TRANSACTIONS

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Continued on page 3 of Wrapper.

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1890.

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CONTENTS.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY OF LONDON.

I. *On* Dinornis (Part XXV.): *containing a Description of the Sternum of* Dinornis elephantopus. *By* Sir Richard Owen, *K.C.B., F.R.S., F.Z.S., &c.*

Received March 6th, 1884, read March 18th, 1884.

[Plate 1.]

In 1868 I received an incomplete sternum of *Dinornis elephantopus*, wanting the anterior border with the costal processes. As, however, the specimen, then unique, showed modifications of breadth to length contrasting with those of a sternum of *Dinornis rheides*, it was described and figured in the under-cited volume [1].

I have now been favoured, through the kindness of John Enys, Esq., with a specimen of a sternum of the same species of *Dinornis*, found on his estate at Christchurch, New Zealand, with the anterior border entire, and lacking only the ends of the long "lateral processes."

The breadth of the anterior border is here shown to be, in a straight line, $9\frac{1}{3}$ inches; but following the curvature, which is convex outwardly, it measures 10 inches 6 lines.

This border is smoothly convex, about $\frac{1}{2}$ inch in breadth, bent inwards [2] for an extent of more than an inch. The convexity thus formed changes gradually to a concavity towards each lateral border of the bone, separating the base of the "costal process," *b d*, from the beginning of the "costal tract," *m, c*.

The costal process, *d*, is subcompressed, $1\frac{1}{2}$ inch in length, 1 inch 4 lines in breadth at its obtuse free border; a smooth, oblong, flattish, rather rough surface, 9 lines by 3

[1] Trans. Zool. Soc. vol. vii. part ii. (1870), p. 115, plate vii.

[2] Terms of aspect and position relate to the skeleton of the bird in the standing posture.

lines, suggests the attachment of a coracoid ligament. The cavity, fig. 2, at each end of the anterior border, which received the articular end of the coracoid, is 1 inch 9 lines in length, 1 inch in breadth.

The costal tract, figs. 1, 2, 3, *m*, *n*, indicates the articulations of not more than two sternal ribs; whereas the sternum of the larger species (*Dinornis giganteus*), described in vol. iii. of the 'Transactions of the Zoological Society' (1848), p. 354, and figured in plate lvii. fig. 1, showed a nearer resemblance to the sternum of the Apteryx (ib. fig. 8) in the relative extent of the "costal border" (ib. fig. 3), and in the number, four, of the articular surfaces for the sternal ribs. In the proportions of length to breadth the sternum of *Dinornis elephantopus* resembles that of *Dinornis giganteus*.

The articulation for the foremost of the sternal ribs in *Dinornis elephantopus* (Pl. I. fig. 1, *m*), is bent outwards and encroaches upon the outer aspect of the bone in a greater degree than in the sternum of *Dinornis rheïdes*[1]. The rib, so articulated in *Dinornis elephantopus*, must have had a firm junction, the surface, *m*, being concave in one (the longitudinal) direction, and as strongly convex in the other (transverse) direction. The second articular surface, ib. *n*, divided by an interspace of 10 millims. from the first, is of a simple oblong shape, slightly convex, 10 millims. in length by 8 millims. in breadth. The lateral margin of the sternum, continued from this articular surface, is at first thin and smooth, then thickens to a transversely convex border, which is continued along the exterior of the lateral process, *h*. On the inner side of the costal tract are two narrow oblong depressions, sharply bounded, mesially, which are distinct from the above-described costal surfaces. If these inner facets aided in giving attachment to sternal ribs, the articular ends of these would seem to have been bifid.

As the less complete sternum of *Dinornis elephantopus* was represented by the inner or back view in plate vii. of the above-cited volume, the subjoined drawing of the more perfect bone from the outer side may not be unacceptable.

To the hinder extremity of the body of the sternum—broken off in the subject of plate vii., tom. cit.—the more complete specimen here described shows there a mesial notch, answering, probably, to that which indents the narrower and more prolonged "xiphoid" end of the bone in *Dinornis rheïdes* (*tom. cit.* plate viii. fig. 1, *g*). It may be that the notch, *g*, in *Dinornis elephantopus*, is the anterior border of a foramen, answering to that in advance of the terminal notch of the *rheïdes's* sternum; but I deem the first interpretation the more probable one.

The feeble convexity of the outer surface of the body of the sternum subsides at the hinder half to flatness. The total breadth across the ends of the lateral processes is 1 foot 1 inch. The breadth of such process at its base is 40 millims., at the broken end 23 millims.; the inner margin of this long process is trenchant to near the end of the fracture, where it begins to thicken.

[1] Trans. Zool. Soc. vol. vii. plate viii. fig. 1, *m*.

On the inner (upper) surface of the sternum the shallow depressions behind the inflected anterior border repeat the pneumatic foramina, but are fewer in number than in the subject of plate vii., *p*, *n*, of the above-cited volume.

Regarding the sternum as the most characteristic of the single bones of the bird's skeleton, and since the evidences of the distribution of the kinds of Moa in New Zealand mostly consist of detached bones, the record of such a specimen as the subject of the foregoing description may not be without its use.

DESCRIPTION OF THE PLATE.

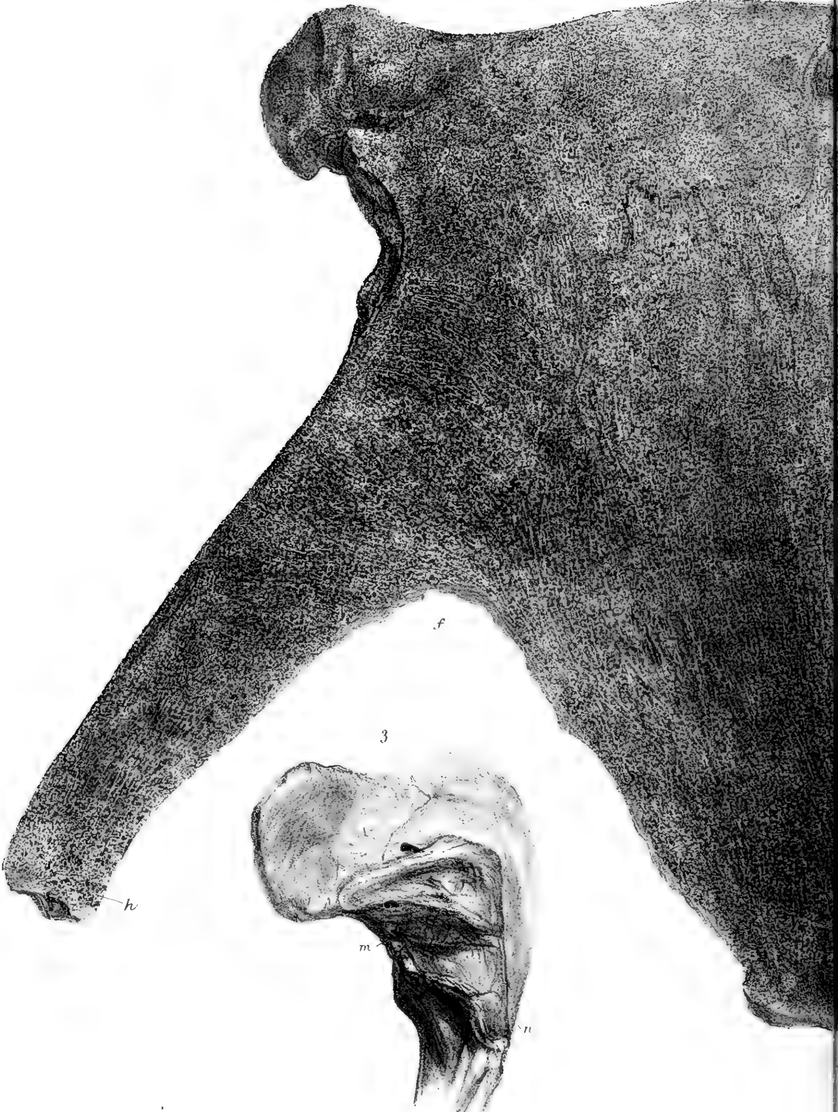
PLATE I.

Sternum of *Dinornis elephantopus*, nat. size.

Fig. 1. Outer surface: *a*, *b*, anterior border; *c*, *c*, costal border; *d*, coracoid articular surface; *f*, *f*, posterior vacuities; *g*, xiphoid notch; *h*, *h*, lateral processes; *m*, anterior costal articular surface; *n*, posterior costal articular surface.

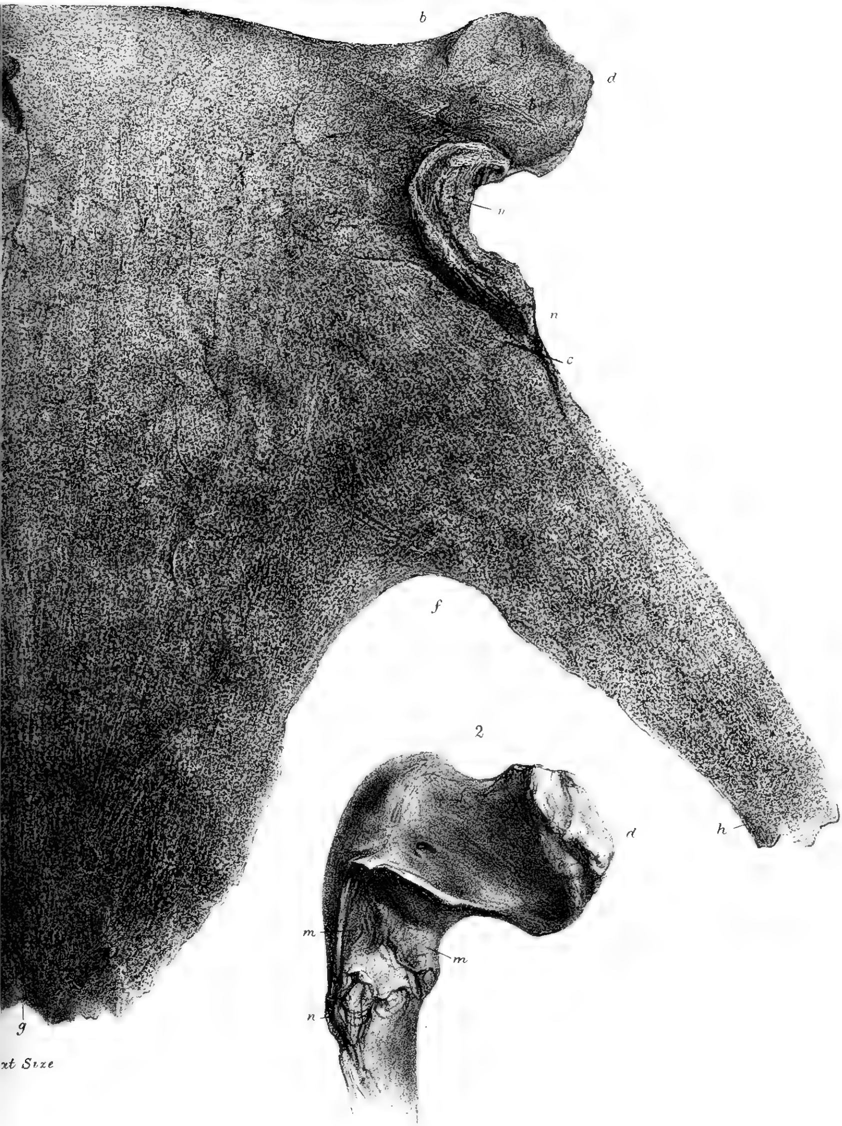
Fig. 2. Left costal and coracoid border; *m* and *n* as above.

Fig. 3. Right costal border; *m* and *n* as above.



From nat. on Stone by J. Erxleben

STERNUM OF DINOR



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IS ELEPHANTOPUS

II. *Studies in New-Zealand Ichthyology.—I. On the Skeleton of* Regalecus argenteus.

By T. Jeffery Parker, *B.Sc. Lond., Professor of Biology in the University of Otago, New Zealand.*

Received March 18th, 1884, read April 1st, 1884.

[Plates II.–VI.]

Contents.

The species *Regalecus argenteus* was founded on a specimen cast ashore at Moeraki, Otago, in June of the present year (1883). On July 11th I read before the Otago Institute a paper describing the specimen in detail, and giving a critical *résumé* of the observations of other zoologists on the various species of the genus. The paper will be published in the next (16th) volume of the 'Transactions of the New Zealand Institute;' I extract from it, for convenience of reference, the following systematic description (see Pl. II. figs. 1–4).

Regalecus argenteus, *T. J. P.*

D. 15 / 190. P. 13. V. 1. Br. 6.

Height of the body about one tenth, length of head about one seventeenth of the total length. Eye one sixth of the length of the head. Length and height of the head about equal. The fifteen anterior dorsal rays form a crest, the height of which is more than double that of the head; its rays have their lower halves united by membrane, their upper halves having a narrow membranous fringe; more or fewer of them terminate in lanceolate cutaneous lobes, and they are not spinose. Ventral rays fringed posteriorly by membrane. No caudal fin. Four longitudinal ridges and an indistinct fifth extend from head to tail above the lateral line, by which they are obliquely cut in front. Surface studded with numerous hard but not bony tubercles, which are largest and most elevated on the ridges: those forming the ventral edge are not perceptibly hooked backwards. Teeth absent. Surface silvery, with black, irregular, wavy, sub-vertical stripes and spots; "forehead" and membranous portions of snout blue-black; fins crimson.

Total length 12·5 feet; greatest height 15·25 inches; greatest thickness 3·5 inches.

As all the figures of *Regalecus* of which I have been able to obtain information are small, and wanting in detail, I have included in the illustration to the present paper a figure of the head (Pl. II. fig. 1), two showing the mode of termination of one of the rays of the crest (figs. 2 and 3), and one of a transverse section of the body (fig. 4).

The specimen, as I received it, was cut into four pieces: fortunately, however, the injury to the bones was slight, in spite of the inevitable fractures of the delicate neural spines and fin-rays; and the skeleton, as now mounted for the Otago University Museum, is fairly perfect. The work of preparation was a decidedly difficult one on account not only of the fragility of the bones, but also of the extreme thickness and toughness of the periosteum covering the vertebral centra; it was, however, very successfully performed by my senior assistant, Mr. E. Jennings.

Until all my drawings were made, I was under the impression that no description of the skeleton of *Regalecus* had been published; I now find that there is an account of that of *R. banksii*, by Lütken[1], written in Danish about ten years ago. In an abstract of his researches[2], Lütken seems to say that the head of the specimen described by him was destroyed; but even if this were not the case, I am disposed to think that it is better for me to publish an independent account of another species, rather than wait many months for his paper, of which only the plates would be of any use to me, owing to my ignorance of Danish.

It will be convenient to describe the skeleton under the following heads:—

1. The cranium, or brain-case, with the nasals and suborbitals.
2. The suspensory apparatus, with the upper and lower jaws.
3. The opercular bones.
4. The hyoidean apparatus.
5. The branchial arches.
6. The vertebral column and dorsal fin.
7. The shoulder-girdle and pectoral fin.
8. The hip-girdle and pelvic fin.

In the description of the skull, I have used the terms employed in Parker and Bettany's 'Morphology of the Skull;' for the rest of the skeleton the names are, for the most part, those employed in Huxley's 'Anatomy of Vertebrated Animals.'

[1] 'Videnskabelige Meddelelser fra den naturhistoriske Forening' for 1881, p. 190.

[2] Ann. & Mag. Nat. Hist. ser. 5, vol. xi. p. 176.

1. The Cranium. (Plate IV. figs. 6–10, and Plate V. fig. 1.)

As usual in Teleosts, the cranium consists of a compact mass of mingled bone and cartilage, formed from the parachoidal, trabecular, and otic elements of the primitive skull, with the addition of certain closely fitting membrane-bones. A considerable amount of the original cartilage (coloured purple) is retained, especially in the auditory, ethmoidal, and prenasal regions. The bones are very thin and spongy, consisting of delicate plates and needles which shoot, almost like crystals, through thin cartilaginous or membranous ground-work. So imperfect, indeed, is the ossification of the cranium, as well as of other parts of the skeleton, that there is rarely any difficulty in distinguishing, in the adult, between cartilage and membrane-bones. The former are in all the figures, except that of the entire skeleton (fig. 5, Pl. III.), coloured yellow.

In consequence of the very irregular edges of the bones, the determination of their boundaries was a matter of considerable difficulty, and in many cases was impossible without actual disarticulation. As there was only a single specimen at my disposal, I had the cranium bisected, after making the necessary sketches of it (figs. 7–10), and then, having drawn the longitudinal sections (figs. 11 and 12), disarticulated the left half (fig. 13, Pl. V).

Compared with the facial part of the skull, the cranium is remarkably small; its form is very peculiar, having a curious superficial resemblance to the skull of a Chamæleon. Its strange appearance is largely due to the fact that the basis cranii is produced downwards into a thin vertical plate—the *subcranial crest*—the height of which is considerably greater than that of the brain-case proper. As a result of this, the parasphenoid (*pa.s*) is carried ventralwards far below the proper level of the basis cranii (fig. 11, *b.cr*), and the ethmoidal and prenasal regions (*p.n*) are bent down to meet the vomer (*vo*), which, as usual, forms a direct forward continuation of the parasphenoid. This remarkable distortion of the cranium seems to be correlated with the great size of the eye and the consequent necessity for an increase in the dimensions of the orbits. In fig. 5 (Pl. III.) the sclerotic is shown *in situ*, and it is seen that although the eye is by no means unusually large, as compared with the whole skull (*cf.* fig. 1), yet it is immense in comparison with the cranium.

Another noteworthy peculiarity is the absence of the large processes which are usually so marked a feature of the teleostean skull. There is no trace either of supraoccipital crest or of epiotic or parotic process; there is, indeed, a fairly prominent blunt elevation (figs. 8 and 10, *b.tm*) near the ordinary position of the parotic process, but this is really formed not by a cranial bone at all, but by the posttemporal or dorsalmost bone of the shoulder-girdle (*vide infrà*, p. 26), which has not the usual forked form, and is so closely applied to the dorsal surface of the auditory capsule as to require some force for its removal.

The occipital condyle ($o.c^1$, $o.c^2$) is divided into three facets, one large and medio-ventral in position ($o.c^2$), and two smaller, paired and supralateral ($o.c^1$); these correspond with the similar facets on the atlas vertebra (fig. 21, Pl. VI., p. 24). The medio-ventral facet is not vertical, but is inclined at an angle of about 45° (figs. 7 and 11). Immediately external to each dorso-lateral facet is a small aperture (x) which probably transmits the glossopharyngeal and vagus nerves.

The foramen magnum (figs. 10 and 12, *f.m*) is a small aperture having the form of a long oval, and is considerably inclined forwards. The whole posterior surface of the skull also slopes forwards, and passes almost insensibly into the dorsal surface, which is arched from before backwards, and from side to side. The anterior half of the middle region of the dorsal surface is quite unossified, consisting of the cartilaginous *tegmen cranii* (figs. 8, 11, and 12, *t.cr*). This is bounded externally by large paired processes of the frontals (*fr*); its right and left moieties slope inwards, uniting in a slight longitudinal groove.

Laterally, the roof of the cranium is bounded by well-marked *supraorbital ridges* (fig. 8, *fr*), from which are continued inwards large *supraorbital plates* (figs. 7 and 9, fr^1) forming the dorsal walls of the orbits. These plates, formed by the frontals (fr^1), orbitosphenoids (*os*), and alisphenoids (*als*), meet one another in the middle ventral line in front, forming a sort of false floor to the anterior third of the brain-cavity (figs. 11 and 12, *os*); but posteriorly a large median oval space (figs. 7 and 9, *A*) is left immediately in front of the true basis cranii, apparently serving for the transmission of the second to fifth cerebral nerves.

Posteriorly each supraorbital ridge terminates in a well-marked *postorbital process* (figs. 7 and 8, *sp.o*), from which a pillar of bone (figs. 7, 9, 10, 11, *p.or.p*) is continued downwards and inwards immediately in front of the subcranial crest, finally uniting with its fellow of the opposite side; these may be conveniently called the *postorbital pillars.*

The subcranial crest is Y-shaped in horizontal section, its posterior moiety (figs. 7 and 11, *b.s*, *pa.s*) consisting of a single plate formed by the basioccipital and parasphenoid, its anterior moiety of paired laminæ ($op.o^4$), which diverge in front, enclosing a wedge-shaped space, and are descending processes of the opisthotics. Each of these laminæ is separated in front by a narrow cleft from the corresponding postorbital pillar with which it articulates below; there is an oval foramen (figs. 7 and 11, *B*) separating it below from the unpaired portion of the subcranial crest. The wedge-shaped space thus enclosed, beneath the anterior part of the basis cranii, by the descending processes of the epiothotics and the postorbital pillars, doubtless serves for the origin of the ocular muscles.

Anteriorly, each supraorbital ridge ends in a large, blunt, imperfectly ossified *antorbital process* (*p.eth*). Between and in front of these, the cranium is continued forwards into the *prenasal rostrum* (*p.n.*), a median, vertical, somewhat wedge-shaped mass of cartilage, having a straight lower edge embraced by the vomer (*vo*), and a curved anterior and dorsal border continuous posteriorly with the tegmen cranii.

At about the middle of the roof of the skull the tegmen cranii is perforated by two median apertures; the anterior of these (figs. 8, 11, and 12, *I*) probably transmits the delicate crura of the olfactory lobes; of the functions of the other I am quite ignorant; very possibly it serves for the passage of an artery.

On each side of the base of the rostrum, and piercing the base of the antorbital process, is a large oval foramen (figs. 8 and 9, V^1), which doubtless transmits the orbito-nasal nerve.

On the lateral surface of the hinder, or auditory region of the cranium is a sigmoid depression in the cartilage (fig. 7, $h.m^1$); with this, the large hyomandibular is articulated, as shown in fig. 6 (*h.m*).

A longitudinal vertical section of the cranium shows that the hinder third of the *basis cranii* (fig. 11, *b.cr.*) is raised into a sort of step; I was unable to ascertain whether this had any definite relation to the form and disposition of the brain. The same section shows that the form of the cranial cavity is largely determined, not merely by the bones and cartilages which form its proper walls, but by the immensely thick periosteum with which these latter are lined. In fig. 11, the cranium is shown with the periosteum (coloured blue) still in place; in fig. 12, in which it has been removed, the form of the cavity is seen to be quite changed.

