along the whole length and spines at intervals; the terminal joint is quite small.

The second antennæ (in the female) are short, obscurely three-jointed, the first joint being a broad tubercle, the other two joints linear.

The mandibles are of the usual simple character, ending in narrow, finely denticulate cutting plates. Of the other mouth-organs as much as could be made out is shown in the figures; they are not suggestive of anything exceptional, apart from the figure *x*, which does not agree with anything hitherto described for this genus. Whether it may be a part of the maxillipeds I have not been able to determine.

The first gnathopods. The side-plates are bluntly pointed in front; the second joint has the edges almost parallel, with minute spinules along the front one; the short third joint has a terminal spine; the fourth joint is very little longer than the third; it has spinules on the hind margin and two apical spines; the fifth joint is a little longer than the sixth, the two together being longer than the second; each carries a single spine and a pair of spines at intervals on the hind margin; the sixth joint is slightly curved; the finger is straight and slender, nearly half the length of the sixth joint.

The second gnathopods nearly resemble the first, but the side-plates are larger, the second, fifth, and sixth joints longer, and the finger seemingly shorter. The branchial vesicles are broader than the second joint, and more than two-thirds as long. The marsupial plates of the specimen are smaller than the branchial vesicles, and successively smaller to the last, the fourth, pair. Of the five pairs of branchial vesicles the third is the largest.

The first and second peræopods are much longer than the gnathopods, with similar but larger side-plates. The second joint is not wider and not greatly longer than the fifth; the fourth joint is rather longer than the sixth. There are no strong marginal spines. The finger is minute, clasping between two sharp forward-directed teeth at the apex of the hind margin of the sixth joint. In all the limbs the muscles are short, leaving plenty of space for the glandular secretion, which probably finds an exit just above the finger-tip.

Third peræopods. The side-plates are produced in a spine-like manner both forward and backward, the hinder processes being very prominent features in the appearance of the animal, extending back considerably beyond the sixth segment. The second joint has five spines on the hind margin, and three spines on the front margin, the apical tooth of which reaches almost as far as the small apical tooth of the short third joint. The fourth joint carries eleven or twelve spines on each margin, and is considerably longer than the long second joint. The remainder of the limb was missing.

The fourth and fifth peræopods are alike. The side-plates of the fourth are the larger, with a backward-directed point, which is evanescent in the next segment. The joints are nearly as in the second peræopods, but the sixth joint is longer and without the apical teeth, and the finger is more produced.

The pleopods carry two very small coupling spines, and have five or six joints to the inner branch, and six or seven to the outer branch, the large first joint of the inner branch carrying a long cleft spine.

The uropods are narrow and elongate, the first a little longer than the second, and the second than the third; the first has a minute serration of the outer margin, and numerous small spines on the lower half of the peduncle; its coalesced inner branch is about two sevenths of its length; the outer branch is imperfect, less than half the length of the inner; the second pair have a few spines on the outer and several on the inner margin, the coalesced branch a little damaged, but probably like that in the preceding pair, the free outer branch longer than in the preceding pair and probably more than half as long as the inner; the third pair have three spines on the outer margin, the free outer branch shorter than the inner, but both damaged at the apex.

From the front of the head to the extremity of the uropods the specimen scarcely measured one-tenth of an inch. It could not be persuaded to lie flat, though it would readily stand on its head. Neither body nor appendages showed any inclination to break, notwithstanding pressure repeatedly applied, so that the texture must be tolerably tough. That the third peræopods were already broken was no doubt due to their exceptional length.

Habitat. Atlantic. Lat. 7° 54′ N., long. 17° 25′ W. Taken with the tow-net from a depth of five fathoms, between 7.20 and 8.20 P.M.

The specific name, from the Greek ἀκανθώδης, refers to the spiny armature of the body, a feature so uncommon among the Hyperidea.

SCINA STENOPUS, n. sp. (Plate LII. A.)

The head is slightly emarginate between the antennæ. The first four segments of the peræon were to a certain extent twisted and telescoped, so that their relative lengths could not be accurately ascertained. The last three segments of the peræon are equal in length to the first three of the pleon. These latter have the postero-lateral angles well rounded. The next three segments of the pleon are short, together scarcely longer than the third segment. The fifth and sixth segments are apparently coalesced, and the telson seen in profile seems to be narrow, about equal in length to the sixth segment.

The eyes are small, consisting of about a dozen ocelli; the colour in spirit very pale.

The first antennæ are longer than the whole body from head to telson, with the first joint or peduncle stout, not very much longer than broad. In the elongate, straight, tapering flagellum no division could be discerned even near the apex. The inner margin is fringed with numerous filaments, which when highly magnified are seen to be broad and round-ended. The outer margin carries many spinules.

The second antennæ (of the female) are minute, planted near the hind margin of the head, and only extending forward as far as the eyes. A trace of division into two or three joints could rather be imagined than seen.

The mouth-organs form a small, nearly circular, group, the pointed apex of the epistome scarcely reaching halfway from the back to the front of the head.

First gnathopods. The side-plates of these and the following limbs are small and but faintly distinguished. All the limbs of the peræon are exceedingly narrow, and the first gnathopods are the shortest. Of its joints the second is the longest, the third the shortest. The fourth, which is not twice as long as its breadth, is distinguished by an armature of prickles. The fifth is longer than the sixth; they carry a few setules, and are together longer than the second joint; the sixth has a small tooth at the apex. The finger is very slender, a little over half the length of the preceding joint.

Second gnathopods. The branchial vesicles are small. The limbs are not very different from the preceding pair, but with the second, fifth, and sixth joints longer, and the fourth not prickly.

First and *second peræopods.* The branchial vesicles are slightly larger than those of the preceding, and smaller than those of the following limbs, those of the large third peræopods being the largest. These slender and unarmed limbs have all the joints, except the third and seventh, longer than in the gnathopods, and the fourth joint longer than the fifth. The finger is small.

Third peræopods. The elongate second joint is less than half the total length of the limb, armed with spines on both margins, those on the front being the larger, and this margin ending in a tooth which projects beyond the similar but smaller tooth of the short third joint. The fourth joint is considerably longer than the fifth, the two together being a little shorter than the second. The sixth is considerably shorter than the fifth, and the finger is minute.

Fourth peræopods. The branchial vesicles, though smaller than the preceding pair, are larger than any of the others. The limbs are unarmed, more slender than the preceding pair and shorter, but not very greatly so. The proportions of the joints are not very dissimilar, but the fourth and fifth together are a little longer than the second. The length of the limb is equal to that of the first five joints of the third peræopods. The sixth joint is longer than in that pair.

Fifth peræopods. The slender, unarmed limbs are about two-thirds the length of the fourth peræopods, which they much resemble in the proportions of the joints. The finger is minute, apparently hooked.

Pleopods. The peduncles are strong. The two coupling-hooks are minute, with three pairs of backward-directed points to each. The slender rami have seven or eight joints with the usual setæ, and the cleft spine on the first joint of the inner branch.

Uropods. These are subequal to one another and half the length of the first antennæ. No outer ramus could be distinguished in the first pair; the second have a very small one, little more than a quarter the length of the coalesced inner branch, which is itself not quite a fifth of the total length of the uropod. The third pair are slightly the shortest. The outer branch is fully two-thirds the length of the inner, which is a fifth of the total length of the uropod. The first and third have spines on both margins, the second appeared to have them only on the outer margin. The outer branch of the third pair has spines on the inner margin.

The length is half an inch, the first antennæ measuring one-fifth of an inch, the body nearly the same, and the uropods a tenth.

The specific name, from the Greek στενόπους, meaning narrow-footed or narrow-legged, speaks for itself.

Habitat. Atlantic. Lat. 7° 1′ 1″ N., long. 15° 54′ W. Taken in the daytime from a depth of 100 fathoms.

Of species hitherto described not one makes any very near approach to the present, unless possibly Dana's *Clydonia longipes* from the Pacific, but even in that the uropods are entirely different.

Scina œdicarpus, n. sp. (Plate LII. B.)

The head has the front shallowly emarginate. The peræon is dilated, with the last two segments narrowing rather abruptly. The pleon is narrow, and has the fifth and sixth segments coalesced. The telson is small; owing to its transparence its outline could not be clearly discerned.

The eyes are small, and pale in spirit.

The first antennæ are equal in length to the peræon and first three segments of the pleon. They have the usual stout one-jointed peduncle and two-jointed flagellum, the long first joint carrying minute spines on the outer margin and long filaments on the inner.

The second antennæ are folded in a curve across the underside of the head above the mouth-organs. The first three joints are short, the basal one partially soldered to the head; the fourth joint is not twice as long as the third; the fifth joint is rather longer than the preceding four together, and represents the flagellum in an early stage. The condition of these antennæ indicates that the specimen is a male not fully adult.

The first gnathopods have the fifth joint rather longer than the sixth. As in the other limbs there is scarcely any armature, but the short fourth joint has a few spinules and the two following joints a few slender setæ.

The second gnathopods have the second joint rather longer than that in the first pair, the fourth joint smooth, the fifth shorter than the sixth.

The first peræopods have the fourth joint much longer than that of the gnathopods, but much shorter than the fifth joint, which is dilated and almost entirely glandular; the following joint is slender.

The second peræopods scarcely differ from the first, except in having the fifth joint not dilated.

The third peræopods have the second joint longer than all the rest of the limb, with spine-like serrations on both margins, those on the front the stronger. The apical tooth is produced much beyond the short third joint. The fourth joint is decidedly longer than the fifth, which is not quite three times as long as the sixth. The finger is minute and bent.

The fourth peræopods have the second joint little more than half the length of that in the preceding pair; the fourth joint longer than the fifth, and these two together a little longer than the second. The sixth joint is half as long as the fifth. The finger is very small, strongly curved.

The fifth peræopods are slender, about half as long as the fourth, and a third as long as the third pair. The fourth, fifth, and sixth joints are subequal one to another, and two of them together are subequal to the second joint. The finger is minute, seemingly retractile.

The first uropods are rather longer, while the other two pairs are rather shorter, than half the upper antennæ. In all, the peduncles are elongate, but shorter than the coalesced inner ramus. The outer ramus in the first two pairs is like a small spine; in the third pair it is slender, but rather longer than half the inner ramus. The marginal armature in all three pairs is extremely minute, except for a single spine or process on the inner margin of the first pair a little higher up than the outer ramus.

The total length a little exceeds a fifth of an inch, the measurement without the antennæ and the uropods being just one tenth of an inch.

Habitat. Atlantic. Lat. 7° 1′ 1″ N., long. 15° 54′ W. Taken in the daytime from a depth of 100 fathoms.

Branchial vesicles were present on the first, second, third, and fourth peræopods, but not on the second gnathopods. No stress, however, can be laid on this deficiency, since on one side of the specimen the vesicles were absent also from the first and second peræopods.

From *Scina atlantica* (Bovallius), to which the present species makes the nearest approach, as well as from all other known species of the genus, it is distinguished by the proportions of the third peræopods, which are unique in having the second joint longer than all the remainder of the limb. The specific name, from the Greek οἰδεῖν, to swell, and καρπός, wrist, refers to the wrist or fifth joint of the first peræopods, which is more tumid than usual, though in this genus it is normally glandular. Dr. Bovallius has noticed that in species of *Rhabdosoma* the females sometimes have the fourth and fifth joints of the first and three following peræopods "inflated and almost egg-shaped, owing to a strongly developed glandular mass surrounding the axis of the joint for the whole of its length." He supposes the development of these powerful glands to be periodical, and "to have some connection with the fixation of the eggs on the underside of the body." He had seen full-grown females of some species without the joints inflated at all, but had never seen females of the same species with eggs or young ones which had not at the same time those joints more or less inflated. He therefore deems it "probable that the development of these glands may be connected with the maternal functions of the animal." In the present species of *Scina* this glandular development occurs, it will be observed, in a male specimen.

Scina rattrayi, n. sp. (Plate LIII. A.)

The head is broad, dorsally smooth, with the front margin between the antennæ faintly concave or perhaps straight. The segments of the peræon are broad, except the last two. The first four segments of the pleon are rather long, each subequal in length to the coalesced fifth and sixth segments, of which the part furnished by the fifth is abruptly narrower than the fifth. The telson is small and tongue-shaped. The length of the body from the front of the head to the end of the peræon is the same as that of the outstretched pleon to the end of the telson.

The eyes are minute, situated at the anterior corners of the head.

The first antennæ are nearly equal in length to the head and pleon. They are set wide apart. The first joint of the flagellum carries numerous filaments; the small and slender second joint is tipped with a long fine seta.

The second antennæ of the specimen are short, two-jointed.

The first gnathopods have the second joint equal in length to the three following together, and broader than the corresponding joint in any of the other limbs. The fourth joint has some minute prickles on the hind margin, and a long spine and a short one at its apex; the fifth is considerably longer and broader than the sixth, and is armed with numerous setæ or seta-like spines on the distal half of the front margin and along the hind margin, which carries a rigid spine near its apex; the sixth joint is straight and narrow, with flexible spines on both margins and on the surface. The needle-like finger is about half the length of the preceding joint.

The second gnathopods have a few spines but no prickles on the hind margin of the fourth joint, the fifth joint considerably shorter and very little broader than the sixth; both these joints being armed with spines, but less densely than in the first pair. The finger is slightly curved, and is much less than half the length of the preceding joint.

The first peræopods have the second joint equal in length to the fourth and fifth together, the fourth rather more than half the length of the fifth. The latter, which is as usual specially glandular, is considerably broader and a little longer than the sixth joint. The finger is minute.

The second peræopods scarcely differ from the first.

The third peræopods have the second joint equal in length to the first antennæ minus the terminal joint. The front margin is produced into a short tooth, in advance of which are two spine-like processes; on the hind margin there are twelve of these processes. The third joint does not equal the breadth of the second; the fourth is slender, but in length remarkable, falling not far short of the second; the fifth is about two-fifths of the length of the fourth; the sixth less than half the length of the fifth. The finger minute.

The fourth peræopods are slender and very long, though shorter than the fifth; the second and fourth joints being much shorter than in the preceding pair, while the fifth joint is fully as long, and the sixth between two and three times as long as in that pair.

The fifth peræopods are very slender and short, the total length scarcely equalling that of the second joint in the preceding pair. The minute finger has a bulbous base and a slender hooked termination.

Branchial vesicles are attached to the first four pairs of peræopods, and apparently also to the second gnathopods. Some of the vesicles exhibit a rather unusual appearance, the centre seeming to be occupied by a series of little globules.

The pleopods have nine joints to the outer ramus and seven to the inner.

The uropods all have the peduncle considerably longer than the coalesced inner branch. The first pair are the longest, but do not reach quite so far back as the third; they have three spines spaced on the inner margin of the rather broad peduncle: the outer branch is represented by a small spine; the inner is finely serrate on the outer margin. The second pair have a similar outer branch, and the inner branch slightly serrate on the inner margin, and reaching back as far as or a little beyond that of the first pair. The third pair have two spines on the inner margin of the peduncle, the outer margin of the inner ramus serrate with six or seven tiny spinules; the outer ramus about four-fifths of the length of the inner, microscopically serrate, and carrying minute spinules on its inner margin.

The length of the specimen, including antennæ and uropods, is a quarter of an inch.

Habitat. Atlantic. Lat. 1° 55′ 5″ N., long. 5° 55′ 5″ E. Taken after 9 P.M. from a depth of 360 fathoms.

The specific name is given in compliment to John Rattray, Esq., under whose supervision the present collection of Amphipoda was made.

The only species which make any approach to the peculiar character of the third peræopods here exhibited are *Scina tullbergi* (Bovallius) and *Scina pacifica* (Bovallius), the latter of which may, according to Dr. Bovallius himself, be only a variety of the former. They do not, however, show so great an elongation of the fourth joint in the limbs in question, and they have very different proportions in the fourth peræopods, and exhibit many differences in the uropods. Of the pleopods in the two species above named Bovallius writes that the exterior ramus has seven joints, the interior nine joints. He also assigns fewer joints to the outer than to the inner ramus in the pleopoda of *Scina sarsii*, *Scina atlantica*, and *Scina marginata*, giving more to the outer than to the inner only in his species *Scina clausi*. In all the species of *Scina* which I have examined the pleopods have uniformly had the smaller number of joints on the inner, not on the outer ramus. It may be useful to mention that when the pleopod is detached from the animal the presence of the cleft spine on the inner branch distinguishes it with certainty from the outer.

SCINA CONCORS, n. sp. (Plate LIII. B.)

The head is dorsally smooth, truncate between the antennæ, this part of the margin not at all concave, but by the rounding of its corners tending rather to become convex. The peræon is broadly ovate, together with the head equalling in length the pleon to the end of the coalesced segments. These latter, with the fourth pleon-segment, are together scarcely equal to half the length of the first three segments of the pleon. The fifth segment is much broader but not longer than the sixth, which is coalesced with it. The small telson is broader than its length, with the apex truncate, as in *Scina acanthodes*. The shape and proportions are unusual in this genus, but there is nothing in either case to indicate that the telson is either broken or abnormal.

The eyes are comparatively large, composed of some nine or more pairs of cones arranged in loose order.

The first antennæ are rather shorter than the peræon, with the first joint of the flagellum broad, four-sided, armed below with fourteen teeth, and on the outer margin with ten, the inner densely fringed with cylinders. The short second joint has four cilia on the inner margin, and is tipped with a fine seta not so long as itself.

The second antennæ are set well behind the first on the underside of the head, and have behind them a prominence, apart from which the peduncle is four-jointed, with the third and fourth joints longer than the first and second. The flagellum is of great length, though consisting, perhaps, of not more than eight or nine joints. The first of these is nearly as long as the peduncle, or not quite half the length of the upper antennæ; it narrows from a broad base, and is again a little enlarged apically; its upper or inner margin is fringed with decurrent cilia. The remaining joints are also more or less ciliated, filiform, some longer, some shorter than the first, but the boundaries not always easy to detect, unless where the apical dilatation is seen broadside on.

The mouth-organs, as seen without dissection, show a broad and deep helmet-shaped epistome, rather small mandibles with finely-toothed cutting-edges, the plates of the maxillipeds elongate, with the apices not acute but rounded.

The first gnathopods have a short spine at the apex of the third joint, prickles along the hind margin of the fourth joint, and two spines at the apex; the fifth joint longer and much broader than the sixth, beset with several slender spines; the sixth joint narrow, especially in the distal half, and beset with many spines; the finger slender, nearly straight, about half the length of the sixth joint.

The second gnathopods have both the fifth and sixth joints slender, the sixth the longer.

The first and second peræopods have the sixth joint much shorter than the fifth, subequal in length to the fourth, but much narrower, with three minute spinules indenting the distal half of the hind margin. The finger is curved, much shorter than in the gnathopods.

The third peræopods have the long second joint much broader than it is in any of the other pairs, with its hind margin cut into about fourteen teeth, the front having only the apical one, and that small; the fourth joint is about three-quarters the length of the second, the fifth two-thirds the length of the fourth, and the very slender sixth a little shorter than the fifth. The finger is minute.

The fourth peræopods have the second joint three-quarters the length of that in the preceding pair; the fourth, fifth, and sixth joints each subequal to the fifth in the preceding pair and to each other, but the fifth slightly the longest of the three. The finger is very small, yet longer than in the other peræopods.

The fifth peræopods are small, but not strikingly slender. The second joint is more than half the length of that in the fourth pair; the fourth and fifth joints are subequal, together longer than the second; the sixth joint is much shorter and narrower than the fifth. The finger is small, consisting of a bulbous base and a short spine-like tip.

The branchial vesicles are rather large, showing the cell-structure rather conspicuously.

The pleopods have strong peduncles. The branches are shorter, with ten joints to the outer, and nine to the inner.

The uropods have the peduncles longer than the coalesced inner ramus, considerably in the second pair, less so in the first, and very slightly in the third. The first pair have the inner ramus serrate along much of the outer margin, the outer ramus resembling a considerable spine, equal to a fourth of the length of the inner; the second pair are serrate on the inner margin from a little above the commencement of the ramus, the outer ramus spine-like, but longer than in the first pair, and equal to two-fifths of the inner ramus; the third pair are serrate on the outer margin of the inner, and the inner of the outer ramus, the latter being two-thirds as long as the former.

The specimen measures a little more than a fifth of an inch, by inclusion of the first antennæ and the uropods.

Habitat. Atlantic. Lat. 4° 26′ 7″ S., long. 10° 1′ 8″ E. Taken in the daytime from a depth of 135 fathoms.

From the closely allied species, *Scina tullbergi* and *Scina pacifica* of Bovallius, the present is distinguished by shorter fingers to the gnathopods and the first four pairs of peræopods, by a longer sixth joint in the third pair, and especially by differences in the uropods, the outer branch being here longer in the second than in the third pair instead of *vice versâ*, and the outer branch of the third pair being lanceolate and serrate instead of linear and smooth, and also much longer than in the other species. The difference in the shape of the telson might be considered to outweigh all the other distinctions, but its very peculiarity arouses some suspicion that the shape may be accidental. The specific name refers to the near agreement of this with the species reported from Cape Horn and from the Pacific, at Corinto, Nicaragua.

SCINA SIMILIS, n. sp. (Plate LIV. A.)

The head is dorsally smooth, truncate or even slightly convex between the antennæ. The length of the head and peræon equals that of the pleon to the tip of the telson. The fifth and sixth segments of the pleon are coalesced. The telson is narrowly triangular, about a third of the length of the peduncle of the third uropods. The ovaries extend backwards to the end of the sixth peræon-segment.

The eyes appear to be composed of nine ocelli, each ocellus consisting of four cones. In the present condition of the specimen these four cones seem to be encircled by a ring, and are separated one from another by a cross-shaped interval.

The first antennæ are equal in length to the last five segments of the peræon. The first joint of the flagellum has seven spiniform processes along the outer margin and a larger number on the inner, over which the long and numerous filaments project. The slender second joint is tipped with a fine seta.

The gnathopods of both pairs agree closely with those of *Scina concors*, except that the fingers are proportionally a little longer.

The first and second peræopods have the sixth joint longer than the fourth, and nearly as long as the fifth. The finger is slender, curved, not a quarter of the length of the hand.

The third peræopods have thirteen teeth on the hind margin of the second joint, its front margin smooth, with an apical tooth a little longer than the third joint. The fourth joint is only a little shorter than the second apart from its apical tooth; the fifth is a little more than half the length of the fourth; the sixth is about three-quarters the length of the fifth. The finger is small and slender.

The fourth peræopods have the fourth and sixth joints subequal to the fifth in the preceding pair, but the fifth joint shorter than either of these and about half the length of the second joint. Both the sixth joint and the finger are considerably longer than the corresponding parts in the preceding pair.

The fifth peræopods are slender, scarcely equal in length to the second joint in the third pair. The sixth joint is slightly shorter than the fourth or fifth. The finger is very slender, with only a small bulb at the base.

The first uropods have the peduncle equal in length to the coalesced inner branch, the outer margin of the peduncle more faintly serrate than that of the branch, the inner margin of both smooth; the outer branch is spine-like. The second uropods are more slender than the first, with peduncle and inner branch subequal, serrate only along the inner margin, and having a spine-like outer branch, which is a little thinner and a very little longer than that of the first pair. The third pair have the peduncles a little longer than the outer branch, but considerably shorter than the coalesced inner branch; the outer is two-thirds of the length of the inner branch; the outer margin of the inner and the inner of the outer branch are serrate.

The specimen, a female with setiferous marsupial plates, measures three-twentieths of an inch, antennæ and uropods included.

Habitat. Atlantic. Lat. 3° 0′ 8″ N., long. 7° 43′ W. Taken at noon from a depth of 50 fathoms.

The specific name refers to the general likeness which this species presents to the species *tullbergi*, *pacifica*, and *concors*. Yet it differs from all three in the relative proportions of the joints of the fourth peræopods, and by the different character of the fifth peræopods, especially in regard to the finger; moreover, the proportions of the uropods are different, not to mention other marks of distinction which separate it from one or other of the species in question.

Scina uncipes, n. sp. (Plate LIV. B.)

The outline of the head was probably broadly truncate between the antennæ, but owing to an accidental damaging of the specimen this cannot be affirmed with certainty. The telson is triangular, scarcely a third of the length of the peduncles of the third uropods.

The eyes resemble those of *Scina similis*.

The first antennæ are stout, equal in length to the hinder half of the pleon, from the base of the fourth segment to the extremity of the uropods. The first joint of the flagellum has twelve teeth on the outer margin and about sixteen on the inner, over which project some setules, and a rather slender supply of filaments. The second joint is only a small stump, without any setæ; but this is probably not its normal condition.

The second antennæ have at the base two short stout joints. The third is longer and more slender than either of these, and the fourth than the third, with a slight dilatation near the middle. The fifth joint is more slender than the fourth, but quite as long. The four remaining joints are together somewhat longer than the preceding joint. This form is no doubt a stage in the development of the antennæ of the male.

The gnathopods differ little from those of *Scina similis.* There are branchial vesicles attached to the second gnathopods and to the first four pairs of peræopods.

In the first and second peræopods the fifth joint is longer than the fourth or the sixth. The finger is much curved.

The third peræopods have twelve teeth on the hind margin and about the same number on the front, together with an apical tooth longer than the third joint. The fourth and fifth joints are subequal in length; together they are as long as the second joint apart from its apical tooth. The sixth joint is rather shorter than the fifth. The finger is minute, triangular, its apex forming a nail.

The fourth peræopods are shorter than the first or second. They have the fourth and fifth joints equal, the sixth shorter than the fifth and a little shorter than the corresponding joint in the preceding pair, while the finger is similar to that of the third pair, but rather stouter.

The fifth peræopods are robust, with the fourth joint longer than the fifth, and the fifth than the sixth. The finger is curiously shaped, thick at the base, then narrowing, and again widening, the widened extremity being closely beset by a pair of spines or sort of double nail.

The pleopods have nine joints to the outer and seven to the inner branch.

The first uropods reach beyond the second, nearly to the extremity of the third. They have the peduncle rather shorter than the inner branch, of which the outer margin is minutely serrate; there are teeth sparsely set on the inner margin of both peduncle and branch. The outer ramus is a small thick spine. The second pair reach nearly as far as the outer branch of the third pair; they have the peduncle rather shorter than the inner branch, which is finely serrate on its inner margin; the outer branch is a little longer than in the first pair. The third pair have the peduncle nearly as long as the outer branch, which is fully four-fifths as long as the inner; the confronting margins of the two branches are serrate.

The specimen measures three-tenths of an inch.

Habitat. Atlantic. Lat. 7° 54′ N., long. 17° 25′ W. Taken between 6 and 7 P.M. from a depth of 50 fathoms.

The specific name refers to the peculiarly hooked finger of the fifth peræopods. From the more or less nearly related species, *Scina marginata* (Bovallius) and *Scina lepisma*, Chun, it is separated not only by the finger in question, but by the hands of the gnathopods, which are not apically produced into a sharp process.

Scina cornigera (Milne-Edwards).

1830. *Hyperia cornigera,* Milne-Edwards, Ann. des Sci. Nat. t. xx. p. 387.
1840. *Tyro cornigera,* Milne-Edwards, Hist. Nat. des Crustacés, t. iii. p. 80.
1885. „ *sarsii,* Bovallius, Some forgotten Genera of Amphipoda, p. 15, figs. 3, 3 *a*.
1887. „ *sarsi,* Bovallius, Contributions to a Monograph of the Amph. Hyperiidea, p. 9, pl. 1. figs. 1–17, pl. 2. figs. 1–10.
1888. *Scina cornigera,* Stebbing, 'Challenger' Amphipoda, p. 1273, pl. 146.

The identity of *Tyro sarsii,* Bovallius, with *Tyro cornigera,* Milne-Edwards, cannot be insisted on as more than probable. If the later name is upheld, the earlier one might as well be cancelled.

A specimen more than half an inch in length was obtained by the 'Buccaneer' near the surface after dark, in the Atlantic, at lat. 5° 88′ N., long. 14° 20′ W., together with two other specimens of the same species.

Scina atlantica (Bovallius).

1885. *Tyro atlantica,* Bovallius, Some forgotten Genera of the Amphipoda, p. 14.
1887. „ „ Bovallius, Contributions to a Monograph of the Amph. Hyperiidea, p. 13, pl. 2. figs. 11–18.
1888. *Scina atlantica,* Stebbing, 'Challenger' Amphipoda, p. 558.
1889. „ „ Chun, Zool. Anzeiger, Jahrg. xii. no. 308, p. 289.

A specimen, apparently belonging to this species, was taken in the daytime from a depth of 100 fathoms, in the Atlantic, at lat. 7° 11′ N., long. 15° 54′ W. It measured fully a fifth of an inch. The first antennæ are unusually wide apart. The third peræopods in this specimen are unsymmetrical, so that a distinct species might be made out of each longitudinal half of the animal. The peræopod on the right side has the full number of joints, but all, except the third, are dwarfed. The preceding limbs are affected in a similar manner, but to a smaller extent.

Scina pacifica (Bovallius).

1887. *Tyro pacifica,* Bovallius, Systematical List of the Amph. Hyperiidea, p. 4.
1887. „ „ Bovallius, Contributions to a Monograph of the Amph. Hyperiidea, p. 25, pl. 3. figs. 10–17.
1888. *Scina pacifica,* Stebbing, 'Challenger' Amphipoda, p. 587.

The differences between this species and the earlier *Tyro tullbergii,* Bovallius, 1885, are, as Dr. Bovallius himself remarks, very slight. A specimen, agreeing best with the *atlantica* form, was taken by the 'Buccaneer' with the tow-net at noon from a depth of 235 fathoms in the Atlantic, in lat. 4° 26′ 7″ S., long. 10° 18′ E. The specimen measured three-twentieths of an inch, including as usual the antennæ and uropods. It contained about a dozen relatively large eggs.

It seems not a little remarkable that the only twelve specimens of the genus *Scina* which I have been able to discover in the collection should include ten distinct species, of which no less than seven are new. One may without rashness forecast that, if species continue to multiply at this rapid rate, before long it will be thought necessary to relegate such forms as *acanthodes*, *stenopus*, and *uncipes* to so many separate genera.

Family RHABDOSOMIDÆ.

In his admirable work on the Oxycephalids, published in 1890, Dr. Bovallius separated from the Oxycephalidæ a new family which he named Xiphocephalidæ, distinguished by having the eyes planted between an outdrawn neck-like portion of the head and a long needle-shaped rostrum, by having the telson articulated to the preceding segment, by having the fifth pair of peræopods reduced to a single bladder-like joint, and by the absence of marsupial plates from the ovigerous female. Dr. Bovallius recognized that the 'Challenger' species *Rhabdosoma brevicaudatum*, as described, formed an exception, by having its telson coalesced with the preceding segment, and that his own genus *Tulbergella*, with the fifth peræopods four-jointed, was in that respect intermediate between the other Oxycephalidæ, which have those limbs fully jointed, and the Xiphocephalidæ, in which he supposed them to be limited to a single joint. After the publication of his book he came to England and inspected the type specimen of *Rhabdosoma brevicaudatum* at the British Museum. He persuaded himself that the telson was in fact articulated; but from a re-examination of the specimen I am myself convinced that the original description was correct, and that any appearance to the contrary is due to the transparency of the animal, making it somewhat difficult to perceive that the ventral suture is not dorsal. There is now to be described another short-tailed *Rhabdosoma*, in which likewise the telson is coalesced with the preceding segment. No stress, therefore, can properly be laid on the articulation of the telson as a family characteristic. In yet another new species of *Rhabdosoma* the fifth peræopods prove to be three-jointed, thus making a close approach to what is found in the acknowledged Oxycephalid genus *Tulbergella*. Even the neck-like constriction and the needle-shaped rostrum of the Rhabdosomid head are met with, though in far less exaggerated form, among the Oxycephalidæ, so that it seems inconsistent on the part of Dr. Bovallius to rely on these as points of distinction between the two families, while, on the other hand, he introduces into the Oxycephalidæ the very different-looking and blunt-snouted *Simorhyncotus*. The effect of the latter innovation is at least very awkward for the received nomenclature, since the family name, which signifies that the beak is sharp, is made to cover a genus the name of which signifies that the beak is blunt. There still remains for the Xiphocephalidæ the substantial distinction that the female is unprovided with marsupial lamellæ, and carries her eggs in the singular manner which Dr. Bovallius has described. The reason for changing the name Xiphocephalidæ into Rhabdosomidæ will be apparent from the discussion of the synonymy of the solitary genus by which the family is at present represented. The change of name should not deter the student from consulting the exceedingly important morphological notes with which Dr. Bovallius has enriched his elaborate account of this family.

Genus Rhabdosoma, Adams and White, 1847.

1847. *Rhabdosoma,* Adams & White, in White's List of Crustacea in the British Museum, p. 138.
1848. „ Adams & White, Zoology of the Voyage of H.M.S. 'Samarang,' p. 63.
1858. *Macrocephalus,* Spence Bate, Annals and Magazine of Natural History, ser. 3, vol. i. p. 361.
1862. *Rhabdosoma,* Spence Bate, British Museum Catalogue of Amphipodous Crustacea, p. 344.
1887. *Rhabdonectes,* Bovallius, Systematical List of the Amphipoda Hyperiidea, Bihang till Kongl. Svenska Vet.-Akad. Handlingar, Bd. xi. no. 16, p. 39.
1888. *Rhabdosoma,* Stebbing, 'Challenger' Amphipoda, p. 1606.
1890. *Xiphocephalus,* Bovallius, The Oxycephalids, Royal Society of Sciences of Upsala, pp. 3, 116, &c.

For other references the two last-named works may be consulted. Dr. Bovallius assigns the genus, with the name *Xiphocephalus* and the date 1841, to the well-known zoologist Guérin-Méneville, on the authority of Eydoux and Souleyet[1]. He quotes the passage in point from those authors, which is to the following effect:—" M. Guérin-Méneville, who has been kind enough to study this species with us, thinks that it will have to be separated from the genus *Oxycéphale* to form a new generic division to which might be given the name of *Xyphicéphale,* which expresses its principal character; he bases his view on the fact that the true species of *Oxycéphale* have the body shorter, of different shape, and on the fact that they have seven pairs of feet, of which two pairs are didactyle and five ambulatory."

It will be observed that here the genus is not instituted, but only an opinion given that it will eventually have to be, and the reasons for that opinion are stated. A suitable name for the genus thus foreshadowed is indicated by the French word *Xyphicéphale.* It is, or was, a common custom with French authors to give zoological names both in French and Latin. The Latin form is in this case not added, very likely because the authors intended to leave to Guérin himself the privilege of technically naming the genus, when a proper occasion should present itself. Of this privilege he appears to have never availed himself. The short Latin account of the species under discussion actually calls it "*Oxycephalus,* corpore perangusto, elongatissimo," &c. Under these circumstances I cannot bring myself to believe that the French form *Xyphicéphale* has any claim to be accepted as an authoritative name, and, since it is a monstrosity in spelling, its rejection should inspire but little regret. Three changes in it have to be made in order to polish it into *Xiphocephalus,* a name which Guérin-Méneville might have given, but did not. By discarding *Xyphicéphale* we are brought

[1] "Voyage autour du monde exécuté pendant les années 1836 et 1837 sur la corvette la 'Bonite.'" Zoologie. Tome 1er, pp. 267–271, pl. iv. figs. 13–32. Paris (1841 ?).

to *Rhabdosoma* as the earliest name of the genus, and thus in a manner forced to change the name of the family from Xiphocephalidæ to Rhabdosomidæ.

Dr. Bovallius has very acutely unravelled the synonymy, and explained the distinctions between the species hitherto included in the genus *Rhabdosoma*. These are *Rhabdosoma armatum* (Milne-Edwards), 1840, *Rhabdosoma whitei*, Spence Bate, 1862 (the *Xyphicéphale* of Eydoux and Souleyet), *Rhabdosoma lilljeborgi* (Bovallius), 1890, and *Rhabdosoma brevicaudatum*, of the 'Challenger' Report, 1888. Two new species, *R. piratum* and *R. brachyteles*, are now instituted.

Rhabdosoma piratum, n. sp. (Plate LV. A.)

The head is longer than the peræon and the first three segments of the pleon, as long as the whole pleon to the extremity of the uropods. The slender rostral part is nearly double as long as the part behind the first antennæ. Of the peræon-segments the fourth, fifth, and sixth are the longest. The first three segments of the pleon have the postero-lateral angles acute. The third is a little longer than either of the first two or the fourth, but a little shorter than that which is formed by coalescence of the fifth and sixth. The narrow tapering telson is considerably longer than any of the preceding segments, and reaches a little beyond the first uropods.

The eyes are of the character usual in the genus.

The first antennæ are very small, two-jointed, tipped with four short filaments.

No second antennæ were apparent in the specimen.

The first gnathopods are as usual minute, the second joint a little sinuous, the fourth scarcely larger than the third, the fifth sharply produced behind as far as the minutely toothed apex of the hand, which is narrower than the basal part of the wrist, but about as long. The finger is slender, very slightly curved, more than half the length of the hand.

The second gnathopods differ little from the first, but have the process of the fifth joint a little shorter, and the apical margin of the hand narrower.

First peræopods. The second joint is rather wider but not longer than the fourth; the fifth is narrower and shorter than the fourth, to which the slightly curved sixth is subequal in length though not in breadth. The finger is slender, curved, half as long as the preceding joint.

The second peræopods scarcely differ from the first, except in slightly greater length of some of the joints.

Third peræopods. The branchial vesicles are oval, more than half as long as the second joint of the limb and much wider than it. No trace of branchial vesicles could be perceived on any of the preceding limbs. In slenderness and general structure the third are very like the first and second peræopods, but they have the second, fourth, and sixth joints much longer, and the second decidedly longer than the fourth.