The ossifications of the cranium are twenty-seven in number, of which twenty-two are paired and five median.

The *basioccipital* (*b.o*) is a vertical plate of bone constituting the posterior and dorsal portion of the subcranial crest. Above, it becomes much thickened and forms the medio-ventral facet of the occipital condyle. Although it enters into the formation of the basis cranii, it does not actually bound the cranial cavity, since it is covered by the exoccipitals (*e.o*) and opisthotics (*op.o*). It is the best-ossified bone in the skull, and shows no trace of its original cartilaginous groundwork. It articulates above with the exoccipitals and opisthotics, below with the parasphenoid (*pa.s*), and in front with the descending processes of the opisthothics ($op.o^4$).

The *exoccipitals* (*e.o*) are two irregular bones bounding the occipital foramen laterally, and, by their union with one another in the middle ventral line, forming also its lower boundary. Each furnishes one of the dorso-lateral facets of the occipital condyle ($o.c^1$), and is perforated by the vagus foramen (X). The posterior face of the exoccipital is nearly flat, its inner face is irregular (see fig. 12), and is excavated by a deep pit leading into a tunnel for the posterior semicircular canal (*cf.* fig. 11). The united exoccipitals form the upper part of the elevated posterior third of the basis cranii, its lower part being formed by the basioccipital and opisthotic, with which bones the exoccipitals therefore articulate below. Externally, each articulates with the pterotic (*pt.o*), and dorsally with the epiotic (*ep.o*).

The most noteworthy point about the exoccipitals is their union with one another below the foramen magnum. In this particular, *Regalecus* agrees with the Cyprinoids [1].

The *epiotics* (*ep.o*).—Immediately in front of, and above the exoccipital, comes another pair of bones occupying the positions usually taken up by the supraoccipital, and united to one another by a narrow strip of cartilage, which broadens out at its hinder end, forming the upper boundary of the occipital foramen (fig. 10). Each of these bones has an irregularly oval outline, articulates behind with the exoccipital, in front with the supraoccipital (*s.o*) and parietal (*pa*), and externally with the pterotic (*pt.o*), while from its inner or cranial surface an irregular snag-like process is given off, which articulates with a similar process of the opisthotic (figs. 12 and 13, $op.o^1$). The arch of the posterior semicircular canal runs through this bone, which I have no hesitation in identifying as the epiotic, in spite of its unusual size.

The *supraoccipital* (*s.o*).—Continuing forwards, the epiotic is a median shield-shaped bone, forming the central part of the skull-roof, and bounded in front by the cartilaginous tegmen cranii. It is a cartilage bone, and is clearly the supraoccipital displaced from its proper connection with the exoccipitals by the abnormal development of the epiotics. Externally it articulates with the parietals (*pa*). Its middle portion is very thick, and is covered internally with unusually thick periosteum (fig. 11).

The *opisthotics* (*op.o*) are of very irregular form, and are perhaps the most remarkably modified bones in the skull. They are united with one another in the middle ventral line forming the anterior two thirds of the basis cranii, and thus coming to articulate posteriorly with the basi- and exoccipitals. Each opisthotic sends off a large, irregular, ascending process (figs. 12 and 13 $op.o^1$), which articulates with a similar process of the epiotic; a forward process ($op.o^2$), which articulates with the alisphenoid (*als*) and unites with its fellow of the opposite side [2]; a posterior process ($op.o^3$) articulating with the basi- and exoccipitals, and uniting with its fellow in the middle line; and a thin, laminar, descending process ($op.o^4$), which articulates with the basioccipital behind and with the parasphenoid below, and, with its fellow, forms the anterior or double portion of the subcranial crest. The anterior process is perforated by a small aperture (*V*), which I am disposed to think, from examining a very badly preserved specimen of *Trachypteris altivelis*, transmits the third division of the fifth nerve. With the exception of the descending process, the opisthotic does not appear on the outer surface of the skull, the otic region being formed externally largely of unossified cartilage (figs. 7 and 9).

The *prootics* (*pr.o*).—These are small bones, consisting of a considerable groundwork

[1] Stannius, 'Zootomie der Fische,' p. 56.

[2] As the skull is bisected, I cannot state positively whether the exoccipitals, opisthotics, and orbitosphenoids are actually ankylosed with one another, or only united by suture; I think, however, that there is actual ankylosis in the case of the two former.

of cartilage very poorly ossified. Each has a nearly straight anterior and a curved posterior border; articulates in front with the sphenotic (*sp.o*) and frontal (*fr*), below with the alisphenoid (*als*) and opisthotic (*op.o*[2]), while behind it is separated from the ascending process of the opisthotic (*op.o*[1]) and from the epiotic by a mass of cartilage produced on the cranial side into a large projecting base (figs. 11 and 12). The small size of this bone is very unusual; according to Stannius[1] it always unites with its fellow of the opposite side in the middle ventral line, so that the wide separation of the prootics in *Regalecus* appears also to be highly exceptional[2]. In most Teleosts, also, the bone under consideration is grooved or perforated in front for the exit of the fifth nerve; in the present case the nerve apparently passes out in front of the alisphenoid (*vide infrà*). It is further very usual for paired laminæ of the prootic to form the sides of the canal for the ocular muscles; in *Regalecus*, as stated above, it is mainly the opisthotics which bound the functional representative of this canal.

The *pterotics* (*pt.o*) are the largest of the otic bones, ossifying a considerable part of the dorsal and external regions of the auditory capsules. Each pterotic consists of two portions; a flat plate, which articulates behind with the exoccipital, in front with the prootic, and below with the opisthotic; and an elongated, forwardly directed portion, which forms the dorso-lateral boundary of the auditory region, and articulates on its inner side with the epiotic and parietal, while in front it is wedged in between this parietal, frontal, and sphenotic.

The *sphenotics* (*sp.o*) form, as usual, the postorbital processes. Each is overlapped in front by the frontal, articulates by its inner border above (fig. 8) with the pterotic, below (fig. 9) with the alisphenoid; by its posterior edge it joins the prootic. Below it sends off a strong descending process, which, articulating with an ascending process of the parasphenoid, forms the postorbital pillar (*p.or.p*).

The *alisphenoids* (*als*).—Immediately in front of the prootic, and below the sphenotic, is a flat bone with a straight ventral and a curved dorsal border, and having a very evident groundwork of cartilage. It forms the lower moiety of the skull-wall immediately in front of the auditory region, and, with its fellows, bounds the large foramen marked *A* in the figures. It articulates by the whole of its dorsal edge with the orbital plate of the frontal (fig. 12, *fr*[1]) on the inner face of the skull-wall, with the sphenotic (fig. 9) on its outer face. The sphenotic overlapping the frontal in this region, its anterior border articulates with the frontal and the orbitosphenoid (*o.s*), and its posterior border with the prootic and anterior process of the opisthotic.

It is evident that this bone has, on the whole, the relations of the alisphenoid, and, as far as I can see, the only difficulty in the way of the interpretation is the fact that there is no foramen for the fifth nerve behind it, and that, as far as one can judge

[1] *Op. cit.* p. 58.

[2] In Parker and Bettany's 'Morphology of the Skull,' p. 66, the union of the prootics in the Salmon is spoken of as a "most interesting fact."

from the skull alone, the trigeminal probably passes out through the foramen A, that is, leaves the skull in front of the bone in question.

I do not think, however, that the place of each of the nerves can possibly be held as absolutely determining the homologies of bones with which they are related. In many Mammals the first division of the fifth passes out altogether in front of the alisphenoid, and the second and third divisions through foramina in that bone. The spinal nerves of Vertebrates, too, sometimes perforate the neural arches instead of passing through the intervertebral foramina.

The bones under discussion are the hindermost paired ossifications in the trabecular or preauditory region of the skull; I think, therefore, they must be considered as alisphenoids, but that, by a curious variation, each of them has joined with the corresponding opisthotic behind the trigeminal foramen. Or the case may be better put thus:—the nerves are formed long before the ossifications appear; in the present case, the prootic is so small as not to extend so far forwards as the trigeminal foramen, and the ophisthotic and alisphenoid meeting in front of it, that is, between it and the foramen, have caused the latter to be situated in front of the alisphenoid instead of between it and the prootic.

The *orbitosphenoids* (*o.s*).—In front of each alisphenoid is a thin flat bone which forms the anterior and ventral region of the supraorbital plate and is united (? suturally [1]) with its fellow in the middle ventral line, forming a false floor to the brain-case in front. It articulates above with the orbital plate of the frontal, behind with the alisphenoid, and in front with the mesethmoid (*m.eth*). It is an ectostosis, and evidently represents the orbitosphenoid.

The *mesethmoid* (*m.eth*).—This is apparently a partly ectosteal, partly endosteal bone, occurring at the junction of the tegmen cranii with the prenasal rostrum; it extends around the orbitonasal foramina (fig. 8, V^1), and though the cartilage to its ventral surface (figs. 11 and 12), where it articulates behind with the orbitosphenoids. The mesethmoid contains a cavity (figs. 11 and 12, *m.n.c*), which forms a vertical cleft between the tegmen cranii and the prenasal cartilage, and evidently represents the mesonasal cavity of the Salmon [2]. It is, however, much smaller than in the latter fish, and is lined and roofed by the mesethmoid, whereas in the Salmon it is mainly surrounded by cartilage, and is covered in above by a parostosis, the supraethmoid or dermo-ethmoid.

The *ectethmoids* or *parethmoids* (*p.eth*) are paired ectosteal ossifications of the antorbital region, articulating above with the frontals. They are largely subcutaneous bones, being covered only by the thin silvery epiderm (*cf.* fig. 1).

The remaining ossifications of the cranium are parostoses, or membrane-bones.

[1] See note on p. 9.

[2] W. K. Parker "On the Structure and Development of the Skull in the Salmon," Phil. Trans. vol. 163, 1873, p. 108; Parker and Bettany, 'Morphology of the Skull,' p. 72.

The *parietals* (*pa*) are long narrow bones situated one on either side of the supra-occipital, and elevated considerably above the level of that bone, so as to form paired longitudinal crests of considerable size. Each articulates by its inner edge with the supraoccipital, by its outer edge with the frontal and pterotic. The parietals do not appear on the inner surface of the skull-wall.

The *frontals* (*fr*) are the largest bones in the brain-case, forming a considerable portion of its dorsal wall as well as the chief part of the supraorbital plates. They differ from the homologous bones in most Teleosts in not uniting with one another, either by suture or ankylosis, in the middle line; on the contrary they are separated by a wide cartilaginous interval in front, and behind by the whole width of the supra-occipital and parietals. Each frontal is arched from before backwards, and produced in front into an irregular plaited process (figs. 7, 11, and 12, *fr*), which rises well above the tegmen cranii and helps to give the skull its peculiar form. It also forms the greater part of the supraorbital ridge, and is produced inwards into a supraorbital process (fr^1), which, together with the orbitosphenoid and alisphenoid, constitutes the roof of the orbit. The frontal articulates in front with the ectethmoid, and behind with the sphenotic and pterotic, overlapping the former and being overlapped by the latter (*cf.* fig. 13); the supraorbital process articulates not only with the orbito- and alisphenoid, but also to a slight extent with the prootic (fig. 12). A small part of the supraorbital ridge is subcutaneous (see fig. 1).

The *parasphenoid* (*pa.s*), as stated above, is carried far below the proper level of the basis cranii, owing to the great size of the orbit. It is a gently curved bone, keeled in the middle ventral line, and greatly compressed from side to side posteriorly, where it forms the ventral portion of the subcranial crest. In this part of its extent it is embraced above by the supraoccipital, that bone being divided below into two laminæ between which the parasphenoid is inserted (*cf.* figs. 7 and 11). In front of the foramen *B* the parasphenoid articulates on each side with the descending plate of the opisthotic ($op.o^4$), and sends off a process which passes upwards and slightly outwards, articulating with the descending process of the sphenotic, and forming with it the postorbital pillar. In front the parasphenoid underlies the prenasal cartilage, and is underlain by the vomer (*vo*).

The *vomer* (*vo*) is a thin slender bone, clamping the ventral edge of the prenasal cartilage, and extending backwards beneath the parasphenoid. Near its anterior end it sends off on each side a somewhat irregular laminar process, which is directed upwards and backwards on the side of the prenasal cartilage (fig. 7).

The following loosely attached bones are best considered in connection with the brain-case.

The *nasals* (fig. 6, *na*) are small irregularly oblong bones, attached by fibrous tissue to the frontals and arching over the nostrils.

The *preorbitals* (figs. 6^1, *pr.or*) are two bones on each side, articulating with the antorbital process of the cranium. The first has an irregular outline, and is continued forwards by a process which forms the lower boundary of the nostril; the second is nearly oblong in outline. These are the only representatives of the suborbital chain of bones so common in Teleosts. They are both subcutaneous (*cf.* fig. 1).

2. The Suspensorium and the Upper and Lower Jaws.
(Plate IV. fig. 6, & V. figs. 14–16.)

These bones, although many of them are of peculiar form, do not differ from the ordinary teleostean type to anything like the same extent as those of the cranium.

The *hyomandibular* (*h.m*) is an irregular bone articulating by a dilated proximal extremity or head with a sigmoid groove on the outer surface of the auditory capsule (*cf.* figs. 6, 7, and 15), and ending distally in a sharply truncated extremity. Immediately below the head, near the posterior border of the bone, is an oval facet (fig 15, *op*[1]) covered with cartilage, for articulation with the opercular (*cf.* figs. 6 and 14).

The *symplectic* (*sy*) is a small rod-like bone, truncated at its proximal, pointed at its distal end, separated by a cartilaginous interval from the hyomandibular, and fitting into a groove on the inner face of the quadrate (fig. 15, *qu*).

The *quadrate* (*qu*) is a triangular bone, with its lower or distal angle produced into a process which bears the glenoid cavity for the articulation of the mandible. It articulates by its anterior edge with the pterygoid (*pt*), while its slightly curved dorsal border passes into a thin plate of cartilage with a sinuous dorsal edge, evidently the remains of the embryonic palato-pterygoid process of the mandibular arch (fig. 15).

The *pterygoid* (*pt*) is a narrow bone placed nearly vertically; its posterior border articulates with the quadrate and mesopterygoid (*ms.pt*), its upper border with the palatine (*pl*).

The *mesopterygoid* (*ms.pt*) is a very thin and irregular bony plate, closely connected with the inner surface of the plate of cartilage mentioned above, but extending considerably beyond its dorsal edge. The mesopterygoid is marked by radiating lines which start from a point altogether above the cartilage (fig. 15); the latter is, in its dorsal portion, easily separable from the contiguous bone, but lower down the two become inseparably united (fig. 14). I should judge from these facts that the mesopterygoid, unlike its homologue in the Salmon, commences as a parostosis, the ossification afterwards extending into the cartilage and becoming ectosteal. This, if true, is decidedly interesting, since the pterygoid of many of the higher Vertebrata, from Amphibia to Mammals, is parosteal.

The *metapterygoid* (*m.pt*) is a triangular bone, articulating by its base with the mesopterygoid and pterygoid cartilage, and passing upwards and backwards along the anterior edge of the hyomandibular.

The *palatine* (*pl*) is a short irregular bone, rather broader than long, uniting by suture with the pterygoid and mesopterygoid, and articulating by a large facet with the antorbital process of the cranium.

The upper jaw is completed, as usual, by two pairs of membrane bone, the premaxillæ and the maxillæ.

The *premaxilla* (fig. 6, *pmx*) is a slender bone consisting of two well-marked parts, an alveolar portion (*pmx*) which bounds the gap, and consists of a thin narrow plate of bone, strengthened by a raised rib along its outer surface; and a nasal process (pmx^1) which passes backwards and slightly upwards, parallel to and in contact with its fellow of the opposite side, and embracing splint-wise the dorsal edge of a large laterally compressed cartilage. This latter works freely in the groove of the tegmen cranii and between the anterior processes of the frontals, the protrusion and retraction of the jaws being thus provided for.

This cartilage is evidently homologous with the irregular nodule which supports the premaxillæ in the Cod (*Gadus*), and with which every one who has dissected the head of that fish must be familiar. Curiously enough, no mention is made of it by either Stannius, Owen, Huxley, Gegenbaur, Macalister, or Parker and Bettany.

The *maxilla* (fig. 6, *mx*) is a widish plate of bone, narrowing gradually from its lower to its upper extremity, and produced at its upper end into a strong internal process. It does not enter into the gap, and its whole outer surface is subcutaneous (see fig. 1).

The form of the lower jaw is remarkable. It consists of two rami, loosely united by fibrous tissue, each of which may be described as consisting of a suprameckelian and an inframeckelian portion, separated from one another by Meckel's cartilage (fig. 14, *mck*). The suprameckelian portion has something the form of an equilateral triangle, the inframeckelian of a right-angled triangle with altitude about one fourth of its base, so that the whole jaw comes to be rather higher than long. Each ramus contains the usual three bones.

The *articular* (figs. 6 and 14, *ar*) is a large bone furnishing a concave facet for articulation with the quadrate; it forms the posterior half of the suprameckelian portion of the jaw, and about the posterior sixth of its inframeckelian portion. From near the proximal end of its inner surface a slender Meckel's cartilage (*mck*) is continued to the symphysis.

The *angular* (*ang*) is a small rod-like bone, applied to the proximal end of the inner surface of the inframeckelian portion of the articular.

The *dentary* (*d*) is a considerable bone, forming the anterior half of the suprameckelian, and the anterior five sixths of the inframeckelian portions of the mandible. It is united to its fellow of the other ramus by fibrous tissue forming the mandibular symphysis.

3. The Opercular Bones. (Plate IV. fig. 6, Plate V. fig. 14.)

The number and disposition of these bones is quite normal; like the other subcutaneous bones, they are sculptured externally, and covered in the recent state by an extremely thin layer of silvery epiderm (*cf.* fig. 1).

The *opercular* (*op*) is a large flat bone articulating by a well-marked concave facet with the opercular process of the hyomandibular (fig. op^1). In the neighbourhood of this facet it is of tolerable thickness, but in the rest of its extent it is extremely thin, and cracks readily at the edge on drying. Its dorsal edge is marked with three strong crenations, its posterior border is gently sinuous, its antero-ventral border evenly curved. The markings on its surface radiate from the articular end.

The *preopercular* (*p.op*) has the usual relations to the suspensorium, and there is nothing peculiar about its form. The sculpturings on its surface radiate from a point near its middle.

The *subopercular* (*s.op*) is a small bone, also very thin and papery, and is marked with ridges which radiate from its lower and anterior corner.

The *interopercular* (*i.op*) is a greatly elongated bone, truncated at its posterior, pointed at its anterior end, and marked with ridges which radiate from a point near the junction of its anterior and middle thirds.

4. The Hyoidean Apparatus. (Plate IV. figs. 14–16.)

This is of rather unusually small size as compared either with the suspensorium or with the branchial arches; the two cornua of which it consists are short and wide, and contain the normal number of ossifications.

The *interhyal* (*i.hy*) is a small rod-like bone, tipped with cartilage, which joins each hyoidean cornu to the synchondrosis between the hyomandibular and symplectic.

The *epihyal* (*ep.hy*), or dorsalmost ossification of the cornu proper, is of somewhat triangular form.

The *ceratohyal* (*c.hy*) is a very irregular bone, forming the main part of the cornu, and separated by a cartilaginous interval from the epihyal.

The *hypohyals* (*h.hy*) are two short nodular bones, attached to the inner face of the distal or lower end of the ceratohyal, and separated from one another by cartilage. The hypohyals of opposite sides are separated from one another by the *glossohyal*, a median ventral element of the hyoid arch (figs. 6 and 17, cp^1): this will, however, be more conveniently considered along with the branchial arches.

The *branchiostegal rays* (*br.r*).—These are six sabre-shaped bones attached by membrane to the outer face of each hyoidean cornu near its posterior border. The first or dorsalmost of the series ($br.r^1$) is connected with the epihyal, the other five with the ceratohyal. They diminish progressively in length from above downwards, the first being a little more than 5 inches long, while the lowest or distal ray ($br.r^6$) is hardly more than $1\frac{1}{2}$ inch.

The *urohyal* or *basi-branchiostegal* (fig. 6, *u.hy*) is a flat unpaired bone nearly 4 inches long, placed upright below the ventral ends of the hyoidean cornua.

5. The Branchial Arches. (Plate V. fig. 17.)

These are also quite typical in their general arrangements, consisting of five pairs of arches united ventrally by a median longitudinal series of azygos pieces or *copulæ*. As regards the details of segmentation, however, there are a good many variations from the usual state of things.

The first arch is the longest, and consists of four segments; the ventralmost of these is a comparatively long *hypo-branchial* ($h.br^1$); next comes a long *cerato-branchial* ($c.br^1$); then a short *epibranchial* ($e.br^1$) like the two former, of a rod-like form, and grooved on its outer side for the branchial vessels; then a wider and more flattened *pharyngo-branchial* ($ph.br^1$): and finally a slender rod of cartilage ($pa.br^1$) with an extremely thin ossific crust, articulated to the dorsal end of the pharyngo-branchial, and lying in the natural position of the parts, almost vertically against the subcranial crest, close behind the postorbital pillar (fig. 6, $pa.br^1$). I can find no mention of any segment corresponding to this in other fishes, and propose to name it the *parabranchial*. A further peculiarity is the presence of a small distinct nodule of cartilage (x) articulated to the dorsal end of the cerato-branchial, internal to the epibranchial.

The second arch closely resembles the first as to its hypo- ($h.br^2$) and cerato-branchial ($c.br^2$) segments. The epibranchial ($e.br^2$) is bent upon itself almost at a right angle; the pharyngo-branchial ($ph.br^2$) is much broader and flatter than in the first arch, and articulates with the epihyal, not by its end, but by a small cartilage-covered tubercle on one side; with its narrow anterior end is articulated a para-branchial ($pa.br^2$) slightly larger than that of the first arch, and quite unossified.

In the third arch the hypobranchial ($h.br^3$) presents a modification very usual in Teleosts: it is produced into a downwardly directed hook-like process (shown in the figure by a dotted outline), which, with its fellow, helps to bound the canal for the ventral aorta. There is a large synchondrosis between this segment and the cerato-branchial ($c.br$ 2), which latter calls for no special remark. The epibranchial ($ep.br^3$) is a forked bone, the anterior branch of the fork, or *processus articularis*, evidently answering to the forwardly directed limb of the second epibranchial, while the posterior branch, or *processus muscularis*, is represented in the second arch only by a slightly projecting knob at the bend of the epibranchial. The pharyngo-branchial ($ph.br^3$) is similar to that of the second arch, to the outer surface of which it is closely applied: in the figure it is unnaturally separated from the epihyal, by the parts being spread out in one plane for convenience of sketching. There is no para-branchial in this or in either of the succeeding arches.

In the fourth arch the hypobranchial is absent: as in the preceding arches a small nodule of cartilage (x^4) is articulated to the upper end of the cerato-branchial ($c.br^4$). The epibranchial ($ep.br^4$) is similar to that of the preceding arch, to which it is closely applied. The pharyngo-branchial ($ph.br^4$) is a small flat bone articulated by a step-like process with the third pharyngo-branchial.

The fifth arch or inferior pharyngeal bone (br^5) is unsegmental, but is tipped at its upper end with cartilage.

The *copulæ* or medio-ventral elements of the branchial skeleton (*cp.* 1–*cp.* 8) are eight in number, three of them (*cp.* 2, *cp.* 4, *cp.* 6) being ossified.

The first copula (*cp.* 1) is unossified, bluntly pointed, and supports the tongue. It has been variously called the *entoglossal* (Stannius), *glossohyal*, and *basihyal* (W. K. Parker). The hypohyals articulate partly with it, partly with the succeeding segment.

The second copula (*cp.* 2) is a bony plate with cartilaginous ends, broader behind than in front: it is evidently homologous with the segment called by W. K. Parker, the first basi-branchial[1]. Following this, comes a short caritlaginous piece (*cp.* 3), distinctly segmented from both the preceding and the next following copulæ, and excavated on each side by a large concave articular facet for the first hypobranchial. Next follows a well-ossified plate (*cp.* 4), the second basibranchial of W. K. Parker; then another cartilaginous segment (*cp.* 5) with which the second hypobranchials articulate; then a slender rod of cartilage ossified by a thin flat plate (*cp.* 6), the third basibranchial of W. K. Parker. So far, the copulæ are all regularly articulated with one another. The remaining two, on the other hand, are isolated, or, more strictly, connected with surrounding parts by membrane only: one, a somewhat pear-shaped nodule of cartilage (*cp.* 7), comes immediately in front of the ventral end of the fourth arch (fourth basibranchial); while the other (*cp.* 8) is smaller, and is similarly related to the fifth (fifth basibranchial).

I am disposed to think that the nomenclature of these copulæ now generally used is not very satisfactory as applied to *Regalecus*. According to it, the bone marked *cp.* 2 is counted as part of the first branchial arch, its midventral or basibranchial segment. Similarly, *cp.* 4 is considered as part of the second arch, *cp.* 6 of the third, *cp.* 7 of the fourth, and *cp.* 8 of the fifth. But in the present case it will be observed, the only copulæ which actually unite the ventral ends of branchial arches are the cartilaginous pieces *cp.* 3 and *cp.* 5. On the other hand, each of the segments *cp.* 2, *cp.* 4, and *cp.* 6–8, is interposed between two successive arches, but is itself definitely referable to neither. So that, as the arches themselves are inter-segmental—the segments being determined by the branchial nerves and clefts—the copulæ enumerated in the preceding sentence are segmental, bearing something the same sort of relation to the arches that the chevron bones of a reptile bear to its caudal vertebræ. On the other hand, the copulæ *cp.* 3 and *cp.* 5 are intersegmental like the arches themselves, *cp.* 3 being definitely referable to the first arch, *cp.* 5 to the second.

If this view be correct, the cartilage *cp.* 3 is the true first basibranchial, and *cp.* 5 the second. The five copulæ ordinarily known as the basibranchials may then be termed *interbranchials*. The first copula (*cp.* 1), judging from the analogy of its successors, in which there is an alternation of inter- and basibranchial (segmental and

[1] "Salmon's Skull," Phil. Trans. 1873, p. 95; 'Morphology of the Skull,' p. 80.

intersegmental) elements, is probably intersegmental, and should therefore retain its usual name of *basihyal.*

It will probably be urged against the above view, that in the Salmon and other Teleosts which have been carefully examined, the so-called basibranchials are ossifications in a continuous cartilage, what I have called the true basibranchials being mere synchondroses: and further, that one can hardly expect a primitive mode of segmentation in a highly specialized Acanthopterygian like *Regalecus.* But it must be borne in mind that the skeletons of Teleosts are, more often than not, examined dry, in which condition there would be no distinction between a distinct intercalated cartilage and a synchondrosis. Moreover, as we know practically nothing about the phylogeny of the various Teleostean groups, it is certainly premature to say that "primitive" arrangements should or should not be found in any one of them.

Attached to the branchial arches are the delicate parosteal *gill-rakers*, of which each of the first four arches bears two sets, an anterior (*a.g.r*), and an internal (*i.g.r*). In the second, third, and fourth arches, each series consists mainly of delicate triangular laminæ, about $\frac{1}{10}$ inch in length, set transversely to the long axis of the arch. Alternating with these, which may be called *primary ossicles* come smaller *secondary ossicles*, not more than $\frac{1}{10}$ inch in length, and between these and the primary are intercalated a *tertiary* set, less than $\frac{1}{20}$ inch high. Calling the primary ossicles A, the secondary B, and the tertiary *c*, their typical arrangement on the branchial arches is shown diagrammatically thus:—

A *c* B *c* A *c* B *c* A.

On the first arch, the primary ossicles of the anterior series ($a.g.r^1$) are greatly elongated, forming scythe-like laminæ a little more than an inch in length. Those on the cerato- and upper part of the hypobranchial are kept in place by a fold of pigmented mucous membrane about $\frac{1}{4}$ inch wide, which unites their proximal ends: the secondary and tertiary ossicles are attached to the free border of this membrane, being thus carried quite away from the branchial arch itself.

In the fifth arch only, the internal series of ossicles is present. On the first arch both series are continued on to the pharyngo-branchial: in the remaining arches this is not the case, but the pharyngo-branchials are fringed with delicate spinose denticles. Similar denticles fringe the edges of all the gill-rakers.

6. The Vertebral Column and the Dorsal Fin.

(Plate III. fig. 5, and Plate VI. figs. 20–26.)

The vertebral column consists of 93 vertebræ, with the neural arches of which are connected 206 interspinous bones, serving for the attachment of 205 (15 + 190) dermal fin-rays.

The Vertebræ.

These, like the other parts of the skeleton, are extremely fragile, so much so that the majority of the neural spines were found, on the removal of the flesh, to be broken, although the utmost care was used in cleaning them.

The vertebral centra (figs. 22–24) are deeply amphicœlous, and may be described as consisting of two cones (fig. 23) of wonderfully thin papery bone, united apex to apex, and bound together externally by a larger or smaller number of longitudinal bony plates (figs. 22 and 24), radiating outwards from the long axis of the centrum. Of these *radiating lamellæ,* as they may conveniently be called, the dorsalmost on each side is vertical, projects beyond the general level of the vertebra, and forms a *neural plate* (*n.pl*), from which, usually near the middle of the vertebra, a comparatively slender *neural process* (*n.pr*) is given off. This latter, uniting with its fellow of the opposite side, forms the neural arch, from which an extremely slender neural spine (*n.s*) passes usually vertically upwards. Similarly the ventralmost lamella of each side is vertical, and in all but the first twenty vertebræ projects beyond the general level of the centrum, forming a *hæmal plate* (*h.pl*), from which a *hæmal process* (*h.pr*) is given off. It will be evident from this description that the neural plate and process together constitute the neurapophysis of the vertebra, the hæmal plate and process its hæmapophysis. In no case do the latter unite to form a hæmal arch. The radiating lamellæ on the lateral surfaces of the centra (*r*) usually end flush with its general surface and form mere strengthening ridges.

The long wedge-shaped spaces between these lamellæ are partly filled up with the remains of the original cartilage of the vertebra (coloured purple in figs. 23, 24), outside which is a thick layer of remarkably tough fibrous tissue (coloured blue), the presence of which made the cleaning of the centra a very tedious and difficult task.

Perhaps the most striking point about the vertebræ is the gradual increase in length of the centra from before backwards (see fig. 5). The centrum of the first or atlas (fig. 20, *c.* 1), is a mere flat disk, not more than $\frac{1}{10}$ inch from front to back; in the second vertebra (*c.* 2) the antero-posterior measurement is increased to $\frac{1}{5}$ inch, in the third (*c.* 3) to $\frac{2}{5}$ inch, in the seventh to $\frac{3}{4}$ inch, in the twenty-second to 1 inch, in the fiftieth to $1\frac{1}{2}$ inch, in the eightieth to 2 inches, in the ninetieth to 3 inches, and in the ninety-second (fig. 25, *c.* 92) to 4 inches. The last or ninety-third vertebra (fig. 25, *c.* 93) is a little under $2\frac{1}{2}$ inches long; but as I shall point out, it is probably to be considered as representing only the anterior half of a vertebra, so that the exception in its case is only apparent.

The *atlas* (fig. 20, *c.* 1, *n.s.* 1, *tr.p.* 1; fig. 21) has a thin discoidal centrum, presenting on its anterior face three facets corresponding with those of the occipital condyle: its arch is the largest, and its spine the stoutest of the whole series; the spine also is shorter than any but those of the last three or four vertebræ—the entire height of the atlas being a little under 2 inches—and is markedly inclined forwards. On each side at the junction of the neural arch with the centrum, is given off a long, gently curved, transverse process (*tr.p.* 1), nearly $1\frac{3}{4}$ inch in length, which passes at first upwards, and slightly backwards and outwards, and then almost directly backwards, nearly in contact with the succeeding vertebræ, and ending at about the middle of the fifth. The presence of transverse processes to the atlas is quite unusual.

The *second vertebra* is, as stated above, almost double the thickness of the atlas; its centrum (*c.* 2) has five strengthening ridges on each side. The neural process is given off from near the anterior end of the neural plate, the posterior end of which is produced into a small, somewhat triangular process, which functions as a posterior zygapophysis (*p.zy*). There is no transverse process.

The *third vertebra* has well-developed transverse processes (*tr.p.* 3) springing from the two uppermost of its strengthening ridges, and passing almost horizontally backwards. The neural processes now spring from near the centre of the neural plates, and there are anterior as well as posterior zygapophyses developed from the extremities of these plates.

The *fourth* to the *seventh vertebræ* closely resemble the third: they increase progressively in all dimensions save the thickness of the neural spine, which is reduced in the seventh to about $\frac{1}{20}$ inch, this thickness being now retained through the whole column. The transverse processes are gradually inclined downwards, and from the fifth vertebra onwards spring from the second and third of the lateral radiating lamellæ or strengthening ridge; at the same time the zygapophyses undergo a considerable increase in size, becoming high triangular processes.

The *eighth vertebra* differs from its predecessors in possessing ribs (*r.* 8), slender bony rods attached along the whole posterior edge of the transverse processes, and projecting about $\frac{1}{2}$ inch beyond them, the total length of the ribs being about $1\frac{1}{4}$ inch.

In the succeeding vertebræ the transverse processes become attached lower and lower down on the sides of the centra, springing in the *thirteenth* from the third and fourth strengthening ridges: they also become turned more and more directly downwards, and at the same time increase in width, becoming flat subtriangular plates. The ribs also increase in length, attaining their maximum in the eleventh vertebra, in which they are $1\frac{3}{4}$ inch long, and project $1\frac{1}{4}$ inch beyond the end of the transverse process.

In the *twenty-first vertebra*, only four strengthening ridges can be made out on each side, the third being very poorly developed. The transverse process still springs from the third and fourth, but mainly from the latter, which has now begun to take on the characters of a hæmal plate: the hinder end of the latter is produced downwards into a triangular process (see fig. 22, $n.pl^1$), having much the character of a posterior hæmal zygapophysis. In the *twenty-second* the ribs have become greatly reduced, and appear for the last time in the *twenty-fifth*, so that there are altogether eighteen (eighth to twenty-fifth vertebræ inclusive) pairs. In the *twenty-third* the zygapophyses are poorly developed, and in succeeding vertebræ they gradually disappear.

In the *twenty-seventh vertebra* the dimensions of the hæmal plate are markedly increased, and a hæmal process is given off from it. The latter increases in length, the hæmal plate continues to be divided into a larger anterior (fig. 22, *h.pl*), a smaller posterior ($h.pl^1$) portion, and the zygapophyses become practically obsolete, until, in the *thirty-second* vertebra, the characters shown in fig. 22 are assumed. In this there are seen to be only three strengthening ridges on each side, making with the neural and hæmal plates five pairs of radiating lamellæ.

Between the *thirty-sixth* and the *forty-fifth* vertebræ, the increase in length of the centrum is small; the neural and hæmal plates diminish in height, the length of the hæmal processes increases, and the lateral ridges are reduced from three to two. In the *fiftieth* a small bony lump or knot appears in the middle of the lateral surface of the centrum: this occurs in all succeeding vertebræ, attaining its maximum in the *ninety-second* (fig. 25, *c.* 92): the bone of which it is composed is the hardest in the body.

Between the *fiftieth* and the *sixtieth* vertebra, the two strengthening ridges become gradually fused into one; this is retained throughout the rest of the vertebral column (figs. 24 and 25): the neural and hæmal plates also undergo further reduction. In the *fifty-second*, the hæmal processes attain a length of a little more than $1\frac{1}{2}$ inch, and from about the *seventieth* to the *ninetieth* this is increased to the maximum length of nearly 2 inches: they continue to be slightly inclined backwards up to the *eighty-eighth*, in which the inclination becomes more marked. In succeeding vertebræ they become more and more tilted upwards, until in the *ninety-second* (fig. 25) they are nearly parallel to the centrum.

It is somewhat remarkable that in no case do the hæmal processes unite distally to form a hæmal arch, and that consequently there are no hæmal spines in any part of the vertebral column.

As mentioned above, the neural spines from about the *seventh* vertebra onwards are very slender, not more than $\frac{1}{20}$ inch in diameter. They gradually increase in length as far as about the *thirtieth*, where the maximum length of $4\frac{1}{4}$ inches is reached, and is retained to about the *sixty-sixth* vertebra, from which point they begin gradually to shorten, being reduced to 3 inches in the *eightieth*, to $1\frac{1}{2}$ inch in the *ninetieth*, and to $\frac{3}{4}$ inch in the *ninety-second.*

The vertebral column is terminated by a bone which I have called, for convenience, the *ninety-third vertebra.* This (fig. 25, *c.* 93) is a subconical bone nearly $2\frac{1}{2}$ inches in length, having low neural and hæmal plates, but neither neural, anal, nor hæmal processes, and marked externally by a lateral ridge which undergoes a great thickening at the posterior end of the bone. In longitudinal section (fig. 26) it is seen to have a single subconical cavity ending bluntly near the hinder end, and, like the cavities of the other vertebræ, filled with the gelatinous remains of the notochord. The bone thus has all the characters of the anterior half of a vertebra, and may be conveniently called a *demivertebra.* Its size distinctly tends to confirm this interpretation of its nature; if completed it would be nearly 5 inches long, that is about an inch longer than its predecessor, which is itself three quarters of an inch longer than the antepenultimate (91st), the latter being again one quarter of an inch longer than the ninetieth.

The tail is thus seen to be perfectly diphycercal; there is not the slightest upturning of the end of the notochord, nor any trace of hypurals.

The transverse vertical plane passing through the centre of a vertebra corresponds with the septum between two myotomes, or, what comes to the same thing, to the dividing plane between two mesoblastic somites or protovertebræ; so that the demivertebra and the posterior half of the ninety-second vertebra of *Regalecus*, must be together formed from the last mesoblastic somite. One would like to know whether demivertebræ are of anything like general occurrence, or whether, as a rule, nothing corresponding to a vertebral body is formed in the posterior half of the last mesoblastic somite.

It must be borne in mind, however, that according to Lütken there is very possibly a caudal fin in young individuals, the condition of the tail in adult specimens being due to mutilation. If this were the case, the demivertebra would be at once explained as the anterior half of a vertebra which had been broken through the middle, as in the mutilated tail of a Lizard. But the somewhat peculiar, *i. e.* not regularly conical, form of the cavity of the demivertebra, and the absence of any trace of neural or hæmal processes above and below the bony thickening, which may be taken as marking the point corresponding with the middle of an ordinary vertebra, seem decidedly to tell against Lütken's view. A further objection is furnished by the disposition of the posterior interspinous bones (*vide infra*).

The Interspinous Bones and Dermal Fin-rays.

The interspinous bones are for the most part delicate bones (fig. 25, *i. sp.* & fig. 5) having the form of a Y with short stout *arms* and an extremely long slender *stem*; in the anterior interspinous bones, the arms occur more or less united into a single triangular plate (fig. 20). In length they agree pretty nearly with the neural spine, varying with the latter in different parts of the body; the majority of them are a little over 4 inches long, those at the anterior and posterior ends of the body gradually diminishing to $1\frac{1}{2}$ inch or less. The arms and upper portion of the stem are fully $\frac{1}{7}$ inch in diameter, but the stem narrows below to about $\frac{1}{20}$ inch, that is about the same width as the neural arches. Their dorsal portions exhibit an evident cartilaginous ground-work.

In correspondence with the length of the vertebræ, the distance between the arms of the spinous bones varies in different parts of the body; in the middle this distance is about $\frac{3}{4}$ inch, in the posterior part it rises to fully an inch (fig. 25), and anteriorly sinks to $\frac{1}{4}$ inch (fig. 20).

There is also considerable variation in the precise position of the interspinous bones with regard to the neural spines (see fig. 5). In the anterior part of the body there are, as a rule, two spinous bones to each vertebra; in some cases they alternately lie in an interneural space and immediately over a neural spine, being connected to it by ligament; in others two occur in a single interneural space, both being unconnected with a neural spine. In the posterior part of the body there is an average of three interspinous bones to each vertebra, and here, again, one of these is sometimes directly connected with a neural spine, while in other cases all three lie in an interneural space.

The last interspinous bone (fig. 25, *i. sp.* 205), having to take part in the support of but one fin-ray, has only its anterior arms developed, the posterior arm being represented by a mere tubercle; it is situated over the ninety-second vertebra, about halfway between its middle and its hinder end.

The neural spines and interspinous bones are united by a strong longitudinal ligament (figs. 20 and 25, *lg*), formed by the intersection of intermuscular septa, which extends from the tip of the first to that of the last neural spine; a similar ligament (fig. 25, lg^1) passes from the rudimentary posterior arm of the last interspinous bone to the upper surface of the demivertebra, at about the junction of its middle and posterior thirds.

The arrangements described in the preceding paragraphs do not appear to me to give the impression that the tail has suffered mutilation; one would hardly expect, if this had taken place, to find the line of fracture through the interspinous bones so much in front of that through the vertebral bodies. Moreover, if curtailment has taken place, the ligament lg^1 must be an entirely new structure, which seems hardly likely. I must repeat, however, that I have not seen Lütken's original paper, and am therefore arguing against a view with which I am very imperfectly acquainted.

The mode of articulation of the interspinous bones and fin-rays is decidedly interesting. The interspinous bones are so arranged (fig. 25) that the posterior arm of one comes in close contact with the anterior arm of its successor, the two being bound together by ligament, and their ends sloped towards the point of contact so as to form a sort of shallow cavity. In this cavity is fastened by ligament an ovidal nodule of cartilage (figs. 4, 20, and 25, *c.n*), about $\frac{1}{4}$ inch in long diameter, upon which is perched, by its saddle-shaped proximal end, a dermal fin-ray (*fr*). I have not met with cartilages of this kind in any fish which has come under my notice, and can find no account of any such in the works at my disposal; I regard them as representing a second or distal series of radials or *pterygiophores*[1], the interspinous bones forming the proximal series.

The dermal fin-rays (figs. 4, 20 and 25, *fr*) are delicate, semitransparent, unjointed bones, split longitudinally and vertically along their whole length into right and left halves (fig. 4). Their proximal ends are expanded and pedate, and furnish saddle-shaped surfaces, which articulate with the cartilaginous nodules described above. This

[1] I propose to use the word *pterygiophore* to signify any radial fin-supporting cartilage or bone in either the median or the paired fins; it will include, therefore, the cartilaginous fin-rays of Cyclostomes, Elasmobranchs, and Ganoids, and the interspinous bones and brachial ossicles of Teleosts. In the latter group it will be decidedly convenient to have a single word which may be used instead of "interspinous bone," the awkwardness of which in long descriptions is sufficiently obvious from the foregoing paragraphs.

maximum length in the second dorsal fin is 3 inches, but this is reduced to $1\frac{1}{2}$ inch at the anterior and posterior ends of the fin.

The first fifteen rays are, as mentioned in the systematic description (p. 5), modified to support the characteristic crest (figs. 1, 5, and 20). In the specimen described, only the seventh and ninth of these are perfect, and measure $17\frac{1}{2}$ and $15\frac{1}{2}$ inches respectively. The first to fifth rays have evidently lost very little; the first is $17\frac{1}{2}$ inches long. All these rays are semitransparent, not longitudinally divided, very brittle, and taper from the proximal to the distal end, terminating when perfect in an extremely fine point (figs. 2 and 3).

The interspinous bones supporting the crest are also peculiarly modified (fig. 20). The first nine of them come altogether in front of the atlas, and are gradually, passing from behind forwards, more and more sloped forwards at their anterior ends, so that the anterior five of them (*isp.* 1–*isp.* 5) are nearer horizontal than vertical. These first five interspinous bones are, moreover, ankylosed together, forming an irregular laterally compressed bone, and thus affording a firm support to the crest. The dorsal end of this compound bone shows clearly the extremities of the five interspinous bones which enter into its composition; its ventral (posterior) end is forked vertically; the lower limb of the fork is straight, abuts against the spine of the atlas a little below its middle, is produced into two lateral wings so as to have a somewhat flattened lower surface, and appears to belong to the first interspinous bone only; the upper limb is curved, nearly horizontal, connected with the extremity of the spine of the atlas, and apparently belongs to the coalesced second to fifth interspinous bones; with its upper edge the lower ends of the sixth to tenth interspinous bones are connected.