Fourth peræopods. The branchial vesicles are a little longer than the preceding pair.

The limbs differ very little from the third peræopods, unless the second joint be a little longer and the sixth a little shorter than in that pair.

Fifth perœopods. These are minute, with a shortly pear-shaped dilated portion that may be taken to represent the second joint, which is immediately followed by a much shorter and very much narrower piece carrying at its truncate apex the tiny finger, broad at the base, and slender at the strongly bent tip.

The pleopods are not very robust, with very small coupling-spines. The outer branch has four and the inner three or four joints.

The first uropods have the peduncle about four times as long as the branches, with sixty or more spinules along the inner margin and many along the outer one. The branches do not reach quite to the extremity of the telson: the outer is bordered with nine long spine-like teeth on each side; the inner, which is slightly the shorter, has eighteen teeth on the inner margin, small near the base and larger behind; the outer margin has eight teeth, and its upper part unarmed. The second pair have the peduncle subequal in length to the two coalesced segments of the pleon, the outer branch a little more than half as long as the inner, carrying about six teeth on each margin: the inner branch has six long teeth and one or two very small ones on each margin; it is coalesced with the peduncle, which has about fifteen small teeth on the inner margin, and apparently a smaller number on the outer. The third pair have the peduncles intermediate in size between those of the first and second pairs, subequal in length to the telson, not twice as long as the coalesced inner ramus, with many teeth on two margins, the upper ones small and distant. The outer ramus is not half as long as the inner; it carries six long teeth on the inner margin, and two or more on the outer. The coalesced inner ramus has about fourteen teeth on each margin.

The specimen was a little less than half an inch long.

Habitat. Atlantic. Lat. 0° 38′ 6″ N., long. 6° 25′ 8″ E., off St. Thomas's Island. Taken with the tow-net at noon from a depth of 10 fathoms.

The specific name is given in remembrance of the vessel by aid of which the present collection of Amphipoda was made.

Rhabdosoma brachyteles, n. sp. (Plate LV. B.)

The head is considerably shorter than the pleon to the extremity of the uropods, and has the rostral not greatly longer than the part behind the first antennæ. Of the peræon-segments the fourth, fifth, and sixth are the longest. The first three pleon-segments have the postero-lateral angles blunt, not produced backwards: these segments are subequal in length; the fourth is slightly shorter; the coalesced remainder of the pleon scarcely longer. The telson is very bluntly pointed, not so long as the combined fifth and sixth segments, with which it is itself coalesced.

The eyes and antennæ are as in the previous species, and the same may be said of the minute gnathopods.

The first and second peræopods have the second joint decidedly broader and longer than the fourth, which exceeds the fifth in length and is subequal to the sixth. The finger is slender, curved, fully half as long as the preceding joint.

The third and fourth peræopods have the second, fourth, and sixth joints longer than in the two preceding pairs; they also have rather large oval branchial vesicles, of which no trace could be detected on the preceding limbs.

The fifth peræopods are extremely minute, with the upper part only a little more dilated than the hand, of which the articulation is very indistinct. The finger has the usual broad base and slender hook.

The pleopods have the branches three-jointed.

The uropods are comparatively broad. The peduncles of the first pair are between two and three times as long as the branches, reaching beyond the telson, and are minutely denticulate on the inner margin; the branches are subequal, more or less strongly denticulate on both margins. The peduncles of the second pair extend but little beyond the base of the telson, and the coalesced inner branch does not reach its apex; the outer branch is more than half as long as the inner; both have denticulations on the distal halves of both margins. The peduncles of the third pair extend a little beyond those of the first; the coalesced inner branch is about as much longer as the free outer branch is shorter than the branches of the first pair; both are denticulate on the distal part of both margins.

The specimen was a quarter of an inch in length from tip of rostrum to the extremity of the uropods.

Habitat. Atlantic, near lat. 0° 19′ 2″ S., long. 7° 19′ E. It was taken February 2, 1886, at 8.45 P.M., near the surface.

The specific name, from βραχύς, short, and τέλος, end, refers to the shortness of the telson.

EXPLANATION OF THE PLATES.

PLATE LI.

Scina acanthodes (p. 352).

The full figure in dorsal view slightly inclined to the left, the line above it indicating the actual length of the specimen.

C. Dorsal view of cephalon and peræon.
Pl. Dorsal view of pleon.
a.s., *a.i.* Upper and lower antennæ.
m., *mx.*1, *mxp.* Mandible, first maxilla, maxilliped, *in situ*.
m. Mandible, separated from the other mouth-organs.
x. A doubtful portion of the oral apparatus.

gn. 1, *gn.* 2. The first and second gnathopods.
prp. 1, 2, 3, 4, 5. The first, second, third, fourth, and fifth peræopods.
plp. Pleopod.
ur. 1, 2, 3. First, second, and third uropods.
T. Telson.

PLATE LII.

A. *Scina stenopus* (p. 354).

Lateral view of the animal without the head, the natural size being indicated above. A separate ventral view is given of the head and antennæ, on the same scale as the lateral view of the rest of the animal.

For the separate figures the lettering is the same in all the Plates.

B. *Scina œdicarpus* (p. 356).

The full figure is given in dorsal view, as much of the ventral ganglionic chain being shown as could be seen through the transparent integument.

PLATE LIII.

A. *Scina rattrayi* (p. 358).

The full figure is given in dorsal view.

B. *Scina concors* (p. 360).

The full figure is given in dorsal view.

PLATE LIV.

A. *Scina similis* (p. 362).

The full figure is given in dorsal view, the outline of the ovaries appearing as seen through the transparent integument.

[B. *Scina uncipes* (p. 363).

The antennæ and the limbs of one side are all drawn to the same scale. The uropods are more highly magnified, being drawn on the same scale as the larger figures of *prp.* 3 and *prp.* 5.

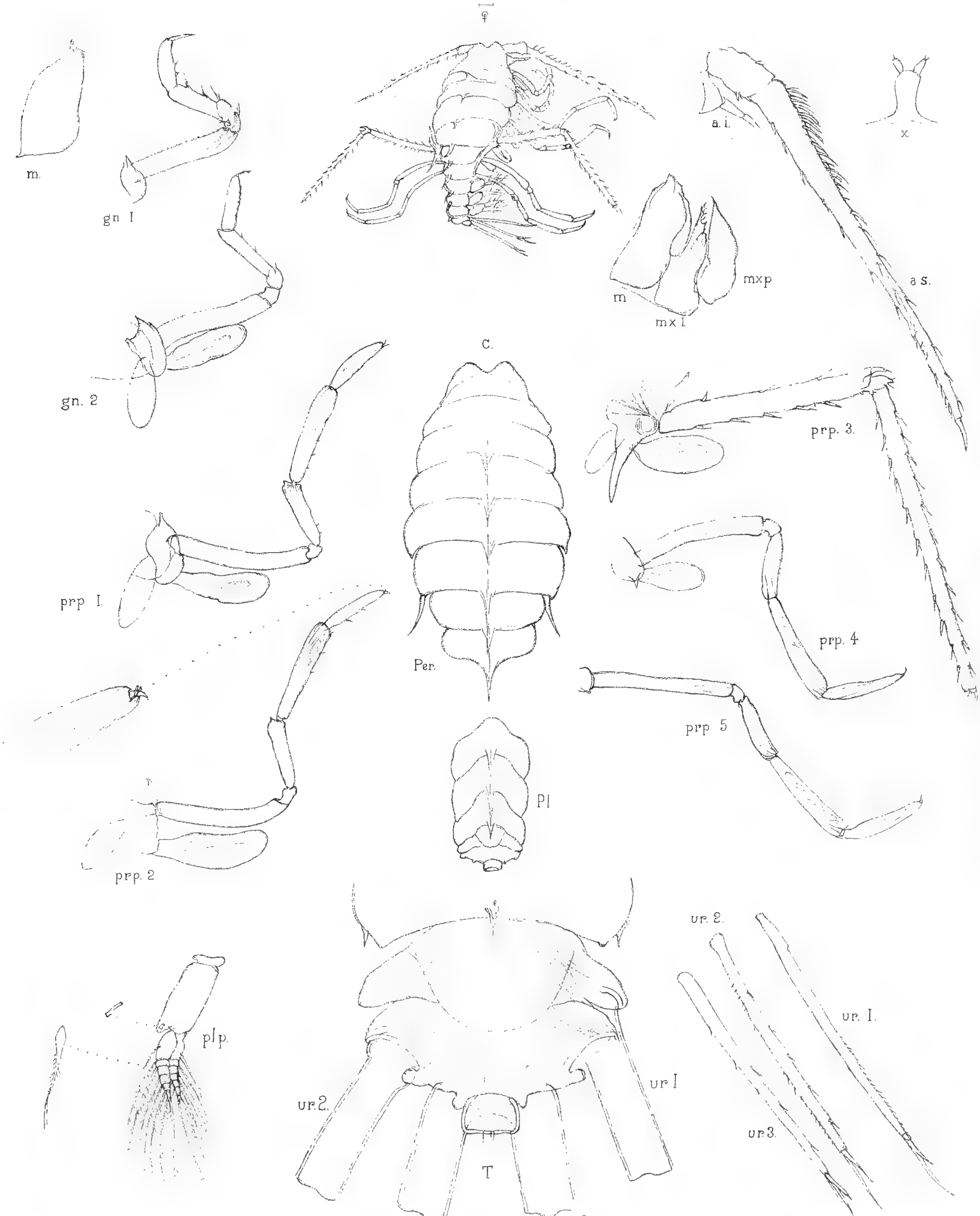
PLATE LV.

A. *Rhabdosoma piratum* (p. 368).

The full figure is given in lateral view.

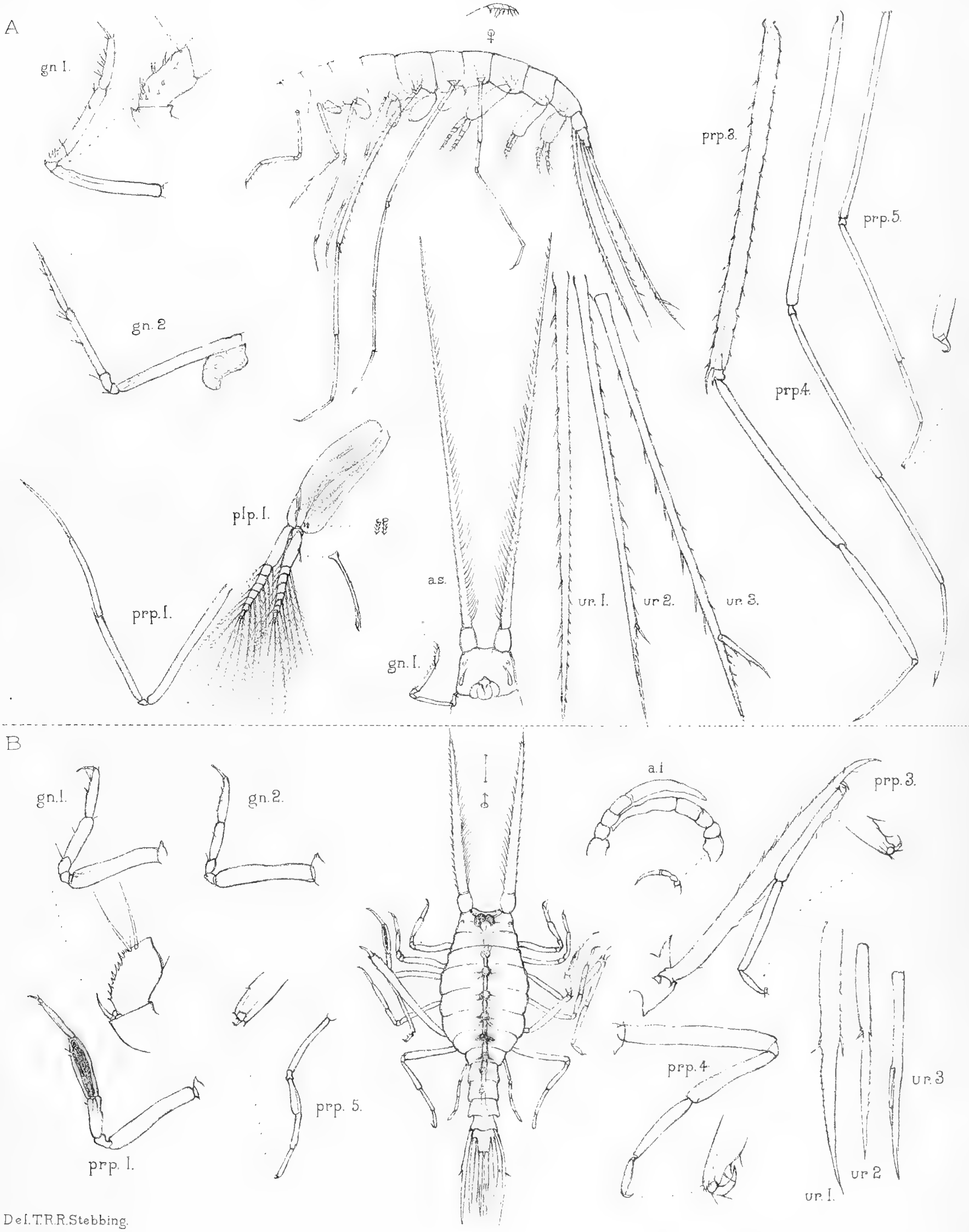
B. *Rhabdosoma brachyteles* (p. 369).

The full figure is given in lateral view.



Del. T.R.R. Stebbing.

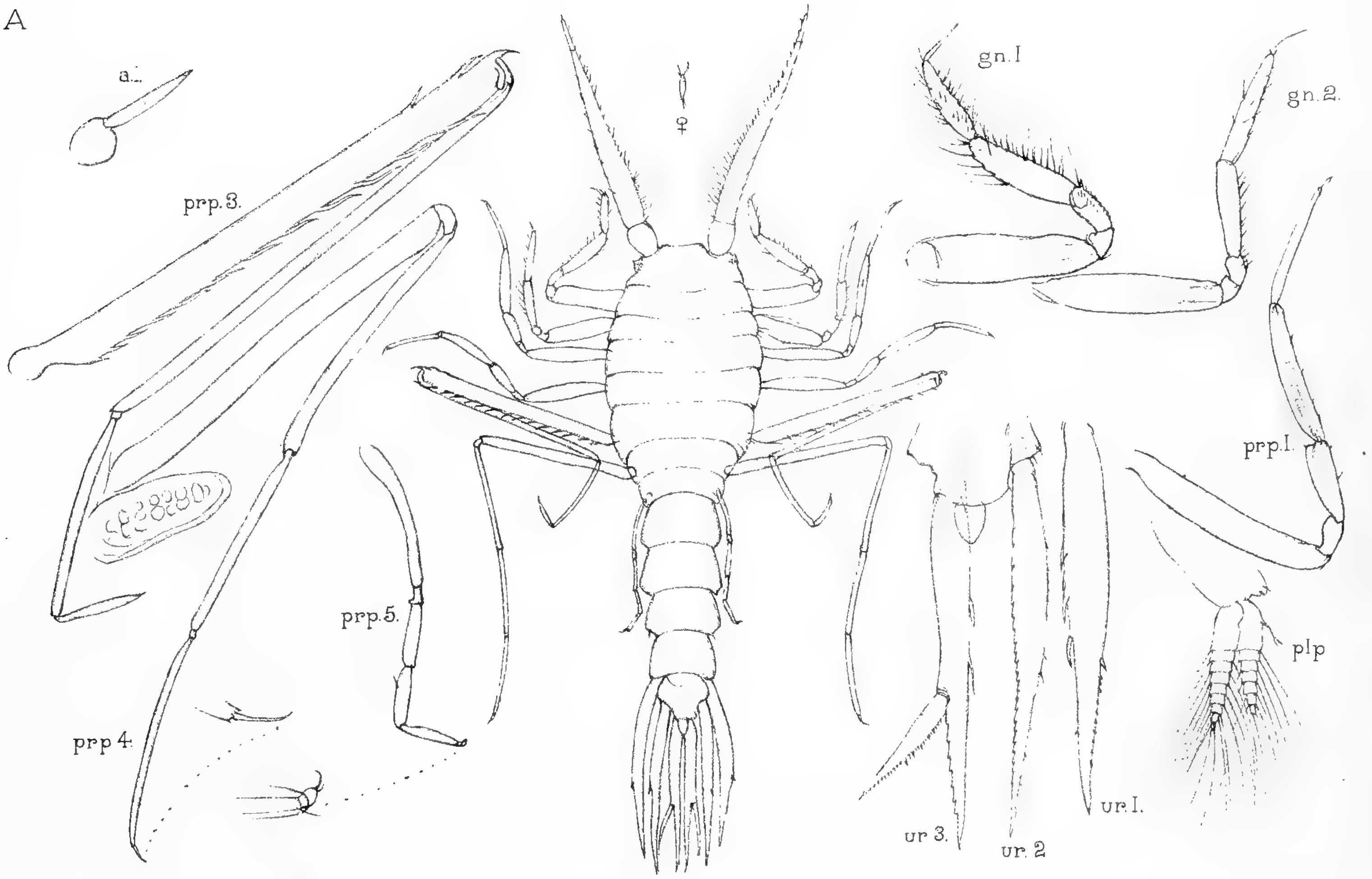
SCINA ACANTHODES.



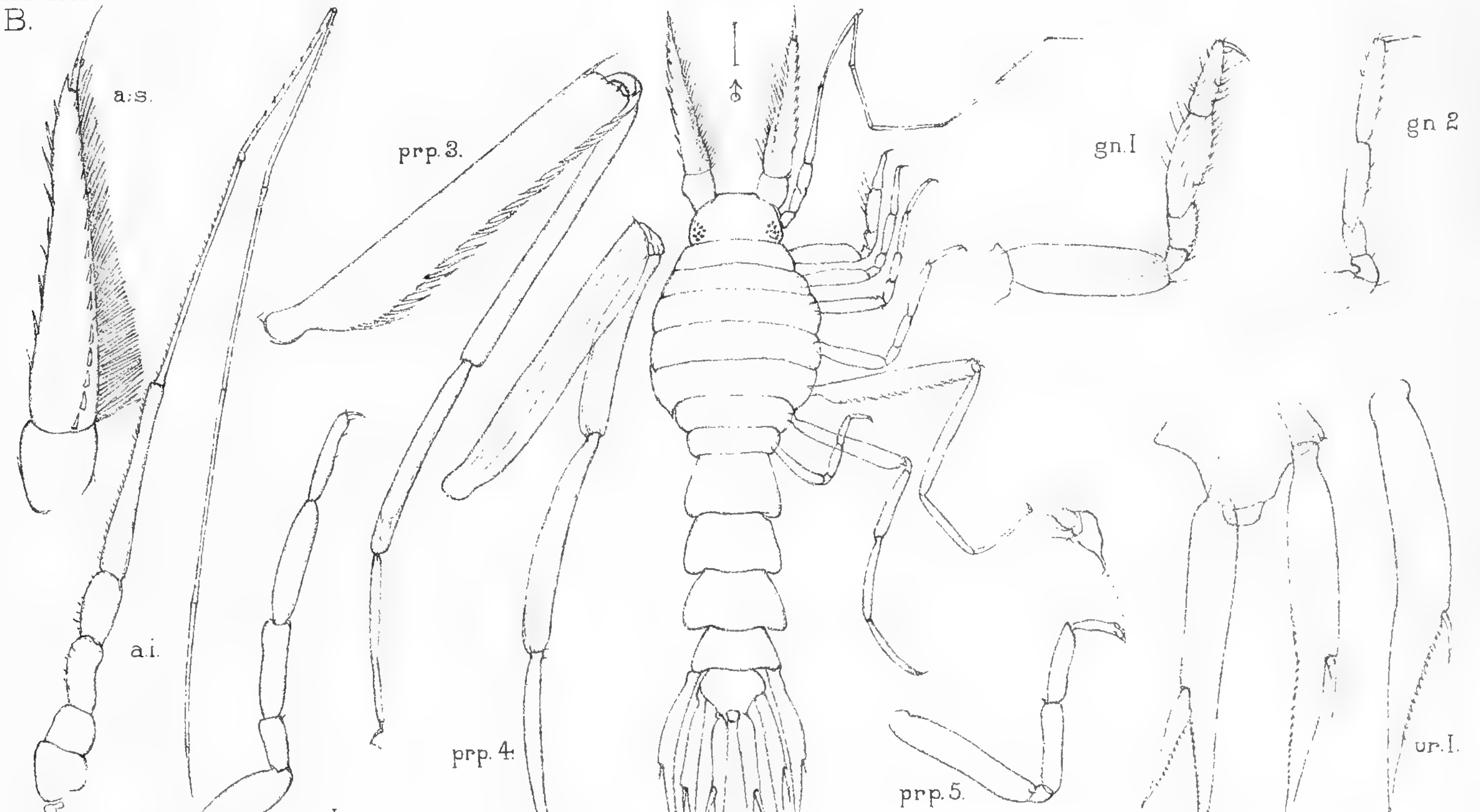
Del. T.R.R. Stebbing.

A. SCINA STENOPUS. B. SCINA OEDICARPUS.

A

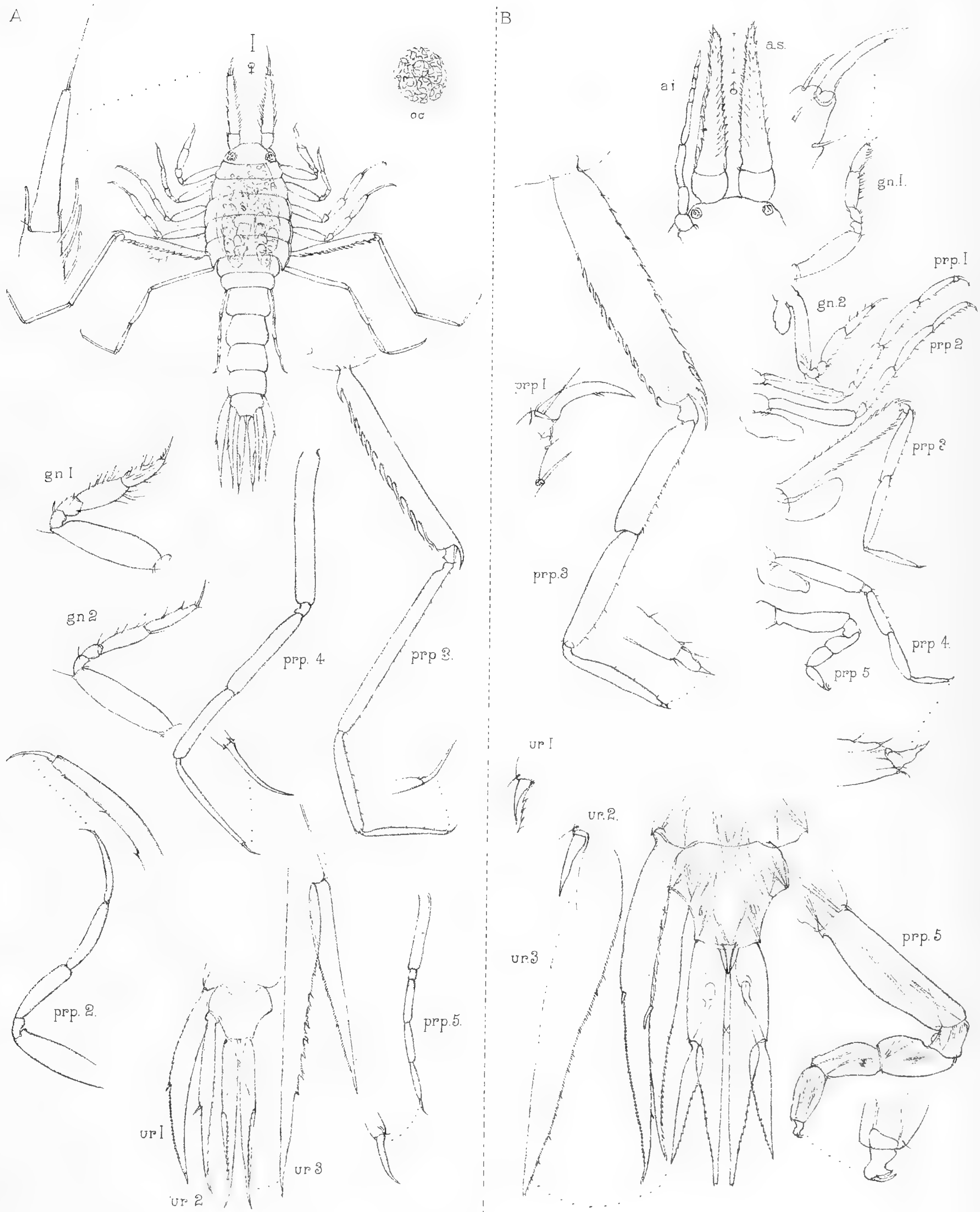


B.



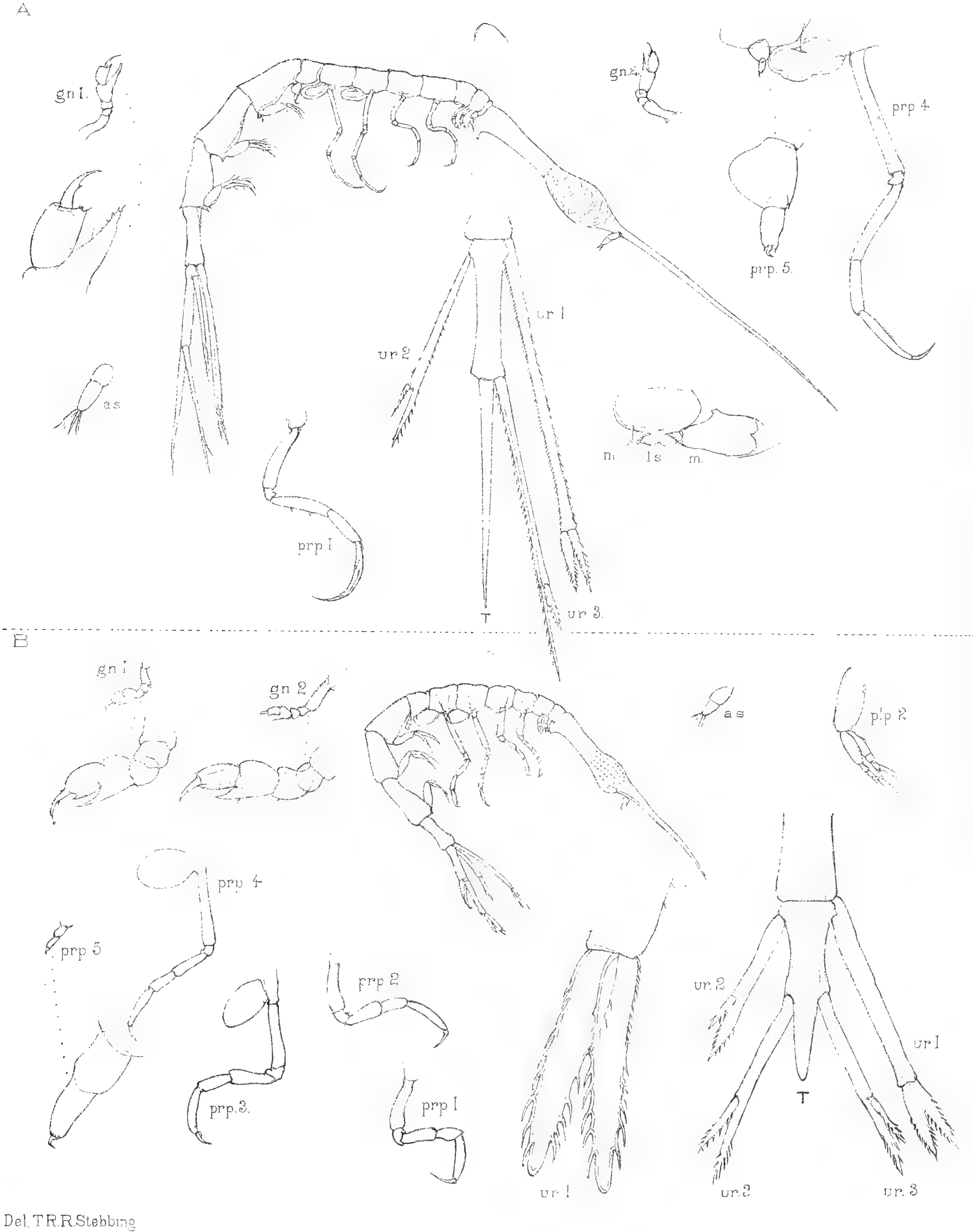
Del. T.R.R.Stebbing.

A. SCINA RATTRAYI. B. SCINA CONCORS.



Del. T.R.R. Stebbing.

A. SCINA SIMILIS. B. SCINA UNCIPES.



Del. T.R.R.Stebbing

A. RHABDOSOMA PIRATUM

B. RHABDOSOMA BRACHYTELES.

XV. *On the Cranial Osteology, Classification, and Phylogeny of the* Dinornithidæ. *By*

T. JEFFERY PARKER, *D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, New Zealand.*

Received December 5th, 1892, read February 14th, 1893.

[PLATES LVI.–LXII.]

CONTENTS.

1. INTRODUCTORY.

A FIRST glance at the magnificently illustrated series of memoirs by Sir Richard Owen on the osteology of the Dinornithidæ gives the impression that the whole subject has been exhausted; but a more careful perusal, aided by a comparison with the recent works of Lydekker (12) and Hutton (9), is enough to show that the material at Sir R. Owen's disposal was far from complete, that skulls were assigned to the skeletons of certain species on purely conjectural grounds, and that some of the figures were even made up of portions belonging to different species. The reason of this confusion is that it is extremely seldom that the bones of a single individual skeleton, or even the parts of a single individual skull, are found associated together and apart from those of other individuals.

It is to this circumstance that the chief difficulty of the present investigation was due—the difficulty of assigning correct names to the various skulls examined. To mention only the two most recent authorities: Lydekker describes four genera and nineteen species; Hutton seven genera and twenty-six species: species associated in a single genus by the one are widely separated by the other: and, most confusing of all, skulls assigned by Lydekker to certain species are considered by Hutton to have been wrongly associated with the leg-bones upon which the species were founded. Moreover, while my enquiries fully confirm the view that the Dinornithidæ are divisible into several genera, the generic groups, as deduced from a study of the skulls, do not agree with those of either of the authors referred to. It seems reasonable, however, to claim that, if constant and definable differences can be shown to occur in the skulls, these should outweigh mere differences in the size and proportions of the limb-bones.

I have derived the greatest assistance throughout the investigation from frequent correspondence with Captain Hutton, who has, with rare generosity, placed at my disposal the wide knowledge of the whole Moa question gained during the course of his extended, and still partly unpublished, researches. Sir James Hector has most kindly lent me the entire collection of Moa skulls in the Colonial Museum, Wellington, including the unique skull of *Mesopteryx*, species β, figured on Plate LX. figs. 20 & 21. Dr. H. O. Forbes has been good enough to lend me the large series of skulls in the Canterbury Museum, recently collected by himself at Enfield, near Oamaru, as well as the skulls from four skeletons in the Canterbury Museum, articulated under the superintendence of the late Sir Julius von Haast. Mr. A. Hamilton, Registrar of the University of Otago, has placed at my disposal the large collections made by himself at the Te Aute swamp, near Napier, and at Castle Rocks, Oreti River, Southland—the latter collection including several immature skulls which have been quite invaluable for my purpose. I am also indebted to Mr. Hamilton for the drawings from which figs. 59–64 are taken. Mr. R. J. Kingsley has lent me the skull of a fine individual skeleton in his possession, the type of *Dinornis torosus*, Hutton. Mr. J. Thomson, Lecturer on Applied Mechanics in this University, has devoted a great deal of time and trouble to taking the photographs from which Plates LVI., LVIII., & LX. are copied. And, lastly, during my visit to England I have received the kindest help from Prof. Newton, Dr. Henry Woodward, Mr. A. Smith Woodward, and Mr. H. M. Platnauer. To all these gentlemen I beg to return my most sincere thanks.

2. List of Specimens Examined.

As the nomenclature of many species is still doubtful, and as it is desirable to refer to certain individual specimens in the various collections to which I have had access, the following list is given in order to facilitate identification:—

Genus Dinornis, Owen.

1. Dinornis maximus, Owen.

a. The skull belonging to the large skeleton in the British Museum (Natural History) and numbered 46050 (Lydekker, Cat. Foss. Birds, p. 232).

b. Portions of a skull in the same Collection, numbered 46631–3 (figured by Owen, Extinct Birds of N. Z. pl. lxii.).

The measurements of this last-named skull do not differ from those of *D. robustus* [1].

[1] Through the kindness of Captain Hutton, I have just examined a very fine skull of *D. maximus* belonging to Mr. McEwen, of Christchurch. There is nothing to distinguish it from *D. robustus*.—*June* 1895.

2. Dinornis robustus, Owen.

a. The skull belonging to the very fine individual skeleton found at Tiger Hill, Otago, and now in the Museum of the Philosophical Society, York.

This specimen is referred by Hutton to his *D. potens*, but I am more than doubtful whether the distinction from *robustus* can be maintained, and prefer to place it in the present species.

b. The skull belonging to an individual skeleton found at Highley Hill, Otago, the property of Dr. T. M. Hocken. (Otago University Museum.)

c. An imperfect and partly restored skull from Hamilton Swamp, Otago. (Otago Univ. Mus.)

d. Mandible belonging to an individual skeleton found at Shag Valley, Otago. (Otago Univ. Mus.)

e. Associated premaxillæ, maxillo-jugal arch, quadrate, and mandible from Maungatua, Otago. (Otago Univ. Mus.)

f. A cranium from Enfield, Otago. (Dr. H. O. Forbes's collection.)

This species is figured by Owen, Trans. Zool. Soc. vol. v. pls. liii. & liv. (Ext. Birds of N. Z. pls. lxii. & lxiii.).

3. Dinornis torosus, Hutton.

a. Skull belonging to a nearly perfect skeleton, the type of the species, found in the Takaka district, Nelson. (Mr. R. J. Kingsley's collection.)

b. A nearly complete skull from Hamilton Swamp. (Otago Univ. Mus.)

Captain Hutton considers that this skull is probably referable to *D. struthioides*, but I can see no differences of any importance between it and the previous specimen.

This species is figured by Owen as *D. ingens*, Trans. Zool. Soc. vol. vii. pl. xv. (Ext. Birds of N. Z. pl. lxxxii.); also by Jaeger, as *Palapteryx ingens*, Reise der Novara, Paläontologie, pls. xxv. & xxvi.

4. Dinornis, species *a*.

A damaged cranium of the same size as that of *D. torosus*, but differing from it in having the temporal and lambdoidal ridges in contact. (Coll. H. O. Forbes.)

Genus Pachyornis, Lydekker.

1. Pachyornis elephantopus, Owen.

a. Six crania with separate premaxillæ, maxillo-jugal arches, quadrates, and mandibles, from Enfield; in one instance (Plate LX. fig. 22) premaxillæ and maxillo-jugal arches were found which exactly fitted a cranium, and I have no doubt that they belonged to the same individual. (Coll. H. O. Forbes & Cant. Mus.)

b. Two crania, one with (? associated) premaxillæ and mandible; locality unknown. (Coll. Mus. Wellington.)

c. An imperfect cranium with associated premaxillæ and mandible from Hamilton Swamp. (Otago Univ. Mus.)

Hutton (9, p. 133) has brought forward evidence for considering that this skull should be associated with the leg-bones upon which the species *crassus* was founded; if this were the fact it would, according to the nomenclature I have adopted, be placed in the genus *Emeus*, which genus would then change places with *Pachyornis* in my table of classification (p. 427). I learn, however, by recent communication with Prof. Hutton that he is still somewhat uncertain upon this point, and I think it will give rise to less confusion if I follow Owen and Lydekker and assign the present skull to the leg-bones upon which the species *elephantopus* was founded.

2. PACHYORNIS IMMANIS, Lyd.

Cast of a cranium in the Nat. Hist. Museum, numbered A. 201, and described by Lydekker, Foss. Birds, p. 344. I doubt whether this specimen can be specifically distinguished from *elephantopus* [1].

This species is figured by Owen, as *Dinornis elephantopus*, Trans. Zool. Soc. vol. vii. pl. x. (Ext. Birds of N. Z. pls. lix. & lxxvi.). The best skull from Enfield is figured from beneath on Plate LX. fig. 22.

3. PACHYORNIS, species α.

a. A cranium from Shag Point, differing from *P. elephantopus* in its greater breadth, especially across the postorbital processes, and in having the temporal and lambdoidal ridges in contact. (Coll. A. Hamilton.)

Figured in outline, Plate LXI. figs. 26 & 39, and Plate LXII. fig. 50.

b. A skull with greatly damaged cranium, from a skeleton named *Dinornis struthioides* by Sir J. von Haast, is probably to be referred here. (Canterbury Museum.)

Both these skulls may belong to very muscular individuals of *P. elephantopus*; but I hardly think so, as in all the specimens undoubtedly referable to that species the temporal and lambdoidal ridges are distinct. They may ultimately be found to belong to *D. rheides*, the skull of which is not known.

4. PACHYORNIS, species β.

A single cranium from Glenmark, differing from *P. elephantopus* in being decidedly narrower in proportion to its length.

5. PACHYORNIS, species γ.

A single cranium, from Enfield, differing from *P. elephantopus* in its much smaller size, but agreeing with it in other respects. It is very possibly a mere variety, but I have found no intermediate sizes.