As shown in the figure of the entire skeleton (fig. 5) these peculiarly modified anterior interspinous bones overhang the skull, and it is by the filling up of the interval between the two that the "forehead" of *Regalecus* is produced.

The articulation of the anterior rays presents some peculiarities. The first (*fr.* 1) articulates with the cartilaginous extremity of the first interspinous bone; the second and third with a small cartilaginous pad, capping the posterior half of the first and the second interspinous bones; the fourth, fifth, and sixth with a much larger pad applied to the tops of the third, fourth, fifth, and anterior half of the sixth interspinous bones. The remaining rays articulate in the normal manner with cartilaginous nodules alternating with the interspinous bones. A slight variation is, however, seen as far as the eleventh ray, in that the ligamentous fibres joining the interspinous bones take on an increased development and form large pads of fibrous tissue (fig. 20, *fp*), immediately underlying the cartilaginous nodules and capping the contiguous halves of two adjacent interspinous bones.

7. The Shoulder-girdle and Pectoral Fin. (Plate IV. fig. 6, and Plate V. fig. 18.)

The only deviations of any importance from the ordinary Teleostean type in the shoulder-girdle of *Regalecus* are the simple form of the posttemporal and its intimate connection with the skull, and the abnormal position of the scapula, coracoid, and brachials, correlated with that of the pectoral fin.

The *posttemporal* (figs. 6, 8, 10, & 18, *p.tm*) is a small bone, flattened for the most part, and closely applied to the dorsal surface of the auditory capsules, in a groove between the epiotic and the pterotic; its posterior end is thickened, and forms a saddle-shaped articular surface for the supraclavicle.

The *supraclavicle* (*s.cl*) is a gently curved bone, having on its dorsal (anterior) end a saddle-shaped surface for the posttemporal; its lower two thirds is flattened, and applied splint-wise to the outer surface of the clavicle.

The *clavicle* (*cl*) is a flat curved bone, having its dorsal half strongly bent forwards and applied to the inner surface of the supraclavicle; its lower half is subvertical in position. It is widest in the middle and narrows gradually to both ends.

The *postclavicle* (*p.cl*) has the usual form of a long slender bone, attached by ligament to the inner face of the clavicle and passing backwards and downwards; it is about six inches long.

The *coracoid* (*cr*) is rather a large bone, having a straight lower and curved upper border; it is attached by ligament to the posterior edge of the clavicle, and takes a direction upwards and backwards. The outline is unbroken by the usual notch in the posterior edge.

The *scapula* (*sc*) is very small in proportion to the coracoid, an exaggeration of the usual state of things in Teleosts, and especially in Acanthopterygians, and is an irregular bone with a deep notch near the anterior end of its lower border.

The pterygiophores or *brachials* (*br.* 1–3) are three in number, and so closely applied to one another as to appear like a single bone, the boundary lines between them only appearing after drying. They lie in the same horizontal line as the scapula, being tilted up posteriorly so as to bring the fin into its peculiar vertical position. The first and second are roughly oblong, the third triangular, and all have about the same vertical height as the scapula. Hence all four bones appear to form a single series, and it is only by comparison with other fishes that the real homology of the scapula becomes apparent.

The *pectoral fin* (fig. 6, *p.f*) consists of thirteen unjointed rays; but in front of the first of them is a small nodule of bone, exactly resembling the proximal ends of the other rays and evidently representing a rudimentary first or preaxial ray, thus bringing the actual number to fourteen.

The rudimentary ray and the first of the regular series articulate with the scapula, a very usual connection, the second and third with the first or preaxial brachial, the fourth to the seventh with the middle, and the eighth to the thirteenth with the postaxial brachial.

8. THE HIP-GIRDLE AND PELVIC FIN. (Plate IV. fig. 6, and Plate V. fig. 19.)

The os innominatum.—The hip-girdle consists of two distinct innominate bones[1] each of which has the form of a triangle with an elongated base and greatly produced posterior angle. From its inner face arises a vertical ridge (fig. 19, *sy*), which passes inwards and is united to its fellow of the opposite side by ligament, forming an anterior symphysis; a posterior symphysis is formed by a similar ligamentous union of the whole of the opposed postero-superior borders (sy^1) of the innominate bones. On the ventral border, at about the junction of its anterior and middle third, the os innominatum is greatly thickened and forms a large saddle-shaped surface or an acetabular facet for the pelvic ray. The ridges with which the bone is marked all radiate from this facet.

In the natural position of the parts, the antero-superior portion of the hip-girdle is embraced and hidden by the shoulder-girdle (fig. 6).

The *pelvic* (so-called *ventral*) *fin* (fig. 6 and 19, *pr.f*), consists of a single slender ray, articulating by a thickened, saddle-shaped, proximal end with the acetabular facet. In the specimen both pelvic rays were broken, but the more perfect of the two was 3 feet 1 inch long, and tapered so nearly to a point that it is improbable that more than a few inches were lost. The proximal end of the ray is about $\frac{1}{3}$ inch thick.

SUMMARY.

The following are the most important osteological peculiarities of *Regalecus argenteus*:—

1. Owing to the large size of the eyes as compared with that of the cranium, the orbit is enlarged by the formation of a *subcranial crest* (Pl. IV. figs. 7, 10, 11) formed by a downward prolongation of the basis cranii and having a triradiate horizontal section (p. 7, also *vide infra* §§ 5, 9, and 17).

2. There is no supraoccipital crest, nor any epiotic or parotic processes (p. 7, figs. 7, 8, and 11).

3. A large part of the cranium remains cartilaginous, there being a well-developed and very thick *tegmen cranii* (figs. 8, 11, and 12, *t.cr*) quite uncovered by bone, and a large *prenasal rostrum* (*p.n*); a considerable part of the auditory capsule also remains unossified (pp. 8 and 9).

4. The perichondium lining the cranium is so thick as quite to alter the shape of the cavity (p. 9, figs. 11 and 12).

5. The basioccipital (figs. 7–13, *b.o*) does not enter into the formation of the foramen magnum, being covered above by the united exoccipitals (*e.o*); it furnishes a medio-ventral facet to the occipital condyle ($o.c^2$), and is produced downwards into a median vertical plate, which forms the postero-superior portion of the subcranial crest (p. 9).

6. The exoccipitals (*e.o*) unite with one another below, thus forming the ventral as well

[1] Davidoff (Morph. Jahrb. vol. vi. p. 433) considers the so-called os innominatum or pelvic bone of Teleostei to be really the basipterygium; but his views require confirmation.

as the lateral boundary of the foramen magnum and the posterior third of the basis cranii (pp. 9 and 10); they also furnish the supero-lateral facets of the occipital condyle ($o.c^1$).

7. The supraoccipital (*s.o*) is displaced from its usual position by the union with one another in the middle line of the unusually large epiotis (*ep.o*) (p. 10).

8. The prootics (*pr.o*) are very small, and do not unite with one another below, or help to enclose the canal for the ocular muscles (pp. 10 and 11).

9. The opisthotics (*op.o*) are very large and unite with one another mid-ventrally, forming the anterior two thirds of the basis cranii; each sends off several processes, one of which ($op.o^2$) articulates with the alisphenoid (*al.s*), and another ($o.po^4$) forms with its fellow the anterior or double portion of the subcranial crest, the wedge-shaped space between the two forming the canal for the ocular muscles (p. 10).

10. The sphenotics (*sp.o*) send off descending processes, which, uniting with ascending processes of the parasphenoid (*p.as*), form a pair of *postorbital pillars* (*p.or.p*), immediately in front of the descending processes of the opisthotics (p. 11).

11. Owing to the union of the large alisphenoid (*als*) with the opisthotic, the fifth nerve apparently makes its exit, partly in front of the alisphenoid (through the foramen marked A), partly through a foramen (V^3) in the opisthotic (pp. 11 and 12).

12. There are large orbitosphenoids (*o.s*) uniting with one another in the middle line below, forming a false floor to the anterior part of the brain-case (p. 12).

13. There is no trace of either basisphenoid or presphenoid.

14. There is an irregular mesethmoid (*m.eth*) enclosing a small mesonasal cavity (*m.n.c*) (p. 12).

15. The parietals (*pa*) form faint elevated longitudinal crests on the dorsal surface of the cranium (p. 13).

16. The frontals (*fr*) do not unite with one another in the middle line; they furnish orbital processes (fr^1) which roof the orbit; in front they are produced into large, irregular, pointed processes (p. 13).

17. The parasphenoid (*pa.s*) is carried far below the proper level of the basis cranii by the formation of the subcranial crest of which it forms the ventral portion (p. 13).

18. The vomer (*vo*) sends off paired ascending processes which clasp the prenasal cartilage laterally (p. 13).

19. There are distinct, loosely attached nasals (fig. 6, *na*), bounding the nostril above (p. 13).

20. The suborbital chain is reduced to two preorbital bones (fig. 6, *p.or*), the anterior of which bounds the nostril below (pp. 13 and 14).

21. The *mesopterygoid* (fig. 6, 14, and 15, *ms.pt*) apparently begins as a parostosis, the ossification afterwards extending into the pterygoid cartilage (p. 14).

22. The premaxillæ (fig. 6, *p.mx*) have large nasal processes ($p.mx^1$) which embrace splint-wise a large laterally compressed cartilage, which works in a median groove of the tegmen cranii and allows for the protrusion and retraction of the jaws (p. 15).

23. The mandible (figs. 6 and 14) is remarkably short and high (p. 15).

24. The first and second branchial arches (fig. 17) are terminated dorsally by a segment apparently not before described (*pa.br*^{1}, *pa.br*^{2}), and which it is proposed to call the *parabranchial* (p. 17).

25. The copulæ, or medio-ventral elements, of the branchial skeleton are eight in number (fig. 17, *cp.* ^{1}–*cp.* ^{8}), of which the first (*cp.* ^{1}) is the entoglossal or basihyal; of the others, two (*cp.* ^{3} and *cp.* ^{5}) join the ventral ends of the first and second arches respectively, and are considered to be the only two true *basibranchials*; the others are intermediate, each between two arches, and it is therefore proposed to call them *inter-branchials* (p. 18).

26. The vertebral column (fig. 5) consists of ninety-three vertebræ, with the neural arches of which are connected two hundred and six interspinous bones, serving for the attachment of two hundred and five (15+190) dermal fin-rays.

27. There is a gradual increase in length of the vertebral bodies from before backwards, the first (fig. 20, *c.* 1) being $\frac{1}{10}$ inch, the ninety-second (fig. 25, *c.* 92) 4 inches in antero-posterior dimensions (p. 20).

28. The atlas bears long transverse processes; the second vertebra is devoid of these, which, however, reappear in the third (p. 20).

29. Small slender ribs are borne by the eighth to the twenty-fifth vertebra inclusive (p. 21).

30. None of the hæmal processes unite below, so that there are neither hæmal arches nor hæmal spines in any part of the vertebral column (p. 22).

31. The bone terminating the vertebral column posteriorly (Pl. VI. fig. 25, *c* 93) is considered to be a *demivertebra*, that is to represent the anterior half of a vertebral body; it is in the same straight line with the rest of the vertebral column, so that the tail is strictly diphycercal (pp. 22 and 23).

32. In the anterior part of the body there is an average of two, in the posterior part, of three interspinous bones to a vertebra (p. 23).

33. The fin-rays are articulated to the interspinous bones not directly, but through the intermediation of ovoid cartilaginous nodules (figs. 20 and 25, *c.n*), which alternate with the interspinous bones and are considered to represent a second or distal set of radials or *pterygiophores* (p. 24).

34. The anterior nine interspinous bones lie altogether in front of the atlas and overhang the skull (fig. 20); the first five of them are peculiarly modified and ankylosed together to support the crest (p. 25).

35. The posttemporal (Pl. IV. figs. 6, 8, and 10, and Pl. V. fig. 18, *p.tm*) is not forked, and is closely applied to the dorsal surface of the skull, in a groove between the epiotic and the pterotic (p. 26).

36. There are three brachials (figs. 6 and 18, *br.* $^{1-3}$) supporting the pectoral fin; they are irregular flat bones, having a vertical height equal to that of the scapula (p. 26).

37. In front of the first well-developed ray of the pectoral fin (fig. 6, *pc.f*) is a small bone which probably represents a rudimentary first (preaxial) ray (p. 26).

38. The innominate, or pelvic bones (figs. 6 and 19, *o.in*), are very large, and unite with one another by a double symphysis (p. 27).

DESCRIPTION OF THE PLATES.

Complete List of Reference Letters.

A. Foramen for cranial nerves (probably second to fifth).
a (in fig. 2). Point at which the membrane was ruptured in the specimen.
a.g.r. Anterior gill-rakers, numbered according to the arch to which they are attached.
al.s. Alisphenoid.
ar. Articular.
a.zy. Anterior zygapophyses.
B. Foramen in subcranial crest.
b.cr. Basis cranii.
b.o. Basioccipital.
br. $^{1-3}$ (in figs. 6 and 18). Brachials.
br. ^{5} (in fig. 17). Fifth branchial arch.
br.r. Branchiostegal rays.
c. Centra of vertebræ, numbered in figs. 20 and 25.
c.a. Caudal artery.
c.br. $^{1-4}$. Cerato-branchials.
cl. Clavicle.
c.n. Cartilaginous nodules (distal pterygiophores) with which the fin-rays are articulated.
cp. $^{1-8}$. Copulæ (*cp.* 1, basi-hyal; *cp.* 3 and *cp.* 5, first and second basibranchials; *cp.* 2, *cp.* 4, and *cp.* 6–8, interbranchials.
cr. Coracoid.
c.v. Caudal veins.
d. Dentary.
ep.br. 1–4. Epibranchials.
e.o. Exoccipital.
ep.o. Epiotic.
f.m. Foramen magnum.
f.p. Fibrous pads beneath the cartilaginous nodules of the anterior fin-rays.
fr. Frontal.
fr. Orbital plate of frontal.
f.r. Fin-rays (numbered in figs. 20 and 25).
g.c. Gastric cæcum.
h.br. $^{1-3}$. Hypobranchials.
h.hy. Hypo-hyals.
h.m. Hyomandibular.
h.m^{1}. Facet for hyomandibular on outer surface of auditory capsule.
h.pl. Hæmal plate.
h.pr. Hæmal process.
I. Olfactory foramen.
i.hy. Inter-hyal.
i.g.r. Internal set of gill-rakers, numbered according to the arch to which they are attached.
i.m.s. Inter-muscular septa.
i.sp. Interspinous bones or proximal pterygiophores (numbered in figs. 20 and 25).
lg. Longitudinal ligament uniting the neural spines and interspinous bones.
lg'. Ligament passing from the last

interspinous bone to the demi-vertebra.

mck. Meckel's cartilage.
m.eth. Mesethmoid.
m.n.c. Meso-nasal cavity.
m.pt. Metapterygoid.
ms.pt. Meso-pterygoid.
mx. Maxilla.
my. Spinal cord.
na. Nasal.
n.pl. Neural plate.
n.pr. Neural process.
n.s. Neural spine.
o.c[1]. Dorsal } facet of occipital condyle.
o.c[2]. Ventral } facet of occipital condyle.
o.in. Os innominatum.
op. Opercular.
op.o. Opisthotic (*op.o*[1], ascending process; *op.o*[2], anterior process; *op.o*[3], posterior process; *op.o*[4], descending process).
o.s. Orbitosphenoid.
pa. Parietal.
pa.br. 1–2. Parabranchials.
pas. Parasphenoid.
pc.f. Pectoral fin.
p.cl. Post-clavicle.
p.eth. Par- (or ecto-) ethmoid.
ph.br. 1–4. Pharyngo-branchials.
pl. Palatine.
pmx. Alveolar portion of premaxilla.
pmx'. Nasal process of premaxilla.
p.n. Prenasal cartilage.
p.op. Preopercular.
p.or.p. Postorbital pillar.
pr.o. Pro-otic.
pr.or. Pre-orbitals.
pt. Pterygoid.
pto. Pterotic.
p.tm. Post-temporal.
pv.f. Pelvic fin.
pzy. Posterior zygapophysis.
qu. Quadrate.
r (in figs. 22 and 24). Strengthening ridges of centrum.
r^1–r^5 (in fig. 4). Cutaneous ridges.
r^8 (in fig. 20). First rib.
sc. Scapula.
s.cl. Supra-clavicle.
s.o. Supra-occipital.
s.op. Subopercular.
spo. Sphenotic.
sy (in fig. 14 and 15). Symplectic.
sy.sy[1] (in fig. 19). Symphyses of innominate bone.
t.cr. Tegmen cranii.
tr.pr. Transverse processes, numbered in fig. 20.
u.hy. Urohyal or basi-branchiostegal.
V^1. Foramen for orbitonasal nerve.
V^3. Foramen for mandibular nerve (?).
vo. Vomer.
X. Foramen for vagus.
x^1–x^4. Cartilaginous nodules on the dorsal ends of the cerato-branchials.

Cartilage coloured *mauve.*
Cartilage-bone coloured *yellow.*
Periosteum, ligament, &c., coloured *blue.*

PLATE II.

Fig. 1. Head of *Regalecus argenteus* from the left side, with the snout protruded: showing the natural colours of the freshly captured fish. $\frac{1}{4}$ nat. size.

Fig. 2. The seventh ray of the crest, showing the fringing membrane (broken at *a*) and the terminal lobe. Nat. size.

Fig. 3. Terminal lobe of seventh ray, showing the termination in it of the bony ray. $\times 4$.

Fig. 4. Transverse section through the body, near the middle (diagrammatic), showing the relation of the intermuscular septa to the skeleton and to the cutaneous ridges. $\frac{1}{2}$ nat size.

PLATE III.

Fig. 5. Skeleton of *Regalecus argenteus*. $\frac{1}{10}$ nat. size.

PLATE IV.

Fig. 6. The skull, with the shoulder and hip-girdles, from the left side. $\frac{1}{2}$ nat. size.

Fig. 7. The cranium from the left side. Nat. size.

Fig. 8. The cranium from above. Nat. size.

Fig. 9. The cranium from beneath. Nat. size.

Fig. 10. The cranium from behind. Nat. size.

Fig. 11. Longitudinal vertical section of the cranium with the periosteum in place. Nat. size.

Fig. 12. The same, with the periosteum removed. Nat. size.

PLATE V.

Fig. 13. The bones of the cranium, disarticulated. Nat. size.

Fig. 14. The suspensorial apparatus with the lower jaw and opercular bones of the left side, seen from within. $\frac{1}{2}$ nat. size.

Fig. 15. The left suspensorial apparatus and hyoid cornu, seen from the outer side, the opercular bones being removed. $\frac{1}{2}$ nat. size.

Fig. 16. The left hyoidean cornu, viewed from within. $\frac{1}{2}$ nat. size.

Fig. 17. The branchial arches of the left side, with the copulæ, seen from within: the posterior pharyngobranchials are somewhat displaced in order to bring the parts into one plane: most of the gill-rakers are supposed to be removed. Nat. size.

Fig. 18. The left shoulder-girdle, from within, the rays of the pectoral fin being removed. $\frac{1}{2}$ nat. size.

Fig. 19. The left innominate bone with the proximal end of the pelvic fin, seen from within. $\frac{1}{2}$ nat. size.

PLATE VI.

Fig. 20. The first five vertebræ, with the corresponding pterygiophores and fin-rays. Nat. size.

Fig. 21. The atlas, seen from the front. Nat. size.

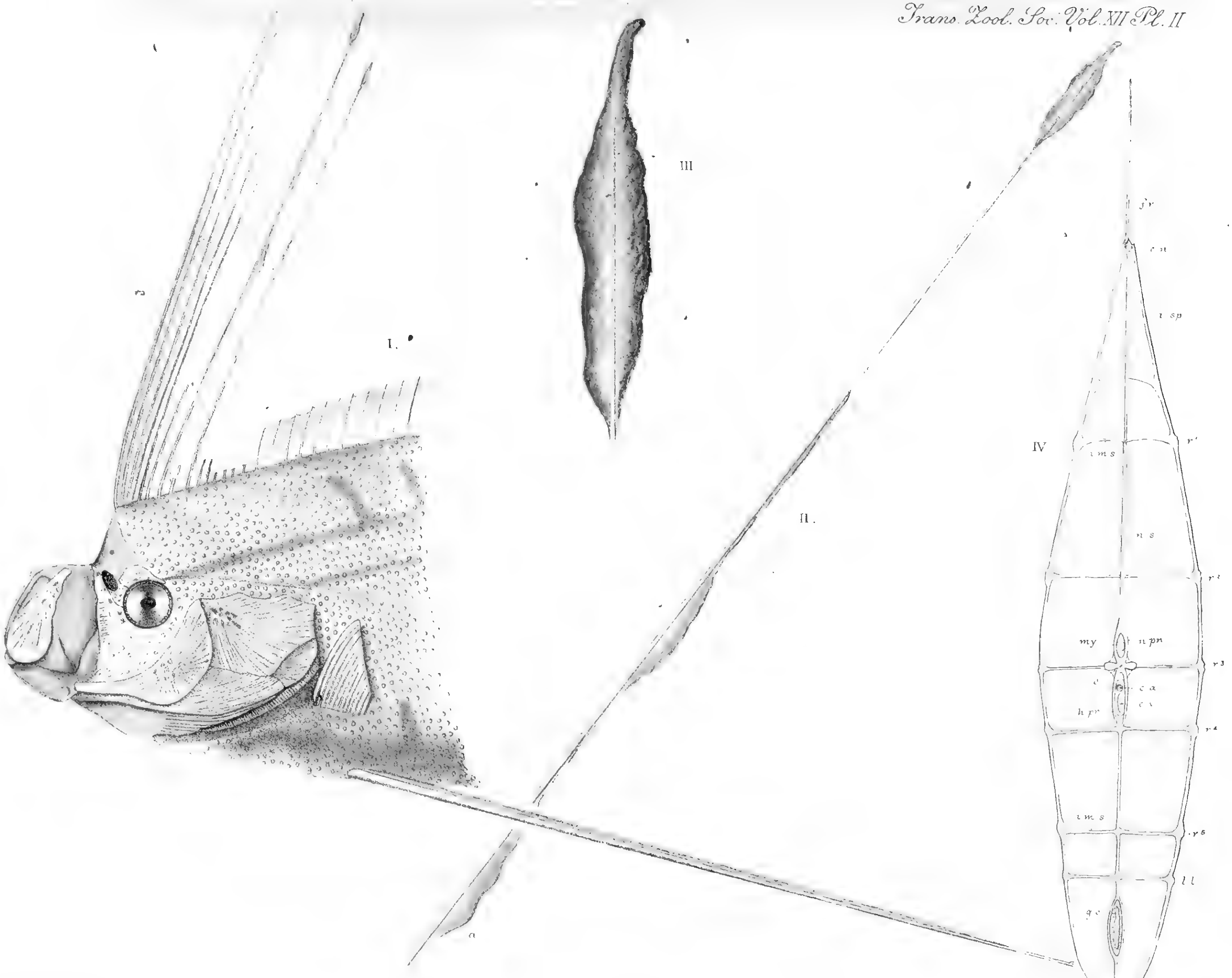
Fig. 22. The thirty-second vertebra, from the left side. Nat. size.

Fig. 23. Longitudinal vertical section of the seventy-fourth vertebra. Nat. size.

Fig. 24. Transverse section of the seventy-fifth vertebra. Nat. size.

Fig. 25. The last two vertebræ with the corresponding pterygiophores and fin-rays. Nat. size.

Fig. 26. Longitudinal vertical section of the last vertebra (demivertebra). Nat. size.



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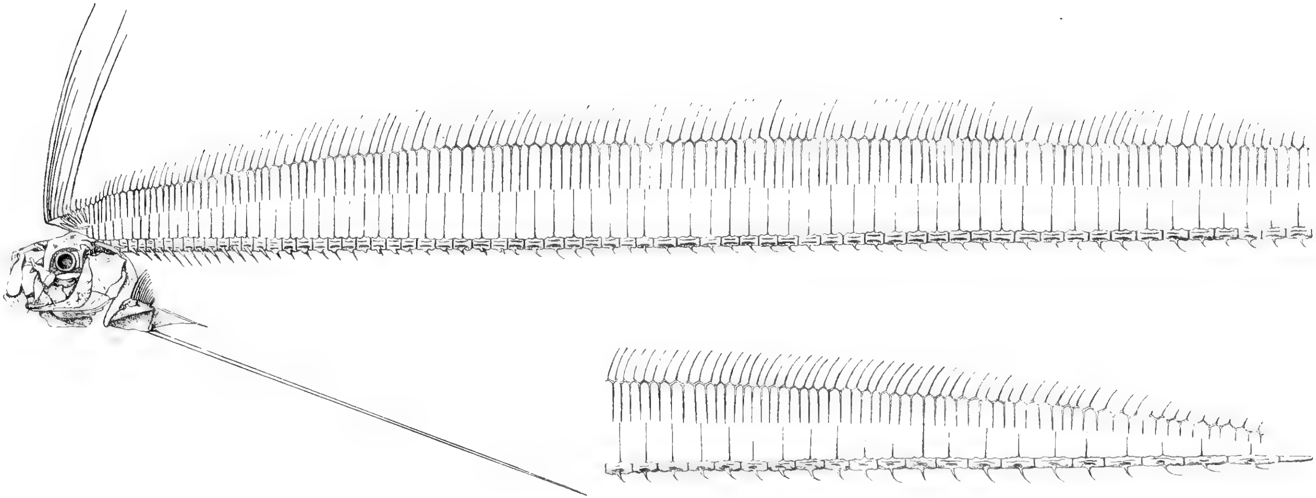
Parker & Coward lith.

REGALECUS ARGENTEUS.

West, Newman & Co imp.

Fig. 5



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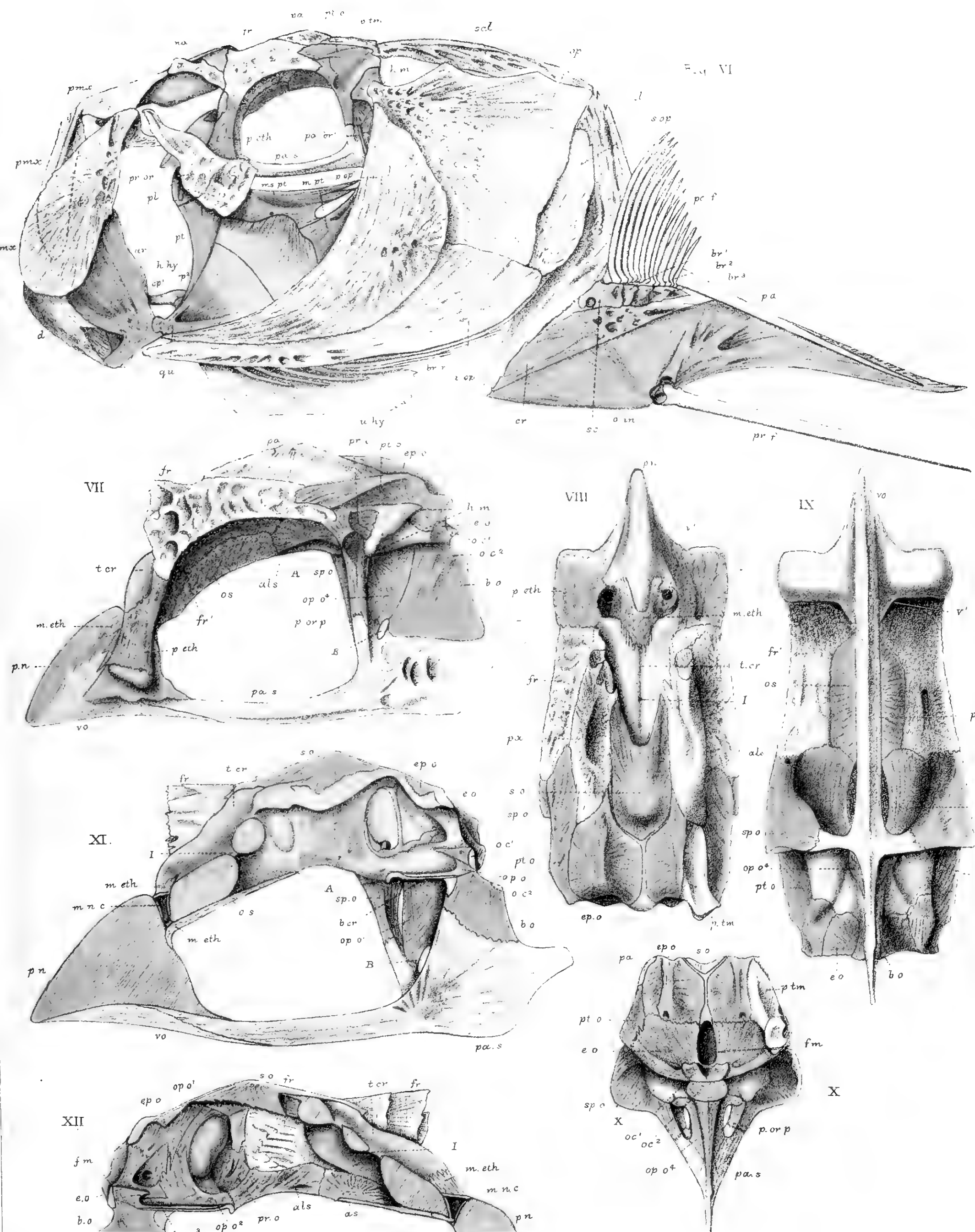

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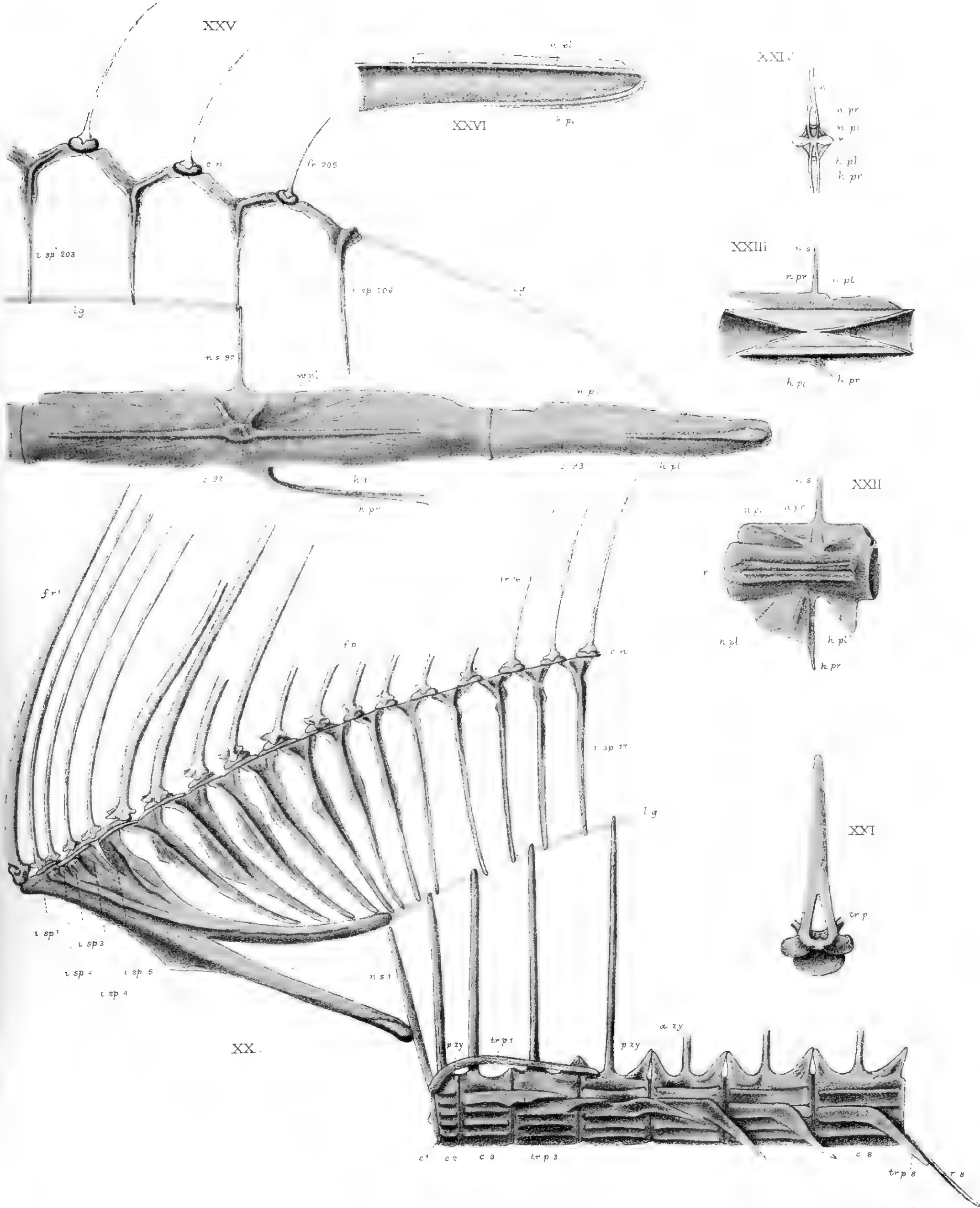

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February 1886.

P. L. SCLATER,
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OF

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Continued on page 3 of Wrapper.

III. *On the Reptiles and Batrachians of the Solomon Islands.* *By* G. A. Boulenger, F.Z.S.

Received April 24th, 1884, read May 6th, 1884.

[Plates VII. to XIII.]

Very little was known about the herpetology of the Solomon Islands until two important collections, made there and sent to the British Museum by H. B. Guppy, Esq., M.B., of H.M.S. 'Lark,' in 1883 and 1884, brought to light several new and interesting forms, such as could hardly have been expected from that district.

The first collection, received in June 1883, was formed in San Christoval and the neighbouring small islands of Santa Anna, the Three Sisters, and Ugi; it also contained a Crocodile's skull from Guadalcanar, and a Frog from Treasury Island. The second collection was received in March 1884, and proved to be of the greatest interest. It was formed in the small islands south-east of Bougainville—viz. the Shortland Islands, Treasury Island, and Faro Island [1]. The diagnoses of the new species have already been published in the 'Proceedings' of this Society; and I now propose to give an account of the herpetological fauna of the Solomon Islands.

The position of this group of islands on the limits of two great zoological districts renders the study of its fauna of special interest, as it is the point where many of the Papuasian and Polynesian forms intermingle. Curiously, all the Batrachians belong to species not hitherto found elsewhere, and one of them is even so strongly modified as to be the type of a distinct family.

The Reptiles may be grouped under four headings, viz.:—

A. Species belonging to both the Papuasian and Polynesian districts.

B. Indo-Malayan or Papuasian species, not extending further east or south-east.

C. Polynesian species, not extending further north and west than New Ireland.

D. Species not hitherto found elsewhere than in the Solomons (and New Ireland).

A.	B.	C.	D.
Gymnodactylus pelagicus.	Crocodilus porosus.	Gonyocephalus godeffroyi.	Lepidodactylus guppyi.
Gehyra oceanica.	Gecko vittatus.	Mabuia carteretii.	Lipinia anolis.
Mabuia cyanura.	Varanus indicus.	—— nigra.	Corucia zebrata.
Platurus fasciatus.	Keneuxia smaragdina.	Enygrus bibronii.	Dendrophis solomonis.
	Enygrus carinatus.		Hoplocephalus par.
	Dipsas irregularis.		

[1] Mr. Guppy supplies the following remarks:—"The islands from which these specimens were obtained may be generally referred to as 'the islands of Bougainville Straits,' as they lie in and off the western entrance

A comparison of the Reptile-fauna of the Solomons with that of Duke of York Island (between New Ireland and New Britain), as known from the collection made a few years ago by the Rev. G. Brown, and described by Dr. Günther [1], is interesting :—

Duke of York Island.	Solomon Islands.
CROCODILIA.	
	1. *Crocodilus porosus*, Schn.
LACERTILIA.	
Geckonidæ.	
1. *Gymnodactylus pelagicus*, Gir.	2. *Gymnodactylus pelagicus*, Gir.
	3. *Gehyra oceanica*, Less.
	4. *Lepidodactylus guppyi*, Blgr.
2. *Gecko vittatus*, Houtt.	5. *Gecko vittatus*, Houtt.
Agamidæ.	
3. *Gonyocephalus godeffroyi*, Ptrs.	6. *Gonyocephalus godeffroyi*, Ptrs.
Varanidæ.	
4. *Varanus indicus*, Daud.	7. *Varanus indicus*, Daud.
Scincidæ.	
5. *Mabuia albofasciolata*, Gthr.	
6. —— *carteretii*, D. & B.	8. *Mabuia carteretii*, D. & B.
7. —— *cyanura*, Less.	9. —— *cyanura*, Less.
8. —— *nigra*, Hombr. & Jacq.	10. —— *nigra*, Hombr. & Jacq.
9. *Hinulia megaspila*, Gthr.	
10. *Keneuxia smaragdina*, Less.	11. *Keneuxia smaragdina*, Less.
	12. *Lipinia anolis*, Blgr.
	13. *Corucia zebrata*, Gray.
OPHIDIA.	
Boidæ.	
11. *Liasis amethystinus*, Schn.	
12. *Nardoa schlegelii*, Gray.	
13. *Enygrus carinatus*, Schn.	14. *Enygrus carinatus*, Schn.
	15. —— *bibronii*, Hombr. & Jacq.
14. *Erebophis asper*, Gthr.	

of the Straits separating the large continental islands of Bougainville and Choiseul. They are all of them (Treasury Island, Shortland Island, and Faro Island) of no great size, the largest of them, and also the highest, being Faro Island, which is 12 miles long and 1900 feet in height. I should add that in the most recent Admiralty chart of the Solomon Islands, Faro Island is not laid down; it is, however, to the N.E. of the Shortland Islands, in the middle of the Straits, and its position will be given in the next chart published of the group."

[1] Proc. Zool. Soc. 1877, p. 127.

Duke of York Island.		Solomon Islands.
	Colubridæ.	
15. *Lielaphis modestus,* Schl.		
16. *Tropidonotus hypomelas,* Gthr.		
17. *Dendrophis solomonis,* Gthr.		16. *Dendrophis solomonis,* Gthr.
18. —— *macrops,* Gthr.		
19. *Dipsas irregularis,* Merr.		17. *Dipsas irregularis,* Merr.
	Elapidæ.	
20. *Diemenia muelleri,* Schl.		
		18. *Hoplocephalus par,* Blgr.
	Hydrophiidæ.	
21. *Platurus fasciatus,* Daud.		19. *Platurus fasciatus,* Daud.

In the following pages I give a list of all the species hitherto found in the Solomon group, with notes on the general habitats. The forms which are restricted to these islands are described.

REPTILIA.

CROCODILIA.

Crocodilus, Laur.

1. Crocodilus porosus, Schneid.

Of this widely-spread Crocodile, ranging from Southern China and the Indian continent throughout the East-Indian and Papuasian islands to North Australia, a skull, 12 inches long, was obtained by Mr. Guppy in the island of Guadalcanar. The animal was said to have been shot there by Capt. Shipman, master of the 'Mary Anderson,' who took the skin to Sydney, but left behind the skull[1].

LACERTILIA.

GECKONIDÆ.

Gymnodactylus, Spix.

2. Gymnodactylus pelagicus, Girard.

This species, which must be distinguished from A. Duméril's *G. arnouxii*, is distributed over nearly the whole of the Austro-Malayan subregion. The British Museum has specimens from Cape York, Torres Straits, Duke of York, New Hebrides, Loyalty, Fiji, and the species has also been found in New Guinea. Mr. Guppy obtained specimens in the Shortland Islands.

[1] Since the reading of this Paper, we have received (Febr. 1885) a second skull, that of a female specimen, 11 feet long, shot by Mr. Guppy in the Shortland Islands, and to which the following note is appended:—"Inside the stomach, I found, but partially digested, an Opossum and a large Lizard $1\frac{1}{2}$ foot long, belonging or allied to the genus *Cyclodus* [probably *Corucia zebrata*]. The same lizard has been sent to the Australian Museum, Sydney, by traders at Ugi, at the other end of the group; but I was unable to procure a specimen here. The crocodiles, of which I have seen several in this locality, do not apparently attain a greater length than 12 or 13 feet."

Gehyra, Gray.

3. Gehyra oceanica, Lesson.

Also a widely distributed species, occurring in the Moluccas, New Guinea, and many Polynesian islands. Specimens from the Admiralty Islands, Lord Howes Island, Fiji, Tongataboo, Samoa, Savage Island, and Rarotonga Island, are in the British Museum. Mr. Guppy collected specimens in the Shortland and Faro Islands.

Lepidodactylus, Fitz.

4. Lepidodactylus guppyi. (Plate VII. fig. 1.)

Lepidodactylus guppyi, Bouleng. Proc. Zool. Soc. 1884, p. 210.

The striking character in the physiognomy of this species is slenderness, the length of the head being contained four times in the distance between the end of the snout and the vent, and the diameter of the body nearly six times between those points. The hind limb, when stretched forwards, covers three fifths the distance between axilla and groin; the fore limb reaches the centre of the eye. The head, which is hardly distinct from the neck, is regularly oviform and very convex; the snout measures once and one third the diameter of the orbit, which equals its distance from the nostril or from the ear-opening; the upper surface of the snout is slightly concave medio-longitudinally; the ear-opening is very small and roundish.

The upper surface of the head is covered with granular scales, which are minute on the occiput and larger on the snout; the rostral is quadrangular, a little more than twice as broad as long, and with four short vertical clefts above, the median pair being the most distinct; on each side eleven or twelve small upper labials; the nostril is pierced between the rostral, the first supralabial, and three small nasals, forming a slight swelling; the granules bordering the labials are rather enlarged. The mental is very small, smaller than the adjacent infralabials, not half the width of the rostral; its shape is pentagonal, narrowed posteriorly; on each side eleven or twelve infralabials, the anterior distinctly larger than the supralabials; three or four transverse rows of very small polygonal chin-shields, passing gradually into the minute gular granules.

The body, which is feebly depressed, is covered above with uniform small granules, smaller than those on the snout, and larger than those on the occiput. The abdominal scales are juxtaposed round flat granules, the size of which is three or four times that of the dorsal granules. The limbs are covered with granules similar to those on the body. The digits, which are united at the base by a short web, are moderately elongate and strongly dilated; the inner is well developed; the infradigital lamellæ, which are similar under the fingers and under the toes, are strongly chevron-shaped: the distal lamella is, as usual, entire, the two or three next are divided by a median groove, the others undivided; under the inner digit the lamellæ are also chevron-shaped, but without median groove.

The unique specimen being a female shows no femoral nor preanal pores; but enlarged scales on these regions indicate that both kinds of pores are developed in the males

The tail is rather slender, cylindrical, tapering, much narrower than the body, and covered with uniform juxtaposed round granules, about the size of the ventrals. This organ appears to be prehensile.

The upper surfaces are pinkish brown, indistinctly dotted with darker on the back, more distinctly on the sides and limbs; a rather ill-defined dark-brown streak extends from the end of the snout to the ear, passing through the orbit; upper lip pink, brown-dotted; the upper surface of the tail is crossed by dark-brown bars, separated by interspaces of a pink colour. The lower surfaces are yellowish white, finely dotted with reddish brown on the throat.

Total length	93 millim.
From end of snout to vent	48 ,,
Head	12 ,,
Width of head	7 ,,
Fore limb	11·5 ,,
Hind limb	17·5 ,,
Tail	45 ,,

A single (female) specimen was collected by Mr. Guppy on Faro Island.

Gecko, Laur.

5. Gecko vittatus, Houtt.

Occurs in the Solomon Islands in both the typical form and the var. *bivittatus*, D. & B. To the latter belong four specimens from San Christoval, which have long been in the British Museum; another specimen of the same variety was collected by Mr. Guppy in Santa Anna Island, and one of the typical form in Faro Island. The species occurs in the Moluccas, New Guinea and the neighbouring islands, the Pelew Islands, Duke of York Island, and, according to Peters, also in North Australia.

AGAMIDÆ.

Gonyocephalus, Kuhl.