[1] In the 'Transactions of the New Zealand Institute,' vol. xxvi. (1893), I have described a skull of *Pachyornis* which is about 10 per cent. larger in nearly all dimensions than *P. elephantopus*, and have referred it provisionally to *P. immanis*.—*June* 1895.

6. PACHYORNIS, species *a*, Lydekker.

The cranium in the British Museum (Nat. Hist.), No. 32197, so named by Lydekker (Foss. Birds, p. 320).

7. PACHYORNIS, species *b*, Lydekker.

A cranium in the Nat. Hist. Museum, numbered 32205, and described by Lydekker, *l. c.* p. 345. It agrees in all measurements, except a narrower temporal fossa, with *P. elephantopus*.

Genus MESOPTERYX [1], Hutton.

1. MESOPTERYX CASUARINA, Owen.

a. Twenty-nine crania, with several mandibles, premaxillæ, quadrates, and maxillo-jugal arches, from Enfield [2]. (Cant. Mus. and coll. H. O. Forbes.)
b. A cranium from Hamilton Swamp. (Otago Univ. Mus.)
c. A cranium from Glenmark Swamp, Canterbury. (Cant. Mus.)
d. A cranium from Castle Rocks. (Coll. A. Hamilton.)

The examination of this large series of skulls has convinced me that *didina*, Owen, and *huttonii*, Owen, are synonyms of *casuarina*; there is a perfect gradation between the larger skulls (*casuarina*) and the smaller (*didina*). The same gradation is found by Prof. Hutton in the case of the leg-bones from Enfield, but as there are considerable differences between the two ends of the series he prefers to keep the species distinct.

e. A skull in the Natural History Museum, numbered 32210. A typical but unusually large specimen.
f. A skull in the same collection, numbered 32214, 32199.

This species is figured by Owen as *Dinornis rheides* (with mandible of *Pachyornis*), Trans. Zool. Soc. vol. vii. pl. xii. (Ext. Birds of N. Z. pl. lxxv.). The best of the Enfield skulls is figured in Plate LX. fig. 19.

[1] Reichenbach's name *Syornis* has priority for this genus, having been applied to the type species *casuarina*; but, as Lydekker has pointed out (11, p. 254), this name clashes with *Synornis*, Hodgson, and I have therefore adopted Hutton's name *Mesopteryx*, the type species of which (*M. didina*) is probably only a small form of *casuarina*. [Captain Hutton (Trans. N. Z. Inst. vol. xxvii. 1894) now considers that *Meionornis*, Haast, is the correct name of this genus.—*June* 1895.]

[2] According to Mr. Forbes (2) the Moa-remains from Enfield belong chiefly to the species *elephantopus*, *ingens*, and *rheides*. This is hardly correct; the vast majority of the skulls belong to the species now under discussion, a few to *Pachyornis elephantopus*, and one or two to *Dinornis*, sp., and *Emeus*, sp. My determinations are confirmed by Prof. Hutton's measurements of 351 metatarsi from this abundant deposit sent to the Canterbury Museum. He finds that 181, or more than half, are referable to three doubtful species—*casuarina*, *didina*, and *huttonii*, all of which I include under *casuarina*; of the rest he assigns 40 to *rheides*, 38 to *crassus*, 40 to various species of *Dinornis*, and 52 to species of *Pachyornis*.

2. Mesopteryx, species *α*.

A cranium and mandible from Te Aute, near Napier. (Coll. A. Hamilton.)

This skull was referred by Prof. Hutton to *Cela geranoides*, but the evidence for the determination appears to me to be insufficient, and I think it best to leave the name in abeyance [1].

Figured in outline, Plate LXI. figs. 28 & 41, Plate LXII. fig. 52.

3. Mesopteryx, species *β*.

An entire skull found by Mr. A. M'Kay in a limestone fissure on Salisbury Tableland, Nelson. (Col. Mus., Wellington.)

This skull, which was found associated with the cervical vertebræ, is one of the most perfect ever discovered. It does not correspond with any of the figures or descriptions I have met with and appears to belong to a species the skull of which has not hitherto been described.

Figured on Plate LX. figs. 20 & 21.

4. Mesopteryx, species *γ*.

The skull on a mounted skeleton of *M. didina*, from Hamilton Swamp. (Otago Univ. Mus.)

This skull differs from the Enfield specimens of *M. casuarina* in the form of the orbit, which is right-angled as in *Dinornis*.

Figured in outline, Plate LXI. figs. 30 & 44, and Plate LXII. fig. 54.

Genus Anomalopteryx, Reichenbach.

1. Anomalopteryx didiformis, Owen.

a. Three perfect crania with premaxillæ, maxillo-jugal arches, quadrates, and mandibles; all found in the same cave (with the skeletons) at Castle Rocks, Southland. (Mr. A. Hamilton's collection.)

b. One perfect and several imperfect immature crania, from the same locality. (Coll. A. Hamilton.)

c. A cranium with (? associated) premaxillæ; locality unknown. (Colonial Museum, Wellington.)

These skulls are assigned to this species in accordance with Prof. Hutton's researches (9, p. 123), confirmed by Mr. Hamilton's discoveries at Castle Rocks. The skull referred by Lydekker (12, p. 275) to this species is apparently that of *Mesopteryx didina*.

The most perfect of the immature crania referred to above is figured on Plate LVIII. figs. 12 & 13.

[1] Since writing the above, Captain Hutton has lent me for examination a cranium which he considers to be that of *Megalapteryx tenuipes*, since it was found in a cave associated with bones of that species. The skull was a good deal damaged, but appears to agree very closely with that of *Mesopteryx*, species *α*.—*June* 1895.

2. ANOMALOPTERYX PARVA, Owen.

Skull of the very fine individual skeleton in the Natural History Museum, numbered A. 3, and figured and described by Owen, Trans. Zool. Soc. vol. xi. pl. lii.

It is an open question whether this species is distinct from *didiformis*; I am inclined to think it is merely a small variety, and only keep it separate in order to give measurements of the type specimen.

Figured by Owen as *Dinornis parvus*, Trans. Zool. Soc. vol. xi. pl. lii.

Genus EMEUS, Reichenbach [1].

1. EMEUS CRASSUS, Owen.

a. Two nearly perfect skulls from Shag Point, Otago; in both, the premaxillæ and bones of the palate were fixed *in sitû* by the collector Mr. R. S. Booth [2]. (Otago Univ. Mus.)

b. A similar skull, from the Maniototo Plains, Otago. (Coll. H. O. Forbes.)

c. Four less perfect skulls from Shag Point. (Otago Univ. Mus.)

d. About fifty crania belonging to this or the next species, from Shag Point. (Otago Univ. Mus. and coll. A. Hamilton.)

This species is figured by Owen as *D. crassus*, Trans. Zool. Soc. vol. x. pl. xxxi. (Ext. Birds of N. Z. pl. cxiv.); the beak and mandible of the skull figured as *D. crassus* in Trans. Zool. Soc. vol. vii. pl. xi. (Ext. Birds, pl. lxxvii.) belongs to this species, and probably the skull called *D. gravis* on pl. xiv. (Ext. Birds, pl. lxxxi.).

2. EMEUS, species *α*.

a. An entire skull found by Mr. R. S. Booth at Shag Point. (Otago Univ. Mus.)

With the unimportant exception of a slight injury to the left antorbital, this skull is absolutely perfect and is probably on the whole the best Moa skull ever found. (See Plate LVI.)

b. Two less perfect skulls, also from Shag Point. (Otago Univ. Mus.)

c. About fifty crania belonging either to this or to the preceding species. (Otago Univ. Mus. and coll. A. Hamilton.)

This species is easily distinguished from *elephantopus* by the shorter and narrower beak, but I can find no constant difference between the crania.

Figured on Plate LVI. and Plate LVIII. figs. 9 & 10.

3. EMEUS, species *β*.

The skull on the skeleton of *gravis* in the Canterbury Museum, so named by Sir J. von Haast. (Cant. Mus.)

This skull undoubtedly belongs to the present genus, but appears to exhibit well-marked differences from the two preceding species.

[1] Captain Hutton (Trans. N. Z. Inst. vol. xxvii. 1894) considers that this name should give way to *Euryapteryx*, Haast.—*June* 1895.

[2] A similar skull was found at the same place by Prof. Hutton and was presented by him to the British Museum; it is figured by Owen in Trans. Zool. Soc. vol. x. pl. xxxi., as *D. crassus*. Lydekker describes it an *Emeus*, species *a*.

4. EMEUS, species γ.

The cranium on a skeleton from Hamilton Swamp, named *D. gravis* by Prof. Hutton. (Otago Univ. Mus.)

This skull agrees in general characters with the present genus, but has right-angled orbits—a character I have never observed in any of the preceding species.

Figured in outline, Plate LXI. figs. 34 & 40, and Plate LXII. fig. 58.

3. A COMPARATIVE ACCOUNT OF THE SKULL IN THE DINORNITHIDÆ.

The skulls of the Moas are usually found in a more or less fragmentary condition, and it will be advisable, for the sake of convenience, to take this circumstance into consideration and to describe the skull under the following heads:—

a. Cranium.
b. Premaxilla.
c. Maxillo-jugal arch.
d. Vomer, palatine, and pterygoid.
e. Quadrate.
f. Mandible.
g. Hyoid.

The cranium is the part most commonly found · in large deposits of Moa-bones crania may occur in hundreds, whilst other portions of the skull are of comparatively rare occurrence. Premaxillæ, quadrates, and lower jaws are not uncommon, while a complete maxillo-jugal arch is rare, and very few skulls have been found with the palatines, pterygoids, and vomer uninjured.

a. *The Cranium.*

In the cranium the following regions may be distinguished:—

i. The *occipital region*, including the whole posterior portion of the skull; it contains the occipital condyles and foramen and is produced at the sides into the large and prominent paroccipital processes.

ii. The *cranial roof*, continuous behind with the occipital region.

iii. The *base of the skull*, also continuous behind with the occipital region; posteriorly it is raised into a prominent squarish elevation, the *basitemporal platform*; anteriorly it is continued into a more or less cylindrical rod of bone, the *rostrum*, which forms the axis of the beak.

iv. The *lateral surface of the cranium*, presenting three well-marked depressions—the *orbit* in front; the *temporal fossa* immediately behind the orbit and separated from it by a downward projection of the skull-roof, the *postorbital process*; and the *tympanic cavity*, bounded above and separated from the temporal fossa by an outstanding mass of bone, the *squamosal prominence*, and bounded behind by the paroccipital process.

v. The *ethmoidal region*, lying anterior to the orbits, enclosing the olfactory chambers, and produced forwards into a median vertical partition, the *mesethmoid*, ankylosed below with the rostrum.

vi. The *cranial cavity*.

i. *The occipital region.* (Plate LVIII. fig. 9; Plate LIX. fig. 14; Plate LXII. figs. 47–58.)

The *occipital condyle* (*oc. con.*) is distinguished by its more or less pedunculate character; its dorsal surface is usually somewhat flattened, and its hemispherical posterior face often presents a well-marked dimple-like depression indicating the position of the notochord. Its median portion is formed by the basioccipital, its lateral portions by the exoccipitals (fig. 14); the latter bones converge from below upwards, so that a very narrow strip of the dorsal surface of the condyle is furnished by the basioccipital (fig. 15).

The *occipital foramen* varies in form from subcircular to squarish; in *Dinornis* the plane of the foramen is nearly at right angles to that of the basitemporal platform, while in the other genera it is distinctly inclined backwards; in the former case the occipital condyle projects beyond the dorsal margin of the foramen, a unique peculiarity pointed out by Owen. In some instances the condyle projects beyond the level of the paroccipital processes, but as a rule the reverse is the case.

Immediately above the occipital foramen is a median vertical ridge (fig. 9), the *occipital crest* (*oc.cr.*; median vertical ridge, Owen), which is connected ventrally with another ridge lying immediately above the foramen, at first close to its dorsal border and afterwards diverging laterad and becoming lost on the paroccipital process. I propose to call this the *supraforaminal ridge* (*sup.for.r.*; lower transverse supra-occipital ridge, Owen); it is well developed in all the species, while the crest, although usually well marked, is often obscure and sometimes absent in *Dinornis*.

The occipital crest passes anteriorly into a transverse ridge which extends laterally on each side to the base of the paroccipital process; the median portion of this *lambdoidal ridge* (*lamb.r.*; transverse occipital ridge, Owen) is frequently double (figs. 1, 9, & 12), a transversely elongated lozenge-shaped area being enclosed between its two divisions; we may thus distinguish an *anterior lambdoidal ridge* (*ant.lamb.r.*), which is dentated and serves as the chief line of insertion of the neck-muscles, from a *posterior lambdoidal ridge* (*post.lamb.r.*). The distinction between the two varies greatly in different species, being best marked in *Anomalopteryx*, and hardly distinguishable in *Dinornis* (Plate LXI. figs. 25–34). On each side of the occipital crest, close to its junction with the posterior lambdoidal ridge, is a more or less well-marked depression, the *supraoccipital fossa* (fig. 9, *s.oc.fos.*).

The precise relation of the lambdoidal suture to the ridges of the same name is difficult to make out, as the ridges are obscure in young specimens, but it appears to be a little in front of the posterior ridge.

The paroccipital processes (*par.oc.pr.*) are large and prominent; in *Dinornis* they are comparatively flat, and their ventral edges are evenly curved and not greatly produced downwards (Plate LXII. fig. 47); in *Mesopteryx casuarina* (fig. 51) they are very convex backwards, and their ventral borders are produced into bluntly pointed processes which extend downwards to the level of the mamillar tuberosities. Other species show intermediate conditions (figs. 47–58). In *Emeus* the supraforaminal ridge stops short at the base of the paroccipital process; in most other species it is continued on to its lower angle.

Externally to the supraoccipital fossa there is frequently a foramen, usually continued into a groove, for one of the cerebral veins. The line of junction between the supra- and exoccipitals is probably situated mesiad of this foramen, but I have not seen a skull in which those two bones are distinct; the paroccipital process is no doubt constituted entirely by the exoccipital.

ii. *The cranial roof.* (Plate LVI. fig. 1; Plate LVII. fig. 5; Plate LVIII. fig. 12; Plate LIX. fig. 17; Plate LX. fig. 20; Plate LXI. figs. 23–34.)

The roof of the cranium is formed mainly by the parietals (*pa.*) and frontals (*fr*), the coronal suture passing transversely about halfway between the posterior lambdoidal ridge and a line drawn between the posterior margins of the postorbital processes (figs. 5 & 12). It is usually evenly arched both from before backwards and from side to side. The lateral curvature is least in *Dinornis* (fig. 47), in which also, taking the basitemporal platform as horizontal, the anterior or frontal region is considerably deflected (fig. 35). In *Mesopteryx casuarina* (fig. 27), *Mesopteryx*, species α (fig. 30), and *Emeus*, species γ (fig. 34), the roof is swollen on each side of the middle line, producing a double tumidity; in the other species of *Emeus* (figs. 38, 42, & 46) there are slight unpaired elevations in the anterior and posterior frontal regions, the intervening portion being flat or depressed. The roof is continuous behind with the occipital region and with its squamosal prominences, narrowed between the temporal fossæ, and immediately in front of these produced into the large *postorbital processes* (*post.orb.pr.*), which pass outwards and downwards, forming the posterior boundary of the orbit and almost meeting the maxillo-jugal arch (figs. 3 & 7). In most cases the postorbital process forms an even curve; in *Dinornis* and *Pachyornis* it is divisible into horizontal and descending portions, the former gently inclined downwards, the latter vertical.

Anteriorly the postorbital process passes into the *supraorbital ledge*, which is itself continued into a short *preorbital process* (*pre.orb.pr.*) formed by a part of the ankylosed lacrymal (figs. 5, 7, & 8). The margin of the orbit thus constituted exhibits certain well-marked differences in the various genera and species. In most cases the whole orbital margin is evenly curved or slightly sinuous; in *Dinornis* the supraorbital ledge is at right angles to the postorbital process (figs. 23 & 35); in *Anomalopteryx* the *postorbital angle* thus formed is slightly obtuse (fig. 36). The doubtful crania referred to *Mesopteryx*, species γ (figs. 30 & 44), and *Emeus*, species γ (figs. 34 & 40), differ from the other species of the genera in which I have provisionally placed them in possessing a distinctly right-angled orbit.

The anterior part of the cranial roof, between the preorbital processes, is formed partly by the frontals, partly by the nasals. The junction between the two bones is well shown in the young skull of *Anomalopteryx didiformis* (figs. 12 & 17), in which, the nasals being lost, each frontal is seen to present a deep triangular notch for the lateral portion of the corresponding nasal, while between the notches the frontals end in a straight transverse border, with which both the mesial portions of the nasals and the nasal process of the premaxilla articulate.

The nasals are in contact by their ventral surfaces with the ethmoid, exposed by their removal in figs. 12 & 17, and unite with one another in the middle line beneath the premaxilla, for the reception of which the mesial portion of the conjoined bones is excavated in the form of a shallow, parallel-sided groove, the *premaxillary fossa* (figs. 23 & 34). Thus the mesial portion of the nasals is hidden in the entire skull, and the roof of the olfactory chamber is formed in this region of a triple layer of bone—premaxilla externally, ethmoid internally, and nasals between. Laterad of the premaxillary fossa the nasal appears on the surface as a triangular bone the curved base of which forms the posterior boundary of the nostril (figs. 5, 7, & 8), its external angle being produced, in a young specimen of *Anomalopteryx didiformis*, into a short maxillary process. In *Dinornis torosus* this process is continued as a slender bar of bone which passes vertically downwards, in close contact with the anterior border of the lacrymal (preorbital process), completing the lacrymal foramen externally, and articulating by its lower or distal end with the maxilla. In *Emeus*, species α, and *E. crassus* this process is represented by a distinct ossification which I propose to call the *maxillo-nasal* (figs. 7 & 8, *mx.na.*). I have been unable to ascertain the precise condition of these parts in the other genera, but I am inclined to think there is a distinct maxillo-nasal in *Anomalopteryx*, while in *Pachyornis* there appears to be a maxillary process as in *Dinornis.*

In the skull referred to *Mesopteryx*, species β, the anterior portion of the skull-roof is marked with numerous shallow pits arranged more or less regularly in lines radiating backwards and slightly outwards from the edges of the premaxillary fossa (Plate LX. fig. 20). They appear to indicate the presence of a crest of specially strong feathers, which must have consisted in the present case of paired tufts, since the pits are absent in the middle line. In the type specimen of *Dinornis torosus*, and in the specimen of *D. robustus* (*D. potens*, Hutton) in York Museum, similar pits occur, extending across the middle line and on to the preorbital processes. Similar but less distinct pits occur in two skulls of *Anomalopteryx didiformis.* Since in the two last-named species the pits are absent in certain skulls, it seems probable that the crest was possessed only by the male.

iii. *The base of the skull.* (Plate LVI. fig. 2; Plate LVII. fig. 6; Plate LX. figs. 19, 21, & 22.)

The *basitemporal platform* (*b.temp.pl.*) is a prominent flattened elevation on the base of the skull, having a nearly vertical posterior face separated by a deep groove, the *precondylar fossa* (fig. 2, *pr.con.fos.*), from the occipital condyle; in the fossa two pits, probably venous, occur in *Dinornis*. The middle region of the posterior edge of the platform is usually somewhat excavated, the excavation being bounded on either side by a larger or smaller prominence, the *mamillar tuberosity* (Owen: basioccipital process, Lydekker, *mam.tub.*), which forms the postero-lateral angle of the platform. Owen considers these tuberosities to occur at the junction of the basisphenoid and basioccipital, but the examination of a young skull shows them to lie at the junction of the basioccipital, exoccipital, and pro-otic (figs. 6, 7, & 14). About the posterior third of the platform is formed by the basioccipital, the rest by the basitemporal underlying the basisphenoid; whether the basitemporal extends so far back as I have shown it in fig. 6 is uncertain.

Each mamillar tuberosity is separated from the corresponding paroccipital process by a deep *paroccipital notch*, immediately behind which occur one large and several small foramina. The larger of these is the *vagus foramen* (precondyloid foramen, vagal foramen, Owen, *vag.for.*) for the ninth and tenth nerves; the smaller holes or *condyloid foramina* (*con.for.*) give exit to the twelfth nerve. The notch between the paroccipital process and the mamillar tuberosity is sometimes converted into a foramen by a slender bar of bone bridging it over. Immediately in front of it is the *carotid foramen* (fig. 6, *car.for.*), leading into the canal by which the carotid artery passes to the pituitary fossa. In young skulls the greater part of the carotid canal is an open groove.

The antero-lateral angles of the basitemporal platform are formed by a pair of broad projections, flattened from above downwards, the *basipterygoid processes* (*b.pt.pr.*); they articulate by their distal ends with the pterygoid bones. Between the basipterygoid process and the mamillar tuberosity, the lateral border of the platform is obliquely furrowed by a deep groove for the Eustachian tube (figs. 2 & 6, *eus.gr.*). The edges of the groove are often produced into roughened ridges, but these never meet below so as to convert the groove into a tube; in this respect the adult Moa resembles the Kiwi at the time of hatching.

In the centre of the basitemporal platform and between the inner ends of the Eustachian grooves is usually to be found a more or less well-marked depression of variable form—sometimes short and wide, sometimes long and narrow. At its posterior end there frequently occurs a deep fossa, which in one young specimen was represented by a foramen opening into the cranial cavity a short distance posterior to the pituitary fossa. The aperture (fig. 6) is the *posterior basicranial fontanelle* (median venous foramen, basisphenoidal mid-ventral canal, Owen, *p.b.cr.fon.*), marking the incomplete concrescence of the parachordal cartilages of the embryo (24); the depression apparently marks the incomplete extension mesiad of the basitemporal.

Another interesting embryonic character is the occasional presence of a small pit or foramen situated in the middle line at the junction of the rostrum with the basitemporal platform, and at the level of the anterior borders of the basipterygoid processes; when patent it leads into the pituitary fossa. This is a remnant of the *anterior basicranial fontanelle* (*a.b.cr.fon.*) through which the pituitary pedicle passes from the pharynx to the cranial cavity. Its retention in the adult is somewhat remarkable, as in Apteryx (24) it is completely covered by the rostrum, and only visible when, in the young skull, the latter is stripped from the underlying cartilage.

The rostrum as seen from below has the appearance of a more or less cylindrical rod of bone; actually it is doubtless crescentic in section, as in other birds. It is frequently slightly constricted towards its junction with the basitemporal platform, its middle region is often much compressed and keel-like, and its anterior end is pointed. It will be further considered in connection with the ethmoidal region, but one remark must be made here as to its position. It usually lies nearly or quite in the same horizontal plane as the basitemporal; but in *Dinornis* the two are set at an obtuse angle (about 150°) with one another, thus giving rise to the deflected beak characteristic of that genus.

iv. *The lateral surface of the cranium.* (Plate LVI. fig. 3; Plate LVII. fig. 7; Plate LVIII. fig. 13; Plate LIX. fig. 18; Plate LXI. figs. 35–46).

The *tympanic cavity* is a deep depression bounded behind by the paroccipital process, above by the squamosal prominence, and mesially by a greatly pitted surface furnished by the exoccipital and pro-otic bones. It is continued downwards and forwards into a sort of pocket, the *anterior tympanic recess*, bounded in front by a thin, oblique, quarter-cylinder of bone, the *pretemporal wing* (figs. 6 & 13, *pr.temp.w.*). A young skull shows this process to be part of the combined basisphenoid and basitemporal; probably, as in other birds, it is formed by the latter. In some cases the anterior tympanic recess becomes largely filled up with spongy bone and thus reduced to a quite insignificant cavity; it is best marked in young skulls of *Anomalopteryx didiformis*, but is also large and conspicuous in *Mesopteryx casuarina* and some other species.

The *squamosal prominence* (*sq.prm.*) is a thick outstanding mass, convex above, deeply concave below, and formed by the squamosal bone (mastoid, Owen), which articulates mesially with the parietal, exoccipital, alisphenoid, and pro-otic. It is produced downwards into the *zygomatic process* (mastoid process, Owen, *zyg.pr.*), which, in the entire skull, lies immediately external to the quadrate, is directed slightly forwards, and is sometimes bifid (fig. 3); it varies considerably in length. It is continued upwards on to the lateral surface of the squamosal by a slightly wavy, subvertical *posterior temporal ridge* (*post.temp.r.*), the dorsal end of which joins the inferior temporal ridge described below (figs. 3 and 13).

The margin of the tympanic cavity varies in form: in *Dinornis* (fig. 35) its dorsal edge, furnished by the squamosal, forms an even curve with its posterior edge, furnished by the paroccipital process, the latter being directed slightly backwards. In *Emeus* (figs. 38, 42, and 46) the two form a slightly acute angle, the paroccipital process being directed forwards; in *E. crassus* there is often a kind of step at the junction of the two, the margin of the cavity being therefore sinuous. In *Anomalopteryx* (fig. 36) the paroccipital is still more sharply inclined forwards, the dorsal and posterior edges of the tympanic cavity meeting at a very acute angle, and the width of the cavity from before backwards being greatly reduced.

On the roof of the tympanic cavity is the large obliquely-transverse articular facet for the head of the quadrate; its outer end is immediately mesiad of the posterior temporal fossa described below, and is bounded behind by the zygomatic process; from this point it passes inwards and backwards, its inner end being exactly opposite the Eustachian groove. According to my observations the inclination of the quadrate facet (see Lydekker, 12, p. 298) is a point of no classificatory value; a straight line drawn through the axis of the facet makes an angle with the sagittal plane, which rarely sinks below 130° or rises above 140°, and which is, moreover, very variable, sometimes differing considerably on the two sides of the same skull. The outer two-thirds of the facet is furnished by the squamosal, the inner third in about equal proportions by the exoccipital and pro-otic (Plate LXII. fig. 70).

The zygomatic process is, as it were, bent round the quadrate facet so as to bound its outer end posteriorly as well as externally, and its flattened posterior face is continued backwards into a horizontal *tympanic ledge* (fig. 2), the inner border of which gives attachment to the tympanic membrane, while externally it is produced into a rough horizontal *supratympanic ridge*.

Immediately posterior to the quadrate facet is a large pneumatic foramen leading into the diploë of the pro-otic and squamosal. Mesiad of the inner end of the facet are usually three more or less well-marked depressions in the roof of the tympanic cavity; of these, the one nearest to the quadrate facet is a pneumatic foramen; the hindermost of the other two is a simple depression in the bone, while the foremost is the *fenestral recess*, containing the fenestra ovalis and fenestra rotunda. Just anterior to the recess, and separated from it by a vertical bar of bone, is the small aperture for the facial nerve, immediately dorsad of which is a large pneumatic pit. There is another small but deep pneumatic foramen encroaching on the anterior border of the quadrate facet, and the whole wall of the tympanic cavity is honeycombed with less constant depressions of various sizes.

The *temporal fossa* is a deep depression between the postorbital process in front and the squamosal prominence behind. It is limited above by a strongly marked temporal ridge (linea semicircularis, *temp.r.*) which marks the origin of the temporal muscle; the ridge forms an even curve, passing from the posterior edge of the post-orbital process, at first backwards and upwards, and then curving round and passing downwards and forwards (figs. 3 and 13), so that the whole temporal fossa has a strong backward slope; at the base of the zygomatic process it joins the posterior temporal ridge already mentioned (p. 385), and finally ends in a short, blunt *pretympanic process*, situated immediately in advance of the outer end of the quadrate facet. The ventral portion of the posterior limb of the tympanic ridge, between its junction with the posterior tympanic ridge and its termination in the pretympanic process, is conveniently distinguished as the *inferior tympanic ridge* (*inf.tymp.r.*). Between the inferior and posterior ridges thus defined, a more or less triangular space is enclosed which serves for the origin of the second portion of the temporal muscle, and may be distinguished as the *posterior tympanic fossa* (*post.tymp.fos.*). Lastly, the main temporal fossa is imperfectly divided, in some species, by a vertical *mid-temporal ridge* (figs. 12 & 13, *m.temp.r.*) at about the junction of its anterior and middle thirds and just over the lateral portion of the coronal suture.

The temporal fossa varies considerably in width in the different species, being narrowest proportionally in *Mesopteryx casuarina*, widest in *Anomalopteryx didiformis*. But its most striking feature is the different degree of its extension on to the cranial roof; in most species the distance between the right and left ridges is but little less than the diameter of the cranium in the temporal region, while in *Anomalopteryx didiformis* it is hardly more than half that dimension. Moreover, there is usually a flat area between the temporal and lambdoidal ridges (see Plate LXI.); but in *Anomalopteryx didiformis* (fig. 24), *Dinornis*, species *α*, and *Pachyornis*, species *α* (fig. 26), in all of which the temporal fossa is unusually large, the two ridges are in contact. In *Pachyornis elephantopus*, in which there is a wide area between the two lambdoidal ridges, the anterior one often touches the temporal before uniting with the posterior ridge.

The portion of the dorsal region of the temporal fossa lying behind the mid-temporal ridge is formed, as already stated, by the parietal, the part in front of the ridge by the frontal (figs. 7 & 18); its ventral region is furnished by the alisphenoid, which, in the young, joins the parietal by a straight horizontal suture situated at about the level of the roof of the tympanic cavity. Below, the alisphenoid is separated from the basisphenoid, in the youngest cranium I have seen, by a gently curved suture (fig. 18) extending forwards and downwards from the trigeminal foramen.

The *trigeminal foramen* (foramen ovale, Owen, *trig.for.*), for the second and third divisions of the fifth nerve, is situated in the side-wall of the cranium below the temporal fossa, and in the same transverse plane as the posterior edge of the basipterygoid process (figs. 3 & 13); it is bounded above by the alisphenoid, below by the pretemporal wing. Sometimes it is partially or completely divided into two passages by a horizontal bar of bone; this duplication of the foramen seems to be constant in *Mesopteryx casuarina*. About 1 cm. below and in front of the trigeminal foramen is a small (*qu.* arterial?) foramen situated just above the base of the basipterygoid process as in *Apteryx*.

The *orbits* are smaller than in the majority of birds, and, as Owen pointed out, there can hardly be said to be an interorbital septum, owing to the backward extension of the olfactory chambers. There the *Dinornithidæ* show, to a less degree, the state of things which reaches its maximum among birds in *Apteryx*.

As already remarked, the upper margin of the orbit, formed by the supraorbital ledge, may be either evenly curved, sinuous, or right-angled. The roof of the cavity formed by the projecting ledge is almost horizontal from within outwards; its mesial wall slopes from the supraorbital ledge downwards and inwards to the optic and lacerate foramina, the slope being far steeper in the narrow-skulled genera than in the wide-skulled *Dinornis*.

Both roof and mesial wall of the orbit are pierced with vascular foramina, but the first feature of importance met with in this region of the skull is the optic foramen (*op.for.*). This lies in the postero-ventral region of the orbit, slightly in advance of the base of the rostrum. In *Emeus* it is a nearly circular aperture directed from the cranial cavity outwards, forwards, and upwards, and its lower margin is separated from that of its fellow of the opposite side by a distance of about 9 or 10 mm. In *Dinornis* it is proportionally smaller and oval in outline; its lower margin is formed by a thin obliquely horizontal shelf of the presphenoid, represented in the other genera by a mere ridge, and the distance between the two foramina is about 30 mm.

The greater part of the inner wall of the orbit is furnished by the orbital plate of the frontal (fig. 18), which, in the young skull, articulates below with the inferior aliethmoid (*inf.al.eth.*) and the orbitosphenoid (*or.sph.*); the suture passes about 2 mm. above the optic foramen, which is therefore bounded above by the orbito-sphenoid, below by the presphenoid.

Bounded above by the shelf or ridge forming the lower margin of the optic foramen, and below by the rostrum, is a depression, the *presphenoid fossa* (fig. 18, *pr.sph.*), very obvious in *Dinornis*, *Pachyornis*, *Anomalopteryx*, rather obscure in *Mesopteryx* and *Emeus*. The vertical plate of bone separating the fossæ of the right and left sides is very thin, and is the only indication of an interorbital septum, thus showing an interesting approximation to the typical avian structure of the presphenoid.

Immediately posterior to the optic foramen is the aperture called by Owen the prelacerate foramen or foramen rotundum, but more conveniently named the *lacerate fossa*, as it is not a simple foramen, but a pit including three perfectly distinct foramina. One of these (Plate LXII. fig. 76, v^1), placed postero-dorsally, is the opening of a tunnel-like excavation in the alisphenoid, and transmits the orbitonasal nerve. The second (iii), below and in front of the first, is bounded behind by the alisphenoid and in front by the basisphenoid, and transmits the oculomotor nerve. The third (vi & *a*), situated below and in front of the second, perforates the alisphenoid and probably transmits the internal ophthalmic artery; it has in its hinder margin the aperture of a canal through which the sixth nerve enters the orbit. The fourth nerve (iv) enters through a very small foramen placed just above that for the third nerve, and quite outside the lacerate fossa.

v. *The ethmoidal region.* (Plate LVI. figs. 3 & 4; Plate LVII. figs. 7 & 8; Plate LVIII. figs. 11–13; Plate LIX. figs. 16–18.)

The *mesethmoid* (figs. 16 & 18, *meseth.*) is a vertical plate of bone ankylosed in the adult by its whole ventral border to the rostrum, continuous behind with the presphenoid, and having its dorsal border sloping from behind forwards immediately beneath the nasal process of the premaxilla. It is perforated posteriorly by an irregular fenestra of very variable size (fig. 16), which, in the dried skull, places the two olfactory chambers in communication with one another.

The olfactory chambers thus connected form a spacious cavity lying beneath and in front of the anterior portion of the cranial roof and extending nearly as far back as the optic foramen. Postero-dorsally they are perforated, on each side of the middle line, by one or sometimes two rather irregular apertures which serve for the passage of the olfactory nerves. Their roof and side-walls are formed by the *lateral* or *ectoethmoids*, which are divisible into three principal parts. The first, or *superior aliethmoid* (figs. 17 & 18, *sup.al.eth.*) extends almost horizontally outwards on each side from about the posterior half of the dorsal border of the mesethmoid, underlying the nasals and the anterior part of the frontals (fig. 16) and forming the roof of the olfactory chambers. The second portion, or *inferior aliethmoid* (fig. 18, *inf.al.eth.*), is a concavo-convex plate forming the side-wall of the posterior part of the chamber, continuous behind with the pre- and orbitosphenoids, and in the young skull articulating by suture with the orbital plate of the frontal.

These two are the only parts of the ectoethmoid retained in the majority of Moa skulls, but in good specimens there is to be seen more or less of the third portion of the ectoethmoid known as the *antorbital plate* (prefrontal, Huxley), and corresponding with the dilated part of what I have called the fifth portion of the ectoethmoid in *Apteryx* (24). This consists of an upright plate of thin bone (figs. 3 & 7, *a.orb.*) placed somewhat obliquely in the front part of the orbit; its mesial border is continuous with the inferior aliethmoid, and its lateral border is ankylosed to the lacrymal. It is continued forwards (in *Emeus*, species α) beyond its ankylosis with the lacrymal by a thin scroll-like bone, the *alinasal* (figs. 3, 4, 7, & 8, *al.n.*), which nearly meets above with the superior aliethmoid and below with the triangular process described on page 390. The ossified posterior turbinal (figs. 6 & 8, *turb.*) is an ingrowth from the posterior end of the antorbital.

The lacrymal (figs. 7 & 8, *lac.*) is completely ankylosed with the lateral border of the antorbital, is deeply notched, or in *Anomalopteryx didiformis* perforated, for the lacrymal duct, and presents below an oblique facet for articulation with the maxilla. The maxillary process of the nasal, or maxillo-nasal of *Emeus*, lies immediately in front of and parallel with the lacrymal, converting the notch into a foramen (*lac.for.*).

In *Dinornis* the antorbital is a much stouter bone than in the other genera, and is, therefore, more frequently found intact. It is much narrower than in the remaining forms, owing to the great size of the supraorbital fenestra (see p. 390), and is sloped obliquely forwards from its lower edge; it is firmly ankylosed to the inferior aliethmoid as well as to the lacrymal. Its ventral border, instead of being thin and delicate, takes the form of a stout transverse ridge or bar of bone forming the posterior boundary of the aperture between the olfactory chamber and the posterior nasal passage. This *postchoanal bar*, as it may be called, is a very obvious structure when the skull is viewed from below (see Owen, 19, pl. 56, or Ext. Birds of N. Z. pl. 65. fig. 1, *g*), and constitutes a striking difference between *Dinornis* and the smaller genera.

A final ectoethmoidal structure, very characteristic of the whole family, is the *triangular process* (Plate LVI. figs. 2 & 4, *tri.pr.*), a horizontal plate springing by a broad base from the mesethmoid (fig. 18) and extending outwards at the level of the lacrymal foramen. It forms the anterior boundary of the aperture between the olfactory chamber and the posterior nasal passage, and its posterior border is connected by a horizontal ridge with the postchoanal bar. The bar, ridge, and triangular process are together called by Owen the girdle or cingulum olfactorium.

The antorbital plate is perforated dorsally by the *supraorbital fenestra.* This, in *Dinornis torosus*, is a single large aperture, more than 1 cm. in length, and continued dorsad into a shallow fossa on the underside of the lacrymal (preorbital process). Apparently the Harderian gland fitted into both the fossa and the fenestra, the orbito-nasal nerve passing through the anterior part of the latter in its passage from the orbit to the olfactory cavity. Above the posterior end of the dorsal margin of the fenestra is a small foramen also leading into the olfactory chamber.

In *Emeus*, species α (fig. 7), the supraorbital fenestra (*sup.orb.fen.*) is quite small and the Harderian pit (*Hard.fos.*) above it very deep; posterior to these is a foramen (*a*) leading into the olfactory chamber, and beneath it a fossa (*b*), sometimes perforated. In *Anomalopteryx didiformis* an intermediate arrangement is found; the supraorbital fenestra is of moderate size and is connected by a wide groove with a fossa in the posterodorsal region of the antorbital—this last answers to fossa *b* in *Emeus*, and to the posterior moiety of the single fenestra in *Dinornis*; above it is a small foramen answering to the similarly placed hole (*a*) in *Pachyornis* and *Dinornis*.

In good specimens a coiled *posterior turbinal* (fig. 6) is seen to spring from the inner surface of the posterior end of the antorbital.

vi. *The cranial cavity.* (Plate LVIII. figs. 10 & 11; Plate LIX. figs. 15 & 16.)

The cavity for the brain has the usual avian form; its length and breadth are nearly equal, the greatest breadth being in the temporal region. The entire cavity may be divided into the following regions:—

α. The metencephalic fossa for the medulla oblongata.

β. The cerebellar or epencephalic fossa for the cerebellum.

γ. The mesencephalic fossæ for the optic lobes.

δ. The pituitary fossa and the optic platform for the pituitary body and the optic chiasma.

ε. The cerebral or prosencephalic fossæ for the cerebral hemispheres.

ζ. The olfactory or rhinencephalic fossæ for the olfactory lobes.

The *metencephalic fossa* is furnished by the post-pituitary part of the basis cranii; it is gently concave both from before backwards and from side to side, and is terminated in front by the dorsum sellæ, while behind it is continued on to the flattened dorsal surface of the occipital condyle. Near its posterior end is seen on each side the large vagus foramen (*va.for.*) and mesiocaudad of this the two small condyloid foramina (*con. for.*).

In front of the vagus foramen and separated from it by a vertical bar of bone about 2 mm. wide is the *internal auditory meatus* (fig. 16, *int.aud.m.*), a shallow pit containing the foramina for the facial and auditory nerves. The minute *abducent foramen* for the sixth nerve lies on a line joining the internal auditory meatus with the middle of the dorsum sellæ (fig. 15, *abd.for.*), and about 5 or 6 mm. from the latter. Between the abducent foramina a median aperture of considerable size is sometimes found, in one instance communicating with the pituitary fossa; this is the internal opening of the posterior basicranial fontanelle.

The *cerebellar fossa* (fig. 11, *cer.fos.*) is in the roof of the cranium and is bounded mainly by the supraoccipital and parietals above and by the pro-otics laterally. It is bounded behind by the dorsal edge of the occipital foramen, and in front by the median portion of the tentorial ridge, while ventrally it passes insensibly on each side into the metencephalic fossa. It is marked by a series of transverse grooves corresponding with the gyri of the cerebellum. On each side, about 3 or 4 mm. above the internal auditory meatus, is the small *floccular fossa*, which varies considerably in size in different individuals.

The *mesencephalic fossa* (*mesen.fos.*) lies in the alisphenoid, laterad of the dorsum sellæ (fig. 10) and is bounded externally by the ventral portion of the tentorial ridge. It is largely occupied by a shallow depression for the root of the trigeminal nerve, and from this depression the trigeminal foramen proceeds directly outwards (fig. 16, *trig.for.*), and the tunnel-like orbitonasal foramen (*orb.na.for.*) forwards and slightly outwards to the lacerate fossa (*vide suprà*, p. 388).

The *pituitary fossa* or sella turcica (*pit.fos.*) is an almost spherical depression in the middle of the cranial floor. It is bounded behind by a ridge, the dorsum sellæ, which curves forwards on each side and ends at the small oculomotor foramen (*oc.for.*). In front the pituitary fossa is bounded by a transverse *prepituitary ridge* (fig. 16, *pr.pit.r.*), anterior to which is a wide ledge, the *optic platform*, terminating on either side in the optic foramen (*op.for.*). Almost vertically above the prepituitary ridge is a similar transverse prominence, the *preoptic ridge* (fig. 16, *pr.op.r.*), forming the upper boundary of the optic platform and passing laterad into the tentorial ridge.

The optic foramen is bounded behind by a vertical bar of bone separating it from the apertures for the third nerve and the internal ophthalmic artery (fig. 16). The oculomotor foramen (*oc.for.*), which is the uppermost of the two, is continued backwards by a groove placed sometimes just above, sometimes just below the continuation of the dorsum sellæ: the internal ophthalmic foramen (*int.op.for.*) is also continued by a groove which extends downwards and backwards to the entrance of the internal carotid artery (*car.for.*). The internal opening of the minute pathetic foramen (*path. for.*) is placed about 1 mm. dorso-laterad of the oculomotor. The internal carotid canals (*car.for.*) open by paired apertures placed close together in the posterior wall of the pituitary fossa. And lastly, in occasional instances, the fossa is perforated anteriorly by the anterior basicranial fontanelle.

The *cerebral fossæ* lie altogether in front of the cerebellar fossa, there being no overlapping of the cerebellum by the hemispheres such as occurs in *Apteryx*. They are separated from the cerebellar fossa by the prominent tentorial ridge, which, starting in the centre of the skull-roof, almost exactly above the dorsum sellæ, sweeps at first backwards, outwards, and downwards, and then forwards, downwards, and slightly inwards, and finely comes to an end near the extremity of the preoptic ridge. From the middle of the tentorial ridge a somewhat less prominent median elevation, the bony falx, passes forwards and ends just over the crista galli, marking the separation of the hemispheres dorsally.

The line of separation between the hemispheres on the ventral surface is similarly indicated by a low median ridge which extends from the crista galli backwards to the preoptic ridge. For a distance of about 5 mm. (in *Emeus*) on each side of this ridge the cerebral fossæ are floored by the presphenoid (fig. 15, *pr.sph.*); from it the orbito-sphenoids (*or.sph.*) extend outwards and backwards, forming the dorsal boundaries of the optic foramina. The resemblance of this portion of the Moa's skull to that of an embryo Kiwi is very striking; in the adult *Apteryx* the presphenoid undergoes a remarkable shortening.

The anterior moiety of the roof and side-walls of the cerebral fossa is furnished by the frontal, the posterior portion by the parietal and alisphenoid. A low horizontal ridge running a short distance above the parieto-alisphenoid suture indicates the presence of a similarly-placed sulcus on the cerebrum.

The *olfactory fossæ* are paired oval pits placed vertically at the anterior end of the cerebral fossæ. They are separated from one another by a narrow bony ridge, the *crista galli*, and the floor of each is perforated by a variable number of somewhat irregular apertures for the branches of the olfactory nerve.

b. *The Premaxilla.*

The premaxilla is a triradiate bone which may be described in general terms as consisting of a thickened *body* which forms the end of the beak, a median dorsal *nasal process*, paired ventro-lateral *maxillary processes*, and thin ventral *palatine processes* connected in front with the body and externally with the maxillary processes.

The anterior extremity of the body, forming the apex of the beak, is rounded in *Dinornis* and *Emeus*, bluntly pointed in *Pachyornis*, *Mesopteryx*, and *Anomalopteryx*.

Its gently curved alveolar margins are marked, especially in *Dinornis*, with a broad, shallow groove, and are continued horizontally inwards into a flattened ventral plate; from this is given off a strong ascending keel, formed posteriorly of paired plates, but solid in front and gradually diminishing in height towards the tip of the beak. The dorsal edge of the triangular vertical keel thus produced is expanded to form a prominent median ridge passing behind into the nasal process and in front continued more or less distinctly to the apex of the beak; this ridge is best developed in *Dinornis*, in *Emeus* it is almost obsolete. The portion of the vertical keel included between the ridge above and the ventral plate below has a triangular form, and is, as already stated, bilaminar posteriorly; it constitutes the *prenarial septum* (Owen), and is especially well-marked in *Dinornis;* the extremity of the ankylosed rostrum and mesethmoid fits between its laminæ.

From the ventral plate of the body the thin, horizontal, palatine processes pass backwards, diverging slightly so as to enclose a median palatine notch, through which in the perfect skull (figs. 2 & 6) the anterior end of the vomer and rostrum are seen. In *Emeus* the posterior end of the inner margin of the palatine plate gives off a somewhat pedate *vomerine process* (*vo.pr.*) which passes inwards and clamps the vomer; this process is small or absent in the other genera. The proportional length of the palatine process and of the body of the premaxilla differs greatly in the various genera.

From the posterior end of the alveolar margin of the body is given off the irregular horizontally-flattened maxillary process, which extends backwards (figs. 3 & 7, *mx.pr.*) dorsad of and in close contact with the anterior end of the maxilla, and ends close to the base of the maxillo-palatine and immediately below the ventral end of the maxillo-nasal.

The nasal process is a flat plate extending backwards and upwards from the body to the fronto-nasal suture, its posterior end lying, as already stated, in a shallow, parallel-sided groove, the premaxillary fossa, furnished by the mesial portion of the nasals. Its anterior or proximal end, where it joins the body of the bone, is slightly thickened in *Dinornis*, considerably thickened and somewhat triangular in section in *Anomalopteryx*, *Pachyornis*, and *Mesopteryx*, greatly thickened and almost cylindrical in *Emeus*.

c. *The Maxillo-jugal Arch.*

This consists of the usual three bones, the maxilla, jugal, and quadrato-jugal.

The *maxilla* consists of two parts, a slender external and posterior portion, the maxilla proper, and an irregular expanded antero-mesial portion, the *maxillo-palatine process* (Plate LVII. figs. 6, 7, & 8, *max.pal.*; Plate LXII. figs. 63 & 64). The maxilla proper is a slender rod presenting a flat ventral surface, an oblique lateral surface, a very narrow, smooth mesial surface, and a dorsal surface, to the whole length of which the jugal is applied.

The maxillo-palatine, in *Dinornis*, *Pachyornis*, *Mesopteryx*, and *Anomalopteryx*, is a very irregular shell of thin bone, with a spacious cavity, the *antrum*, opening posteriorly by an aperture placed in the angle between the maxilla and the palatine (fig. 63). Its ventral surface forms a nearly flat plate, roughly triangular in form; its lateral border and postero-lateral angle pass insensibly into the maxilla proper; its postero-mesial angle is produced into a short recurrent process which articulates with the palatine; the hinder half of its medial border also articulates with the palatine, and its anterior angle and the fore half of its mesial border with the premaxilla. From this flat ventral plate an irregular hollow mass of bone extends dorsad and fits into a space left between the other facial bones at the base of the beak. Its anterior surface appears in the ventro-lateral corner of the external nostril (figs. 7 & 8), articulating with the palatine process of the premaxilla below, with the rostrum mesiad, and with the maxillary processes of the premaxilla and nasal externally. Its dorsal region articulates with the anterior border of the triangular process of the mesethmoid (fig. 8). Its posterior surface, which is smooth and concave, forms part of the anterior wall of the posterior nasal aperture.

In *Emeus* the structure of the maxillo-palatine is strikingly different; its ascending portion, instead of being a hollow shell, is an irregular flattened plate (fig. 64), either quite solid or presenting a mere vestige of the antrum in the form of a very small pit on the posterior surface. By this peculiarity *Emeus* is sharply distinguished—at least so far as my enquiries go—from the remaining Dinornithidæ

The *jugal* is a slender bone forming the greater part of the dorsal surface of the maxillo-jugal arch (figs. 6 & 7). It articulates by about the anterior half of its ventral surface with the maxilla, by the posterior half with the quadrato-jugal. Near its posterior end the dorsal edge of the bone is raised into a low triangular process which extends upwards towards the postorbital process of the frontal.

The *quadrato-jugal* (figs. 6 & 7) articulates by more than the anterior half of its outer surface with the jugal and maxilla; thus the whole length of the bone is exposed on the mesial side of the maxillo-jugal arch, while less than half appears on the lateral surface. In the greater part of its extent it is flattened from side to side, but posteriorly it is much thickened and presents on its inner surface an oval facet for articulation with the quadrate.

d. *The Vomer, Palatine, and Pterygoid.*

The vomer in fully adult specimens of *Emeus*, species *a*, and *E. crassus* is a delicate bone (figs. 2 & 6, *vo.*) formed of paired laminæ united in front but diverging behind, and enclosing an acute dihedral angle. In its whole length it embraces the rostrum; nteriorly it passes dorsad of the vomerine processes of the premaxilla and articulates with the maxillo-palatines; posteriorly each lamina turns outwards and fits into a groove between the palatine and pterygoid, its lateral border articulating with the mesial border of the palatine, and its posterior extremity being covered ventrally by the vomerine process (*vo.pr.*) of that bone.

In *Mesopteryx*, species β (Plate LX. fig. 21) there are distinct paired vomers; a similar condition appears to obtain in *Anomalopteryx* and in young skulls of *Emeus crassus*. Owen's figure of *Dinornis torosus* (20, pl. 15; Ext. Birds of N. Z. pl. 82) also shows paired vomers; probably their concrescence is a sign of age.

The *palatine* is a delicate, twisted plate of bone, passing from the anterior end of the maxilla in front to the pterygoid behind (fig. 6). Its anterior end is somewhat fan-shaped and underlaps the maxillo-palatine; immediately posterior to this expanded portion it is notched for articulation with the recurrent process of the maxilla. The whole bone is twisted, the inner border of its anterior end becoming ventral in the middle and finally external at the posterior end; at the same time the dorsal border turns mesiad, reaching to within a short distance of the rostrum. The posterior end is obliquely truncated and articulated by all but its ventral extremity with the vomer, becoming ankylosed with it in the adult. The ventral extremity of the posterior border is produced into a thickened squarish *vomerine process* (*vo.pr.*) which underlies the posterior end of the vomer, and laterad of this process the bone presents a short pointed end which underlies the pterygoid.

The *pterygoid* (*pt.*) is a stout irregular bone with a bluntly-pointed anterior and a thickened posterior end. By about the anterior half of its ventral border it articulates with the combined palatine and vomer; by its inner surface it articulates with the basipterygoid process; its outer surface lies parallel to and in close contact with the orbital process of the quadrate; and its posterior end expands into a somewhat pedate surface for articulation with the quadrate.

e. *The Quadrate.*

The quadrate consists, as usual, of a *body* bearing the condyle for articulation with the mandible, an upwardly-directed *otic process*, terminating in the *head* for articulation with the tympanic cavity, and a forwardly-directed *orbital process*.

The articular surface on the head is somewhat wider at its outer than at its inner end, and presents no trace of the double facet found in *Apteryx*. The otic process is subtrihedral, presenting a *lateral border* running upwards from the quadrato-jugal facet, a *mesial border* from the outer condyle, and an *anterior border* from the orbital process; a *posterior surface* between the mesial and lateral borders, a *mesial surface* between the anterior and mesial borders, and a *lateral surface* between the anterior and lateral borders. On the mesial surface, just where the otic process merges into the body of the bone, is a pneumatic foramen which varies greatly in size in the different species and even in different individuals of the same species; speaking generally, it appears to be large in *Dinornis*, *Anomalopteryx*, and *Pachyornis* as well as in *Mesopteryx*, species β; smaller in *Emeus*, and smallest of all in *Mesopteryx casuarina*. In *Anomalopteryx didiformis* there is sometimes a second pneumatic foramen on the posterior surface of the bone at a slightly lower level than the mesial one, and in one specimen of *Dinornis robustus* there are two additional foramina on the posterior surface, one at the level of the mesial aperture, the other close to the head. On the whole the characters of the quadrate appear to be too variable to be of much use for systematic purposes.

The orbital process is laterally compressed and bluntly pointed. On its mesio-ventral border is a small facet (*pterapophysial facet*, Owen) for the pterygoid, and at the base of the same border and extending downwards on to the body of the bone is a larger facet with which the posterior end of the pterygoid articulates.

The ventral face of the body bears the usual two condyles for articulation with the mandible. The *inner condyle* is placed transversely and is separated by a narrow interspace from the *outer condyle*, which is set at an angle of about 45° with the sagittal plane. Immediately above the outer extremity of the external condyle is the deep hemispherical fossa for articulation with the quadrato-jugal.

f. *The Mandible.*

The lower jaw consists of two gently curved rami ankylosed with one another in front in a wide symphysis.

Each ramus is expanded at its posterior end to form a cup-like articular surface for the quadrate, the outer border of which projects but slightly beyond the level of the ramus, while internally it is much produced and ends in a triangular *internal angular process*. The surface for the outer condyle of the quadrate forms a long narrow facet running parallel with the outer and posterior edge of the cup: that for the inner condyle is an oval surface, deeply concave from within outwards, situated on the anterior margin of the cup, just mesiad of its junction with the ramus. At the base of the inner surface of the internal angular process is a nearly circular pneumatic foramen, which, however, is sometimes absent in *Emeus* and *Mesopteryx*. At the posterior end of the surface for the outer condyle the bone is produced into a *posterior angular process*, which is small in *Dinornis*, large and prominent in the other genera. Both internal and posterior angular processes are continued on to the ventral surface of the articular cup by ridges which meet each other below: they are especially prominent in *Emeus*.

The ventral edge of each ramus has a sigmoid curve in all genera but *Anomalopteryx*, being convex downwards in its posterior, concave in its anterior half, and the latter being more or less deflected. The curvature of the dorsal follows to some extent that of the ventral border, but is less regular. The deflection is most marked in *Dinornis*, in which, when the mandible is placed upside down on a horizontal surface, the tip of the beak is raised 35–45 mm. above the horizontal. In *Pachyornis*, *Mesopteryx*, and *Emeus* this distance does not exceed 10–15 mm., and in *Anomalopteryx* the jaw is nearly straight. The general plane of the ramus is vertical or nearly so in *Pachyornis*, *Anomalopteryx*, *Emeus*, and *Mesopteryx*; in *Dinornis* it is inclined, sloping outwards from its lower border. The anterior end of the dorsal edge presents a distinct alveolar groove, like that on the premaxilla; the posterior end is produced into a rough irregular *coronoid process* for the insertion of the temporal muscle.

The form of the symphysis naturally follows that of the premaxilla, being broad in *Dinornis* and *Emeus*, narrow in *Pachyornis*, *Mesopteryx*, and *Anomalopteryx*. The result of this is that the entire mandible is **U**-shaped in the two first-named genera, **V**-shaped in the others. The symphysis itself is almost horizontal, and shows considerable variation in its proportional length. Its ventral or outer surface is marked with a broad ridge, like that on the premaxilla, very well marked in *Dinornis*, less so in *Pachyornis*, *Mesopteryx*, and *Anomalopteryx*, and only just raised above the surface in *Emeus*.

On the inner surface of each ramus, 1–2 cm. in advance of the articular cup, is the *dental foramen* for the mandibular nerve; it perforates the bone, appearing externally at the hinder end of a deep groove along which the nerve runs, entering the ramus, between the two laminæ of the dentary, at its anterior end. Two small foramina lie in the groove, one near its lower border, the other towards the anterior end of its dorsal border; they perforate the bone and probably transmit nerves to the tissues on the inner surface of the jaw.

Another pair of foramina, apparently for the symphysial branches of the mandibular nerve, lie in the posterior edge of the symphysis, usually just in the re-entering angle between the rami. They generally lie side by side, occasionally one above another; in some cases they are united at their origin into a single foramen, and in one instance have moved forwards to near the anterior end of the symphysis.

Emeus has, of all genera, the stoutest and most coarsely built jaw, *Anomalopteryx* coming nearest to it in this respect. The mandible of *Dinornis*, in spite of its strong symphysis, has comparatively weak rami, but the most delicate lower jaw of all is that of *Mesopteryx casuarina*.

In young specimens the mandible readily divides into three parts: a symphysial portion, containing the ankylosed dentaries and the splenials, which latter are separate in still younger skulls; and the posterior portions of the two rami, each containing the articular, angular, supra-angular, and coronary (fig. 7). None of the specimens I have seen show the latter group of bones in the separate condition, but in a young mandible of *Anomalopteryx didiformis* the outlines of the angular and supra-angular can be traced where they overlap the articular. The splenial is well shown in a mandible of *Emeus crassus*; it extends from about the level of the dental foramen forwards to within 4 mm. of the symphysis. Lastly, in the type specimen of *Dinornis torosus*, in which the splenial is absent, the articular is continued forwards into a cylindrical tube of bone lying immediately mesiad of the dental foramen and evidently representing the superficially ossified proximal end of Meckel's cartilage.

g. *The Hyoid.*

In the skull of *Emeus*, species α, figured on Plate LVI., the posterior cornua of the hyoid—probably the only ossified parts—are present, as well as the larynx and anterior end of the trachea. They consist of gently curved rods of bone, 57 mm. long, 2 mm. in diameter, and expanded at both ends.

Mr. Booth, who found this skull, told Professor Hutton that he saw in the ear a delicate hair-like bone which he was unable to preserve; no doubt this was the columella auris.

4. A Comparison of the Skulls of the Dinornithidæ with those of the other Ratitæ.

The occipital region is usually less clearly marked off from the skull in the other Ratitæ, the lambdoidal ridge being comparatively faint: the fully adult *Apteryx australis* forms, however, an exception; in it the lambdoidal ridge is very strongly marked, and there is a distinct angulation between the roof and the hinder wall of the cranium. There is no indication of the anterior lambdoidal ridge, and although the median occipital region is swollen over the cerebellar fossa, the occipital crest is generally poorly developed or absent; it is most distinct in *Apteryx australis.* The supraforaminal ridge is obvious in all, and is continued to the angle of the paroccipital process; in *Apteryx* it is interrupted, just at the margin of the foramen magnum, by a notch. *Apteryx* is the only genus which resembles the Moas in its pedunculate occipital condyle, as also in the great breadth—in relation to height—of the entire occipital region. In having the plane of the occipital foramen vertical or nearly so the Dinornithidæ stand alone.

The roof of the cranium is more rounded in the other Ratitæ, and in all but *Apteryx* and *Casuarius* the parietal region slopes backwards instead of being nearly flat. As a consequence of this, the temporal fossa has a much stronger backward inclination in *Struthio, Rhea*, and *Dromæus*, and the postorbital process is nearly in the same transverse plane as the zygomatic instead of being well in advance of it. In this respect the Cassowary approaches very closely to the Moas.

Another very marked difference in the roof of the cranium is due to the relatively small size of the eyes in the Dinornithidæ. In the Ostrich, Emu, and Rhea, the width of the orbit from the postfrontal process to the lacrymal is about equal to the width of the cranium at the paroccipital processes; in *Casuarius galeatus* it is about four-fifths of the width, in the Moas not much more than half. Moreover, the interorbital region of the skull-roof in the Ostrich, Rhea, Emu, and Cassowary is narrow, while its preorbital region broadens out suddenly owing to the presence of large wing-like orbital processes to the lacrymals. In the Moas this projection is only represented by the comparatively small body of the lacrymal. In *Apteryx* there are no post or pre-orbital processes, and the skull-roof narrows gradually from the occipital to the nasal region. *Struthio* is peculiar in having a forwardly-directed process, given off from the supraorbital ridge, which meets the lacrymal, enclosing a notch or foramen.

The nasals of the Dinornithidæ differ from those of all the other Ratitæ in the junction with one another of their posterior ends above the ethmoid, so that none of the latter appears on the surface. In the Ostrich, Rhea, Emu, and Kiwi a lozenge-shaped area of the ethmoid appears between the bases of the nasals; in the Cassowary the same arrangement obtains in the young birds (25) at the time of hatching, but in the adult the actual condition of things is hidden by the development of the crest.

The maxillary process of the nasal is well developed in *Struthio* and *Apteryx*, extremely small and delicate in *Dromæus*, absent in *Rhea* and (?) *Casuarius*. It is somewhat remarkable that the absence or vestigial nature of this process should be given as a general character of the Ratitæ by Garrod (4) and Fürbringer (3).

On the base of the skull of the other Ratitæ the basitemporal platform is not raised beyond the general level of the skull-floor to anything like the same extent as in the Moas, and the precondylar fossa is therefore comparatively shallow. It is best defined in *Apteryx*, in which also the mamillar processes are even longer proportionally than in the Dinornithidæ, while in the other genera they are considerably less developed, being fairly prominent in *Casuarius*, small in *Dromæus* and *Struthio*, and obsolete in *Rhea*.

The paroccipital notch may or may not be bridged over by bone. The vagus foramen lies in the notch in *Apteryx*, *Dromæus*, and *Casuarius*, mesiad of it—as in the Moas—in *Struthio* and *Rhea*. In the Australian genera the ventral edges of the Eustachian tubes are prominent and sometimes meet, converting the groove into a canal. In the Ostrich, Rhea, and Kiwi there are actual tubes, the closure of the groove being more complete in the two first-named genera than in *Apteryx*.

Another variable point is the extent to which the carotid canal is closed by bone and the resulting position of its external aperture. In the Ostrich, as in the Moa, the carotid foramen lies in or slightly in front of the paroccipital notch; in the Emu and Cassowary it is on the lateral surface of the basitemporal platform, immediately caudad of the Eustachian groove and laterad of the mamillar tuberosity; in *Rhea* it is in a similar position, but slightly further forward; and in *Apteryx* it is altogether in front of the mamillar tuberosity and fully visible from below.

The basipterygoid processes are most dinornithic in *Apteryx* and *Dromæus*; in the other three genera they are proportionately longer and more slender. Between their bases the minute anterior basicranial fontanelle sometimes occurs in *Struthio*, *Rhea*, *Casuarius*, and *Dromæus*, but I have never seen any trace of it in the adult *Apteryx*. Amongst my specimens a young *Rhea* is the only one showing any sign of the posterior basicranial fontanelle.

The rostrum of the Ostrich is rounded below; that of all the other genera is keeled, except at the posterior end, the carination being most marked in *Apteryx*.

Apteryx is the only genus besides the Dinornithidæ which has a well-marked tympanic ledge; in all the others the cavity is bounded laterally only by the sharp-edged supratympanic ridge.

The quadrate facet on the roof of the tympanic cavity presents some interesting variations in the various genera (Plate LXII. figs. 65–70). In the Dinornithidæ, as we have seen, it is almost regularly oval, its inner third furnished by the pro-otic and exoccipital, its outer two-thirds by the squamosal (fig. 70). In *Struthio* (fig. 65), at about the middle of its anterior or mesial border, it is somewhat deeply notched; as all the specimens at my disposal were adults, the boundaries of the constituent bones could not be made out. A similar notch occurs in *Dromæus* (fig. 67) and *Casuarius* (fig. 68), and the facet is divisible into an inner or prootic-exoccipital and an outer or squamosal region; moreover, in the Cassowary the anterior edge of the external region of the facet is encroached upon by the alisphenoid, which thus takes its share in furnishing the articular surface. In *Rhea* (fig. 66) there is no notch, and the pro-otic portion of the facet appears in an adolescent skull as a wedge of bone near the posterior end of its anterior or mesial margin, and divided into a larger anterior and a smaller posterior portion; the posterior end of the facet is therefore formed mainly by the exoccipital: the alisphenoid enters into the facet as in *Casuarius*. Lastly, in *Apteryx* the facet (fig. 69) is distinctly divided into three portions—a mesial furnished partly by the pro-otic, partly by the exoccipital [1], a postero-lateral by the squamosal, and an antero-lateral by the alisphenoid.

The anterior tympanic recess is large in all genera but *Apteryx*. The Ostrich differs from the others in having a large (*qu.* venous?) foramen excavated in the postero-ventral region of the pretemporal wing immediately cephalad of the Eustachian groove.

The zygomatic process is more slender in the other Ratitæ than in the Moas, and is directed outwards as well as forwards and downwards. The squamosal prominence is always obscure, and there is never more than the merest trace of the posterior tympanic fossa and ridge. In the Emu there is a distinct facet on the inner surface of the distal end of the zygomatic process for articulation with the quadrate. In *Rhea* the squamosal sends off, posterior to the zygoma, a process which passes forwards and is nearly met by a similar process from the pretemporal wing, the two together forming an almost complete ring round the posterior projection of the head of the quadrate.

The temporal fossa and ridge are far less strongly marked in the Ostrich, Rhea, Emu, and Cassowary than in the Moas, and in none of them is there any trace of the mid-temporal ridge. In *Apteryx*, on the other hand, the temporal fossa is very wide from

[1] In my paper on *Apteryx* (24) I incorrectly described this facet as being furnished exclusively by the pro-otic, but a renewed examination of stage M shows a distinct suture passing vertically across it and dividing off a posterior part furnished by the truncated end of a bar-like process of the exoccipital just above the fenestral recess.

before backwards, reaching well in advance of the optic foramen; the temporal ridge is strong, and there is a mid-temporal ridge at about the junction of the middle and posterior thirds of the fossa.

The comparative size of the orbit constitutes, as already remarked, one of the most striking differences between the Moas and Kiwis and the other Ratitæ. In the latter the orbits are separated from one another by a median vertical plate of bone, the interorbital septum, represented in the Dinornithidæ only by the wall between the presphenoid fossæ and wholly absent in *Apteryx*. In an adolescent skull of *Rhea* the posterior third of the septum is formed by the presphenoid, the anterior two thirds by the mesethmoid. There is thus produced an almost straight mesial wall to the orbit, passing above and behind into the arched upper and posterior wall, which is formed above by the orbital plate of the frontal, below by the alisphenoid. In the Dinornithidæ, there is no clear distinction between the mesial and the postero-dorsal wall of the orbit, the two passing insensibly into one another; the anterior part of the mesial wall is formed by the inferior aliethmoid, owing to the backward extension of the olfactory capsules between the eyes, and the presphenoid is limited to a small area below the optic foramen. In *Apteryx* the last trace of the interorbital septum disappears, the swollen aliethmoids reaching back to the optic foramen.

The optic foramina are close together in all the more typical Ratitæ, being separated from one another in front by the edge of the interorbital septum, which is very thin in all but *Struthio*; the adjacent foramina show, however, considerable variations. In the Ostrich (fig. 71) the oculomotor foramen (iii & vi) lies immediately behind the optic and is continued into the interior of the skull by a groove, into the floor of which the canal for the sixth nerve opens, the oculomotor and abducent nerves having therefore a common entrance into the orbit. The internal ophthalmic artery apparently goes out separately by the foramen marked *a*. The small foramen for the fourth nerve (iv) lies just above that for the third, and the orbitonasal foramen (v^1) is an oblique passage just behind it. In a young specimen the foramina for the third, fourth, and sixth nerves are represented by an oblique cleft communicating with the optic foramen. The trigeminal foramen for the second and third divisions of the fifth nerve may be divided by a narrow vertical bony bar.

In *Rhea* (fig. 72) the oculomotor foramen (iii and vi) is immediately behind and below the optic, and the canal for the sixth opens just within its margin; below and in front of it is an equally large aperture (*a*), which probably transmits the internal ophthalmic artery. The oculomotor and pathetic nerves enter through very oblique foramina (iv, v^1) in the usual positions. In *Dromæus* (fig. 73) the sixth nerve (vi) has a special foramen below the oculomotor (iii). In *Casuarius* (fig. 74) the third nerve makes its exit through a notch (iii) in the posterior margin of the optic foramen, the sixth (vi) through a special foramen; a notch (*a*) in the ventral border of the optic foramen possibly transmits the internal ophthalmic artery. In *Apteryx* (fig. 75) there are distinct orbitonasal, oculomotor, and abducent foramina, but the fourth nerve goes out through the optic foramen. Thus all the Australasian genera agree in having a distinct foramen for the sixth nerve; the Moas are peculiar in having the oculomotor, orbitonasal, and abducent foramina sunk in a fossa (fig. 76).

In the structure of the ethmoid *Apteryx* stands at one end of the series, the Dinornithidæ in an intermediate position, and the remaining Ratitæ at the other end. In the Moas, as we have seen, the lateral ethmoid extends backwards almost to the optic foramen, its posterior part consisting of the gently sloping inferior aliethmoid, which is continued in front into the obliquely set antorbital. In *Apteryx* the place of both these portions is taken by the shell-like aliethmoid, which extends from the optic foramen to the lacrymal, bulging outwards in its whole extent and undergoing a special dilatation immediately caudad of the lacrymal. In the remaining Ratitæ the olfactory cavity is not continued backwards behind the antorbital, the latter springing directly from the mesethmoid and passing outwards and forwards to the lacrymal. In *Struthio* and *Rhea* only the mesial portion of the antorbital is ossified, so that in the dry skull a considerable space is left between its outer edge and the lacrymal. In *Dromæus* and *Casuarius* the ossification extends to the lacrymal, and the dorsal portion of the bone is hollowed by a deep pit for the lacrymal gland. In *Struthio*, *Rhea*, and *Casuarius* the descending process of the lacrymal bone is merely notched for the lacrymal duct; in *Dromæus* and *Apteryx* it is perforated.

The postchoanal bar formed by the ventral border of the antorbital is most distinct in the Ostrich and Emu. The mesethmoid is perforated posteriorly, so as to place the olfactory chambers in communication, in the Ostrich, Rhea, and Emu, but not in the Cassowary and Kiwi. In the possession of the triangular process of the mesethmoid the Moas stand alone.

Leaving *Apteryx* aside, the chief difference between the Dinornithidæ and the other Ratitæ as regards the cranial cavity is the greater size of the mesencephalic fossæ in the latter. The pituitary fossa of the Moas is most nearly approached by that of *Struthio*, in which the thickness of the presphenoid gives rise to a broad optic platform, poorly marked in all the other genera. The cerebral fossæ are more pointed anteriorly in the other genera and are continued forwards into deep conical olfactory fossæ; in this point also it is the Ostrich which approaches most nearly to the Moas; its hemispheres are blunter and its olfactory lobes shorter than in the American and Austro-Malayan forms.

Apteryx agrees with the Dinornithidæ in the small size of the mesencephalic fossæ, but is quite peculiar in the great proportional size of the cerebral and olfactory fossæ. The hemispheres extend backwards over the cerebellum, the cerebellar fossa being therefore pushed backwards and the tentorial ridge made almost horizontal. Owing to the great size of the olfactory fossæ, the crista galli is nearly as long as the basis cranii from the dorsum sellæ to the occipital condyle.

The premaxilla has the usual structure in all. In the Ostrich alone the palatine plates are quite vestigial [1]; in the other genera they extend backwards and articulate with the vomer: there is no vomerine process as in some of the Moas. In *Struthio*, *Rhea*, and *Dromæus* the body of the bone is very flat, but in *Casuarius* its median region is elevated into a strong arched keel, from which the nasal process proceeds, and there is a distinct prenarial septum. In *Apteryx* the form of the body is essentially similar: its height is equal to its breadth, and there is a short, thick prenarial septum. The unique form of the beak in this genus is due to the shortening of the body of the premaxilla and to the elongation of the region between the prenarial septum in front and the turbinals behind.

The maxilla shows a wide range of variation. In the Ostrich (Plate LXII. fig. 59) it is a flat bone divided posteriorly into palatine and jugal processes, and sending off from its mesial border an axe-head-shaped maxillo-palatine, which articulates by its thickened inner edge with a facet on the side of the vomer. The lateral half of this process is double, consisting of dorsal and ventral laminæ so arranged as to enclose a wedge-shaped cavity, the antrum, open behind. In *Rhea* (fig. 60) the maxillo-palatine is a broad flat plate which gives off from its dorsal surface a nearly vertical, slender, ascending process, which is attached by an outer crus to the maxilla proper and by a long inner crus to the maxillo-palatine. Between the two crura is a small cavity opening behind, apparently the vestige of an antrum. In the Emu (fig. 61) the maxilla is narrow, except at its anterior end, where it broadens out into a maxillo-palatine having the form of a pocket, wide from side to side, narrow from above downwards, and opening behind along its whole width; this cavity is obviously the antrum, resembling pretty closely that of the majority of the Moas (fig. 63), but situated farther forwards. In *Casuarius galeatus* (fig. 62) the maxilla proper is still narrower, but the maxillo-palatine has the form of a long conical pouch, like a jelly-bag, its point directed forwards, dorsad of the palatine process of the premaxilla, and its base widely open behind. Lastly, in *Apteryx* the maxilla is a long flat bone and the maxillo-palatine is represented only by a narrow seam-like projection of its mesial border: there is no dorsal prolongation of the maxillo-palatine, the walls of the antrum being entirely membranous.

It is obvious that in the structure of the maxillo-palatine, upon which Huxley largely founded his classification of birds (10), the Dinornithidæ, with the exception of *Emeus*, approach most nearly to the Australian Ratitæ. Prof. Huxley makes no mention of the antrum, describing the maxillo-palatine of the Emu, Cassowary, Moa, and Kiwi as flat imperforate plates.

In the structure of the vomer it is *Apteryx* which comes nearest to the Dinornithidæ, that genus having a single vomer, deeply cleft posteriorly and ankylosed with the palatines and pterygoids. The maxillo-palatines touch it by a part of their thin mesial edges, but do not articulate with it. In *Casuarius* it has the same general form and

[1] In the skulls in the Otago University Museum, as also in Huxley's (10) and Selenka's (27) figures; but in my father's figures of advanced embryos (25) large palatine processes are shown.

relations, but is proportionally much longer and more slender; it articulates laterally with the maxillo-palatines. In *Dromæus* it is also forked behind, but its anterior end is expanded into a thin, flat plate, which articulates with the maxillo-palatine and is underlaid by the palatine process of the premaxilla. In *Rhea* it is deeply forked in front, each limb of the fork being underlaid by the corresponding palatine process of the premaxilla. In *Struthio* it is flattened anteriorly, and on each side presents a facet for articulation with the maxillo-palatine; although shorter than in the other Ratitæ, it is considerably longer in the specimens in the Otago Museum than in Huxley's figure, reaching as far forward as the anterior end of the nasals, and its forked posterior end being connected on each side by ligament with the corresponding palatine.