6. Gonyocephalus godeffroyi, Ptrs.

The British Museum possesses specimens from San Christoval, Santa Anna, and Treasury Islands, and others from Duke of York and the Fiji Islands. *Tiaris longii*, Macleay, which appears to be identical with this species, is from Northern Queensland.

VARANIDÆ.

VARANUS, Merr.

7. VARANUS INDICUS, Daud.

The British Museum has specimens from the Solomons, obtained from the late G. Krefft, and others from San Christoval, collected by Mr. Brenchley, and from Santa Anna and Shortland Islands, collected by Mr. Guppy. This Monitor occurs also in Celebes, the Moluccas, New Guinea, Timor Laut, the islands of Torres Straits, Cape York, New Ireland, and the Admiralty Islands.

SCINCIDÆ.

MABUIA, Fitz.

8. MABUIA CARTERETII, D. & B.

Originally described from New Ireland, this Scincoid has been found by Mr. Guppy in Treasury and Santa Anna Islands. Specimens from Murray Island, Duke of York Island, and Erromanga are in the British Museum.

9. MABUIA CYANURA, Lesson.

Of this species, which occurs in abundance in most of the Polynesian an Papuasian islands, extending west as far as Celebes, we have specimens from San Christoval, Santa Anna, Treasury, and Shortland Islands.

10. MABUIA NIGRA, Hombr. & Jacq.

Mr. Guppy collected several specimens in Treasury and Santa Anna Islands. The species occurs also in the Fiji and Samoa Islands and Duke of York Island.

KENEUXIA, Gray.

11. KENEUXIA SMARAGDINA, Lesson.

Occurs from the Philippines and Java, throughout the East-Indian and Papuasian islands to the Solomons, where specimens were obtained by Mr. Guppy on Treasury Island.

LIPINIA, Gray.

12. LIPINIA ANOLIS. (Plate VII. fig. 2.)

Lipinia anolis, Bouleng. Ann. & Mag. N. H. (5) xii. 1883, p. 161.

The general habit is rather slender, more so than in *Keneuxia smaragdina.* The head, which is almost twice as long as broad, is hardly distinct from the neck, strongly depressed, with the supraocular regions slightly convex; the snout is pointed, and its length equals the distance between the eye and the ear-opening; the latter is subelliptical, slightly oblique, small, its vertical diameter equalling the horizontal diameter of the transparent palpebral disk.

The fore limb, stretched forwards, reaches halfway between the eye and the tip of the snout; in males the hind limb, stretched forwards, covers five sixths the distance to axilla, while in females it covers only three fourths. The digits are moderately elongate; the fourth finger is slightly longer than the third, and the fifth slightly shorter than the second; the proportions of the toes, commencing with the shortest, are: 1, 2, 5, 3, 4; the difference between the two last is small. A striking character is the dilatation of the basal part of all the digits. Although a very slight dilatation is observable in several other Scincoids, it never attains so strong a degree as in this species (and apparently also in *L. virens*, Peters), where it is quite comparable to that of the group of *Anolis* known as *Draconura*. The two distal phalanges are narrow and compressed, and form an angle with the dilated portion of the digit, as in *Anolis* or *Gymnodactylus*; except on the first finger and the first and fifth toes, the compressed part is shorter than the dilated. The latter bears inferiorly regular transverse, slightly curved, convex lamellæ, which number sixteen to eighteen on the fourth toe; there are seven lamellæ under the compressed joint of the same. The soles are covered with large round granules.

The rostral is large, six-sided, forming a broad suture with the frontonasal, which is pentagonal and nearly as large as one of the præfrontals; the latter are pentagonal, in contact mesially, the suture measuring less than half their greatest length; the frontal is four-sided, much longer than broad, the anterior sides forming an open angle, the posterior a very acute angle, with the point slightly rounded off; the suture between the frontoparietals measures at least half the length of the frontal; the interparietal has the same shape as the frontal, but is smaller; the parietals are moderately large and form a short suture behind the interparietal. The supraocular plates number five; the anterior is much the largest, triangular, with the anterior angle sometimes cut off; the others are band-like, the posterior smallest; supraciliaries number eight or nine. The nostril is pierced in the centre of the four-sided nasal, which is entirely lateral, and is followed by three loreals, the first or the median being the largest. Three or four large shields cover the temple, and four small scales form a slight denticulation in front of the ear. The upper labials number eight or nine, the sixth or the seventh entering the orbit. The mental is as large as the rostral, and forms a broad suture with the postmental; the lower labials are narrow, numbering seven or eight, and in contact with the chin-shields, of which there are four or five pairs. Behind the parietals are four or five pairs of large transversely dilated nuchal scales.

The scales of the body are all perfectly smooth, largest on the back, very small on the sides; the scales of the two median dorsal series much the largest, twice as broad as long; the scales number sixty-five on the dorsal line, counted from the parietal shields to the base of the tail, and thirty-eight round the middle of the body. A pair of large shields border the anal cleft. The scales on the limbs are small inferiorly, larger superiorly, largest on the fore arm and tibia.

The tail, which is a little longer than head and body, tapers gradually, and is cylindrical, depressed at the base; the scales are uniform and perfectly smooth.

The upper surfaces are of a uniform pale olive or pinkish brown, the head frequently darker and more olive; the limbs are sometimes pinkish. The lower surfaces are white.

	♂. millim.	♀. millim.
Total length	135	124
From snout to vent	57	59
Head (to ear-opening)	14	13·5
Width of head	8·5	7
From ear-opening to fore limb	8	9
Fore limb	21	20
Hind limb	24	22
Tail	78	65

This species was discovered by Mr. Guppy in the Treasury, Santa Anna, and Shortland Islands.

Five other species of the genus *Lipinia* have been described, viz.:—

Lipinia pulchella, Gray, Cat. Liz. 1845, p. 84.—Philippines.

L. vulcania, Girard, Proc. Ac. Philad. 1857, p. 196, and U. S. Explor. Exped., Herp. p. 254.—Philippines.

L. semperi, Peters, Mon. Berl. Ac. 1867, p. 18.—Philippines.

L. aurea, Meyer, Mon. Berl. Ac. 1874, p. 132.—Jobi.

L. virens, Peters, Sitz. Ges. Nat. Fr. Berl. 1881, p. 81.—New Guinea.

Leaving out *L. aurea*, the description of which is insufficient, the characters of the different species appear to be as follows:—

I. Digits not at all dilated.

Five supraoculars, anterior smallest; ear-opening very large; fourth toe much longer than third; 24 scales round the middle of the body . . . . *L. pulchella.*

Four supraoculars; ear-opening large; 30 scales round the middle of the body . . . *L. vulcania.*

II. Digits, especially the toes, slightly dilated.

Four supraoculars; ear-opening large; fourth toe little longer than third; 24 scales round the middle of the body . . . . *L. semperi.*

III. Digits strongly dilated.

Five supraoculars, first nearly as large as the four others together; ear-opening small;

fourth toe little longer than third, with 13 lamellæ under its dilated portion; 30 scales round the body . . . . *L. virens.*

Five supraoculars, first largest, but much shorter than the four others together; ear-opening small; fourth toe little longer than third, with 16 lamellæ under its dilated portion; 38 scales round the body . . . . *L. anolis.*

CORUCIA, Gray.

Corucia, Gray, Proc. Zool. Soc. 1855, p. 217.

Maxillary and mandibular teeth with compressed sharp-edged angular crowns, wearing out obliquely. A few teeth on the pterygoids. Palatine and pterygoid bones not meeting on the median line of the palate. Eyelids well developed, lower without transparent disk. Ear exposed. Limbs well developed, with five strong digits. Tail prehensile. Nostril pierced in a single plate; no supranasals; a large frontonasal; a pair of præfrontals, a frontal, a pair of fronto-parietals, an interparietal, a pair of parietals, several occipitals. Scales on the body large, those on the back slightly striated.

The arrangement of the tubules in the osteodermal plates of the dorsal region differs considerably from that of other Scincoids, approaching nearest that of *Cyclodus*. Instead of a transverse tubule anastomosing with the vertical ones, there is a large network of tubules which occupies the middle of the plate; there are eight longitudinal ones anteriorly and twelve posteriorly.

This interesting genus contains a single large-sized species, the habitat of which appears to be restricted to the Solomon Islands, and, perhaps, only to the island of San Christoval[1], whence the two original specimens were brought, in 1855, to the British Museum, by John McGillivray, who accompanied the expedition of the 'Herald.' More recently a third specimen, stated to be from the Solomons, has been purchased from a dealer. The Lizard was very shortly characterized by Gray, but an excellent figure accompanies the description.

13. CORUCIA ZEBRATA. (Plate VII. fig. 3.)

Corucia zebrata, Gray, l. c. p. 218, pl. viii.

The head is thick, triangular, distinct from the neck, the upper surface perfectly plane, the sides nearly vertical; the snout is very short, broader than long, rounded, considerably shorter than the distance between the eye and the ear-opening; the latter is vertically elliptic, oblique, and nearly as long as the eye.

The body is stout, fusiform, four times as long as the head. The limbs are strong; if stretched forwards, the fore limb reaches the tip of the snout or slightly beyond; the hind limb reaches about two thirds the distance between groin and axilla. The digits are short and strong, feebly compressed, with powerful, sharp, curved claws; the

[1] See footnote, p. 37.

shortest finger is the first, then come successively the fifth, the second, the third, and the fourth, which, however, is only very slightly longer than the preceding; the toes, as regards length, form the following succession, beginning with the shortest:—first, second, fifth, third, fourth. The lower surface of the digits is provided with a series of transverse lamellæ, which are straight under the basal phalanx and angularly curved under the others; twenty or twenty-one lamellæ under the fourth toe. The soles are granular.

The tail is not much longer than the head and body, cylindrical, not very thick, and of nearly the same diameter throughout to the extremity, which is obtuse. But the most striking peculiarity is that this organ is prehensile, as distinctly shown by all three specimens; as far as I know, no other Scincoid possesses this character.

The rostral is small, six-sided, nearly twice as broad as high, not visible from above. The frontonasal is the largest head-shield; it is seven-sided, and nearly as broad as long; a pair of short præfrontals follow. The frontal is small, broader than long, subhexagonal; a pair of fronto-parietals of nearly the same size, or larger than, the frontal. The interparietal is larger than the frontal, longer than broad, subquadrangular, inequilateral, with truncate posterior angle. The parietals are scarcely longer than the interparietal. The hinder part of the head is covered with several occipitals, the central of which forms a suture with the interparietal; two very large temporals, the upper being the largest. There are five band-like supraoculars, the posterior being the smallest, the second the broadest. The nostril is ovate, vertical, slightly oblique, and pierced in the middle of a quadrangular lateral nasal; two loreals follow. A series of five or six infraorbitals separates the eye from the upper labials; of the latter there are six or seven, the first smallest, the last much elongate. The mental is very small and four-sided; on each side are five or six infralabials; the chin-shields are numerous and irregular, and pass gradually into the scales of the gular region.

The scales on the body are large, largest and slightly striated on the back; thirty-six or thirty-eight scales round the middle of the body, and forty-seven to fifty from the occiput to the base of the tail. The scales on the upper surface of the limbs are about the size of those on the flanks; they are smaller on the lower surface. Eight slightly enlarged scales border the anal cleft. The scales on the tail are as on the body, and there is inferiorly a series of transversely dilated ones.

The colour of the upper surfaces is either greenish white with irregular dark brown cross bands, or olive-brown with lighter variegations, and with or without irregular blackish spots. In one of the specimens the head is reddish brown above. The lower surfaces are greenish white.

The largest specimen measures:—

Total length	645 millim.
Head, to occiput	61 ,,
Head, to ear-opening	59 ,,

Width of head	54	millim.
From end of snout to vent	295	,,
From end of snout to fore limb	95	,,
Fore limb	105	,,
Hind limb	124	,,
Tail	350	,,

This Lizard is herbivorous.

OPHIDIA.

BOIDÆ.

ENYGRUS, Wagl.

14. ENYGRUS CARINATUS, Schneid.

Appears to be very abundant and generally distributed in the Solomon group. We have specimens from San Christoval, Santa Anna, Ugi, Shortland, Treasury, and Faro Islands. Mr. Guppy states that he obtained in Treasury Island a specimen $3\frac{1}{2}$ feet long and 6 inches in girth, which, however, went bad in the spirit. The geographical area of *E. carinatus* extends to the Moluccas and the Pelew Islands.

15. ENYGRUS BIBRONII, Hombr. & Jacq.

This strictly Polynesian species is less abundant than the preceding in the Solomons, and has only been found in San Christoval, and, by Mr. Guppy, in the southern island of the Three Sisters; it is not known to occur further west or north. It is found in the Fiji and Friendly Islands, the New Hebrides, and New Caledonia.

COLUBRIDÆ.

DENDROPHIS, Boie.

16. DENDROPHIS SOLOMONIS.

Dendrophis solomonis, Günth. Ann. & Mag. Nat. Hist. (4) ix. 1872, p. 25.

Of this species, which occurs also in Duke of York Island, Mr. Guppy collected specimens in San Christoval, Santa Anna, and Shortland Islands.

DIPSAS, Boie.

17. DIPSAS IRREGULARIS, Merr.

Inhabits Celebes, the Moluccas, New Guinea, New Ireland, and New Britain. Mr. Guppy obtained two specimens in Treasury Island.

ELAPIDÆ.

Hoplocephalus, Cuv.

18. Hoplocephalus par. (Plate VII. fig. 4.)

Hoplocephalus par, Bouleng. Proc. Zool. Soc. 1884, p. 210.

The body is moderately elongate. The head is depressed, moderately large, slightly widened posteriorly; the eye is of moderate size, its diameter one third the length of the snout, with vertical pupil and without supraciliary ridge. The rostral is considerably broader than deep, and its upper border forms a very open angle, which is visible from above; the fronto-nasals are half as long as the præfrontals, which are a little shorter than the frontal; the latter is pentagonal and only a little longer than broad; the length of the parietals equals that of the præfrontals and frontal together. The nasal forms a short suture with the præocular; postoculars two, lower largest. Seven upper labials, third and fourth entering the eye; the first is the smallest, the third is larger than the fourth, the sixth is the largest of all. One temporal in the first row, two in the second, three in the third. The dorsal scales are equal, and their longitudinal series in even numbers; there are sixteen on the anterior and median parts of the body, fourteen on the posterior part; 166 ventral shields and 43 pairs of caudals; the anal is divided.

The coloration is very handsome. The upper surface of the head to the lip is uniform blackish brown, and the same colour forms a narrow border to every one of the dorsal scales except a few of the laterals. The body is crossed above by broad red-brown bands, separated by narrow white interspaces; there are thirty-nine of these red bands to the extremity of the tail. The lower surface of the head and body are uniform white, except on the posterior extremity of the body, where the red and black extend as lines along the sutures of the ventrals; on the tail the red forms complete annuli, the white interspaces being, however, wider inferiorly than superiorly.

Total length 75 centim., tail 11 centim.

One specimen was obtained by Mr. Guppy on Faro Island.

HYDROPHIIDÆ.

Platurus, Latr.

19. Platurus fasciatus, Daud.

This Sea-Snake, which is found throughout the East-Indian archipelago and Polynesia, was also collected by Mr. Guppy.

BATRACHIA.

ECAUDATA.

FIRMISTERNIA.

RANIDÆ.

Rana, Linn.

1. Rana bufoniformis. (Plate VIII.)

Rana bufoniformis, Bouleng. Proc. Zool. Soc. 1884, p. 210.

The vomerine teeth form two short oblique series entirely behind the level of the choanæ; they do not extend outwards beyond the latter, and the space between the two series equals the length of one of them. The lower jaw shows no tooth-like processes. The Eustachian tubes are larger than the choanæ.

The head is very large, its length being contained only once and three fifths in the length of the vertebral column; the length of the nine anterior vertebræ equals the distance from the nostril to the tympanum; the width of the head is greater than its length, and is contained once and one third in the length of the vertebral column; the contour of the head is a semioval. The snout is short and rounded, its length equalling the diameter of the orbit; the upper lip projects but slightly beyond the lower, and the profile of the snout forms a pretty regular curve; the nostril is a little nearer the end of the snout than the orbit; the loreal region is very oblique and concave, and the canthus rostralis is distinct though obtuse, and straight. The eye is very large and perfectly lateral; the interorbital space is plane, and its width equals that of the upper eyelid. The tympanum is perfectly distinct; its vertical diameter, which is little greater than its horizontal, equals one third the horizontal diameter of the eye, and is a little less than the distance which separates it from the orbit.

The fore limb, stretched backwards, reaches as far as the vent. The fingers are short and thick, with obtuse, slightly swollen tips, and with large round subarticular tubercles; the inner finger is nearly as long as the third, and considerably longer than the second, which is a little shorter than the fourth; there are three oval metacarpal tubercles, the inner of which is the largest and the most distinct. The hind limb is short; if stretched forwards along the body, the tibio-tarsal articulation reaches the hinder border of the eye; the length of the tibia equals the length of the head. The toes are short, two thirds webbed, with the tips dilated into regular disks, which are, however, relatively not much larger than in *Rana kuhlii*; the web reaches the penultimate phalanx on the inner side of the third toe and on both sides of the fourth, otherwise attains the distal disks; the subarticular tubercles are very large and oval

There are two metatarsal tubercles—an inner, oval, flattened, and an outer, roundish, rather indistinct. There is not a trace of a fold along the inner edge of the tarsus.

The skin of the head is rough with very small warts, which become large on the hinder half of the upper eyelid and on the occipital region; on the back and sides and on the upper surface of the limbs the warts are very prominent, round, of larger and smaller size, studded with pores as in *Bombinator*; on each side of the back the warts are more elongate and confluent, so as to form an indication of a lateral glandular fold, which is, however, frequently broken up, and does not extend beyond the sacrum. Above the temporal region is a large elongate wart, which might be termed a parotoid gland. The fore limbs are nearly smooth. The lower surfaces are smooth except the belly and the lower surface of the thighs, which are feebly granulate.

The upper surfaces are of a uniform purplish brown, and the lower uniform yellowish.

From snout to vent	145	millim.
Head	55	,,
Width of head	68	,,
Fore limb	85	,,
Hand	34	,,
Hind limb	187	,,
Foot	63	,,

A single female specimen was collected by Mr. Guppy on Treasury Island.

This species, one of the stoutest and most toad-like of the genus, has as nearest ally the East-Indian *Rana kuhlii*. The most important characters which distinguish it from that species are the more posterior vomerine teeth, the larger head, the distinct tympanum, the absence of a tarsal fold, the shorter web, and the shorter limbs.

2. Rana guppyi. (Plate IX.)

Rana guppyi, Bouleng. Proc. Zool. Soc. 1885, p. 211.

The vomerine teeth form two short, straight, transverse series inserted on the posterior edge of a large triangular base, the anterior angle of which reaches the inner corner of the large choanæ, while the toothed posterior border is behind the level of the choanæ; the space between the two series is wider than the length of one of them. There are no tooth-like processes in the lower jaw. The Eustachian tubes are nearly the same size as the choanæ.

The head is very large and subtriangular; its length is contained twice and two thirds in the distance from the end of the snout to the vent, and is a little less than its width. The snout is obtusely acuminate, and measures once and one third the diameter of the orbit; the tip of the snout projects a little, and the profile forms a gentle slope; the nostril is considerably nearer the tip of the snout than the orbit; the canthus rostralis is angular, and very slightly curved; the loreal region is oblique, and not distinctly concave. The eye is of moderate size, and the interorbital space is plane, and equals in width the upper eyelid. The tympanum, which is perfectly distinct and circular, measures two fifths the diameter of the eye, and a little less than the distance which separates it from the orbit.

The fore limb, stretched backwards, reaches as far as the vent. The fingers are moderate, with slightly dilated tips, and with large round subarticular tubercles; the first finger is distinctly longer than the second, slightly longer than the fourth, and a little shorter than the third. The metacarpal tubercles are three in number, the inner being the largest and the most distinct. The hind limb is strong and long, the tibio-tarsal articulation reaching as far as the tip of the snout, and the tibia being nearly as long as the fore limb. The toes are moderately elongate, and nearly entirely webbed, and the tips are dilated into small regular disks; the free edge of the web is strongly curved, and reaches the disks of all the toes; the subarticular tubercles are large and oval. The inner metatarsal tubercle is elliptical and flattened, and there is a second tubercle, at the base of the fourth toe, which is smaller, roundish, and less distinct.

The upper surfaces are vermiculated with very small glandules, which are intermixed with larger ones on the posterior half of the upper eyelid; a few elongate warts on each side of the foremost part of the back show an indication of the lateral glandular fold of other species of *Rana*. A strong glandular temporal fold runs obliquely from the eye, above the tympanum, towards the shoulder. The lower surfaces are perfectly smooth.

The upper parts are uniform blackish olive, with small greyish marblings on the thighs. The lower surfaces are whitish, the throat slightly mottled with greyish.

From end of snout to vent	165	millim.
Head	57	,,
Width of head	66	,,
Fore limb	95	,,
Hand	45	,,
Hind limb	280	,,
Foot	93	,,

A single female specimen, collected by Mr. Guppy on the Shortland Islands.

Except the Bull-Frog of North America, no other *Rana* is known to attain so great a size as this. The nearest ally of *R. guppyi* appears to be *R. grunniens*, Daud., which occurs in Amboyna and Java, but in that species the series of vomerine teeth are oblique, the tympanum is larger, the digital disks are smaller, there is a tarsal fold, and no outer metatarsal tubercle, and the hind limb is shorter.

3. Rana opisthodon. (Plate X.)

Rana opisthodon, Bouleng. Proc. Zool. Soc. 1884, p. 211.

The vomerine teeth form two oblique series entirely behind the level of the choanæ; they do not extend outwards to the vertical of the inner corner of the latter, and the space between them equals hardly the length of one series. The lower jaw shows no tooth-like processes. The Eustachian tubes are a little larger than the choanæ.