In the characters of the palatines also *Apteryx* is the nearest ally of the Dinornithidæ. In it they are short bones, about the same length as the vomer, and having much the same twist as was described above in the Moas. They are also expanded posteriorly, where they unite with the vomer and pterygoids, and are overlaid in front by the maxillo-palatines. Each is, however, clamped along its whole lateral edge by the long palatine plate of the maxilla, and does not reach so far forward as the palatine plate of the premaxilla. In *Struthio* the palatines are long, flat rods, their posterior ends expanded for union with the pterygoids, and their anterior ends passing ventrad of the maxillo-palatines and reaching nearly as far forward as the anterior end of the vomer. In *Rhea*, *Dromæus*, and *Casuarius* the palatines are short, thin plates, more or less curved, which pass from the pterygoids behind outwards and forwards to the palatine processes of the maxillæ; they are not ankylosed with either the vomer or the pterygoids in the Rhea and Emus in the Otago Museum, but are firmly united to both in *Casuarius galeatus*.

The pterygoid is a rod-shaped bone in all but *Struthio*, in which it is expanded in front. Without the opportunity of examining good specimens of adolescent skulls, it is impossible to enter into a detailed account of the modifications of this bone in the various genera.

In all the other Ratitæ except *Apteryx*, the head of the quadrate resembles that of the Moas, bearing an elongated oval articular surface broader at its lateral than at its mesial end, and showing no trace of division into two facets. In *Apteryx*, as I have pointed out elsewhere (24), the quadrate is practically double-headed; the details of its form are, however, subject to considerable variation. In an adult *A. oweni*, the mesial end of the head bears a very distinct, nearly circular surface for articulation with the facet furnished by the pro-otic and exoccipital (Plate LXII. fig. 69); passing outwards from this it narrows considerably and at its lateral end is greatly expanded, forming a surface, very convex from before backwards, for articulation with the concave surface furnished by the squamosal and alisphenoid. In an adult *A. australis* there is a perfectly distinct facet on the anterior surface of the outer end of the head for articulation with the alisphenoid; in another specimen of the same species the usually distinct facets are so close together that the head is virtually single. In *Dromæus* alone there is a facet on the base of the otic process, just anterior to the lateral ridge, for articulation with the surface already mentioned on the zygomatic process.

It was pointed out that in all the Moas there is a pneumatic foramen on the mesial surface of the otic process, while a second foramen occurs on the posterior surface in certain instances. The only other case in which I have found the mesial foramen is that of *Struthio*, in which there is an extremely small aperture in the corresponding position, looking, however, more like a vascular or nervous than a pneumatic foramen. The posterior foramen is of moderate size in the Emu and Cassowary, and is situated near the base of the otic process; in the Ostrich it is higher up and proportionally smaller; in *Rhea* it is on the posterior margin of the head, immediately below the articular surface. In the adult Kiwi there are several small foramina in the same position, but at the time of hatching there is a single large foramen in the same position as in *Anomalopteryx*. The otic process in *Apteryx* is peculiar for sending off small mesial and lateral processes just below the head.

In the orbital process the Cassowary presents the closest resemblance to the Moas, but is more compressed and blunter at the apex than in the latter. In the Emu it is blunt and thick, and takes a more nearly horizontal direction than usual. In the Ostrich it is also compressed and the apex truncated. In *Rhea* it is extremely short and blunt. In *Apteryx* it is unusually long and strongly compressed, so as to have the form of a thin vertical plate with a thickened ventral rim.

In the mandible the internal angular process and ridge are best developed in *Apteryx* and to a less degree in *Rhea*, but are also well marked in *Dromæus* and *Casuarius*. The posterior angular process and ridge are large in the Ostrich, Emu, and Cassowary, obscure in the Rhea and Kiwi. In the general form of the jaw the Moas come nearest to the Cassowary, in which the rami are moderately stout and slightly deflected distally. The comparative weakness of the mandible in the other large Ratitæ is very marked, and in *Apteryx* the immense length of the symphysis separates it at once from all the other genera; in the strength and solidity of the jaw and in the size of the coronoid process *Apteryx australis* is, however, the only form which approaches the Dinornithidæ.

5. Measurements of the Skulls of the Ratitæ.

Measurements of the skulls of Moas are given by Owen, Haast (5), and Hutton (9). It is, however, desirable for purposes of comparison that a more complete set of measurements should be given, and that the precise way in which they are taken should be accurately defined.

Owing to the early ankylosis of the bones of the cranium, it is impossible to determine such points as the bregma, lambda, pterion, &c., and as the main object of the measurements is to serve as a means of identification, it is important to select standard points which can be readily made use of in any fairly well preserved skull. Moreover, as a matter of convenience it is desirable that the measurements should be made with some common and readily procurable instrument. I have therefore taken them all with callipers, so that in the case of curved surfaces, such as the roof of the skull, the chord is given, not the arc. All measurements are given in millimetres; the standard being so small, fractions are neglected.

The measurements given are defined as follows:—

1. *Total length of skull*: from centre of occipital condyle to anterior extremity of premaxilla.
2. *Length of cranio-facial axis*: from centre of occipital condyle to tip of rostrum.
3. *Length of basis cranii*: from centre of occipital condyle to base of rostrum, *i. e.* to the centre of a line joining the anterior ends of the bases of the basipterygoid processes.

   It will be seen that the expression *basis cranii* is here used in a special sense; the dimension chosen nearly corresponds with the length of the base of the skull as measured from the condyle to the preoptic ridge. The entire basicranial axis, *i. e.* from condyle to junction of presphenoid and ethmoid, can only be got at by bisecting the skull, and even then, owing to the ankylosis of the bones named, cannot be determined with precision.
4. *Length of roof of cranium*: from the centre of the supraforaminal ridge to the middle of a line joining the anterior borders of the lacrymals (preorbital processes).

   Hutton takes the naso-frontal suture as the anterior boundary of this line, but in old skulls the suture is obliterated, and the posterior end of the premaxillary groove which coincides with it is frequently obscure.
5. *Width of cranium at paroccipital processes*: the length of a straight line joining the dorsal ends of the paroccipital processes, immediately below the supratympanic ridges. Occasionally there is a sort of step where the supratympanic ridge passes into the paroccipital process; the measurement should then be taken below the step.
6. *Width of cranium at squamosal prominences*: length of a straight line joining the most projecting portions of the squamosals.
7. *Width of cranium at temporal fossæ*: length of the longest straight line joining the right and left temporal fossæ.

   This measurement gives an indication of the width of the brain-case, the walls of the skull being much thinner at the temporal region than elsewhere.
8. *Width of cranium at postorbital processes*: length of a straight line joining the most prominent parts of the right and left postorbital processes.

9. *Width of cranium at preorbital processes*: length of a straight line joining the posterior borders of the lacrymals.
10. *Distance between temporal ridges*: length of the shortest straight line joining the right and left temporal ridges.
11. *Height of cranium*: length of a perpendicular from the highest part of the cranial roof to the basitemporal platform.
12. *Width of tympanic cavity*: length of the longest horizontal straight line joining the posterior temporal ridge and the edge of the paroccipital process.
13. *Width of temporal fossa*: length of the longest horizontal straight line joining the anterior and posterior limbs of the temporal ridge, above the junction with the latter of the posterior temporal ridge.
14. *Width of orbit*: length of the longest horizontal straight line joining the posterior border of the lacrymal and the anterior border of the postorbital process.
15. *Distance between optic foramina*: length of a straight line joining the lower borders of the foramina.
16. *Greatest length of premaxilla*: from apex of body in a straight line to posterior end of nasal process.
17. *Length of premaxilla to end of maxillary process*: from apex of body in a straight line.
18. *Length of body of premaxilla*: length of a straight line between apex and posterior border of prenarial septum.
19. *Width of body of premaxilla*: length of a straight line between the right and left alveolar borders at the level of the posterior edge of the prenarial septum.
20. *Length of maxillo-jugal arch*: the greatest length in a straight line.
21. *Length of vomer*: the greatest length in a straight line.
22. *Length of palatine*: the greatest length in a straight line.
23. *Length of pterygoid*: the greatest length in a straight line.
24. *Length of quadrate*: length of a straight line from the articular surface of the head to the most prominent part of the internal condyle.
25. *Length of mandibular ramus*: from middle of anterior border of symphysis to extremity of posterior angular process.
26. *Greatest height of mandible*: length of a perpendicular from the coronoid process to the ventral border.
27. *Least height of mandible*: a similar measurement of the anterior part of the ramus a short distance posterior to the symphysis.
28. *Length of mandibular symphysis*: length of a straight line passing from the middle of the anterior to the middle of the posterior border of the symphysis.
29. *Width of mandibular symphysis*: length of a straight line between the right and left alveolar borders at the level of the posterior edge of the symphysis.

Absolute measurements, as defined on pp. 406–407, of the various species examined, are given in Table A.

But, as an aid to the determination and definition of the genera, the proportions of the skull are more important than absolute measurements, a fact recognized by Hutton, who gives (9, p. 107) the proportion between length and breadth, and between breadth and height, in his eight genera. I have come to the conclusion, however, that a more convenient method is to take as a standard the length of the basis cranii as defined above (p. 406, § 3), and to express various other important dimensions as percentages. In this way a number of indices are obtained, many of which are of great importance in the definition of the genera: they are given in Table B.

Table C gives what may be called the temporal index; *i. e.* the width of the cranium at the temporal fossa as compared with the distance between the right and left temporal ridges.

6. Summary of the Cranial Characters of the Ratitæ.

Struthio.

Occipital plane inclined backwards; occipital condyle sessile; a broad occipital crest.

Length of cranial roof nearly three times that of basis cranii.

Width at paroccipital processes about one and a half times length of basis cranii.

Width at squamosals about double length of basis cranii.

Height of cranium nearly double length of basis cranii.

Temporal fossæ continued mesiad on to parietal region; distances between temporal ridges about one third less than width of cranium at temporal fossæ.

Zygomatic process outstanding; no squamosal prominence.

Width of orbit about equal to breadth of cranium at paroccipital processes, or one and a half times length of basis cranii; interorbital septum present; a projecting supraorbital ledge notched in front and produced behind into a short blunt, post-orbital process.

Lacrymal produced into a broad, backwardly-directed orbital process, and a strong descending process passing mesiad of the lacrymal duct.

Nasal has a well-developed maxillary process, and is separated posteriorly from its fellow by an interval in which the mesethmoid appears.

Ossified portion of antorbital does not extend outwards to lacrymal.

Premaxilla weak; body flat, having no prenarial septum; no palatine processes; width of body about equal to length of basis cranii.

Maxilla narrow; extends forwards to body of premaxilla; maxillo-palatine a hatchet-shaped process given off from its mesial border; antrum small.

	ryx	Emeus				Apteryx	Dromæus	Casuarius	Struthio	Rhea
	parva. pecimen.	Species β. 1 specimen.	Species α.	*crassus.*	Species γ. 1 specimen.	*australis.*	*novæ-hollandiæ.*	*galeatus.*	*camelus.*	*americana.*
1. Total length	123	..	122	134–140	..	186	150	170	188	173
2. Length of cr	96 ?	..	110	102–112	..	90	76	? 95	163	122
3. Length of b	31	? 35	37	37–41	40	18	29	29	33	30
4. Length of cr	73	74	73–85	80–94	75	49	80	? 85	93	88
5. Width of cr	54	54	54–59	61–72	? 67	39	43	53	50	48
6. Width of cr	63	70	70–73	76–80	75	33	57	60	65	53
7. Width of cr	44	47	45–51	50–52	52	30	51	54	53	45
8. Width of cr	72	80	79–85	84–86	80	..	66	70	85	62
9. Width of cra	41	39	37–43	40–45	47	16	34	31	59	35
10. Distance bet	26	42	42–49	41–50	50	30	50	54	41	32
11. Height of cr	44	43	45–50	46–50	48	26	47	? 55	62	47
12. Width of ty	15	20	19–24	17–21	20	9	21	24	22	25
13. Width of ten	26	20	16–23	16–28	17	15	13	20	20	21
14. Width of orb	29	30	30–31	29–33	32	..	45	41	53	46
15. Distance bet	9	12	9–11	10	12	4	2	2	9	2
16. Greatest leng	68	..	72	80–88	..	144	80	? 90	109	95
17. Length of pr	56	..	54	60–66	..	? 120	71	93	115	82
18. Length of bo	28	..	28–31	27–33	..	5	23	24	28	29
19. Width of bod	22	..	28–31	37–41	..	4	25	14	35	24
20. Length of ma	70 ?	..	67–72	69–73	..	? 77	87	127	139	92
21. Length of vo	..	..	46	49	..	36	74	86	76	62
22. Length of pa	..	..	43	45	..	? 31	32	? 41	? 87	29
23. Length of pt	..	..	21–25	23–26	..	? 20	? 32	? 32	? 40	33
24. Length of qu	32 ?	..	35	36–40	..	12	25	26	31	25
25. Length of ma	20	..	111	122–127	..	183	141	165	184	173
26. Greatest heig	20	..	20–21	20–22	..	9	9	12	17	12
27. Least height	12	..	12–13	12–13	..	7	8	8	8	9
28. Length of ma	23 ?	..	14–19	16–20	..	101	21	22	11	27
29. Width of ma	21	..	28–31	35–38		12	26	12	24	25

Table A.—Absolute Measurements of the Skulls of Ratitæ (*in millimetres*).

	Dinornis				Pachyornis		Mesopteryx				Anomalopteryx		Emeus				Apteryx	Dromæus	Casuarius	Struthio	Rhea
	maximus. 1 specimen.	*robustus.* 4 specimens.	*torosus.* 2 specimens.	*elephantopus.* 3 specimens.	Species α. 1 specimen.	Species α. 1 specimen	*casuarina.* 7 specimens.	Species α. 1 specimen	Species β. 1 specimen.	Species γ. 1 specimen.	*didiformis* 3 specimens.	*parva* 1 specimen.	Species β. 1 specimen.	Species α.	*crassus.*	Species γ. 1 specimen.	*australis.*	*novæ-hollandiæ.*	*galeatus.*	*camelus.*	*americana.*
1. Total length of skull	226	195–205	? 165–175	156	..	..	132	..	141	..	135–138	123	.	122	134–140	..	186	150	170	188	173
2. Length of cranio-facial axis	..	? 135	?	?	..	109	?	..	111	..	103–110	96 ?	..	110	102–112	..	90	76	? 95	163	122
3. Length of basis cranii	47	46	38–40	37–41	? 41	38	27–33	? 26	36	33	32–35	31	? 35	37	37–41	40	18	29	29	33	30
4. Length of cranial roof	118	105	94–97	90–98	94	85	70–81	59	83	72	85–87	73	74	73–85	80–94	75	49	80	? 85	93	88
5. Width of cranium at paroccipital processes	93	90–105	81–83	62–78	64	57	45–55	44	59	49	59–62	54	54	54–59	61–72	? 67	39	43	53	50	48
6. Width of cranium at squamosal prominences	118	104–115	94	82–92	85	74	58–67	52	76	64	70–74	63	70	70–73	76–80	75	33	57	60	65	53
7. Width of cranium at temporal fossæ	73	65–82	59–63	52–57	50	50	43–50	41	48	47	42–44	44	47	45–51	50–52	52	30	51	54	53	45
8. Width of cranium at postorbital processes	139	120–136	105–110	92–96	102	..	65–75	61	90	69	77–82	72	80	79–85	84–86	80	..	66	70	85	62
9. Width of cranium at preorbital processes	..	84	80	56–67	? 60	54	37–42	38	53	40	47–49	41	39	37–43	40–45	47	16	34	31	59	35
10. Distance between temporal ridges	53	46–59	40–46	37–44	35	35	39–49	37	41	44	22–23	26	42	42–49	41–50	50	30	50	54	41	32
11. Height of cranium	49	50–61	48	51–55	? 52	51	41–43	? 35	47	41	44–46	44	43	45–50	46–50	48	26	47	? 55	62	47
12. Width of tympanic cavity	25	25–29	22–25	23–30	23	22	17–21	18	21	17	16	15	20	19–24	17–21	20	9	21	24	22	25
13. Width of temporal fossa	32	28–37	23–31	26–32	38	29	13–17	16	23	13	28–30	26	20	16–23	16–28	17	15	13	20	20	21
14. Width of orbit	..	35	34–36	32–37	37	..	25–31	24	32	26	32	29	30	30–31	29–33	32	..	45	41	53	46
15. Distance between optic foramina	..	30–35	26–30	15–21	14	13	8–11	9	14	9	9–10	9	12	9–11	10	12	4	2	2	9	2
16. Greatest length of premaxilla	157	110–129	108–110	81–90	..	..	73	..	81	..	73–76	68	..	72	80–88	..	144	80	? 90	109	95
17. Length of premaxilla to end of maxillary process	..	97	? 85–93	68–82	..	..	?	..	63	..	60–62	56	..	54	60–66	..	? 120	71	93	115	82
18. Length of body of premaxilla	82	60	? 49–62	37–43	..	..	25	..	33	.	31–35	28	..	28–31	27–33	..	5	23	24	28	29
19. Width of body of premaxilla	71	63–71	55–57	30–35	..	.	24	..	27	..	30–35	22	..	28–31	37–41	..	4	25	14	35	24
20. Length of maxillo-jugal arch	..	113	..	94	..	..	70	..	73	..	78	70 ?	..	67–72	69–73	..	? 77	87	127	139	92
21. Length of vomer	.	.	..	..	..	..	..	..	53	..	..	..	..	46	49	..	36	74	86	76	62
22. Length of palatine	..	..	..	.	..	..	..	..	42	..	43	..	..	43	45	..	? 31	32	? 41	? 87	29
23. Length of pterygoid	..	..	..	.	..	..	..	..	28	..	..	..	..	21–25	23–26	..	? 20	? 32	? 32	? 40	33
24. Length of quadrate	..	53	41	41	..	..	35	..	34	..	35	32 ?	..	35	36–40	..	12	25	26	31	25
25. Length of mandibular ramus	211	179–208	163–164	141–155	.	.	117	88	125	.	127–135	120	..	111	122–127	..	183	141	165	184	173
26. Greatest height of mandible	24	25–28	20–23	20–21	.	..	16	12	17	..	19–21	20	..	20–21	20–22	..	9	9	12	17	12
27. Least height of mandible	19	16–20	13–19	11–12	..	.	8	7	10	.	11–12	12	..	12–13	12–13	..	7	8	8	8	9
28. Length of mandibular symphysis	29	27–31	22–23	17–20	..	.	14	10	16	..	16–20	23 ?	.	14–19	16–20	..	101	21	22	11	27
29. Width of mandibular symphysis	52	47–52	35–42	24–25	..	..	21	14	21	.	23–25	21	.	28–31	35–38		12	26	12	24	25

ntages of length of basis cranii). [*To face* p. 408.

...eus	Apteryx	Dromæus	Casuarius	Struthio	Rhea
crassus.	*australis*	*novæ-hollandiæ.*	*galeatus.*	*camelus.*	*americana.*
100	100	100	100	100	100
204–247	272	275	? 293	281	293
148–180	216	148	182	151	160
185–216	183	196	206	196	176
121–137	166	175	186	160	150
121–132	144	162	? 189	187	156
51–70	83	44	68	60	70
78–89	. .	155	141	160	153
200–237	800	275	? 310	330	316
67–89	27	79	82	84	96
100–110	22	86	48	106	80
132	200	255	296	230	206
121	171	111	? 141	263	96
309-335	1016	486	568	557	576
92–100	66	89	41	72	83

...eus	Apteryx	Dromæus	Casuarius	Struthio	Rhea
crassus.	*australis.*	*novæ-hollandiæ.*	*galeatus.*	*camelus.*	*americanus.*
100	100	100	100	100	100
100–120	100	100	110	130	140

Table B.—Principal Dimensions of Skulls of Ratitæ (*expressed as percentages of length of basis cranii*).

	Dinornis		Pachyornis	Mesopteryx		Anomalopteryx	Emeus		Apteryx	Dromæus	Casuarius	Struthio	Rhea
	robustus.	*torosus.*	*elephantopus.*	*casuarina.*	Species β.	*didiformis.*	Species α.	*crassus.*	*australis*	*novæ-hollandiæ.*	*galeatus.*	*camelus.*	*americana.*
Length of basis cranii	100	100	100	100	100	100	100	100	100	100	100	100	100
Length of cranial roof	228	235-255	234-245	230-259	230	231-265	211-229	204-247	272	275	? 293	281	293
Width of cranium at paroccipital processes	200-228	202-218	151-195	148-166	163	181-184	145-159	148-180	216	148	182	151	160
Width of cranium at squamosal prominences	239-250	234-247	221-230	200-214	211	208-218	189-197	185-216	183	196	206	196	176
Width of cranium at temporal fossæ	154-178	155-157	139-142	142-166	133	120-137	121-137	121-137	166	175	186	160	150
Height of cranium	117-132	120-128	129-137	127-151	130	125-146	121-135	121-132	144	162	? 189	187	156
Width of temporal fossa	71-80	57-81	70-89	39-62	63	82-87	43-62	51-70	83	44	68	60	70
Width of orbit	76	85-94	80-90	87-93	88	91-100	81-84	78-89	..	155	141	160	153
Greatest length of premaxilla	240-280 ?	270-289	202-225	221	225	217-228	193	200-237	800	275	? 310	330	316
Length of body of premaxilla	130-147 ?	155	92-107	78	91	96-100	75-84	67-89	27	79	82	84	96
Width of body of premaxilla	154	137-150	75-87	75	75	71	75-84	100-110	22	86	48	106	80
Length of vomer	..	..	..	..	147	..	124	132	200	255	296	230	206
Length of palatine	..	..	..	..	116	134	116	121	171	111	? 141	263	96
Length of mandibular ramus	390-452	407-431	352-387	365	347	380-421	300	309-335	1016	486	568	557	576
Width of mandibular symphysis	102-113	71	60-62	65	58	71	75-84	92-100	66	89	41	72	83

Table C.—Temporal Index of Ratitæ.

	Dinornis		Pachyornis	Mesopteryx		Anomalopteryx	Emeus		Apteryx	Dromæus	Casuarius	Struthio	Rhea
	robustus.	*torosus.*	*elephantopus.*	*casuarina.*	Species β.	*didiformis.*	Species α.	*crassus.*	*australis.*	*novæ-hollandiæ.*	*galeatus.*	*camelus.*	*americanus.*
Distance between temporal ridges	100	100	100	100	100	100	100	100	100	100	100	100	100
Width of cranium at temporal fossæ	140-150	140	130-140	100-110	110	180-200	100	100-120	100	100	110	130	140

Vomer more than double length of basis cranii; flattened in front, trough-like and forked behind; articulates with maxillo-palatines; connected with palatines by ligament.

Palatine slender; expanded posteriorly and ankylosed to pterygoid; about two and a half times length of basis cranii.

Mandible weak; symphysis flat, with very obscure median ventral ridge.

Rhea.

Occipital plane inclined backwards; occipital condyle sessile; occipital crest obscure.

Length of cranial roof nearly three times that of basis cranii.

Width at paroccipital processes about one and a half times length of basis cranii.

Width at squamosals less than double length of basis cranii.

Height of cranium about one and a half times length of basis cranii.

Temporal fossæ continued on to parietal region; distance between temporal ridges about one third less than width of cranium at temporal fossæ.

Zygomatic process slender, outstanding; no squamosal prominence.

Width of orbit about equal to width of cranium at paroccipital processes, or one and a half times length of basis cranii; interorbital septum present; supraorbital ledge narrow, not notched in front, produced behind into short blunt post-orbital processes.

Lacrymal produced into pointed, backwardly-directed orbital process and curved descending process which passes mesiad of lacrymal duct.

No maxillary process to nasal; mesethmoid appears on dorsal surface between posterior ends of nasals.

Antorbital quite unossified in the skulls examined.

Premaxilla weak; body flat, with no prenarial septum; long palatine processes; width of body rather less than length of basis cranii.

Maxilla broad; anterior end does not reach to body of premaxilla; maxillo-palatine a broad, thin plate, perforated by small and variable apertures, and produced dorsad into a narrow vertical plate, at the base of which is a vestige of the antrum.

Vomer about double length of basis cranii; flattened and deeply forked in front, carinate and deeply forked behind; not ankylosed to palatines.

Palatine a broad, thin, curved plate, not ankylosed to pterygoid, and shorter than basis cranii.

Mandible weak; symphysis flat, with a median ventral ridge.

Dromæus.

Occipital plane inclined backwards; occipital condyle sessile; occipital crest obscure.

Length of cranial roof less than three times length of basis cranii.

Width at paroccipital processes less than one and a half times length of basis cranii.

Width at squamosals nearly twice length of basis cranii.

Height of cranium about one and a half times length of basis cranii.

Temporal fossa nearly vertical; distance between temporal ridges equal to width of cranium at temporal fossæ.

Zygomatic process strong and outstanding; bears facet for quadrate on the inner surface of its distal end; no squamosal prominence.

Width of orbit rather greater than width of cranium at paroccipital processes, and about one and a half times length of basis cranii; interorbital septum present; supraorbital ledge narrow, not notched in front, produced behind into a short postorbital process.

Lacrymal produced into a pointed, backwardly-directed orbital process, and a slender descending process, which is perforated for the lacrymal duct.

Antorbital well ossified and ankylosed laterad with the descending process of the lacrymal; a deep Harderian fossa.

Maxillary process of nasal vestigial; mesethmoid appears dorsally between posterior ends of nasals.

Premaxilla weak; body flat, with a very short prenarial septum; palatine processes long, width of body rather less than length of basis cranii.

Maxilla rather broad; anterior end does not reach to body of premaxilla; maxillo-palatine thin and pocket-like, containing a wide antrum.

Vomer nearly two and a half times length of basis cranii; broad, flat, and longitudinally grooved in front, narrow and deeply forked behind; ankylosed to pterygoids.

Palatine a thin, oblique plate, somewhat longer than basis cranii, articulating in front with maxilla and behind with pterygoid.

Mandible weak; symphysis flat with a narrow ventral ridge.

Casuarius.

Occipital plane inclined backwards; occipital condyle sessile; occipital crest obscure.

Cranial roof produced into a large crest; nearly three times length of basis cranii.

Width at paroccipital processes nearly double length of basis cranii.

Width at squamosals double length of basis cranii.

Height of cranium, not counting crest, nearly double length of basis cranii.

Temporal fossa nearly vertical; distance between temporal ridges about equal to width of cranium at temporal fossæ.

Zygomatic process narrow and outstanding; no squamosal prominence.

Width of orbit considerably less than width of cranium at paroccipital processes, and about one and a half times length of basis cranii; interorbital septum present; supraorbital ledge continued into cranial crest and produced behind into a broad, nearly vertical, postorbital process.

Orbital process of lacrymal united with cranial crest, only its posterior end projecting as a short, backwardly-directed process; descending process notched for lacrymal duct and sending off, ventrad of the latter, a short upwardly-directed process from its lateral margin, which partly converts the notch into a foramen.

Antorbital well ossified and ankylosed laterad with descending process of lacrymal; a deep Harderian fossa.

No descending process to nasal; the specimen examined does not show whether the mesethmoid is covered by the nasals, but it appears to be so[1].

Premaxilla strong; body high and strongly ridged, with a distinct prenarial septum; narrow palatine processes; width of body about half length of basis cranii.

Maxilla reaches nearly as far forward as prenarial septum; maxillo-palatine an elongated cone with the apex directed forwards, and contains a spacious antrum opening behind by a wide aperture.

Vomer nearly three times length of basis cranii; flattened and obscurely grooved in front, deeply forked behind; ankylosed to palatines and pterygoids.

Palatine a short oblique plate, nearly one and a half times length of basis cranii, articulating anteriorly with the maxilla and ankylosed posteriorly with the vomer and pterygoid.

Mandible weak; symphysis narrow, pointed, and keeled below.

Apteryx.

Occipital plane inclined at an angle of 45° to the basis cranii; occipital condyle pedunculated; occipital crest variable.

Length of cranial roof less than three times that of basis cranii.

Mamillar processes very large and prominent.

Width at paroccipital processes about double length of basis cranii.

Width at squamosals nearly double length of basis cranii.

Height of cranium less than one and a half times length of basis cranii.

Temporal fossa very wide and nearly vertical; distance between temporal ridges equal to width of cranium at temporal fossæ.

[1] See, however, 25, p. 428.

Zygomatic process directed forwards and strongly compressed; no squamosal prominence.

Orbit small and ill-defined; no interorbital septum, supraorbital ledge, or post-orbital process.

Lacrymal ankylosed to aliethmoid and perforated for lacrymal duct; no orbital process.

Antorbital not clearly marked off from rest of aliethmoid, which is strongly convex, completely ossified, and extends backwards to the optic foramen.

Nasal has maxillary process ankylosed to lacrymal; mesethmoid appears dorsally between posterior ends of nasals, but complete ankylosis of the bones in this region takes place in the adult.

Premaxilla strong and greatly elongated; body short but high, with a very short prenarial septum; narrow palatine processes; width of body not more than one-fifth length of basis cranii.

Maxilla broad and flat; articulates in front with maxillary and palatine processes of premaxilla; maxillo-palatine represented by the thin mesial border of the bone; no bony antrum.

Vomer about twice length of basis cranii; flattened and narrow in front; broad, keeled, and deeply cleft behind; ankylosed to palatines and pterygoids.

Palatine a thin, twisted plate with pedate posterior end; about one and three quarters length of basis cranii; ankylosed in front and by its entire outer border to maxilla and behind to vomer and pterygoid.

Mandible strong; symphysis occupies more than half its length, narrow, strongly keeled below.

Dinornithidæ.

Occipital plane vertical or very slightly inclined backwards or forwards; occipital condyle pedunculate; occipital crest variable.

Length of cranial roof from two to two and a half times length of basis cranii.

Mamillar tuberosities usually prominent; basitemporal platform always well defined and separated from occipital condyle by a deep precondylar fossa.

Width at paroccipital processes from less than one and a half to more than twice length of basis cranii.

Width at squamosals from about one and three quarters to two and a half times length of basis cranii.

Height of cranium about one and a quarter times length of basis cranii.

Temporal fossa extends mesiad to a greater or less extent on to parietal region; distance between temporal ridges varies from about width of cranium at temporal fossæ to half that width.

Zygomatic process short, pointed, and nearly parallel to median plane; auditory region of skull produced into a strong squamosal prominence.

Width of orbit about half width of cranium at paroccipital processes, and almost invariably less than length of basis cranii; interorbital septum absent or greatly reduced; a broad supraorbital ledge, produced behind into a strong, broad, post-orbital process.

Lacrymal ankylosed with frontal, forming a preorbital process; no orbital process; a descending process ankylosed with outer border of antorbital and notched or perforated for lacrymal duct.

Mesethmoid produced into paired horizontal triangular processes.

Antorbital well ossified; ankylosed to descending process of lacrymal; perforated dorsally by a supraorbital fenestra of variable size.

Nasal either has a slender maxillary process, or there is a distinct maxillo-nasal bone; meets its fellow of the opposite side in the middle line above the ethmoid, so that the latter does not appear on the dorsal surface; premaxillary groove on upper surface of nasals extends backwards to or beyond naso-frontal suture.

Premaxilla strong; body more or less elevated, and with a distinct prenarial septum; palatine processes broad and produced into more or less definite vomerine processes; width of body always more than half and sometimes one and a half times length of basis cranii.

Maxilla short and narrow; maxillo-palatine a short, flat plate, produced dorsad either into an irregular shell of bone containing a large antrum, or into a thick, oblique plate, containing no, or but little, trace of the antrum.

Vomer less than one and a half times length of basis cranii; consists of thin paired plates meeting each other ventrad in an acute dihedral angle, and either quite free or partially ankylosed with one another in front; firmly ankylosed behind, in fully adult specimens, with palatines and pterygoids.

Palatine a thin twisted plate, about one and a fifth times length of basis cranii; pedate posterior end produced into short mesial vomerine process; articulates at anterior end with maxilla, and posteriorly with vomer and pterygoid, with which, in fully adult specimens, it becomes ankylosed.

Mandible very strong; symphysis short, more or less flattened and ridged below; distal end more or less deflected downwards.

7. The Classification of the Dinornithidæ.

At an early period of his investigations—in 1846—Owen was led to the conclusion that the differences between certain of the Moas were of more than specific value, and instituted the genus *Palapteryx* for the reception of species (*ingens* and *dromioides*) in which the hallux was present. Further investigations, however, convinced him that the retention of a purely vestigial structure was not, even if constant, of sufficient importance to distinguish a genus, and he therefore returned to his earlier practice of placing all the species in the single genus *Dinornis*.

Reichenbach (26) was the first, in 1850, systematically to divide the family into genera, proceeding upon the simple plan of erecting into a genus each of the seven species known to him. His material must necessarily have been very imperfect, and two of his genera (*Moa* and *Movia*) are undoubtedly synonyms of a third (*Dinornis*).

Von Haast (6) was the next, in 1873, to attack the problem. He divided the Moas into two families, each containing two genera; but the characters upon which the definition of the families was based were shown by Hutton (8) to be quite unreliable; many of the generic characters are incorrect and others inconstant; and in at least three instances, in the Canterbury Museum, the skull of one species was assigned to the skeleton of another. Moreover, the brief account of the proposed classification, given in a Presidential address, was never followed up by a detailed statement, and was unsupported by measurements or figures. Under these circumstances the wide acceptance of Von Haast's views is rather remarkable: they are adopted without remark by Wallace (28) in 1876, and with a qualifying note by Newton (14) in 1885; and Lydekker (15) in 1889 discusses the question and comes to the conclusion that the distinction between the two families is a valid one,—a decision which this author's later enquiries (12) have led him to reverse. Fürbringer (3) has a long discussion in his usual judicial manner, and concludes that there is no evidence for the establishment of more than one family.

Last year two classifications were propounded, unfortunately independently: one in England by Lydekker (12), the other by Hutton in New Zealand (9). Both agree in recognizing only a single family, which Lydekker divides into five genera—or four if *Megalapteryx* be excluded—and nineteen species, Hutton into seven genera and twenty-six species. In both schemes the definitions of certain of the genera are wanting in exactness, especially as regards the skull, which Prof. Hutton rightly considers the most important part of the skeleton for generic distinctions. Mr. Lydekker supplies valuable corrections of many of Owen's determinations, but he has only examined the British Museum collection, which is evidently deficient in many important respects. Prof. Hutton, on the other hand, besides examining the large public and private collections in New Zealand, has himself collected Moa-bones in various parts of the colony, and was the first to recognize the important bearing of the geographical distribution of the species.

The table on p. 415 gives a comparison of the arrangement of the Dinornithidæ by the four authors referred to with that adopted in the present paper.

It will be seen that Haast, Lydekker, and Hutton are all agreed as to the limits of *Dinornis*, and that Reichenbach's *Anomalopteryx* corresponds with the similarly-named genus of Hutton and with Haast's *Meionornis*. Lydekker's *Anomalopteryx* includes four of Hutton's genera and part of a fifth. Hutton's *Euryapteryx* includes species from two of Haast's and from two of Lydekker's genera, and so on.

REICHENBACH, 1850.	VON HAAST, 1873.	LYDEKKER, 1891.	HUTTON, 1891.	PARKER, 1892.
			Dinornis	*Dinornis*
	Dinornis	*Dinornis*	altus.	
	maximus.	maximus.	maximus.	maximus.
			excelsus.	
Moa			validus.	
giganteus.		novæ-zealandiæ.	giganteus.	
			firmus.	
Movia	robustus.		robustus.	robustus.
ingens.	ingens.		ingens.	
			potens.	potens (?).
	gracilis.	gracilis.	gracilis.	
Dinornis			torosus.	torosus.
struthioides.	struthioides.	struthioides.	struthioides.	species α.
			Palapteryx	
		Anomalopteryx	plena.	
		dromioides.	dromioides.	
Anomalopteryx	*Meionornis*		*Anomalopteryx*	*Anomalopteryx*
didiformis.	didiformis.	didiformis.	didiformis.	didiformis.
		parva.		parva (?).
			antiqua.	
			Cela	*Mesopteryx*
Cela		geranoides.	geranoides.	species α.
curta.		curta.	curta.	
		oweni.		species β.
			Mesopteryx	species γ.
		didina.	didina.	
Syornis			*Syornis*	
casuarinus.	casuarinus.	casuarina.	casuarinus.	casuarina.
	Euryapteryx			
Emeus	rheides.	*Emeus*	rheides.	*Emeus*
crassus.		crassus.	crassus.	crassus.
				species α.
				,, β.
				,, γ.
			Euryapteryx	
	gravis.	gravipes.	gravis.	
	Palapteryx	*Pachyornis*	ponderosa.	*Pachyornis*
				species α.
	elephantopus.	elephantopus.	elephantopus.	elephantopus.
		immanis.		species β.
				,, γ.
		species *a*.	pygmæa.	,, *a*.
		,, *b*.		,, *b*.

My own observations have led me to the following conclusions, which, it must be remembered, are founded mainly upon a study of the skull, and take no cognizance of several of Hutton's and of one or two of Lydekker's species:—

1. The tall, comparatively slender-limbed forms, with broad skull and long, wide,

deflected beak, constitute a very natural and highly specialized group. It may be called the *maximus*-group, and, so far as I can make out, includes all the species placed by Haast, Lydekker, and Hutton in the genus *Dinornis*, which name should therefore be retained.

2. A second highly specialized or culminating group is constituted by heavy-limbed forms with strongly-built narrow skull, short broad beak, and stout mandible. This may be called the *crassus*-group: its type species is also the type of Lydekker's *Emeus*. I adopt this name.

3. The remaining species together form a comparatively generalized group, including forms of small or moderate height and of varying bulk, having narrow skulls and pointed beaks. This assemblage is divisible into three subdivisions:—

a. The *elephantopus*-group, characterized by a larger and relatively broader cranium than is possessed by either of the following groups, large temporal fossæ, and a wide **V**-shaped mandible. It corresponds with Lydekker's *Pachyornis* and with Haast's *Palapteryx*, and is placed under *Euryapteryx* by Hutton. The name *Pachyornis* should be retained, *Palapteryx* having been wrongly applied by Haast.

b. The *casuarina*-group, so-called from its type species. The skull resembles that of the *elephantopus*-group in general features, but is smaller and more delicate, and has considerably smaller temporal fossæ. This section includes Hutton's *Mesopteryx* and *Cela*, with part of *Syornis*; it corresponds with Haast's *Meionornis*, with Reichenbach's *Syornis*, and with Lydekker's typical group of *Anomalopteryx*. *Casuarinus* being the type species, Reichenbach's name has priority, but, as Lydekker has shown, it clashes with *Synornis* of Hodgson. The group is certainly not congeneric with either the preceding or the following one, and I therefore adopt Hutton's name *Mesopteryx*, the type species of which (*didina*) is here considered to be a variety of *casuarina*[1].

c. The *didiformis*-group, in which *parva*, if really distinct, should be included. It is characterized by an unusually straight beak and immense temporal fossæ. This section corresponds with *Anomalopteryx* of Reichenbach and Hutton, doubtfully with Haast's *Meionornis*, and with Lydekker's Celine group of *Anomalopteryx*. There seems to be no doubt that the name *Anomalopteryx* probably belongs to this group.

I see no evidence favouring the retention of the genera *Palapteryx* and *Cela*. Hutton retains *Palapteryx* for the reception of *dromioides*, Owen, and *plena*, Hutton, the main ground of generic distinction being, as I understand, that the posterior view of the skull of *dromioides*, as figured by Owen (17, pl. 54), shows an undoubted approximation to that of *Dinornis* in its great relative breadth and short rounded paroccipital processes. Lydekker, however, with the skull itself at his disposal, places this species near *casuarina*. As to *Cela*, the type species is *curta*, of which *oweni* is, according to Hutton, a synonym. Judging from Haast's figure of a fragmentary skull, I am disposed to agree with Lydekker in placing this species under *Anomalopteryx*.

[1] *Megalapteryx* probably belongs to this group. See Note above, p. 378.—*June* 1895.

These conclusions may be summarized by stating that the Dinornithidæ are divisible into three groups, two of highly specialized forms and one of more generalized forms, which last may be again split up into three subgroups. These facts might be expressed equally well by making three genera, and subdividing one of them into three sub-genera, or by making three subfamilies, two of them containing a single genus apiece, and the third including three genera. The latter appears to me the more convenient method. Agreeing, as I do, with Hutton and Lydekker, that the differences between, say, *elephantopus* and *didiformis* are of generic value, it appears to me quite clear that those between *robustus* and *elephantopus* or between *didiformis* and *crassus* are something more than generic.

Arranging the groups as nearly as possible according to their affinities as determined by cranial characters, we get the following scheme:—

Family DINORNITHIDÆ.

Subfamily *a*. DINORNITHINÆ.

Genus 1. DINORNIS.

Subfamily *b*. ANOMALOPTERYGINÆ.

Genus 2. PACHYORNIS.

,, 3. MESOPTERYX.

,, 4. ANOMALOPTERYX.

Subfamily *c*. EMEINÆ.

Genus 5. EMEUS.

8. Summary of Cranial Characters of the Subfamilies and Genera of the Dinornithidæ.

Subfamily DINORNITHINÆ.

Width of cranium at paroccipital process nearly always more than twice length of basis cranii.

Distance between optic foramina about two thirds length of basis cranii.

Orbit right-angled.

Greatest length of premaxilla more than two and a half times that of basis cranii.

Body of premaxilla deflected, bluntly rounded; its length and width about one and a half times length of basis cranii.

Maxillo-palatine contains a large antrum.

Nasal has a slender maxillary process.

Mandible much deflected, with bluntly rounded symphysis, width of which is at least three quarters of, and is usually more than, length of basis cranii.

Length of mandible more than four times that of basis cranii.

Genus DINORNIS.

Occipital plane inclined forwards, condyle projecting beyond middle of supra-foraminal ridge; occipital crest usually indistinct.

Paroccipital process short, and evenly rounded below; projects beyond occipital condyle.

Width of cranium at squamosals from two and a third to two and a half times length of basis cranii.

Mamillar tuberosities very large and prominent; a large precondylar fossa.

Margin of tympanic cavity forms a continuous curve.

Temporal fossa large; distance between temporal ridges about two thirds of width of cranium at temporal fossæ; width of temporal fossa more than half length of basis cranii: no mid-temporal ridge.

Temporal and lambdoidal ridges usually distinct, but occasionally in contact.

Posterior tympanic fossa wide; inferior temporal ridge prominent, usually stops short of pretympanic process.

Zygomatic process very short.

Postorbital process angled, consisting of horizontal and descending portions.

Antorbital strong, deeply excavated above by a large supraorbital fenestra; its ventral edge forms a strong transverse postchoanal bar.

Prenarial septum very distinct.

Maxillo-jugal arch compressed, gently curved.

Quadrate has a rather long and compressed orbital process; pneumatic foramen of variable size, but usually very large, on mesial surface of otic process; occasionally two additional foramina on posterior surface.

Posterior angular process of mandible small or obsolete.

Subfamily ANOMALOPTERYGINÆ.

Width of cranium at paroccipital processes less than twice length of basis cranii.

Distance between optic foramina usually less than one third and never much more than one half length of basis cranii.

Orbit evenly curved, sinuous, or obtuse-angled (right-angled in *Mesopteryx*, species γ).

Greatest length of premaxilla less than two and a half times that of basis cranii.

Body of premaxilla narrow and pointed; its length rarely and its breadth never more than length of basis cranii.

Maxillo-palatine contains a large antrum.

Nasal has a slender maxillary process (*qu.* except in *Anomalopteryx*, where there is a distinct maxillo-nasal bone ?).

Mandibular symphysis pointed; its width always considerably less than three fourths of length of basis cranii.

Length of mandible nearly always less than four times that of basis cranii.

Genus Pachyornis.

Occipital plane vertical or slightly inclined backwards; occipital crest prominent; supraoccipital fossæ well marked; anterior and posterior lambdoidal ridges enclose a wide lozenge-shaped area.

Paroccipital process short, bluntly pointed.

Width of cranium at paroccipital processes from one and a half to nearly twice length of basis cranii.

Width at squamosals more than double length of basis cranii.

Cranial roof strongly and evenly arched; an irregular shallow depression at base of postorbital process.

Mamillar tuberosities large.

Margin of tympanic cavity evenly curved.

Temporal fossa large; distance between temporal ridges about one and a third times width of cranium at temporal fossæ; width of temporal fossa about three fourths length of basis cranii; mid-temporal ridge small or absent.

Temporal and lambdoidal ridges may or may not be in contact.

Posterior temporal fossa narrower than in *Dinornis* and *Anomalopteryx*, but wider than in *Mesopteryx* and *Pachyornis*; inferior temporal ridge strong; pretympanic process short.

Zygomatic process long, bluntly pointed.

Margin of orbit rather sinuous; postorbital process angled, consisting of horizontal and descending portions.

Distance between optic foramina about one half length of basis cranii.

Antorbital very thin; supraorbital fenestra moderate; postchoanal bar strongly curved outwards and forwards and more prominent than in any genus except *Dinornis*.

Rostrum broad and flattened in about its posterior 15 mm., then moderately compressed as far as the triangular processes, where it becomes broad and rounded below (the anterior extremity is lost in all the specimens I have examined).

Width of body of premaxilla nearly equal to its length, and about three fourths of the length of the basis cranii.

Prenarial septum distinct.

Maxillo-jugal rather slender, compressed posteriorly, and strongly curved.

Orbital process of quadrate compressed and bluntly pointed; a single pneumatic foramen of variable size on the mesial surface of the otic process.

Mandible strong, V-shaped, moderately deflected; posterior angular process of moderate size.

Genus MESOPTERYX.

Occipital plane vertical or inclined backwards; occipital crest usually distinct; supraoccipital fossæ present.

Occipital condyle often projects beyond paroccipital processes.

Paroccipital process pointed; width of cranium at paroccipital processes about one and a half times length of basis cranii.

Width at squamosal prominences double length of basis cranii.

Mamillar tuberosities small; posterior border of basitemporal platform nearly straight.

Margin of tympanic cavity right-angled (evenly curved in species α).

Temporal fossa small; distance between temporal ridges about equal to width of cranium at temporal fossæ; width of temporal fossa about one half length of basis cranii.

Temporal and lambdoidal ridges never confluent.

Posterior temporal fossa narrow; inferior temporal ridge moderate.

Margin of orbit evenly curved or slightly sinuous (right-angled in species γ); post-orbital process evenly curved.

Trigeminal foramen usually double (single in species β), consisting of apertures placed one above the other and separated by a narrow horizontal or oblique bar.

Distance between optic foramina about one third length of basis cranii.

Antorbital very thin; supraorbital fenestra rather small; postchoanal ridge very thin or barely discernible.

Rostrum dilated but not flattened towards its posterior end, usually much compressed and carinate in its intermediate portion, and slightly dilated between and in front of the triangular processes.

Body of premaxilla narrow and pointed; its width nearly equal to its length and about three fourths length of basis cranii; a distinct prenarial septum.

Maxillo-jugal arch slender and gently curved.

Orbital process of quadrate compressed and bluntly pointed; a single pneumatic foramen of variable size on mesial surface of otic process.

Mandible slenderer than in any other genus, moderately deflected; posterior angular process well developed.

Genus Anomalopteryx.

Occipital plane distinctly inclined backwards, the condyle being hidden in a view from above by the supraforaminal ridge and also in a view from the side by the paroccipital process.

Occipital crest slight, but whole median supraoccipital region dilated to form a wide transversely convex ridge.

Width at paroccipital process about one and three quarters length of basis cranii.

Anterior and posterior lambdoidal ridges usually widely separated.

Width at squamosals about double length of basis cranii.

Mamillar tuberosities large.

Margin of tympanic cavity sharply angled.

Temporal fossa very large; distance between temporal ridges about half width of cranium at temporal fossæ; width of temporal fossa more than three fourths length of basis cranii.

Posterior limb of temporal ridge confluent with lambdoidal ridge; mid-temporal ridge well marked and often prominent.

Posterior temporal fossa wide; inferior temporal ridge strong; no pretympanic process.

Zygomatic process short and blunt.

Margin of orbit obtusely angled; postorbital process evenly curved.

Distance between optic foramina less than one third length of basis cranii.

Presphenoid fossa unusually well defined.

Antorbital very thin; a large supraorbital fenestra; no definite postchoanal bar.

Lateral contour of premaxilla much straighter than in any other genus; body narrow and pointed, its width about two thirds of its length and three fourths of length of basis cranii; a distinct prenarial septum.

Maxillo-jugal arch stout and nearly straight.

Orbital process of quadrate long, compressed, and rather pointed at the tip; a large pneumatic foramen on the mesial surface of the otic process and often a second foramen on its posterior surface.

Mandible stout and nearly straight; symphysis narrow, with a moderately prominent ventral ridge; posterior angular process strong.

Subfamily EMEINÆ.

Width of cranium at paroccipital processes less than twice length of basis cranii.

Distance between optic foramina less than one third length of basis cranii.

Orbit evenly curved or slightly sinuous (right-angled in *Pachyornis*, species α).

Greatest length of premaxilla rarely more than twice, and never more than two and a half times length of basis cranii.

Body of premaxillæ bluntly rounded in front; its length always less, its breadth either less or slightly more than length of basis cranii.

Maxillary process of nasal represented by a distinct maxillo-nasal bone.

Maxillo-palatine devoid of an antrum.

Mandibular symphysis bluntly rounded; its width at least three fourths of length of basis cranii.

Length of mandible usually more than three and less than three and a half times length of basis cranii.

Genus EMEUS.

Occipital plane inclined backwards; occipital condyle hidden in a view from above by supraforaminal ridge, and in a view from the side by paroccipital process.

Occipital crest prominent; supraoccipital fossæ well marked.

Anterior and posterior lambdoidal ridges distinct, but close together.

Width of cranium at paroccipital processes usually about once and a half, but occasionally (in *E. crassus*) once and three quarters length of basis cranii.

Width at squamosals rarely more than double length of basis cranii.

Mamillar tuberosities large.

Temporal fossæ small; distance between temporal ridges but little less than width of cranium at temporal fossæ; width of temporal fossa usually about half length of basis cranii.

Temporal and lambdoidal ridges do not touch; mid-temporal ridge usually well marked.

Posterior temporal fossa narrow; inferior temporal ridge strong.

Zygomatic process long, often bifid.

Postorbital process evenly curved, sometimes slightly inturned at distal end.

Antorbital thin; supraorbital fenestra small; no definite postchoanal bar.

Nasal process of premaxilla very thick, its anterior end not flattened but rod-like; prenarial septum often obscure.

Maxillo-jugal arch strong and nearly straight; maxillo-palatine gives off dorsally an oblique vertical plate, with sometimes the merest vestige of an antrum at its base.

Orbital process of quadrate bluntly pointed; a large pneumatic foramen on mesial surface of otic process.

Mandibular symphysis broader than long, with a very obscure ventral ridge; posterior angular process better developed than in any of the other genera.

9. The Phylogeny of the Ratitæ[1].

The most definite opinion I have met with as to the phylogeny of the Ratitæ is that expressed in the elaborate genealogical tree which illustrates Fürbringer's great work. He ascribes a common origin to the Moas and Kiwis and to the Emus and Cassowaries, but derives his four main groups of Ratitæ—the *Struthioniformes*, *Rheiformes*, *Casuariformes*, and *Apterygiformes*—separately from a primitive stock.

Mivart, in his memoir on the axial skeleton of the Ratitæ (13), gives no definite opinion as to the phylogeny of the group, but his diagram illustrating the mutual relationships of the various genera seems to indicate his belief in their monophyletic origin. He shows a main stem dividing into two branches; one of these divides again for *Struthio* and *Rhea*; the other forks a second time, one branch dividing again for *Casuarius* and *Dromæus*, the other for *Dinornis* and *Apteryx*.

The monophyletic origin of the Ratitæ is also supported by Newton, who, in his luminous article "Ornithology" (14), says "that these forms—Moa, Kiwi, Emu and Cassowary, Rhea, and finally Ostrich—must have had a common ancestor nearer to them than is the ancestor of any carinate form seems to need no proof." Prof. Newton's classification indicates no closer affinity between any of the genera except the Emu and Cassowary, which together constitute his order *Megistanes*; each of the other genera has an order to itself.

A study of the skull certainly confirms the view that the nearest ally of the Dinornithidæ is *Apteryx*, and that the four families of Australasian Ratitæ are more nearly related to one another than is either of them to the Asio-African and South-American forms. *Struthio* and *Rhea* differ so much from the Australasian members of the subclass as to lend strong support to Fürbringer's view that they arose separately from a primitive stock; but whether the Cassowaries and Emus on the one hand and the Moas and Kiwis on the other had a distinct or a common origin is a very complex question.

The main difficulty lies in deciding what characters should be considered as of phylogenetic importance and what merely adaptive, but it appears to me that in the following particulars the Emu and Cassowary show an undoubted relationship to the Moas:—

The general characters of the maxilla, maxillo-palatine, and antrum in both genera.

[1] As my conclusions are based upon a study of the skull, I have omitted all reference to *Æpyornis*, *Dromornis*, *Megalapteryx*, and *Palæocasuarinus*.

The general relations of the vomer, palatines, and pterygoids in both genera.

The presence of a vestige of the maxillary process of the nasal in *Dromæus.*

The well-ossified antorbital ankylosed to the descending process of the lacrymal in both genera.

The elevated body of the premaxilla with its distinct prenarial septum in *Casuarius.*

Dr. Forbes's discovery (1) of a dinornithine bird which he calls *Palæocasuarinus* will, if the detailed account of his very interesting researches bears out the opinions expressed in his preliminary note, lend strong support to this view. The tibiæ upon which the genus is founded have, as the name implies, a remarkable resemblance to those of the Cassowary.

On the other hand I know of no character in the skull of *Rhea* by which it definitely approaches the Moas, and the presence of a maxillary process to the nasal, the form of the cerebral fossæ, and the position of the pneumatic foramen of the quadrate seem the only particulars in which the Ostrich comes in any way near them. *Struthio* and *Rhea* are, in fact, sharply separated both from one another and from the Australasian Ratitæ as well by the characters of the bony palate as by those of the pelvis. The characters possessed by them in common with the other Ratitæ are of two kinds: ancestral characters, such as the form of the vomer, the basi-pterygoid processes, and the single-headed quadrate, which, according to the view taken in this paper, are accounted for by the hypothesis of common descent from a group of generalized flying birds or Proto-Carinatæ; and adaptive characters, such as those of the sternum, shoulder-girdle, and wing, which they share to a greater or less degree with all flightless birds.

The marked differences between the Moas and Kiwis are certainly for the most part adaptive: the two families resemble one another in the increased size of the olfactory organ and the reduced size of the eye; but both processes have gone so much further in *Apteryx* that the differences between the two, in this respect alone, give their skulls the appearance of being more widely separated than those of any other two ratite birds. The real affinities underlying these differences are, however, shown by the striking similarity of the bones of the palate in the two forms. The absence of a maxillary antrum in *Apteryx* seems at first sight a difference of great importance, but the fact that this cavity has disappeared or become vestigial in one of the most specialized genera of Moas seems to indicate that its complete atrophy in the Kiwi is simply to be looked upon as an instance of the extreme specialization of that genus.

As to the origin of the various genera of Dinornithidæ, I am not altogether in accordance with Prof. Hutton (9, p. 428). I think there can be no doubt that *Dinornis* and *Emeus* have diverged furthest from the ancestral stock, but in opposite directions; and that the narrow-beaked forms are the most generalized. Of the three narrow-beaked genera, *Mesopteryx* appears to me to deviate least from the ordinary type of the Ratitæ, its comparatively lightly-built skull and slender mandible bringing it nearer than any other genus to *Dromæus* and *Casuarius*[1]. On the other hand, the relative size of the orbit is greatest in *Anomalopteryx*, and the presphenoid fossa or vestige of the interorbital septum is most marked in that genus and in *Dinornis*: I am disposed, therefore, to derive *Mesopteryx* and *Anomalopteryx* from a common ancestor.

Pachyornis appears undoubtedly to spring from the *Mesopteryx*-stock: these two genera are more nearly allied than any other two, *Pachyornis* being the more differentiated in virtue of its greater bulk, broader skull, larger temporal fossæ, more widely separated optic foramina, and stronger beak.

Emeus is derived by Hutton from *Mesopteryx*, a view which I am strongly inclined to adopt. The cranium of *Emeus* undoubtedly comes nearest to that of *Mesopteryx*,

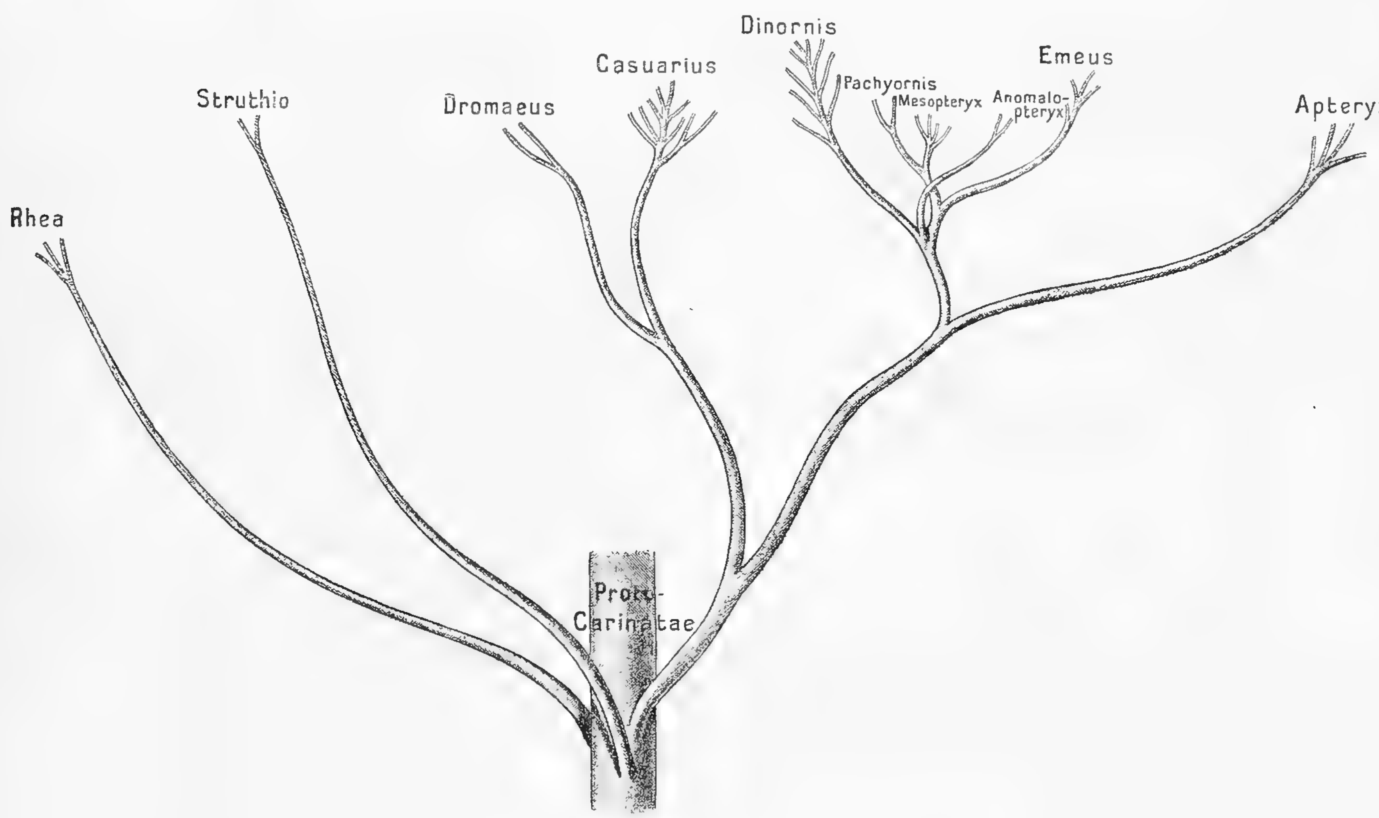


Fig. 1.—Phylogenetic diagram showing the mutual relations of the Ratitæ.

the differences between the two skulls depending mainly on the stronger and coarser character of the whole skull, the broader beak, and the stronger mandible of *Emeus*. I think, therefore, that the latter genus should be considered as springing from the *Mesopteryx*-stock—not, of course, from *Mesopteryx* itself, but from an older member of the line of descent which culminated in that genus.

Dinornis agrees with but goes beyond *Pachyornis* in its widely separated optic

[1] The striking resemblance of the dried head of *Mesopteryx casuarina* (*Didornis didinus*, Owen) to that of an Emu is noticed by Owen (23).

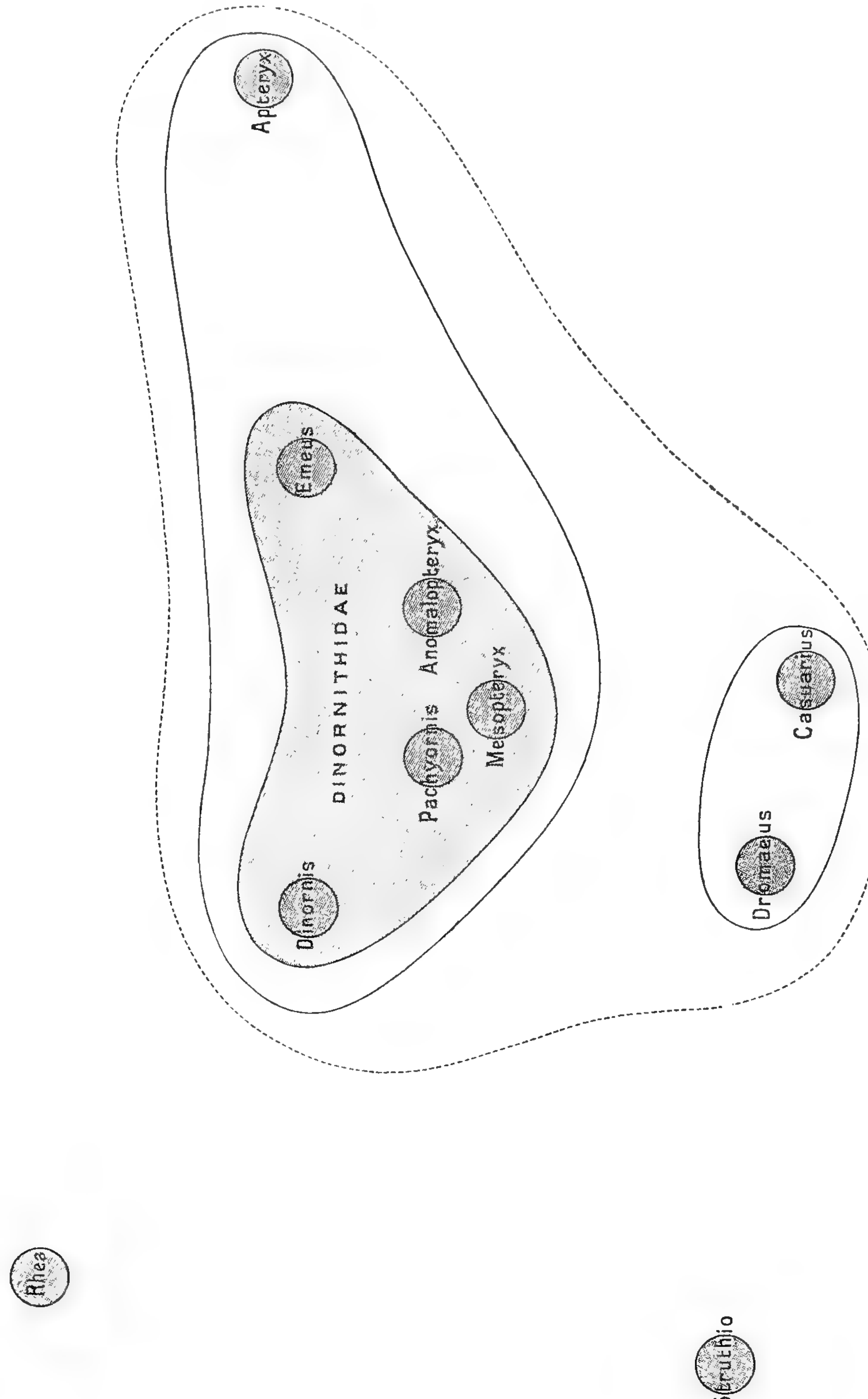


Fig. 2.—A similar diagram in horizontal projection.

foramina and its broad skull, but in other respects—the form of the orbit, the length, breadth, and strong deflection of the beak, &c.—is quite peculiar. I think that on the whole it is reasonable to suppose this most specialized of the Moas to have sprung from the common ancestor of the family independently of all the other existing genera. It is, however, quite possible that future research may show Hutton to be right in placing *Palapteryx* on or near the line connecting *Dinornis* with the generalized ancestor of the group.

The accompanying diagrams (pp. 425, 426) express these views in a graphic form. The first figure has the tree-shape adopted by Fürbringer, which, after several trials, I find more suitable to the present purpose than the usual straight-line diagram. The second figure shows the same thing in horizontal projection: the various genera of Dinornithidæ are included in a tinted area indicating the limits of the family: the Dinornithidæ and *Apteryx* on the one hand, and the Emu and Cassowary on the other, are enclosed by an even line indicating the limits of two groups, probably of subordinal value, including respectively the New Zealand and the Australian forms: finally all these are enclosed within a dotted line to show that the Australasian forms may be included in a natural group, perhaps of ordinal value, clearly separated from the isolated Asio-African and South-American genera.

These conclusions may be further expressed by a table of Classification as follows:—

Subclass **RATITÆ**, Merrem.
- Order I. STRUTHIONES, Newton.
  - Fam. Struthionidæ. Genus *Struthio*.
- Order II. RHEÆ, Newton.
  - Fam. Rheidæ. Genus *Rhea*.
- Order III. MEGISTANES, Newton.
  - Suborder 1. Casuariformes, Fürbringer.
    - Fam. 1. Casuariidæ. Genus *Casuarius*.
    - 2. Dromæidæ. Genus *Dromæus*.
  - Suborder 2. Apterygiformes, Fürbringer.
    - Fam. 1. Dinornithidæ.
      - Subfam. *a*. **Dinornithinæ**. Genus *Dinornis*.
      - Subfam. *b*. **Anomalopteryginæ**. Genera *Pachyornis, Mesopteryx, Anomalopteryx*[1].
      - Subfam. *c*. **Emeinæ**. Genus *Emeus*.
    - Fam. 2. Apterygidæ. Genus *Apteryx*.

List of Works referred to.

1. Forbes, H. O. Preliminary Notice of Additions to the Extinct Avifauna of New Zealand. (Abstract.) Trans. N. Z. Inst. vol. xxiv. (1891), p. 185.
2. Forbes, H. O. On a Recent Discovery of the Remains of Extinct Birds in New Zealand. Nature, vol. xlv. (1892), p. 416.

[1] And probably *Megalapteryx*. See Note, p. 378.—*June* 1895.

3. Fürbringer, M. Morphologie und Systematik der Vögel. 1888. *Amsterdam.*
4. Garrod, A. H. On the Value in Classification of a peculiarity in the anterior margin of the Nasal Bone in certain Birds. Proc. Zool. Soc. 1873, p. 33.
5. Haast, J. von. On the Measurements of Dinornis Bones, &c. Trans. N. Z. Inst. vol. i. (1868), p. 21.
6. Haast, J. von. Presidential Address. Philos. Inst. of Canterbury. Trans. N. Z. Inst. vol. vi. (1873), p. 419.
7. Haast, J. von. On *Dinornis oweni.* Trans. Zool. Soc. vol. xii. (1886), p. 171.
8. Hutton, F. W. Remarks on Dr. von Haast's Classification of the Moas. Trans. N. Z. Inst. vol. ix. (1876), p. 363.
9. Hutton, F. W. The Moas of New Zealand. Trans. N. Z. Inst. vol. xxiv. (1891), p. 93.
10. Huxley, T. H. On the Classification of Birds. Proc. Zool. Soc. 1867, p. 415.
11. Jaeger, G. Bericht über einen fast vollständigen Schädel von *Palapteryx.* Reise der Novara, Paläontologie (1865), p. 305.
12. Lydekker, R. Catalogue of the Fossil Birds in the British Museum. *London,* 1891.
13. Mivart, St. G. On the Axial Skeleton of the Struthionidæ. Trans. Zool. Soc. vol. x. (1871), p. 1.
14. Newton, A. Art. Ornithology. Encycl. Brit. 9th ed. vol. xviii. (1885), p. 2.
15. Nicholson, H. A., and Lydekker, R. Manual of Palæontology. *Edinburgh.* 1889.
16. Owen, R. On *Dinornis*: Pt. 2 (1846). Trans. Zool. Soc. vol. iii. p. 307 (Ext. Birds of N. Z. p. 115).
17. Owen, R. On *Dinornis*: Pt. 3 (1848). Trans. Zool. Soc. vol. iii. p. 345 (Ext. Birds of N. Z. p. 179).
18. Owen, R. On *Dinornis*: Pt. 5 (1850). Trans. Zool. Soc. vol. iv. p. 59 (Ext. Birds of N. Z. p. 205).
19. Owen, R. On *Dinornis*: Pt. 9 (1864). Trans. Zool. Soc. vol. v. p. 337 (Ext. Birds of N. Z. p. 151).
20. Owen, R. On *Dinornis*: Pt. 14 (1869). Trans. Zool. Soc. vol. vii. p. 123 (Ext. Birds of N. Z. p. 262).
21. Owen, R. On *Dinornis*: Pt. 21 (1875). Trans. Zool. Soc. vol. x. p. 147 (Ext. Birds of N. Z. p. 427).
22. Owen, R. On *Dinornis*: Pt. 23 (1882). Trans. Zool. Soc. vol. xi. p. 233.
23. Owen, R. On *Dinornis*: Pt. 24 (1882). Trans. Zool. Soc. vol. xi. p. 257.
24. Parker, T. J. On the Anatomy and Development of *Apteryx.* Phil. Trans. vol. clxxxii. B (1891), p. 25.
25. Parker, W. K. On the Structure and Development of the Skull in the Ostrich Tribe. Phil. Trans. vol. clvi. (1866), p. 113.
26. Reichenbach, H. G. L. Das natürliche System der Vögel. *Dresden.* 1852.
27. Selenka, E. Bronn's Thierreich: Aves.
28. Wallace, A. R. Geographical Distribution of Animals, 1876.

EXPLANATION OF THE PLATES.

PLATE LVI.

Figs. 1–4. Four views of a perfect skull of *Emeus*, species α, in the Otago University Museum. Natural size.

PLATE LVII.

Figs. 5–8. Outline sketches of figs. 1–4, with the various bones distinguished by colour.

PLATE LVIII.

Fig. 9. Back view of the skull shown in Plate LVI.

Fig. 10. Cranium of *Emeus*, species α, in horizontal section.

Fig. 11. The same in sagittal section.

Figs. 12 & 13. Two views of an immature cranium of *Anomalopteryx didiformis*, Owen.

All natural size.

PLATE LIX.

Figs. 14–18. Outline sketches of figs. 9–13, with the various bones distinguished by colour.

PLATE LX.

Fig. 19. Skull of *Mesopteryx casuarina*, in Dr. H. O. Forbes's Collection.

Figs. 20 & 21. Two views of the skull of *Mesopteryx*, species β, in the Colonial Museum, Wellington.

Both natural size.

Fig. 22. Skull of *Pachyornis elephantopus*, in Dr. H. O. Forbes's Collection.

Five-sixths natural size.

PLATE LXI.

Figs. 23–34. Outlines of the crania of various species of Dinornithidæ, from above. Drawn to the same absolute size with the camera lucida.

Figs. 35–46. A similar series of outlines from the left side.

PLATE LXII.

Figs. 47–58. A similar series of outlines from behind.

Figs. 59–64. The maxillo-jugal arch (maxilla only in *Rhea*) of various Ratitæ. Natural size.

Figs. 65–70. The quadrate facet on the roof of the tympanic cavity, in various Ratitæ. Drawn to the same absolute size.

als., alisphenoid; *pr.o.*, prootic; *sq.*, squamosal; *ex.oc.*, exoccipital.

Figs. 71–76. The optic and adjacent foramina in various Ratitæ. Drawn to the same absolute size.

ii, optic foramen; iii, oculomotor foramen; iv, pathetic foramen; v^1, orbitonasal foramen; vi, abducent foramen; *a*, foramen for internal ophthalmic artery.

List of Abbreviations.

a.b.cr.fon. Position of anterior basicranial fontanelle.
abd.for. Abducent foramen.
a.lamb.r. Anterior lambdoidal ridge.
al.n. Alinasal.
al.sph. Alisphenoid.
ang. Angular.
a.orb. Antorbital.
art. Articular.

b.oc. Basioccipital.
b.pt.pr. Basipterygoid process.
b.sph. Basisphenoid.
b.temp. Basitemporal.
b.temp.pl. Basitemporal platform.

car.for. Carotid foramen.
cer.fos. Cerebellar fossa.
con.for. Condylar foramen or foramina.

d. Dentary.
dor.sell. Dorsum sellæ.

eth. Ethmoid.
eus.gr. Eustachian groove.
ex.oc. Exoccipital.

for.a. Foramen *a*.
foss.b. Fossa *b*.
fr. Frontal.

Hard.fos. Harderian fossa.

inf.al.eth. Inferior aliethmoid.
inf.orb.for. Inferior orbital foramen.
inf.temp.r. Inferior temporal ridge.
int.aud.m. Internal auditory meatus.

ju. Jugal.

lac. Lacrymal.
lac.for. Lacrymal foramen.

mam.tub. Mamillar tuberosity.
mesen.fos. Mesencephalic fossa.
mes.eth. Mesethmoid.
m.temp.r. Mid-temporal ridge.
mx. Maxilla.
mx.ju.ar. Maxillo-jugal arch.
mx.na. Maxillo-nasal.
mx.pal. Maxillo-palatine.
mx.pr. Maxillary process.

na. Nasal.
na.pr. Nasal process.

oc.con. Occipital condyle.
oc.cr. Occipital crest.
oc.for. Oculomotor foramen.
olf.ch. Olfactory chamber.
op.for. Optic foramen.

op.pl. Optic platform.
orb.na.for. Orbitonasal foramen.
orb.pr. Orbital process.
or.sph. Orbitosphenoid.
ot.pr. Otic process.

pa. Parietal.
pal. Palatine.
pal.pr. Palatine process.
par.oc.pr. Paroccipital process.
path.for. Pathetic foramen.
p.b.cr.fon. Posterior basicranial fontanelle.
pit.fos. Pituitary fossa.
p.lamb.r. Posterior lambdoidal ridge.
p.mx. Premaxilla.
post.orb.pr. Postorbital process.
post.temp.fos. Post-temporal fossa.
post.temp.r. Post-temporal ridge.
pre.con.fos. Precondylar fossa.
pre.orb.pr. Preorbital process.
pre.temp.w. Pretemporal wing.
pr.lacer.fos. Prelacerate fossa.
pr.op.r. Preoptic ridge.
pr.ot. Prootic.
pr.pit.r. Prepituitary ridge.
pr.sph. Presphenoid.
pr.sph.foss. Presphenoid fossa.
pt. Pterygoid.

q. Quadrate.
q.j. Quadrato-jugal.

rost. Rostrum.

s.ang. Supra-angular.
.oc. Supra-occipital.
s.oc.fos. Supra-occipital fossa.
sq. Squamosal.
sq.prm. Squamosal prominence.
sup.al.eth. Superior aliethmoid.
sup.for.r. Supra-foraminal ridge.
sup.orb.fen. Supra-orbital fenestra.

temp.fos. Temporal fossa.
temp.r. Temporal ridge.
tent.r. Tentorial ridge.
trig.for. Trigeminal foramen.
tri.pr. Triangular process.
turb. Turbinal.

vag.for. Vagus foramen.
vo. Vomer.
vo.pr. Vomerine process.

zyg.pr. Zygomatic process.