The head is large and semioval in contour; its length is contained nearly twice in that of the body, and equals or slightly exceeds the length of the nine dorsal vertebræ; it is a little broader than long. The snout is rounded, sloping gradually, and slightly longer than the diameter of the orbit; the upper lip hardly projects; the nostril is much nearer the tip of the snout than the orbit; the canthus rostralis is not very strongly marked, and slightly curved; the loreal region is oblique and concave. The eye is of moderate size; the interorbital space is convex in the large female, plane in the smaller males, and as broad as or a little narrower than the upper eyelid. The tympanum is distinct; its vertical diameter, which is generally a little greater than the horizontal, equals two fifths to one half the diameter of the eye, or the distance from the orbit to the tympanum.

The fore limb is of moderate proportions, and resembles that of the preceding species, except that the tips of the fingers are not dilated, but simply blunt. The hind limb is of moderate length; the tibio-tarsal articulation reaches the eye, and the length of the tibia equals that of the fore-arm and hand. The toes are two thirds webbed, and the tips dilated into small disks; the web reaches the penultimate phalanx on the inner side of the third toe, and on both sides of the fourth, otherwise attains the distal disks; the subarticular tubercles are large and oval. The inner metatarsal tubercle is elliptic and flat, and an outer tubercle, if distinguishable, is small and rounded. No fold along the tarsus.

In the female specimen the upper surfaces are covered with numerous small, flat, porous warts, which are elongate on the back anterior to the sacrum, rounded on the upper eyelids, the limbs, and the hinder part of the body; in the males the skin is much smoother, without warts, or with small elongate glandules on the flanks; a glandular fold limits the temporal region superiorly. The belly and the lower surface of the thighs are slightly granulate, the rest of the lower surfaces being smooth.

The upper parts are dark brown, with the warts blackish in the female; in the males they are more olive, with a few dark spots and cross bars on the limbs and vertical bars on the upper lip, and a cross band between the eyes. The hinder side of the thighs with small whitish dots. The lower parts are brownish white, and the throat is entirely light brown.

The male is provided with two internal vocal sacs.

	♂. millim.	♀. millim.
From snout to vent	78	125
Head	28	46
Width of head	34	55
Fore limb	45	77
Hand	19	31
Hind limb	112	170
Foot	36	55

Three male specimens from Treasury Island and a female from Faro Island were presented by Mr. Guppy.

R. opisthodon is well distinguished from *R. guppyi* by the much shorter limbs and the arrangement of the vomerine teeth. From *R. grunniens* it is chiefly distinguished by the less oblique and more posterior series of vomerine teeth, the shorter web, and the absence of a tarsal fold.

This species affords another instance of Batrachians dispensing with regular larval stage, the metamorphoses being hurried through within the egg. Mr. Guppy supplies the following notes:—"During a descent from one of the peaks of Faro Island I stopped at a stream some 400 feet above the sea, where my native boys collected from the moist crevices of the rocks close to the water a number of transparent gelatinous balls, rather smaller than a marble. Each of these balls contained a young frog, about 4 lines in length, apparently fully developed, with very long hind legs and short fore legs, no tail, and bearing on the sides of the body small tufts of what seemed to be branchiæ. On my rupturing the ball or egg in which the little animal was doubled up, the tiny frog took a marvellous leap into its existence, and disappeared before I could catch it. On reaching the ship an hour after, I found that some of the eggs which I put in a tin had been ruptured on the way by the jolting, and the liberated frogs were leaping about with great activity. On placing some of them in an open-mouth bottle 8 inches long, I had to put the cover on, as they kept leaping out."

In illustration of this interesting observation, Mr. Guppy sent several ova and recently hatched young, which are to be referred without the slightest doubt to *Rana opisthodon*. The ovum, which measures 6 to 10 millim. in diameter, is a transparent spherical capsule in which the young frog is coiled up in the same way as figured by Peters[1] in *Hylodes martinicensis*; but none of the specimens, which are in an advanced stage of development, show anything of a tail. There are no gills, but on each side of the abdomen are several regular transverse folds (which in their arrangement remind of the gill-openings of Plagiostomous Fishes), the function of which probably is that of breathing-organs, like the tail of *Hylodes*. The tip of the snout is furnished with a

[1] Mon. Berl. Ac. 1876, p. 714, fig. 2.

small conical protuberance, projecting slightly through the delicate envelope of the egg, and evidently used to perforate that envelope, as is shown by one of the specimens (Pl. X. fig. *e*).

4. Rana krefftii.

Rana krefftii, Bouleng. Cat. Batr. Ecaud. p. 64, pl. iii. fig. 2.

The vomerine teeth form two oblique oval groups in the middle between the choanæ, each group being equally distant from the latter and from its fellow. The Eustachian tubes are a little larger than the moderate-sized choanæ.

The general habit is slender, and resembles that of *Rana erythræa*. The head is triangular, slightly longer than broad, depressed, with obtusely pointed snout; the latter, which projects a little beyond the mouth, is a little longer than the diameter of the orbit; the nostril is a little nearer the tip of the snout than the eye; the canthus rostralis is straight and angular, and the loreal region a little oblique and strongly concave. The eye is rather large; the interorbital space is plane, and as broad as the upper eyelid. The tympanum is very distinct, circular, and equals two thirds the size of the eye.

If stretched down along the body, the fore limb reaches beyond the vent. The fingers are slender, with the tips dilated into small, regular, oval disks; the second and third fingers have a distinct dermal border along the inner side; the inner finger is a little shorter than the third, a little longer than the fourth, and longer than the second; the subarticular tubercles are strong and oval. There are three subequal oval metacarpal tubercles. When the hind limb is carried forward along the body, the tibiotarsal articulation reaches between the eye and the nostril. The toes are slender, moderately long, nearly entirely webbed, with the tips dilated into rather large oval disks; the subarticular tubercles are moderately large, oval, prominent. A small oval inner and a small rounded outer metatarsal tubercle are present. There is no tarsal fold.

The skin is smooth, except on the hinder side of the thighs, where it is granulate. A broad, scarcely prominent, glandular fold runs along each side, beginning from the eye, and another, less distinct, from below the eye to the shoulder. On the hind limbs, and most distinctly on the tibia, are narrow raised longitudinal lines.

The upper surfaces are olive or chestnut-brown, without any spots; the sides of the head, limited by the canthus rostralis, and of the body, limited by the lateral fold, black. A whitish band extends from below the nostril, on the lip, to the shoulder, becoming most marked under the eye. The lower surfaces, as well as the hinder side of the thighs, are white (or yellow), largely marbled with blackish brown.

The male is distinguished by the presence of two external gular vocal sacs, and a large elliptic gland on the anterior face of the arm.

	♂. millim.	♀. millim.
From snout to vent	59	73
Head	21	27
Width of head	20	25
Fore limb	39	48
Hand	16	20
Hind limb	94	116
Foot	28	37

This species was founded on two specimens—a male from the Solomon Islands, presented by the late Gerard Krefft, and a female from San Christoval. A third specimen, a female, was collected in Santa Anna by Mr. Guppy.

CORNUFER, Tschudi.

5. Cornufer guppyi. (Plate XI. fig. 1.)

Cornufer guppyi, Bouleng. Proc. Zool. Soc. 1884, p. 211.

The vomerine teeth are inserted on the posterior border of a small triangular base, the anterior angle of which is on a line with the posterior edge of the rather large choanæ; they form a short transverse, straight, or slightly oblique series. The Eustachian tubes are not larger than the choanæ. The tongue shows no conical papilla.

The general appearance is that of *Rhacophorus maculatus*, Gray. The head is large and depressed, a little broader than the body; its length is contained a little less than thrice in the total length, and is a little less than its width. The snout, which is a little longer than the diameter of the orbit, is rounded, not projecting, with distinct, slightly curved canthus rostralis; the loreal region is very oblique and concave; the nostril is much nearer the tip of the snout than the orbit. The eye is large and very prominent; the interorbital space is plane, and equals in width the upper eyelid. The tympanum is very distinct, round, its vertical diameter slightly exceeding its horizontal, and measuring three fifths the diameter of the eye; the space between the orbit and the tympanum is only one third the diameter of the latter in the male, one half in the female.

The fore limb, if stretched down along the body, reaches the vent. The fingers are rather short, much depressed, and their tips are dilated into large, flat, round disks, which, on the outer fingers, are nearly as large as the tympanum; the inner finger is the shortest, the second and fourth are equal, and the third exceeds the latter with the length of the distal disk; the subarticular tubercles are round, moderately large, much flattened. The metacarpal tubercles are very indistinct. When the hind limb is stretched forward the tibio-tarsal articulation reaches the anterior corner of the eye.

The toes are moderately elongate, depressed, with a narrow dermal margin, one third webbed, and the tips are dilated into large roundish disks, which are, however, smaller than those of the fingers; the subarticular tubercles are round and flat, and the metatarsal tubercles, of which there are an inner and an outer, are very much flattened and rather indistinct.

The skin of the upper parts is quite smooth, except on the sides of the head, where there are minute round glandules. A narrow prominent fold extends obliquely from the eye to the shoulder, passing above the tympanum. The belly and the thighs inferiorly are covered with large flat granules, while the rest of the lower surfaces are perfectly smooth.

One of the two specimens, a male, is above greyish brown, minutely speckled with blackish, and with rather indistinct traces of cross bands on the limbs. The other, a female, is above of a light pinkish-brown, darker, purplish on the head, and with irregular dark brown spots on the back and cross bands on the limbs. The lower surfaces are uniform whitish, the lower lip edged with brown.

The male has a pair of internal vocal sacs.

	♂. millim.	♀. millim.
From snout to vent	57	69
Head	21	24
Width of head	22·5	28
Fore limb	36	43
Hand	17	19
Hind limb	83	100
Foot	25	30

Two specimens were collected in Treasury Island by Mr. Guppy.

Cornufer guppyi is allied to *C. dorsalis*, A. Dum., from the Fiji Islands, but differs chiefly in the broader and more depressed head and the larger disks of the toes.

6. Cornufer solomonis. (Plate XI. fig. 2.)

Cornufer solomonis, Bouleng. Proc. Zool. Soc. 1884, p. 212.

The vomerine teeth form two rather long transverse or slightly oblique, slightly arched series behind the level of the choanæ; externally these series extend to the vertical of the anterior border, or of the centre of the choanæ, and the interspace between them is less than the length of one of them. There is no conical papilla on the tongue, and the Eustachian tubes are larger than the choanæ.

The head is very large, moderately depressed, as broad as the body, semioval in contour; its length equals its width, and is contained twice and a half to twice and three fourths in the distance from the end of the snout to the vent. The snout is rounded, and does not project; its length equals, or hardly exceeds, the diameter of the orbit; the canthus rostralis is distinct, obtuse, and straight; the loreal region is oblique and concave; the nostril is much nearer the tip of the snout than the orbit. The eye is very large and prominent; the interorbital space has a slight median ridge or keel, and its width equals about three fourths that of the upper eyelid. The tympanum is round and very distinct; its diameter equals about half that of the orbit; the distance that separates it from the latter is two fifths or half its diameter.

The fore limb stretched backwards reaches as far as the vent. The fingers are moderately long, slender, cylindrical, with the tips not dilated but simply swollen; the subarticular tubercles are remarkably strong and prominent; the inner finger is as long as the third and much longer than the second, which equals the fourth. Three oval metacarpal tubercles are very distinct. When the hind limb is stretched forwards, the tibio-tarsal articulation reaches the centre or the anterior border of the eye. The toes are moderately elongate, slender, cylindrical, free, with a very slight rudiment of web at the base; there are no lateral dermal margins, and the tips are swollen like the tips of the fingers; the subarticular tubercles are extremely strong and prominent, and sub-conical. There are two very prominent tubercles on the metatarsus, an oval inner and a rounded, smaller, outer.

The skin of the back and flanks is more or less corrugated and with irregularly scattered short longitudinal glandular folds, which are shorter and less regular than in *Cornufer corrugatus*, A. Dum.; a prominent narrow oblique fold runs from the eye to the shoulder, passing above the tympanum. The lower parts are smooth, except the lower belly and the lower surface of the thighs, which are feebly granulate.

The colour of the upper parts is a grey-brown or purplish brown; the tympanum is chestnut-brown; on the sides of the head are more or less distinct vertical darker bars, and the cross bars on the limbs also vary in intensity. The lower surfaces are whitish, the throat more or less crowded with brown mottlings, with a series of round lighter spots round the lower lip.

The male with two internal vocal sacs.

One of the females has the oviducts distended with ripe ova. As in the other species of the same genus, the ova are enormous compared to the size of the animal, and there is every reason to believe that the young undergo the metamorphoses within the egg. In a specimen measuring 73 millim. from snout to vent the diameter of a ripe ovum is 5 millim.

	♂. millim.	♀. millim.
From snout to vent	49	75
Head	19	29
Width of head	19	30
Fore limb	30	45
Hand	11·5	17·5
Hind limb	75	108
Foot	24	35

Several specimens were collected by Mr. Guppy in the Shortland, Treasury, and Faro Islands.

This species comes near *Cornufer corrugatus*, A. Dum., from the Philippines, New Guinea, and Duke of York Island. It differs in the larger head, the larger eyes, the shorter hind limbs, and the still stronger subarticular tubercles of the fingers and toes.

CERATOBATRACHIDÆ.

Ceratobatrachidæ, Bouleng. Proc. Zool. Soc. 1884, p. 212.

Both jaws toothed; diapophyses of sacral vertebra not dilated.

CERATOBATRACHUS, Blgr.

Ceratobatrachus, Bouleng. l. c.

Pupil horizontal. Tongue deeply notched and extensively free behind. Vomerine teeth. Head large, skull strongly ossified. Tympanum distinct. Fingers and toes free, with non-dilated tips. Outer metatarsals united. Precoracoids present; omosternum and sternum with a bony style. Distal phalanges simple.

7. CERATOBATRACHUS GUENTHERI. (Plates XII. & XIII.)

Ceratobatrachus guentheri, Bouleng. l. c.

The tongue is large, attached on the anterior half of the median line, subcordiform, notched posteriorly, in every respect like that of *Rana*. The teeth in the upper jaw are minute, closely set, as in Batrachians generally; those in the lower jaw are larger, conical, acute, slightly directed backwards, and inserted on the edge of the mandible, leaving their impressions on the mucous fold which borders the upper jaw. The vomerine teeth form two short, transverse, sometimes crescentic, series inserted on the hinder border of a triangular base which is situated at the posterior inner edge of the choanæ. The latter are rather large, their vertical diameter exceeding the horizontal, but smaller than the Eustachian tubes, which are very large.

The head is enormous, strongly depressed, triangular, broader than long; its length is contained once and two fifths to once and three fifths in the length of the body; the length of the snout equals once and one fourth to once and one third the diameter of the orbit; the end of the snout forms a gentle slope and does not project; the canthus rostralis forms a distinct straight ridge bounding the slightly concave frontal region; the loreal region is very oblique and concave; the nostril is twice as far from the eye as from the tip of the snout. The eye is moderately large; the interorbital space, which is much wider than the upper eyelid, is deeply concave and its borders form a slightly prominent ridge. The tympanum is large and distinct, vertically elliptic, nearly as large as the eye; below the tympanum, at the angle of the mouth, there is a small spine, curved forwards. Other bones of the skull also form prominent ridges, and on the cheeks and fronto-parietal region the skin may adhere to bony rugosities.

The fore limb, when stretched backwards, reaches as far as the vent, or a little beyond. The fingers are moderately elongate, cylindrical, with obtuse, slightly swollen tips and very strong, round subarticular tubercles; they are bordered on each side by a slight dermal ridge. The inner finger is slightly shorter than the third, and much longer than the second, which is slightly shorter than the fourth. Three oval metacarpal tubercles, of which the inner is the largest and the most prominent. The hind limb is rather short; when stretched forwards along the body, the tibio-tarsal articulation reaches the posterior border of the eye, or between the latter and the tympanum; the length of the tibia equals nearly the length of the head. The toes are rather short, cylindrical, free, with a very slight rudiment of web and a narrow dermal margin; their tips are slightly swollen; the fifth toe is much shorter than the third; the subarticular tubercles are very prominent, but smaller than those under the fingers. There are two metatarsal tubercles: the outer is small and rather indistinct, the inner is large, oval, a little compressed, and very prominent.

This Batrachian is remarkable for the numerous appendages and symmetrical folds which ornate its skin. There is a triangular dermal flap on the tip of the snout, on the edge of the upper eyelid, above the vent, and at the tibio-tarsal articulation; the two former are the largest and strongly papillose, indicating clearly that they are used as tactile organs. The upper eyelid is warty and crossed by a more or less marked dermal ridge, which, slightly curved, extends across the interorbital space to the other side; there are frequently small conical glandules, or glandular folds on the head. A narrow prominent fold extends from the upper eyelid to the middle of the side, passing above the tympanum. The back shows more or less numerous short glandular folds, and generally a pair of very prominent narrow curved ridges which extend from the upper eyelid along the middle of the back, meeting near the extremity of the coccyx; one or two pairs of other folds may be present. A small, frequently denticulated, fringe borders the outer side of the tarsus and fore arm. The lower surfaces are entirely shagreened with small granules, smallest on the throat, irregular on the belly.

The coloration varies as much as the teguments. The ground-colour of the upper parts is yellowish, pinkish, brown, grey, or olive, variously marked with darker and lighter. The hinder side of the thighs below the level of the anal flap is always dark, sometimes deep black, and so is the lower surface of the foot and tarsus. In one specimen the sides of the head are cream-coloured, contrasting with the brown of the upper surface, and there is a deep black temporal band. Another is pinkish brown, with two short ink-black longitudinal bands on the middle of the back and a cross band of the same colour on the interorbital region. Another is blackish olive, with a broad light-olive band along each side of the back and across the interorbital space. Others are blackish, dotted with whitish, &c. &c. Out of the twenty specimens before me, no two are perfectly alike. The limbs are regularly cross barred with darker. The lower surfaces are brownish, dotted or clouded with dark brown; the throat is generally dark brown, sometimes with white dots, and there is constantly a pair of round white spots on the pectoral region; the axilla and groin are bright yellow.

The males are distinguished only by the presence of a pair of internal vocal sacs. The ova are very large, and we may presume the development to be of the *Hylodes* type.

The skeleton is essentially that of a Ranoid. It differs in the following points from the normal pattern:—

The skull is strongly ossified, rough, with bony granules on the fronto-parietal and temporal regions, and the sutures are nearly obliterated. The fronto-parietals expand in a large triangular postorbital process. The anterior process of the temporal, the maxillary, and the quadrato-jugal have coalesced without leaving traces of sutures; the latter bone sends off a curved spine directed outwards and forwards. The posterior process of the temporal is expanded horizontally, subtriangular, and its posterior border is divided into several knobs.

The lower jaw, which is so remarkable for the presence of acrodont teeth, is also interesting for the extreme shortness of the dentary, which only quite anteriorly enters the border of the jaw; it bears two or three teeth only, all the others, twenty to thirty in number, being inserted on the articular. In the African *Rana adspersa*, which in its rough skull and triangular postorbital processes shows some resemblance to *Ceratobatrachus*, the dentary, though of more moderate size, also has but a very small share in the edge of the jaw, viz. the tooth-like anterior process. The symphyseal bones are ossified and toothless. In the other *Batrachia ecaudata* with mandibular teeth, viz. *Hemiphractus*, *Ceratohyla*, and *Amphignathodon*, the symphyseals are absent, as in the *Caudata*. The sternal apparatus differs from that of the normal *Rana* only in the basal bifurcation of the omosternum, as in several other Ranoids.

	♂. millim.	♀. millim.
From snout to vent	75	86
Head	31	36
Width of head	35	44
Fore limb	41	50
Hand	16	19
Hind limb	91	110
Foot	29	34

Numerous specimens were collected by Mr. Guppy in the Shortland, Treasury, and Faro Islands.

Mr. Guppy observes:—"Horned frogs are very numerous in these islands, and so closely do they imitate their surroundings in colour and pattern, that on one occasion I captured one by accidentally placing my hand on it when clasping a tree."

ARCIFERA.

HYLIDÆ.

HYLA, Laur.

8. HYLA MACROPS. (Plate XI. fig. 3.)

Hyla macrops, Bouleng. Ann. & Mag. N. H. (5) xii. 1883, p. 164.

The tongue is shortly oval, slightly nicked and slightly free behind. The vomerine teeth form two short transverse oval groups situated exactly in the middle between the choanæ. The latter are large, larger than the Eustachian tubes.

The head is depressed, a little broader than long; in the male its length is contained exactly three times in the total length, in the female it is contained three times and one third to three times and two fifths. The snout is broadly rounded, not projecting, as long as the diameter of the orbit; the canthus rostralis is distinct and curved, and the loreal region very oblique and concave; the nostril is nearer the tip of the snout than the orbit. The eye is large, especially in the male, and the interorbital space plane and as broad as the upper eyelid. The tympanum is very distinct, circular, and measures half the diameter of the eye, or slightly more; its distance from the orbit equals two fifths its diameter.

The fore limb, if stretched backwards, reaches as far as the vent in the female, a little beyond in the male. The disks of the fingers are of moderate size, smaller than the tympanum, and a little larger than those of the toes. The first finger is the shortest, and apparently opposable; the second and fourth are equal; a short web unites the fingers at the base; the subarticular tubercles are small. There are no distinct metacarpal tubercles, and no projecting rudiment of pollex. In the breeding male the inner side of the first finger is covered with blackish rugosities. The hind limb is long and slender, the tibio-tarsal articulation reaching the tip of the snout or nearly so far. The toes are moderate, three fourths webbed, with small subarticular tubercles. Two metatarsal tubercles, the outer very small, or quite indistinct, the inner small and elliptic. No tarsal fold. The skin is smooth, largely granulate on the belly and under the thighs.

The upper surfaces are uniform green, and the lower white; the hinder side of the thighs brown.

A large fronto-parietal fontanella is present, and, as in many South-American *Hylæ*, the bones are green. The male has an internal subgular vocal sac.

	♂. millim.	♀. millim.
Front snout to vent	38	54
Head	13	17
Width of head	13·5	19
Fore limb	25	34
Hand	10	14
Hind limb	61	93
Foot	15	23

Four specimens, one male and three females, were collected by Mr. Guppy in Treasury Island.

9. Hyla thesaurensis. (Plate XI. fig. 4.)

Hyla thesaurensis, Peters, Mon. Berl. Ac. 1877, p. 421.