Fig. 1.

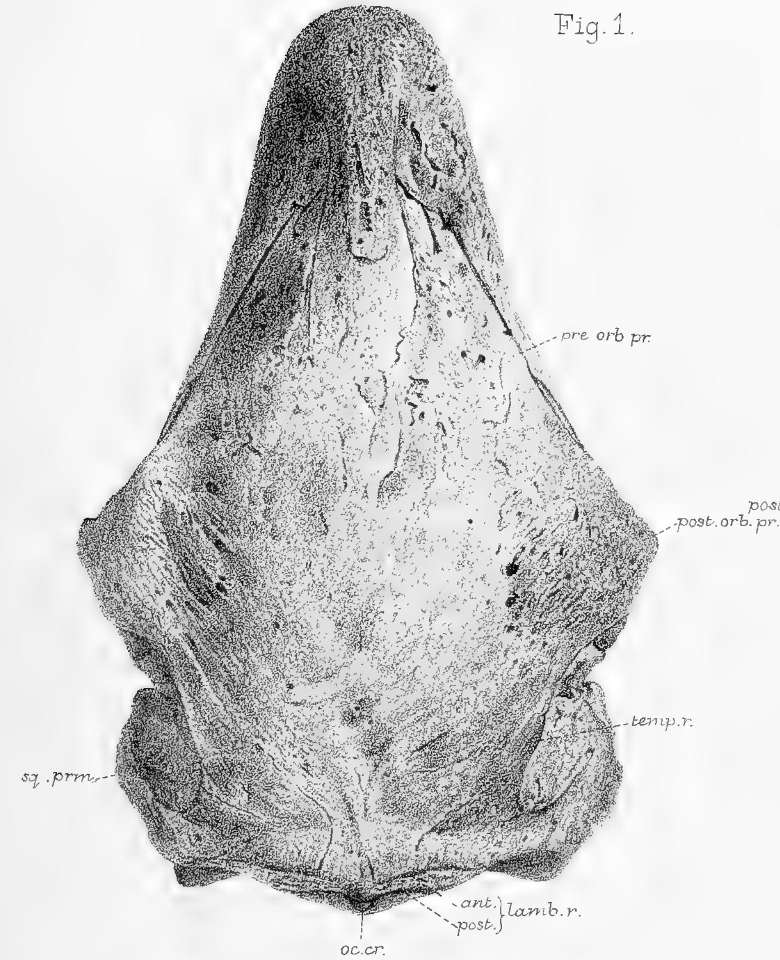


Fig. 2

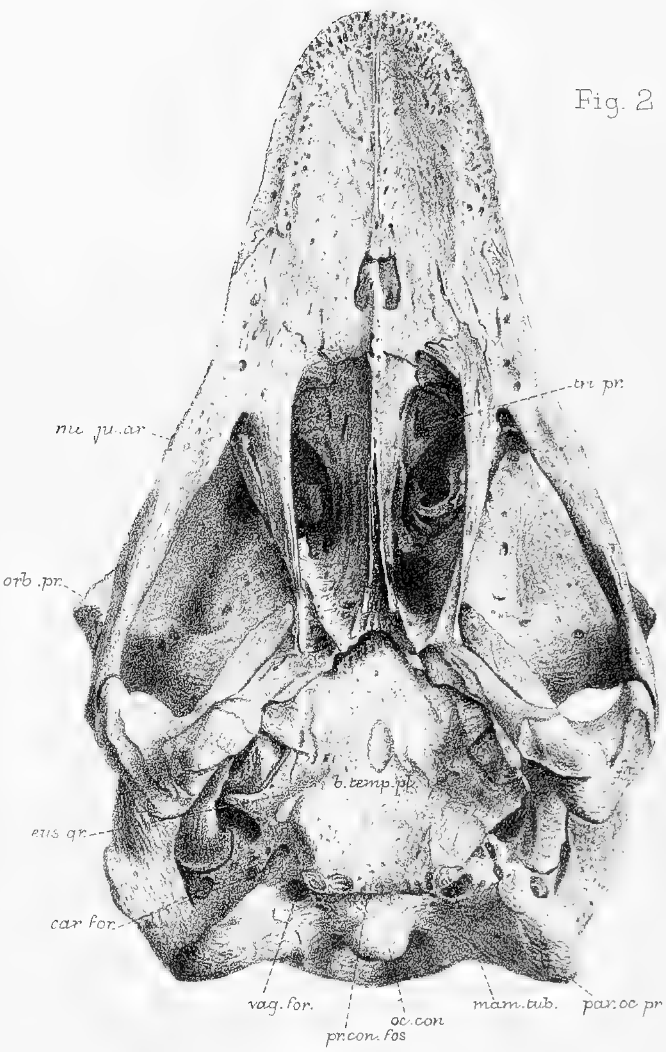


Fig. 3.

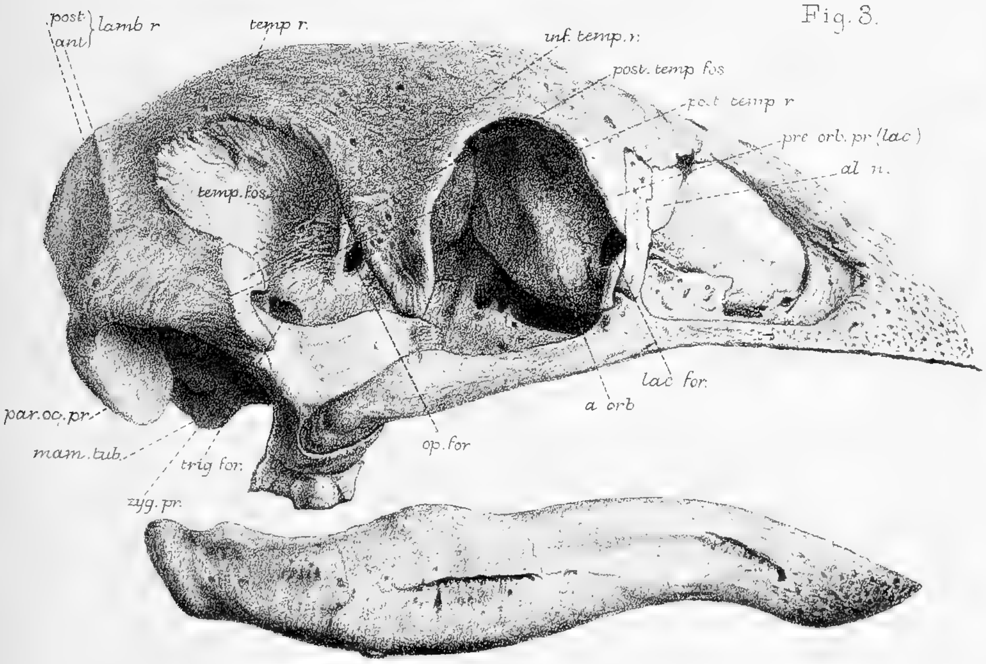
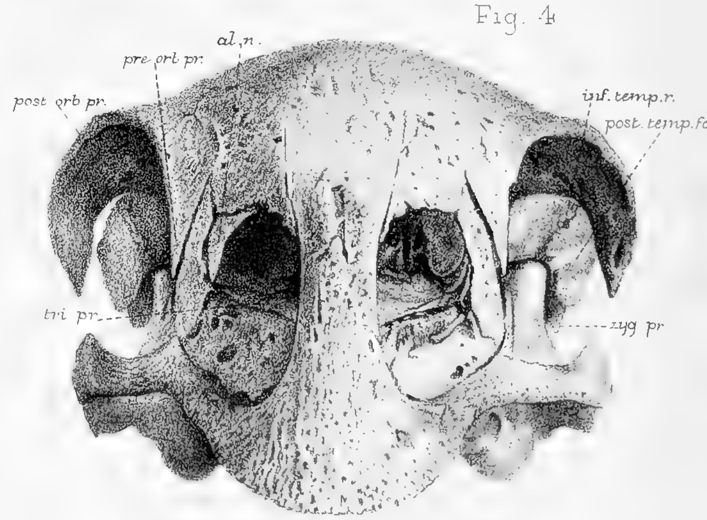


Fig. 4



J. Thomson. photo.
M.P. Parker, lith.

West, Newman, imp.

EMEUS *sp. α.*

Fig. 5

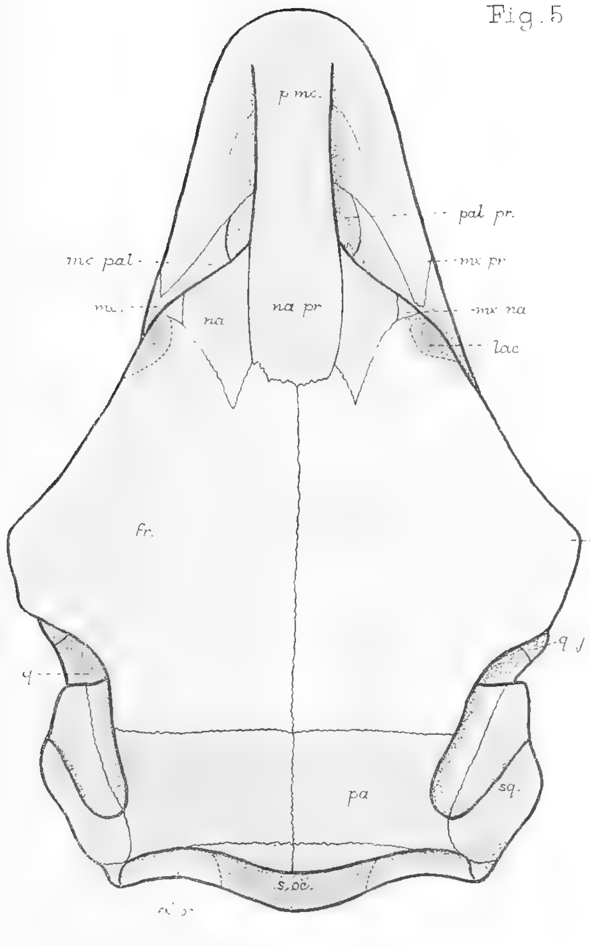


Fig 6

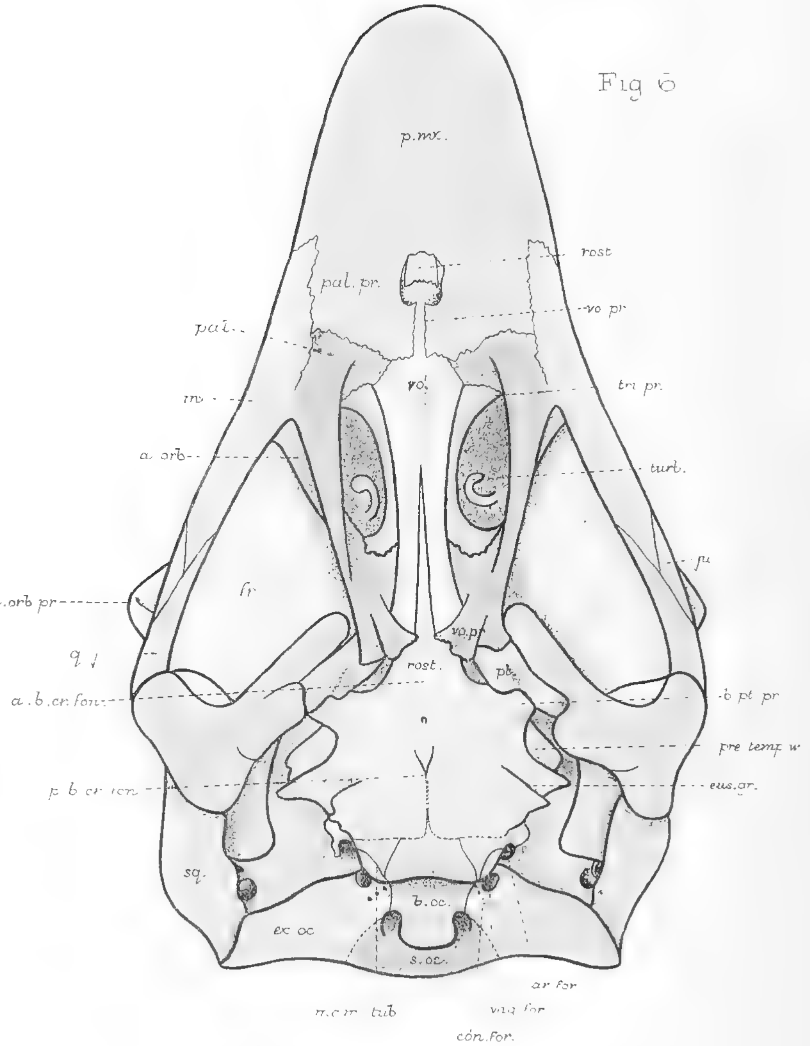


Fig. 7

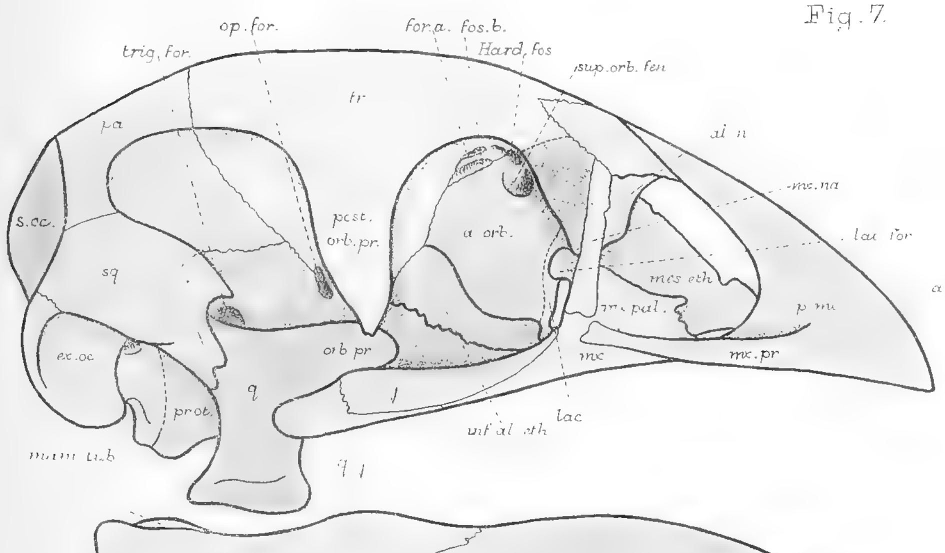
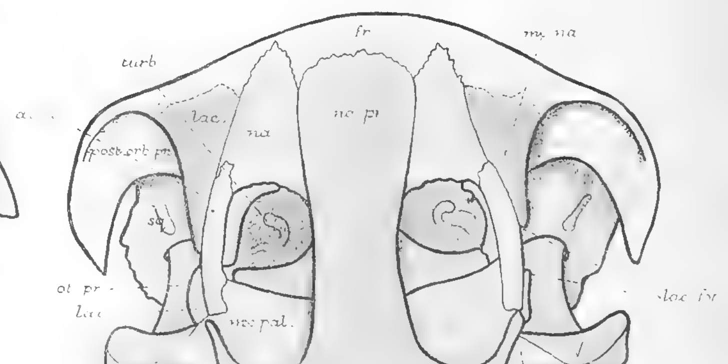


Fig 8



T. J. P. delt.
M. P. Parker Chromo.

West, Newman imp.

EMEUS sp. a.

Fig. 9

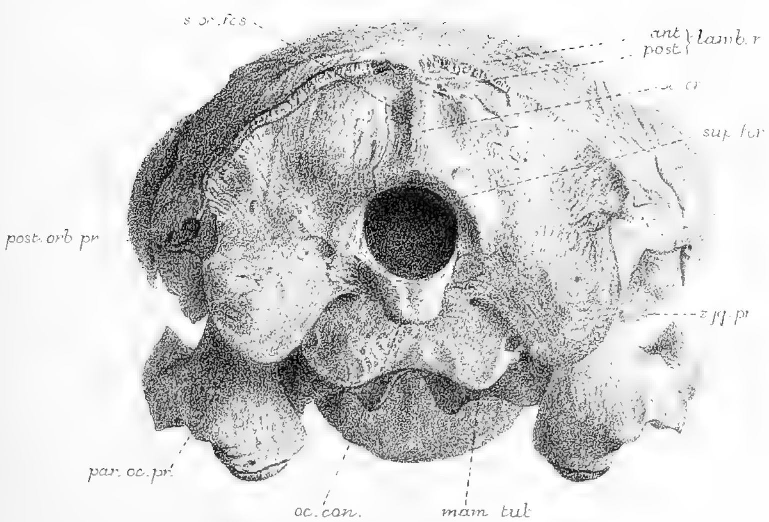


Fig 10

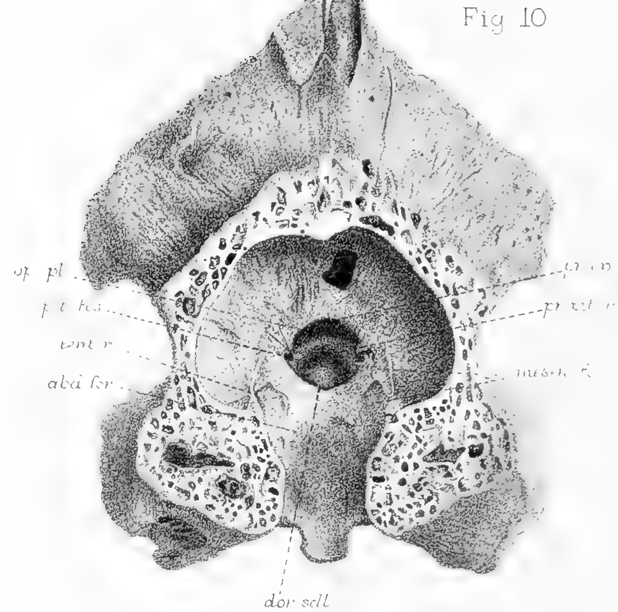


Fig 11

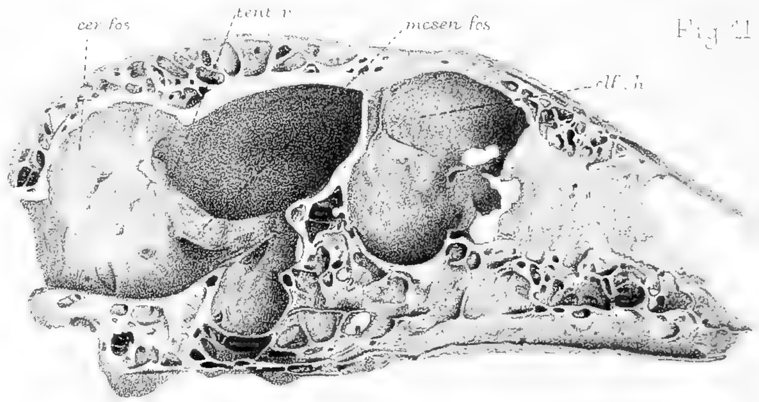


Fig 12

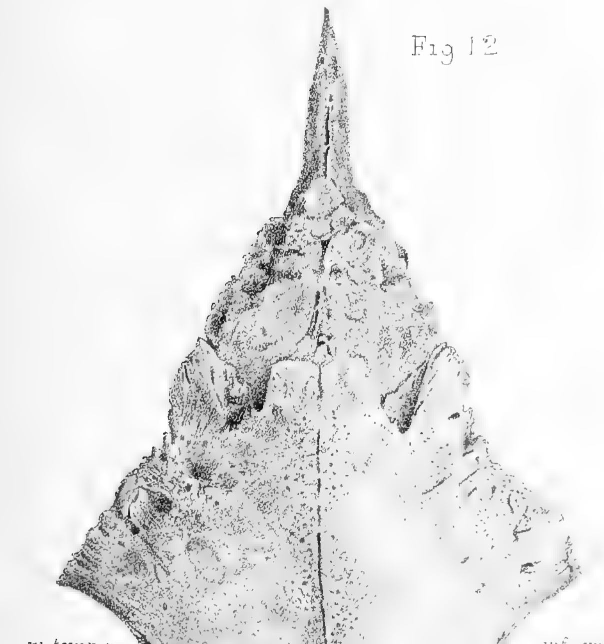
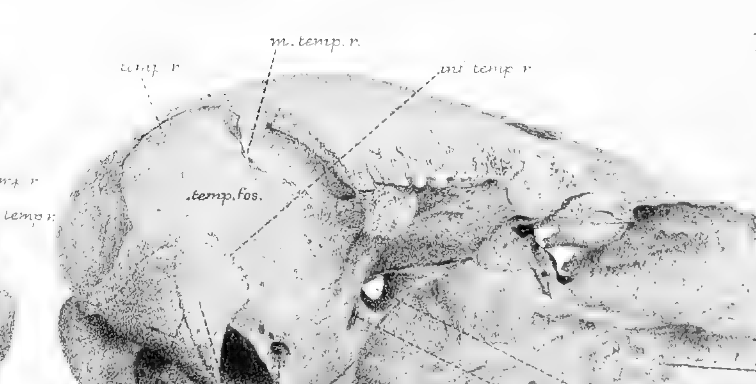


Fig. 13



J. Thomson. photo.
M. P. Parker. lith.

West, Newman imp.

Figs. 9-11 EMEUS *sp. a.*
Figs. 12 & 13, ANOMALOPTERYX DIDIFORMIS.

Fig. 14.

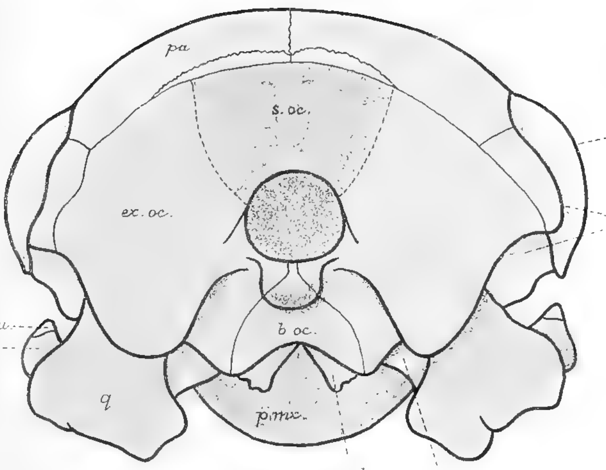


Fig 15.

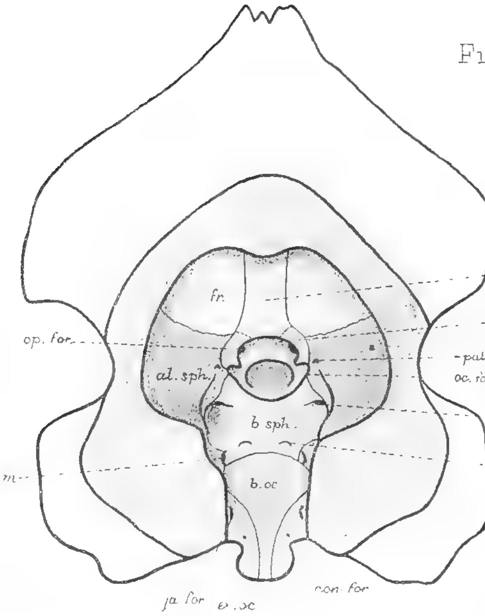


Fig 17

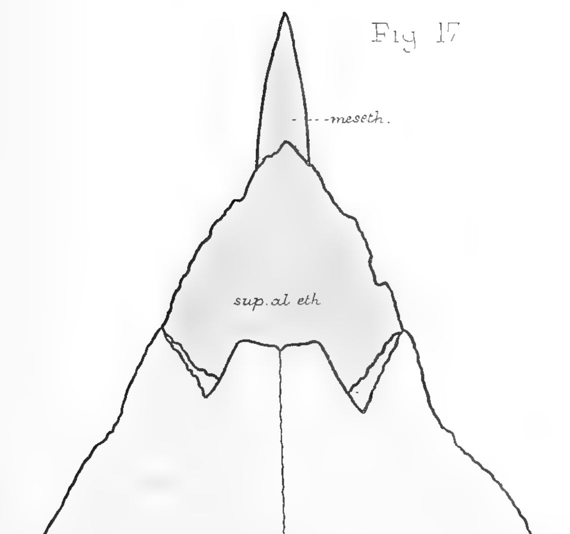


Fig. 16

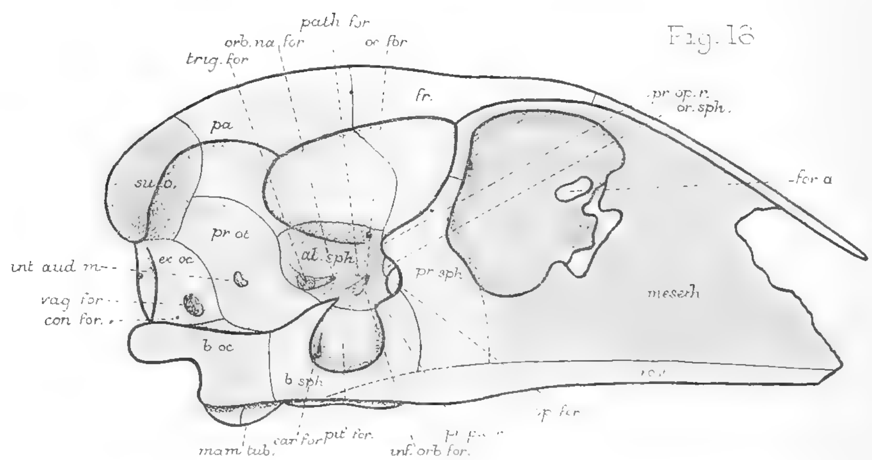
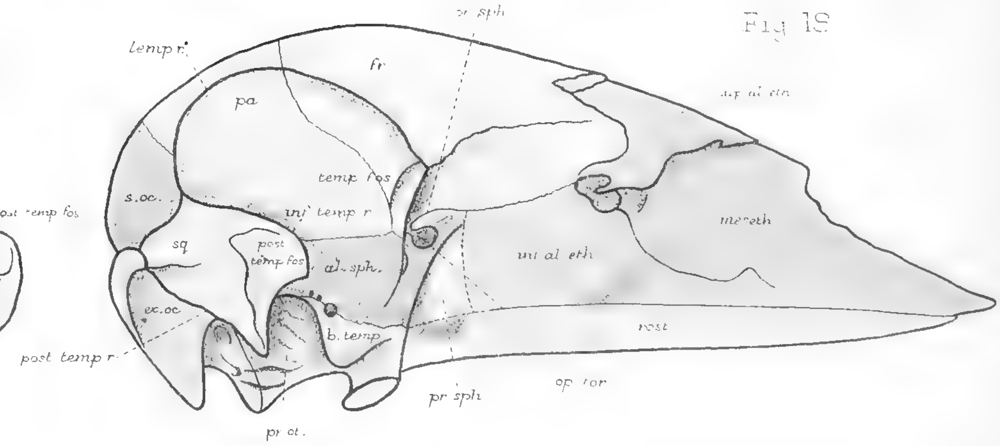


Fig 18



T.J.P. del.
M.P. Parker Chromo.

West, Newman imp.

Figs. 14-16 EMEUS *sp. α.*
Figs. 17 & 18, ANOMOLOPTERYX DIDIFORMIS

Trans. Zool. Soc. Vol. XIII. Pl. LX.

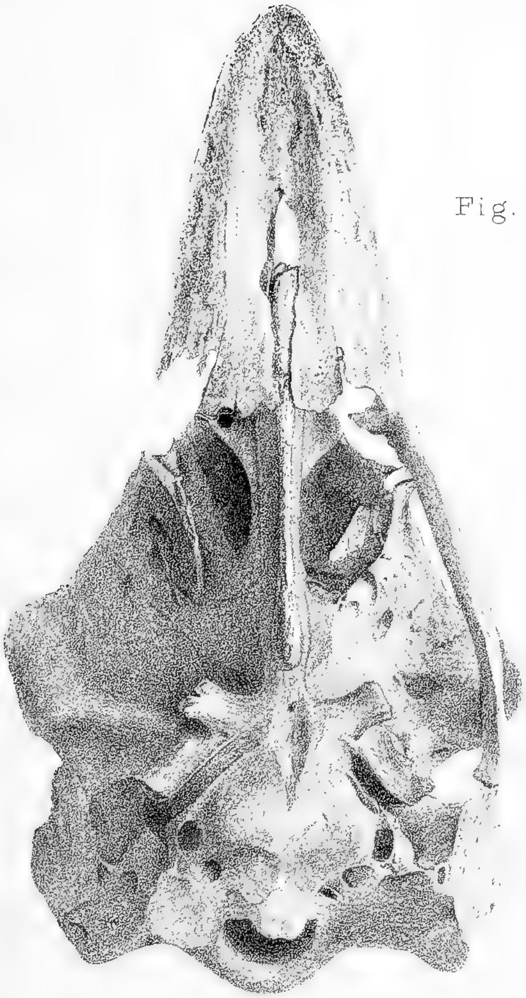


Fig. 19.

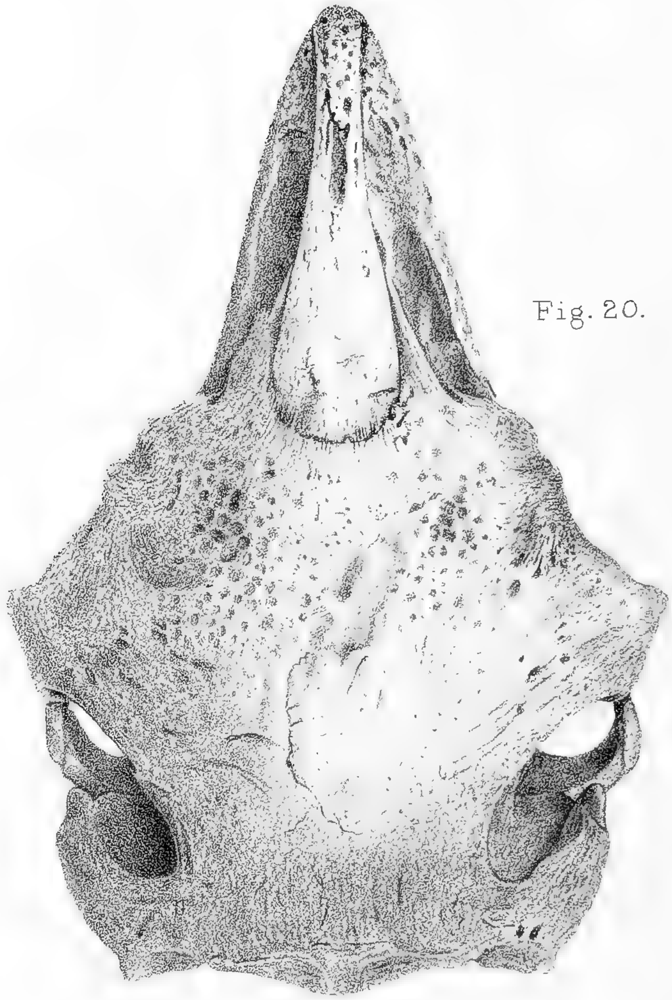


Fig. 20.

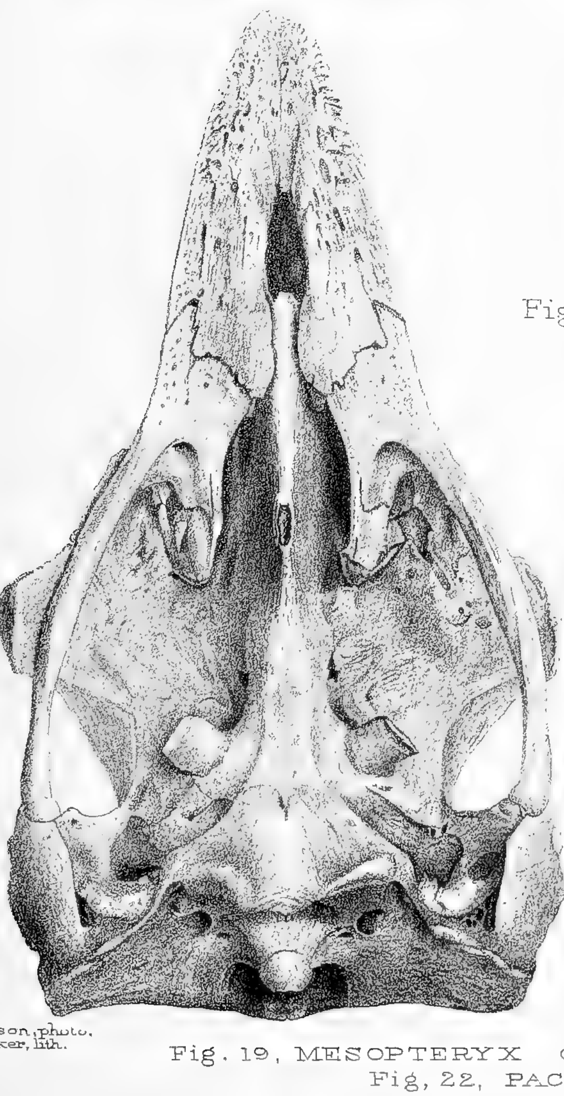


Fig. 22.
× 5/6

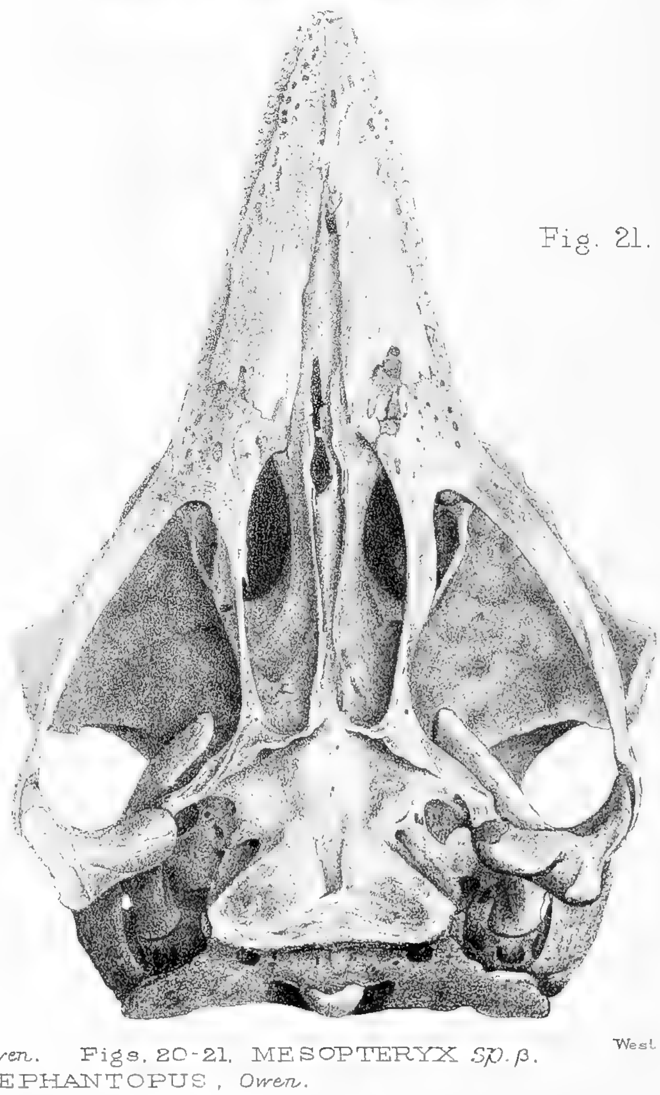
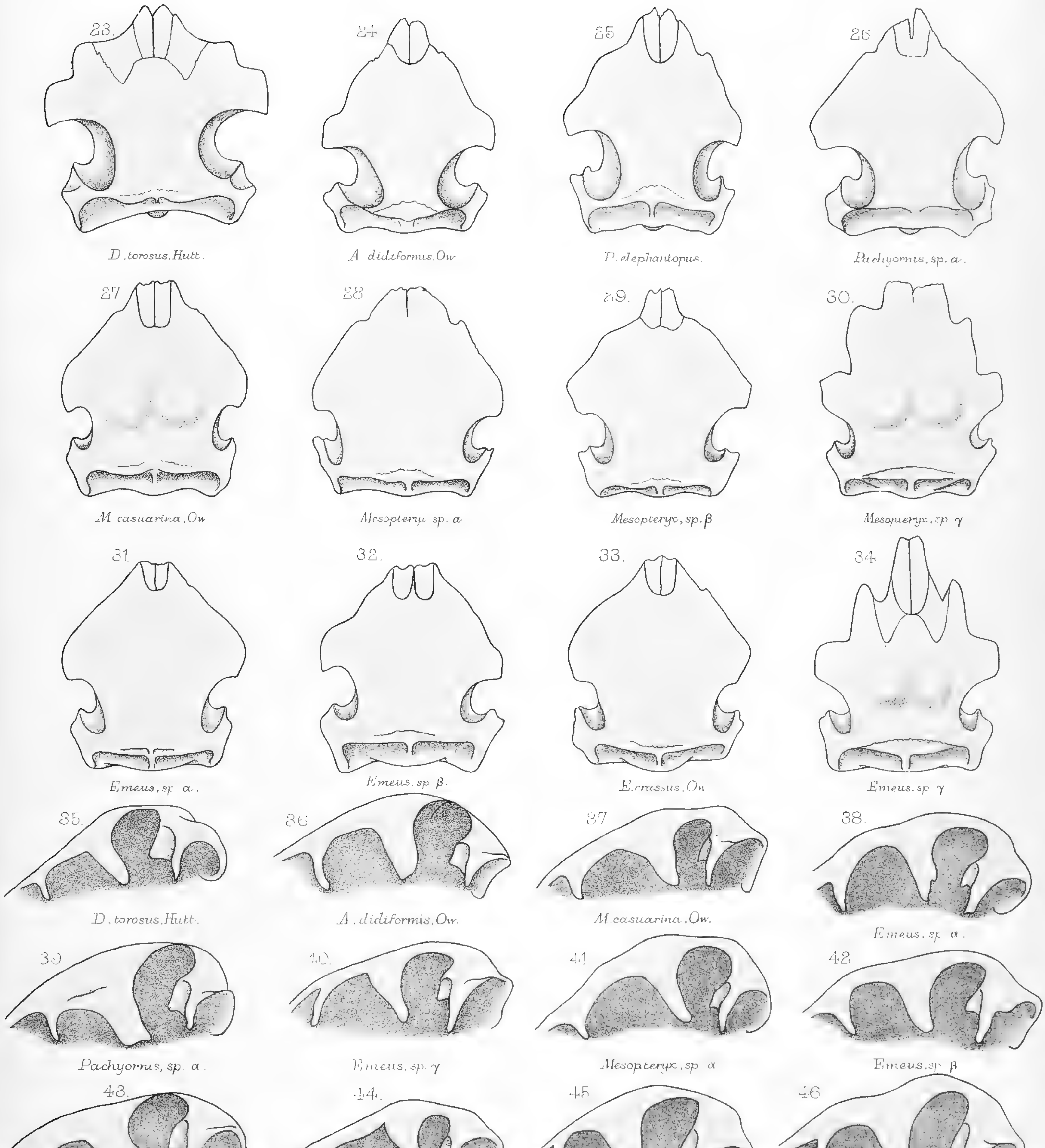


Fig. 21.

J. Thomson, photo.
M. P. Parker, lith.

West, Newman, imp.

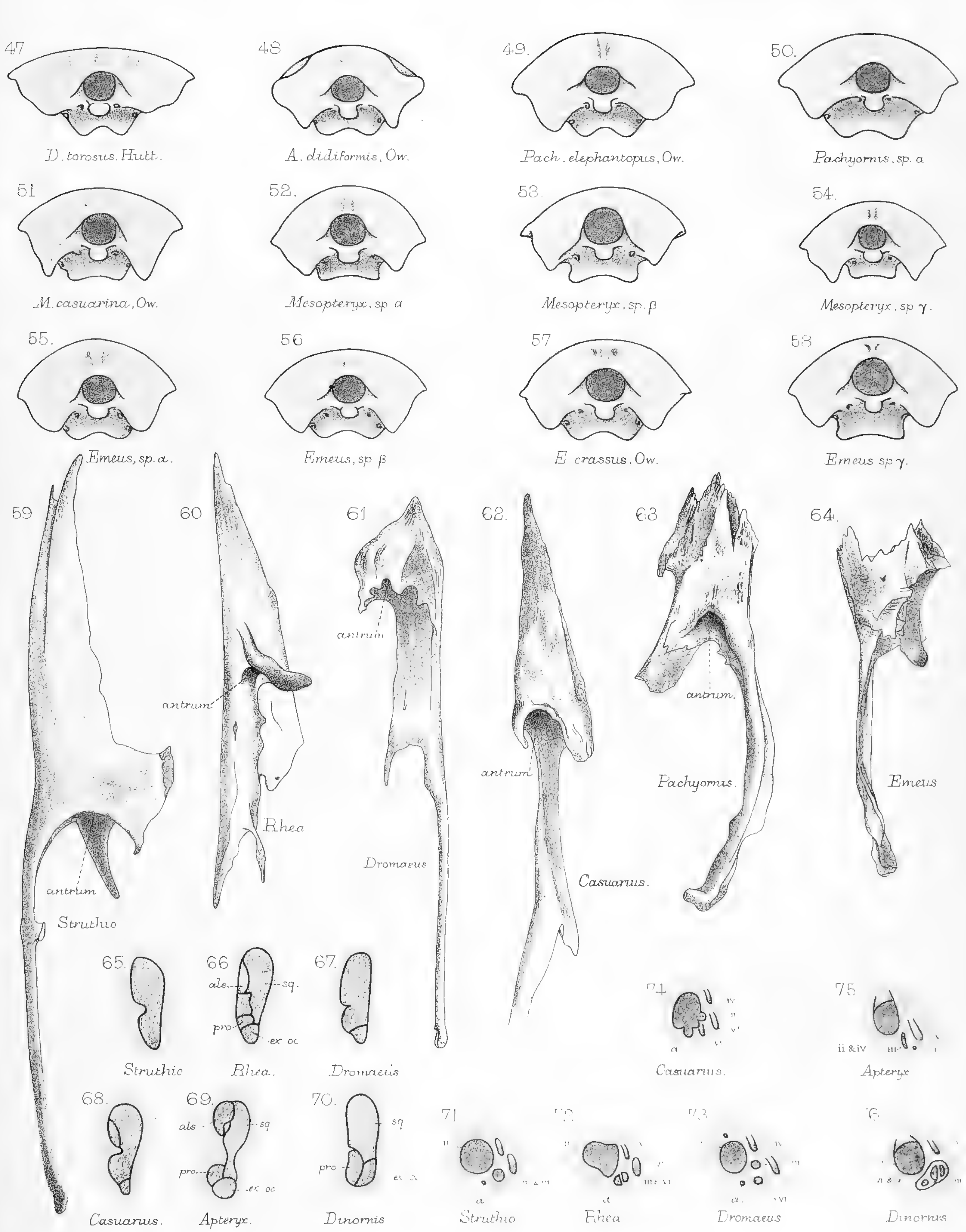
Fig. 19, MESOPTERYX CASUARINA *Owen*. Figs. 20-21, MESOPTERYX *sp.* β.
Fig. 22, PACHYORNIS ELEPHANTOPUS, *Owen*.



J. J. P., del.
M. P. Parker lith.

West, Newman imp.

OUTLINES OF CRANIA OF DINORNITHIDÆ



A. Hamilton & T.J.P. delt.
M. P. Parker. lith.

West, Newman imp.

Figs. 47–58, OUTLINES OF CRANIA OF DINORNITHIDÆ.
" 59–76, PARTS OF SKULL OF VARIOUS RATITÆ.

LIST OF THE PAPERS CONTAINED IN VOL. XIII.

INDEX OF SPECIES, ETC., IN VOL. XIII.

END OF VOLUME XIII.

PRINTED BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

VOL. XIII.—PART 1.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

January 1891.

Price 21*s*.

Taylor and Francis, Printers.] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £	s.	d.	To the Public. £	s.	d.
VOLUME I. (1833–1835, containing 59 Plates)	Price	3	13	6	4	18	0*
VOLUME II. (1835–1841, containing 71 Plates)	Price	4	0	0	5	6	6*
VOLUME III. (1842–1849, containing 63 Plates)	Price	3	8	6	4	11	0*
VOLUME IV. (1851–1862, containing 78 Plates)	Price	6	2	0	8	2	6*
VOLUME V. (1862–1866, containing 67 Plates)	Price	5	4	3	6	19	0
VOLUME VI. (1866–1869, containing 91 Plates)	Price	11	5	0	15	0	0
VOLUME VII. (1869–1872, containing 73 Plates)	Price	10	4	0	13	12	0
VOLUME VIII. (1872–1874, containing 82 Plates)	Price	9	8	3	12	11	0
PART 1. (1872)	,,	0	10	6	0	14	0
,, 2. (1872)	,,	1	11	6	2	2	0
,, 3. (1872)	,,	1	7	0	1	16	0
,, 4. (1873)	,,	0	15	9	1	1	0
,, 5. (1873)	,,	0	18	0	1	4	0
,, 6. (1873)	,,	0	19	6	1	6	0
,, 7. (1874)	,,	0	16	6	1	2	0
,, 8. (1874)	,,	0	18	0	1	4	0
,, 9. (1874)	,,	1	11	6	2	2	0
VOLUME IX. (1875–1877, containing 99 Plates)	Price	12	0	0	16	0	0
PART 1. (1875, containing 22 Plates)	,,	1	11	6	2	2	0
,, 2. (1875, containing 12 Plates)	,,	1	11	6	2	2	0
,, 3. (1875, containing 5 Plates)	,,	0	18	0	1	4	0
,, 4. (1875, containing 14 Plates)	,,	1	11	6	2	2	0
,, 5. (1875, containing 9 Plates)	,,	1	2	6	1	10	0
,, 6. (1876, containing 4 Plates)	,,	0	10	6	0	14	0
,, 7. (1876, containing 7 Plates)	,,	0	15	9	1	1	0
,, 8. (1876, containing 10 Plates)	,,	0	18	0	1	4	0
,, 9. (1876, containing 6 Plates)	,,	1	4	0	1	12	0
,, 10. (1877, containing 5 Plates)	,,	1	2	6	1	10	0
,, 11. (1877, containing 5 Plates and Title and Index)	,,	0	15	9	1	1	0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

VOL. XIII.—PART 2.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

April 1891.

Price 21*s*.

Taylor and Francis, Printers.] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows.				To the Public.		
		£	s.	d.		£	s.	d.
VOLUME I. (1833–1835, containing 59 Plates) . .	Price	3	13	6	. . .	4	18	0*
VOLUME II. (1835–1841, containing 71 Plates) . .	Price	4	0	0	. . .	5	6	6*
VOLUME III. (1842–1849, containing 63 Plates) . .	Price	3	8	3	. . .	4	11	0*
VOLUME IV. (1851–1862, containing 77 Plates) . .	Price	6	2	0	. . .	8	2	6*
VOLUME V. (1862–1866, containing 67 Plates) . .	Price	5	4	3	. . .	6	19	0
VOLUME VI. (1866–1869, containing 92 Plates) . .	Price	11	5	0	. . .	15	0	0
VOLUME VII. (1869–1872, containing 73 Plates) . .	Price	10	4	0	. . .	13	12	0
VOLUME VIII. (1872–1874, containing 82 Plates) . .	Price	9	8	3	. . .	12	11	0
VOLUME IX. (1875–1877, containing 99 Plates) . .	Price	12	1	6	. . .	16	2	0
VOLUME X. (1877–1879, containing 95 Plates) . .	Price	10	0	3	. . .	13	7	0
Part 1. (1877, with numerous woodcuts)	„	0	9	0	. . .	0	12	0
„ 2. (1877, containing 27 Plates)	„	1	2	6	. . .	1	10	0
„ 3. (1877, containing 6 Plates)	„	0	18	0	. . .	1	4	0
„ 4. (1878, containing 9 Plates)	„	1	2	6	. . .	1	10	0
„ 5. (1878, containing 3 Plates)	„	0	9	0	. . .	0	12	0
„ 6. (1878, containing 9 Plates)	„	1	2	6	. . .	1	10	0
„ 7. (1878, containing 7 Plates)	„	0	18	0	. . .	1	4	0
„ 8. (1878, containing 8 Plates)	„	0	15	0	. . .	1	0	0
„ 9. (1878, containing 4 Plates)	„	0	9	0	. . .	0	12	0
„ 10. (1879, containing 6 Plates)	„	0	12	0	. . .	0	16	0
„ 11. (1879, containing 5 Plates)	„	0	9	0	. . .	0	12	0
„ 12. (1879, containing 4 Plates)	„	0	15	9	. . .	1	1	0
„ 13. (1879, containing 7 Plates and Title and Index)	„	0	18	0	. . .	1	4	0
General Index, Vols. I. to X. (1833–1879) . . .	„	0	7	6	. . .	0	10	0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

Vol. XIII.—Part 3.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

October 1891.

Price 24*s*.

Taylor and Francis, Printers.] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

	To Fellows. £ s. d.	To the Public. £ s. d.
VOLUME I. (1833–1835, containing 59 Plates) . . Price	3 13 6	4 18 0*
VOLUME II. (1835–1841, containing 71 Plates) . . Price	4 0 0	5 6 6*
VOLUME III. (1842–1849, containing 63 Plates) . . Price	3 8 3	4 11 0*
VOLUME IV. (1851–1862, containing 77 Plates) . . Price	6 2 0	8 2 6*
VOLUME V. (1862–1866, containing 67 Plates) . . Price	5 4 3	6 19 0
VOLUME VI. (1866–1869, containing 92 Plates) . . Price	11 5 0	15 0 0
VOLUME VII. (1869–1872, containing 73 Plates) . . Price	10 4 0	13 12 0
VOLUME VIII. (1872–1874, containing 82 Plates) . . Price	9 8 3	12 11 0
VOLUME IX. (1875–1877, containing 99 Plates) . . Price	12 1 6	16 2 0
VOLUME X. (1877–1879, containing 95 Plates) . . Price	10 0 3	13 7 0
Part 1. (1877, with numerous woodcuts) . . . . „	0 9 0	0 12 0
„ 2. (1877, containing 27 Plates) . . . . . „	1 2 6	1 10 0
„ 3. (1877, containing 6 Plates) . . . . . „	0 18 0	1 4 0
„ 4. (1878, containing 9 Plates) . . . . . „	1 2 6	1 10 0
„ 5. (1878, containing 3 Plates) . . . . . „	0 9 0	0 12 0
„ 6. (1878, containing 9 Plates) . . . . . „	1 2 6	1 10 0
„ 7. (1878, containing 7 Plates) . . . . . „	0 18 0	1 4 0
„ 8. (1878, containing 8 Plates) . . . . . „	0 15 0	1 0 0
„ 9. (1878, containing 4 Plates) . . . . . „	0 9 0	0 12 0
„ 10. (1879, containing 6 Plates) . . . . . „	0 12 0	0 16 0
„ 11. (1879, containing 5 Plates) . . . . . „	0 9 0	0 12 0
„ 12. (1879, containing 4 Plates) . . . . . „	0 15 9	1 1 0
„ 13. (1879, containing 7 Plates and Title and Index) „	0 18 0	1 4 0
General Index, Vols. I. to X. (1833–1879) . . . „	0 7 6	0 10 0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

VOL. XIII.—PART 4.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

April 1892.

Price 6*s*.

Taylor and Francis, Printers.] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £ s. d.	To the Public. £ s. d.
VOLUME I.	(1833–1835, containing 59 Plates) . . Price	3 13 6	4 18 0*
VOLUME II.	(1835–1841, containing 71 Plates) . . Price	4 0 0	5 6 6*
VOLUME III.	(1842–1849, containing 63 Plates) . . Price	3 8 3	4 11 0*
VOLUME IV.	(1851–1862, containing 77 Plates) . . Price	6 2 0	8 2 6*
VOLUME V.	(1862–1866, containing 67 Plates) . . Price	5 4 3	6 19 0
VOLUME VI.	(1866–1869, containing 92 Plates) . . Price	11 5 0	15 0 0
VOLUME VII.	(1869–1872, containing 73 Plates) . . Price	10 4 0	13 12 0
VOLUME VIII.	(1872–1874, containing 82 Plates) . . Price	9 8 3	12 11 0
VOLUME IX.	(1875–1877, containing 99 Plates) . . Price	12 1 6	16 2 0
VOLUME X.	(1877–1879, containing 95 Plates) . . Price	10 0 3	13 7 0
Part 1.	(1877, with numerous woodcuts) . . . . „	0 9 0	0 12 0
„ 2.	(1877, containing 27 Plates) . . . . . „	1 2 6	1 10 0
„ 3.	(1877, containing 6 Plates) . . . . . „	0 18 0	1 4 0
„ 4.	(1878, containing 9 Plates) . . . . . „	1 2 6	1 10 0
„ 5.	(1878, containing 3 Plates) . . . . . „	0 9 0	0 12 0
„ 6.	(1878, containing 9 Plates) . . . . . „	1 2 6	1 10 0
„ 7.	(1878, containing 7 Plates) . . . . . „	0 18 0	1 4 0
„ 8.	(1878, containing 8 Plates) . . . . . „	0 15 0	1 0 0
„ 9.	(1878, containing 4 Plates) . . . . . „	0 9 0	0 12 0
„ 10.	(1879, containing 6 Plates) . . . . . „	0 12 0	0 16 0
„ 11.	(1879, containing 5 Plates) . . . . . „	0 9 0	0 12 0
„ 12.	(1879, containing 4 Plates) . . . . . „	0 15 9	1 1 0
„ 13.	(1879, containing 7 Plates and Title and Index) „	0 18 0	1 4 0
General Index,	Vols. I. to X. (1833–1879) . . . „	0 7 6	0 10 0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

VOL. XIII.—PART 5.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

February 1893.

Price 15*s*.

Taylor and Francis, Printers,] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £ s. d.	To the Public. £ s. d.
VOLUME I. (1833–1835, containing 59 Plates)	Price	3 13 6	4 18 0*
VOLUME II. (1835–1841, containing 71 Plates)	Price	4 0 0	5 6 6*
VOLUME III. (1842–1849, containing 63 Plates)	Price	3 8 3	4 11 0*
VOLUME IV. (1851–1862, containing 77 Plates)	Price	6 2 0	8 2 6*
VOLUME V. (1862–1866, containing 67 Plates)	Price	5 4 3	6 19 0
VOLUME VI. (1866–1869, containing 92 Plates)	Price	11 5 0	15 0 0
VOLUME VII. (1869–1872, containing 73 Plates)	Price	10 4 0	13 12 0
VOLUME VIII. (1872–1874, containing 82 Plates)	Price	9 8 3	12 11 0
VOLUME IX. (1875–1877, containing 99 Plates)	Price	12 1 6	16 2 0
VOLUME X. (1877–1879, containing 95 Plates)	Price	10 0 3	13 7 0
Part 1. (1877, with numerous woodcuts)	„	0 9 0	0 12 0
„ 2. (1877, containing 27 Plates)	„	1 2 6	1 10 0
„ 3. (1877, containing 6 Plates)	„	0 18 0	1 4 0
„ 4. (1878, containing 9 Plates)	„	1 2 6	1 10 0
„ 5. (1878, containing 3 Plates)	„	0 9 0	0 12 0
„ 6. (1878, containing 9 Plates)	„	1 2 6	1 10 0
„ 7. (1878, containing 7 Plates)	„	0 18 0	1 4 0
„ 8. (1878, containing 8 Plates)	„	0 15 0	1 0 0
„ 9. (1878, containing 4 Plates)	„	0 9 0	0 12 0
„ 10. (1879, containing 6 Plates)	„	0 12 0	0 16 0
„ 11. (1879, containing 5 Plates)	„	0 9 0	0 12 0
„ 12. (1879, containing 4 Plates)	„	0 15 9	1 1 0
„ 13. (1879, containing 7 Plates and Title and Index)	„	0 18 0	1 4 0
General Index, Vols. I. to X. (1833–1879)	„	0 7 6	0 10 0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

VOL. XIII.—PART 6.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

June 1893.

Price 12*s*.

Taylor and Francis, Printers,] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £	s.	d.	To the Public. £	s.	d.
VOLUME I. (1833–1835, containing 59 Plates)	Price	3	13	6	4	18	0*
VOLUME II. (1835–1841, containing 71 Plates)	Price	4	0	0	5	6	6*
VOLUME III. (1842–1849, containing 63 Plates)	Price	3	8	3	4	11	0*
VOLUME IV. (1851–1862, containing 77 Plates)	Price	6	2	0	8	2	6
VOLUME V. (1862–1866, containing 67 Plates)	Price	5	4	3	6	19	0
VOLUME VI. (1866–1869, containing 92 Plates)	Price	11	5	0	15	0	0
VOLUME VII. (1869–1872, containing 73 Plates)	Price	10	4	0	13	12	0
VOLUME VIII. (1872–1874, containing 82 Plates)	Price	9	8	3	12	11	0
VOLUME IX. (1875–1877, containing 99 Plates)	Price	12	1	6	16	2	0
VOLUME X. (1877–1879, containing 95 Plates)	Price	10	0	3	13	7	0
GENERAL INDEX, Vols. I. to X. (1833–1879)	Price	0	7	6	0	10	0
VOLUME XI. (1880–1885, containing 97 Plates)	Price	9	12	0	12	16	0
PART 1. (1880, containing 4 Plates)	,,	0	12	0	0	16	0
,, 2. (1880, containing 7 Plates)	,,	0	18	0	1	4	0
,, 3. (1881, containing 8 Plates)	,,	1	2	6	1	10	0
,, 4. (1881, containing 3 Plates)	,,	0	7	6	0	10	0
,, 5. (1881, containing 13 Plates)	,,	0	18	0	1	4	0
,, 6. (1882, containing 6 Plates)	,,	0	12	0	0	16	0
7. (1882, containing 9 Plates)	,,	0	15	0	1	0	0
,, 8. (1883, containing 11 Plates)	,,	0	12	0	0	16	0
,, 9. (1883, containing 10 Plates)	,,	0	12	0	0	16	0
,, 10. (1885, containing 12 Plates)	,,	1	11	6	2	2	0
,, 11. (1885, containing 14 Plates and Title and Index)	,,	1	11	6	2	2	0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

VOL. XIII.—PART 7.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN AND CO., PATERNOSTER-ROW.

August 1893.

Price 12*s*.

Taylor and Francis, Printers,] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows.				To the Public.		
		£	s.	d.		£	s.	d.
VOLUME I. (1833–1835, containing 59 Plates) . .	Price	3	13	6	. . .	4	18	0*
VOLUME II. (1835–1841, containing 71 Plates) . .	Price	4	0	0	. . .	5	6	6*
VOLUME III. (1842–1849, containing 63 Plates) . .	Price	3	8	3	. . .	4	11	0*
VOLUME IV. (1851–1862, containing 77 Plates) . .	Price	6	2	0	. . .	8	2	6
VOLUME V. (1862–1866, containing 67 Plates) . .	Price	5	4	3	. . .	6	19	0
VOLUME VI. (1866–1869, containing 92 Plates) . .	Price	11	5	0	. . .	15	0	0
VOLUME VII. (1869–1872, containing 73 Plates) . .	Price	10	4	0	. . .	13	12	0
VOLUME VIII. (1872–1874, containing 82 Plates) . .	Price	9	8	3	. . .	12	11	0
VOLUME IX. (1875–1877, containing 99 Plates) . .	Price	12	1	6	. . .	16	2	0
VOLUME X. (1877–1879, containing 95 Plates) . .	Price	10	0	3	. . .	13	7	0
GENERAL INDEX, Vols. I. to X. (1833–1879) . .	,,	0	7	6	. . .	0	10	0
VOLUME XI. (1880–1885, containing 97 Plates) . .	Price	9	12	0	. . .	12	16	0
PART 1. (1880, containing 4 Plates)	,,	0	12	0	. . .	0	16	0
,, 2. (1880, containing 7 Plates)	,,	0	18	0	. . .	1	4	0
,, 3. (1881, containing 8 Plates)	,,	1	2	6	. . .	1	10	0
,, 4. (1881, containing 3 Plates)	,,	0	7	6	. . .	0	10	0
,, 5. (1881, containing 13 Plates)	,,	0	18	0	. . .	1	4	0
,, 6. (1882, containing 6 Plates)	,,	0	12	0	. . .	0	16	0
,, 7. (1882, containing 9 Plates)	,,	0	15	0	. . .	1	0	0
,, 8. (1883, containing 11 Plates)	,,	0	12	0	. . .	0	16	0
,, 9. (1883, containing 10 Plates)	,,	0	12	0	. . .	0	16	0
,, 10. (1885, containing 12 Plates)	,,	1	11	6	. . .	2	2	0
,, 11. (1885, containing 14 Plates and Title and Index)	,,	1	11	6	. . .	2	2	0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

VOL. XIII.—PART 8.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN AND CO., PATERNOSTER-ROW.

April 1894.

Price 12*s*.

Taylor and Francis, Printers.] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £	s.	d.	To the Public. £	s.	d.
VOLUME I. (1833–1835, containing 59 Plates)	Price	3	13	6	4	18	0*
VOLUME II. (1835–1841, containing 71 Plates)	Price	4	0	0	5	6	6*
VOLUME III. (1842–1849, containing 63 Plates)	Price	3	8	3	4	11	0*
VOLUME IV. (1851–1862, containing 77 Plates)	Price	6	2	0	8	2	6
VOLUME V. (1862–1866, containing 67 Plates)	Price	5	4	3	6	19	0
VOLUME VI. (1866–1869, containing 92 Plates)	Price	11	5	0	15	0	0
VOLUME VII. (1869–1872, containing 73 Plates)	Price	10	4	0	13	12	0
VOLUME VIII. (1872–1874, containing 82 Plates)	Price	9	8	3	12	11	0
VOLUME IX. (1875–1877, containing 99 Plates)	Price	12	1	6	16	2	0
VOLUME X. (1877–1879, containing 95 Plates)	Price	10	0	3	13	7	0
GENERAL INDEX, Vols. I. to X. (1833–1879)	„	0	7	6	0	10	0
VOLUME XI. (1880–1885, containing 97 Plates)	Price	9	12	0	12	16	0
PART 1. (1880, containing 4 Plates)	„	0	12	0	0	16	0
„ 2. (1880, containing 7 Plates)	„	0	18	0	1	4	0
„ 3. (1881, containing 8 Plates)	„	1	2	6	1	10	0
„ 4. (1881, containing 3 Plates)	„	0	7	6	0	10	0
„ 5. (1881, containing 13 Plates)	„	0	18	0	1	4	0
„ 6. (1882, containing 6 Plates)	„	0	12	0	0	16	0
„ 7. (1882, containing 9 Plates)	„	0	15	0	1	0	0
„ 8. (1883, containing 11 Plates)	„	0	12	0	0	16	0
„ 9. (1883, containing 10 Plates)	„	0	12	0	0	16	0
„ 10. (1885, containing 12 Plates)	„	1	11	6	2	2	0
„ 11. (1885, containing 14 Plates and Title and Index)	„	1	11	6	2	2	0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

VOL. XIII.—PART 9.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN AND CO., PATERNOSTER-ROW.

October 1894.

Price 15*s*.

Taylor and Francis, Printers,] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

	To Fellows. £ s. d.	To the Public. £ s. d.
VOLUME I. (1833–1835, containing 59 Plates) . . Price	3 13 6	4 18 0*
VOLUME II. (1835–1841, containing 71 Plates) . . Price	4 0 0	5 6 6*
VOLUME III. (1842–1849, containing 63 Plates) . . Price	3 8 3	4 11 0*
VOLUME IV. (1851–1862, containing 77 Plates) . . Price	6 2 0	8 2 6
VOLUME V. (1862–1866, containing 67 Plates) . . Price	5 4 3	6 19 0
VOLUME VI. (1866–1869, containing 92 Plates) . . Price	11 5 0	15 0 0
VOLUME VII. (1869–1872, containing 73 Plates) . . Price	10 4 0	13 12 0
VOLUME VIII. (1872–1874, containing 82 Plates) . . Price	9 8 3	12 11 0
VOLUME IX. (1875–1877, containing 99 Plates) . . Price	12 1 6	16 2 0
VOLUME X. (1877–1879, containing 95 Plates) . . Price	10 0 3	13 7 0
GENERAL INDEX, Vols. I. to X. (1833–1879) . ,,	0 7 6	0 10 0
VOLUME XI. (1880–1885, containing 97 Plates) . . Price	9 12 0	12 16 0
PART 1. (1880, containing 4 Plates) . . . . . . ,,	0 12 0	0 16 0
,, 2. (1880, containing 7 Plates) . . . . . . ,,	0 18 0	1 4 0
,, 3. (1881, containing 8 Plates) . . . . . . ,,	1 2 6	1 10 0
,, 4. (1881, containing 3 Plates) . . . . . . ,,	0 7 6	0 10 0
,, 5. (1881, containing 13 Plates) . . . . . . ,,	0 18 0	1 4 0
,, 6. (1882, containing 6 Plates) . . . . . . ,,	0 12 0	0 16 0
,, 7. (1882, containing 9 Plates) . . . . . . ,,	0 15 0	1 0 0
,, 8. (1883, containing 11 Plates) . . . . . . ,,	0 12 0	0 16 0
,, 9. (1883, containing 10 Plates) . . . . . . ,,	0 12 0	0 16 0
,, 10. (1885, containing 12 Plates) . . . . . . ,,	1 11 6	2 2 0
,, 11. (1885, containing 14 Plates and Title and Index) ,,	1 11 6	2 2 0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

VOL. XIII.—PART 10.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

February 1895.

Price 12*s*.

Taylor and Francis, Printers,] [Red Lion Court, Fleet Street.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £ s. d.	To the Public. £ s. d.
VOLUME I. (1833–1835, containing 59 Plates)	Price	3 13 6	4 18 0*
VOLUME II. (1835–1841, containing 71 Plates)	„	4 0 0	5 6 6*
VOLUME III. (1842–1849, containing 63 Plates)	„	3 8 3	4 11 0*
VOLUME IV. (1851–1862, containing 77 Plates)	„	6 2 0	8 2 6
VOLUME V. (1862–1866, containing 67 Plates)	„	5 4 3	6 19 0
VOLUME VI. (1866–1869, containing 92 Plates)	„	11 5 0	15 0 0
VOLUME VII. (1869–1872, containing 73 Plates)	„	10 4 0	13 12 0
VOLUME VIII. (1872–1874, containing 82 Plates)	„	9 8 3	12 11 0
VOLUME IX. (1875–1877, containing 99 Plates)	„	12 1 6	16 2 0
VOLUME X. (1877–1879, containing 95 Plates)	„	10 0 3	13 7 0
GENERAL INDEX, Vols. I. to X. (1833–1879)	„	0 7 6	0 10 0
VOLUME XI. (1880–1885, containing 97 Plates)	Price	9 12 0	12 16 0
PART 1. (1880, containing 4 Plates)	„	0 12 0	0 16 0
„ 2. (1880, containing 7 Plates)	„	0 18 0	1 4 0
„ 3. (1881, containing 8 Plates)	„	1 2 6	1 10 0
„ 4. (1881, containing 3 Plates)	„	0 7 6	0 10 0
„ 5. (1881, containing 13 Plates)	„	0 18 0	1 4 0
„ 6. (1882, containing 6 Plates)	„	0 12 0	0 16 0
„ 7. (1882, containing 9 Plates)	„	0 15 0	1 0 0
„ 8. (1883, containing 11 Plates)	„	0 12 0	0 16 0
„ 9. (1883, containing 10 Plates)	„	0 12 0	0 16 0
„ 10. (1885, containing 12 Plates)	„	1 11 6	2 2 0
„ 11. (1885, containing 14 Plates and Title and Index)	„	1 11 6	2 2 0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

VOL. XIII.—PART 11.

LONDON:

PRINTED FOR THE SOCIETY,

SOLD AT THEIR HOUSE IN HANOVER-SQUARE;

AND BY MESSRS. LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

October 1895.

Price 21*s*.

Taylor and Francis, Printers,] [Red Lion Court, Fleet Street

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

		To Fellows. £ s. d.	To the Public. £ s. d.
VOLUME I. (1833–1835, containing 59 Plates)	Price	3 13 6	4 18 0*
VOLUME II. (1835–1841, containing 71 Plates)	„	4 0 0	5 6 6*
VOLUME III. (1842–1849, containing 63 Plates)	„	3 8 3	4 11 0*
VOLUME IV. (1851–1862, containing 77 Plates)	„	6 2 0	8 2 6
VOLUME V. (1862–1866, containing 67 Plates)	„	5 4 3	6 19 0
VOLUME VI. (1866–1869, containing 92 Plates)	„	11 5 0	15 0 0
VOLUME VII. (1869–1872, containing 73 Plates)	„	10 4 0	13 12 0
VOLUME VIII. (1872–1874, containing 82 Plates)	„	9 8 3	12 11 0
VOLUME IX. (1875–1877, containing 99 Plates)	„	12 1 6	16 2 0
VOLUME X. (1877–1879, containing 95 Plates)	„	10 0 3	13 7 0
GENERAL INDEX, Vols. I. to X. (1833–1879)	„	0 7 6	0 10 0
VOLUME XI. (1880–1885, containing 97 Plates)	Price	9 12 0	12 16 0
PART 1. (1880, containing 4 Plates)	„	0 12 0	0 16 0
„ 2. (1880, containing 7 Plates)	„	0 18 0	1 4 0
„ 3. (1881, containing 8 Plates)	„	1 2 6	1 10 0
„ 4. (1881, containing 3 Plates)	„	0 7 6	0 10 0
„ 5. (1881, containing 13 Plates)	„	0 18 0	1 4 0
„ 6. (1882, containing 6 Plates)	„	0 12 0	0 16 0
„ 7. (1882, containing 9 Plates)	„	0 15 0	1 0 0
„ 8. (1883, containing 11 Plates)	„	0 12 0	0 16 0
„ 9. (1883, containing 10 Plates)	„	0 12 0	0 16 0
„ 10. (1885, containing 12 Plates)	„	1 11 6	2 2 0
„ 11. (1885, containing 14 Plates and Title and Index)	„	1 11 6	2 2 0

* Only odd parts of these volumes can be supplied.

Continued on page 3 of Wrapper.

TRANSACTIONS OF THE ZOOLOGICAL SOCIETY OF LONDON
(continued).

		To Fellows. £ s. d.		To the Public. £ s. d.
VOLUME XII. (1886–1890, containing 65 Plates) . .	Price	5 8 0	. . .	7 4 0
Part 1. (1886, containing 6 Plates)	,,	0 9 0	. . .	0 12 0
,, 2. (1886, containing 7 Plates)	,,	0 12 0	. . .	0 16 0
,, 3. (1886, containing 2 Plates)	,,	0 4 6	. . .	0 6 0
,, 4. (1886, containing 12 Plates)	,,	0 15 0	. . .	1 0 0
,, 5. (1886, containing 5 Plates)	,,	0 9 0	. . .	0 12 0
,, 6. (1887, containing 7 Plates)	,,	0 12 0	. . .	0 16 0
,, 7. (1888, containing 8 Plates)	,,	0 9 0	. . .	0 12 0
,, 8. (1889, containing 3 Plates)	,,	0 6 0	. . .	0 8 0
,, 9. (1889, containing 7 Plates)	,,	0 15 9	. . .	1 1 0
,, 10. (1890, containing 8 Plates and Title and Index)	,,	0 15 9	. . .	1 1 0
VOLUME XIII. (1891–1895, containing 62 Plates) . .	Price	6 8 3	. . .	8 11 0
Part 1. (1891, containing 6 Plates)	,,	0 15 9	. . .	1 1 0
,, 2. (1891, containing 6 Plates)	,,	0 15 9	. . .	1 1 0
,, 3. (1891, containing 6 Plates)	,,	0 18 0	. . .	1 4 0
,, 4. (1892, containing 1 Plate)	,,	0 4 6	. . .	0 6 0
,, 5. (1893, containing 9 Plates)	,,	0 11 3	. . .	0 15 0
,, 6. (1893, containing 4 Plates)	,,	0 9 0	. . .	0 12 0
,, 7. (1893, containing 6 Plates)	,,	0 9 0	. . .	0 12 0
,, 8. (1894, containing 6 Plates)	,,	0 9 0	. . .	0 12 0
,, 9. (1894, containing 6 Plates)	,,	0 11 3	. . .	0 15 0
,, 10. (1895, containing 5 Plates)	,,	0 9 0	. . .	0 12 0
,, 11. (1895, containing 7 Plates and Title and Index)	,,	0 15 9	. . .	1 1 0

CONTENTS.

THE PUBLICATIONS OF THE ZOOLOGICAL SOCIETY OF LONDON.

The scientific publications of the Zoological Society of London are of two kinds—"Proceedings," published in an octavo form, and "Transactions," in quarto.

According to the present arrangements, the "Proceedings" contain not only notices of all business transacted at the scientific meetings, but also all the papers read at such meetings and recommended to be published in the "Proceedings" by the Committee of Publication. A large number of coloured plates and engravings are attached to each annual volume of the "Proceedings," to illustrate the new or otherwise remarkable species of animals described in them. Amongst such illustrations, figures of the new or rare species acquired in a living state for the Society's Gardens are often given.

The "Proceedings" for each year are issued in four parts, on the first of the months of June, August, October, and April, the part published in April completing the volume for the preceding year.

The "Transactions" contain such of the more important communications made to the scientific meetings of the Society as, on account of the nature of the plates required to illustrate them, are better adapted for publication in the quarto form. They are issued at irregular intervals.

Fellows and Corresponding Members, upon payment of a Subscription of £1 1*s.* before the day of the Anniversary Meeting in each year, are entitled to receive all the Society's Publications for the year. They are likewise entitled to purchase the Publications of the Society at 25 per cent. less than the price charged for them to the Public. A further reduction of 25 per cent. is made upon purchases of Publications issued prior to 1871, if they exceed the value of five pounds.

Fellows also have the privilege of subscribing to the Annual Volume of the 'Zoological Record' for a sum of £1 (which includes delivery in the United Kingdom *only*), but this privilege only holds good if the subscription is paid before the First of December in each year.

Such of those publications as are in stock may be obtained at the Society's Office (3 Hanover Square, W.), at Messrs. Longmans', the Society's publishers (Paternoster Row, E.C.), or through any bookseller.

October 1895.

P. L. SCLATER,
Secretary.