A specimen was collected in Treasury Island by Mr. Guppy, which agrees well with Peters's description, except that the fingers are distinctly webbed at the base while Peters describes them as free. I have, however, no hesitation in referring the specimen to *Hyla thesaurensis.* Another question is whether this form and the preceding are specifically distinct from each other or only colour varieties; I am not able to decide this point at present for want of material, but strongly incline to regard them only as varieties.

The unique specimen appears to be a half-grown female. Its coloration and dimensions are as follows:—The head and back are blackish brown; a broad white vertebral line extends from the fronto-parietal fontanella to the extremity of the coccyx; another one on each side, commencing on the border of the upper eyelid; a short white streak on the end of the snout; a curved transverse white streak between the eyes, and a curved white streak on the side of the head, from below the nostril to the angle of the mouth. The limbs are light olive above, and the lower surfaces white.

From snout to vent	31 millim.
Head	10 ,,
Width of head	11 ,,
Fore limb	19 ,,
Hand	8 ,,
Hind limb	51 ,,
Foot	11·5 ,,

EXPLANATION OF THE PLATES.

PLATE VII.

Fig. 1. *Lepidodactylus guppyi*, p. 38.
Fig. 1 *a*. Ditto, profile of head. × 2.
Fig. 1 *b*. Ditto, lower view of foot. × 3.
Fig. 2. *Lipinia anolis*, p. 407.
Fig. 2 *a*. Ditto, upper view of head. × 2.
Fig. 2 *b*. Ditto, lower view of head. × 2.
Fig. 2 *c*. Ditto, profile of head. × 2.
Fig. 2 *d*. Lower view of foot. × 3.
Fig. 3. *Corucia zebrata*, p. 43. Upper view of head.
Fig. 3 *a*. Ditto, profile of head.
Fig. 3 *b*. Ditto, lower view of foot.
Fig. 3 *c*. Ditto, dorsal osteodermal plate, postero-anterior view. × 3.
Fig. 4. *Hoplocephalus par*, p. 46.
Fig. 4 *a*. Ditto, profile of head. × 2.

PLATE VIII.

Rana bufoniformis, p. 47, with view of open mouth.

PLATE IX.

Rana guppyi, p. 48, with view of open mouth.

PLATE X.

Rana opisthodon, p. 50.

Fig. *a*. Adult female.
Fig. *b*. Open mouth.
Fig. *c*. Egg, natural size.
Fig. *d*. Egg, before hatching, ventral view. × 3.
Fig. *e*. Egg, before hatching, lateral view. × 3.
Fig. *f*. Young, coiled up in the egg, ventral view. × 3.
Fig. *g*. Young, coiled up in the egg, lateral view. × 3.
Fig. *h*. Young, just after leaving the egg, dorsal view. × 3.
Fig. *i*. Young, just after leaving the egg, ventral view. × 3.

PLATE XI.

Fig. 1. *Cornufer guppyi*, p. 53. Female.
Fig. 1 *a*. Ditto, male.
Fig. 1 *b*. Ditto, open mouth.

Fig. 2. *Cornufer solomonis*, p. 54.
Fig. 2 *a*. Ditto, open mouth.
Fig. 3. *Hyla macrops*, p. 59.
Fig. 3 *a*. Ditto, open mouth.
Fig. 4. *Hyla thesaurensis*, p. 60.

PLATE XII.

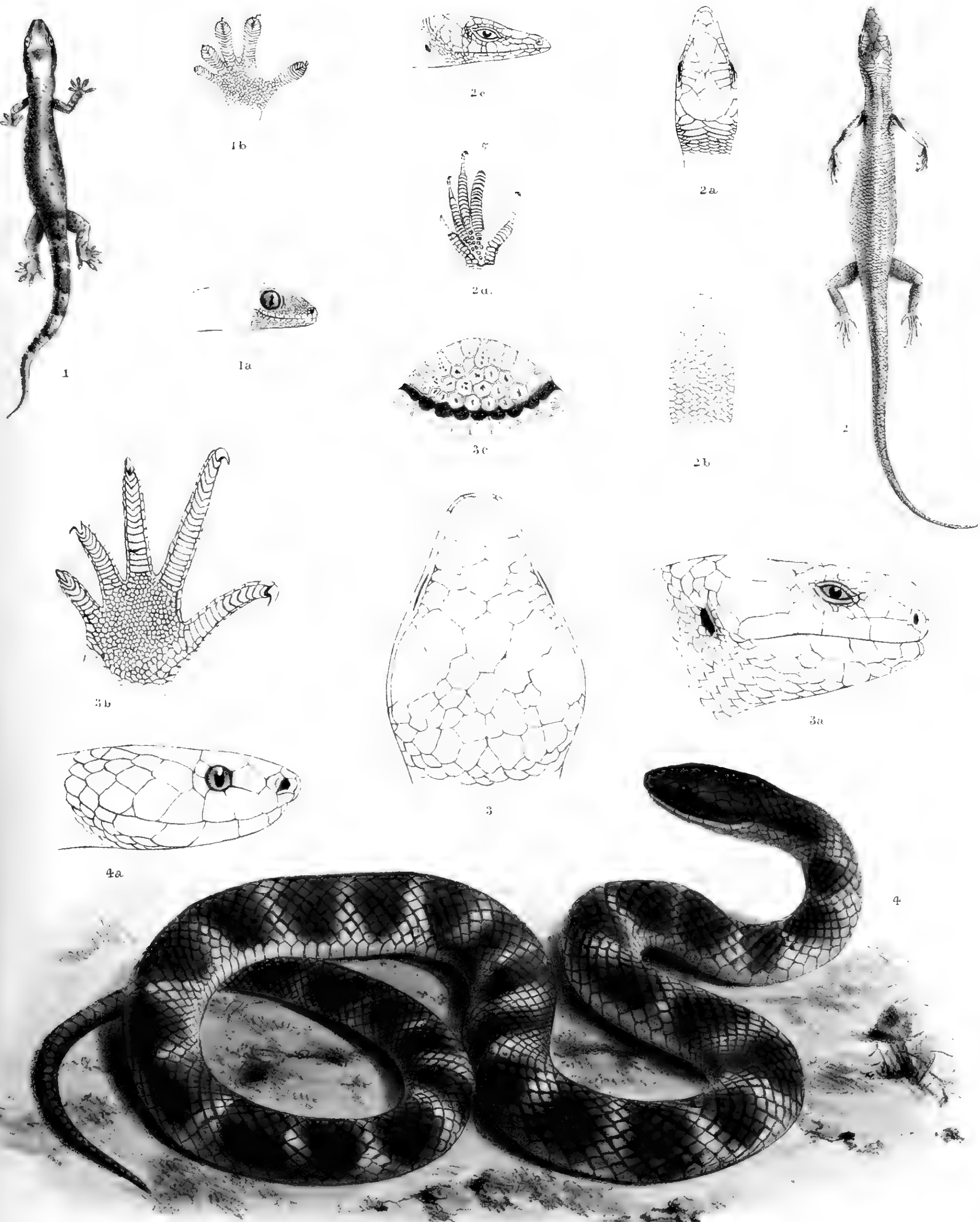
Ceratobatrachus guentheri, p. 56.

Figs. *a–d*. Upper view.
Fig. *e*. Lower view.

PLATE XIII.

Ceratobatrachus guentheri, p. 56.

Fig. *a*. Adult.
Fig. *b*. Half-grown.
Fig. *c*. Profile of head.
Fig. *d*. Open mouth.
Fig. *e*. Skeleton, dorsal view.
Fig. *f*. Lower view of skull.
Fig. *g*. Lateral view of skull.
Fig. *h*. Mandible. × 2.
Fig. *i*. Hyoid. × 2.
Fig. *k*. Sternal apparatus. × 2.



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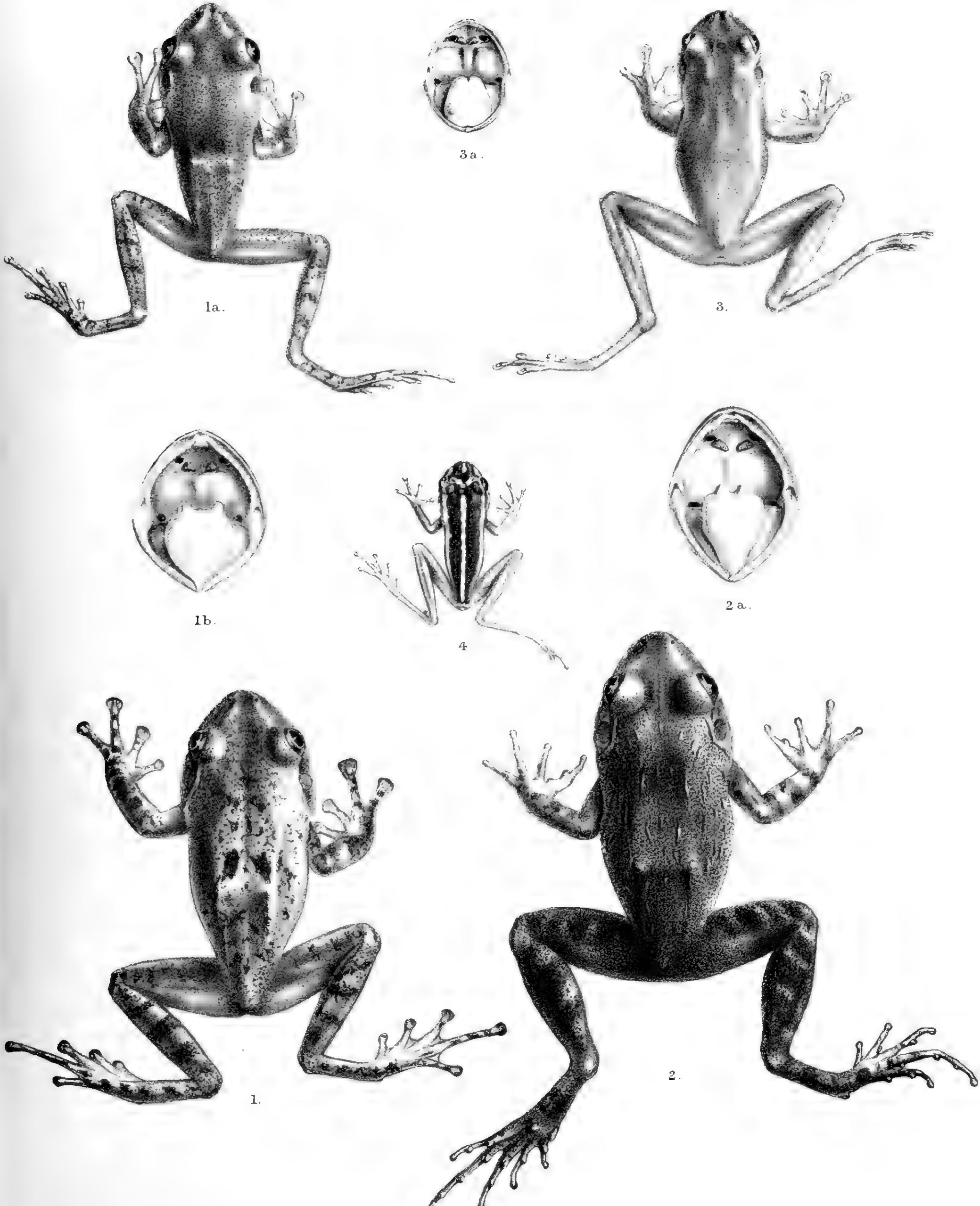

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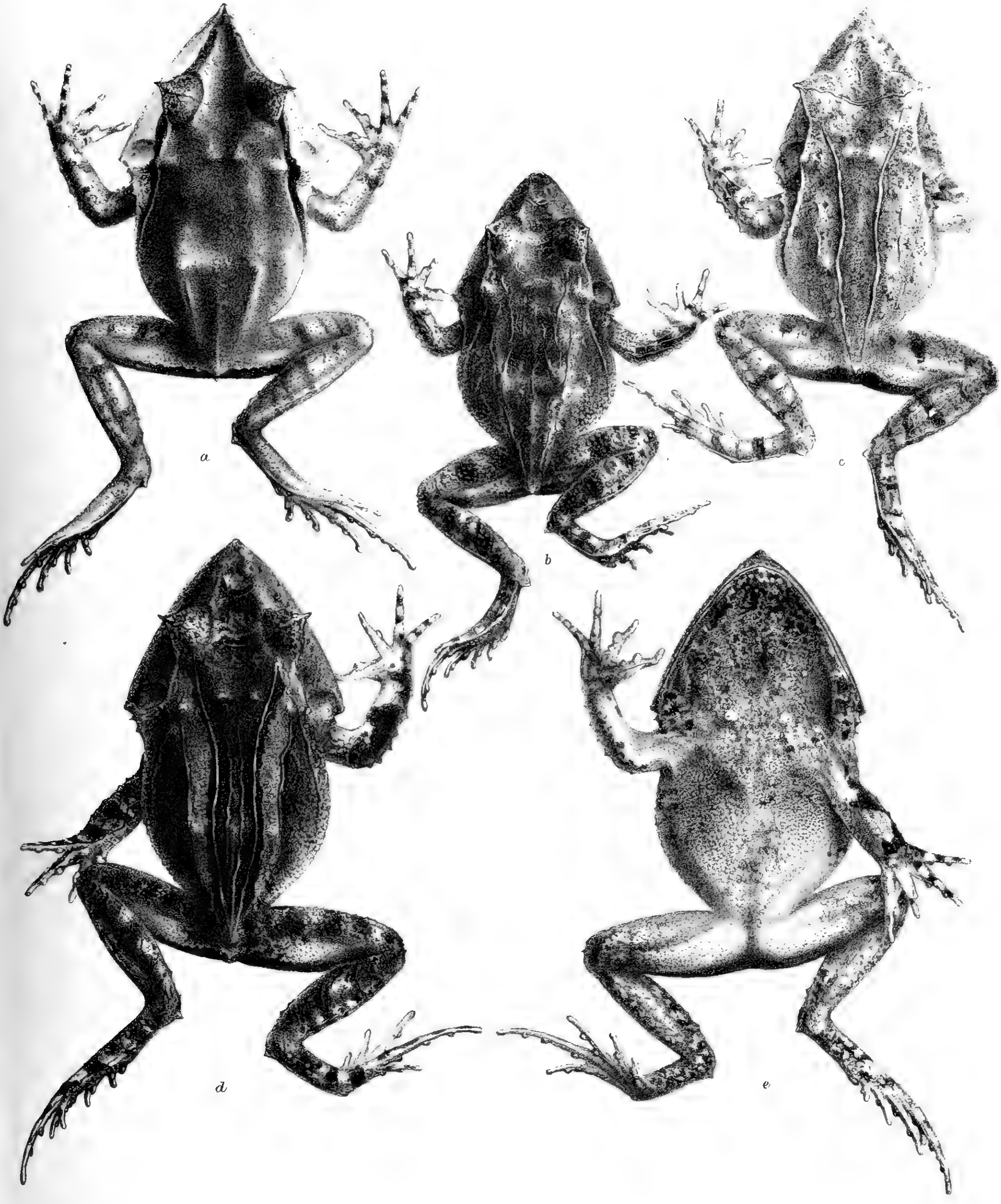

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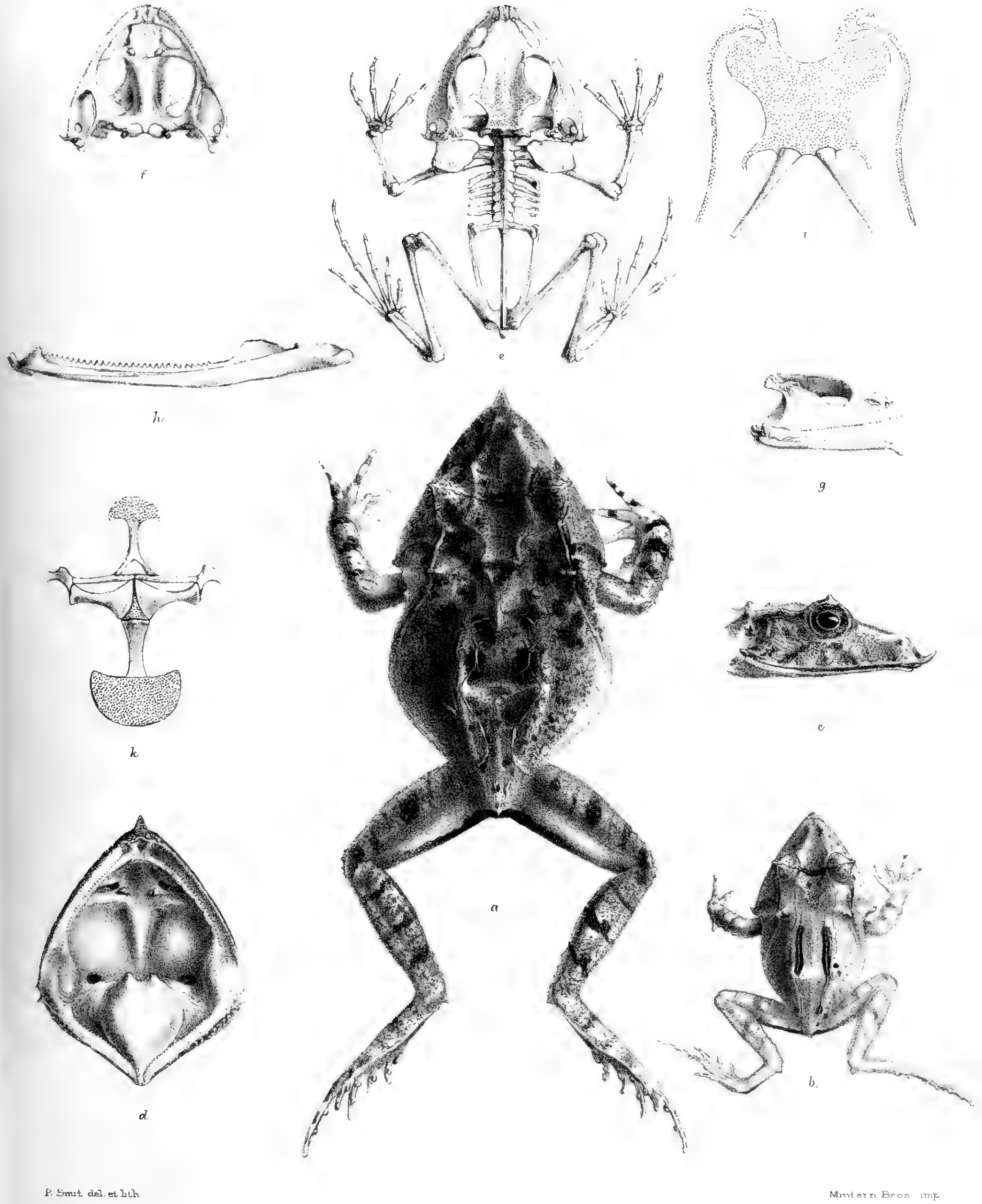

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Continued on page 3 of Wrapper.

IV. *On the Anatomy and Systematic Position of a Gigantic Earthworm* (Microchæta rappi) *from the Cape Colony.* *By* Frank E. Beddard, *M.A., F.R.S.E., F.Z.S., Prosector to the Society.*

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[Plates XIV., XV.]

Introductory Remarks.

SOME forty years ago there was published in the 'Transactions' of the Würtemberg Academy of Sciences[1] a brief account, accompanied by a plate, of a gigantic Earthworm, a native of the Cape of Good Hope. The author of this paper, Dr. Rapp, contented himself with describing the more obvious external and internal characters, and his description will be considered in reference to the several points with which it deals in the course of the present Memoir. Unfortunately at the time when Rapp published his account of "*Lumbricus microchæta*," as he termed this Earthworm, the recorded observations on the anatomy of the group were extremely few, and in consequence it was impossible to compare its structure with other forms. It is not surprising, therefore, to find many structural details, which are now known to be extremely important for classificatory purposes, omitted, and others too briefly described to be of much use, in Rapp's paper; it would, in fact, be quite impossible to decide upon the accurate systematic position of *Lumbricus microchæta* from its perusal, although M. Perrier[2] is quite right in stating that it cannot at any rate belong to the genus *Lumbricus* as now understood.

Of late years more attention has been directed to this very interesting group of animals, and we are now in possession of a very rational scheme of classification, which is due to M. Perrier[3]. This classification is based upon internal structure, though taking in consideration also certain external characters; the impossibility of deciding upon the zoological rank and affinities of an animal by external characters alone is perhaps more strikingly emphasized in the Oligochæta than in any other group in the whole animal kingdom; indeed it appears quite obvious that it should be so when we consider that the differences of habit, physiological needs, and so forth cannot be great between different species.

Setting aside the previous systems of classification, which mainly depended upon the

[1] Jahresheft. d. Ver. f. vaterl. Naturk. in Würtemberg, Jahrg. iv. (1848) p. 142.

[2] Arch. de Zool. Exp. t. ix. p. 239, note. At the conclusion of his paper Rapp does suggest the formation of a new genus *Microchæta*, which I adopt here, naming the species after Rapp, since he first described it.

[3] Nouvelles Arch. d. Museum, t. viii.

arrangement of the setæ, M. Perrier directed attention to the variability of the generative system, and divided the Oligochæta terricola into three main groups:—(1) *Lombriciens preclitelliens,* (2) *Lombriciens intraclitelliens,* and (3) *Lombriciens postclitelliens*; in the first of these the ducts of the testes open in front of the clitellum, in the second group they open within it, in the third they open behind. The number and position of the copulatory pouches, the characters of the vascular system, and so forth, serve to subdivide these three orders into genera and into species; even the species are found to differ by definite internal characters, generally the number and structure of the copulatory pouches.

Being anxious to secure a specimen of *Lumbricus microchæta,* I wrote to the Rev. G. R. Fisk, C.M.Z.S., of Breakwater, Cape Town, who most kindly secured and sent to me a fine living specimen of the worm, which arrived in perfect safety at the end of August last. Mr. Fisk had previously brought the matter before the Philosophical Society of Cape Town[1] in order to obtain information as to the way in which a specimen could be got. In the discussion which followed, a number of interesting facts respecting the occurrence of these gigantic creatures were made known, which are well worth repeating here; I quote the following passages:—"Professor Guthrie could vouch for Earthworms of 4 feet in length, though he believed they only appeared after very heavy rains. He remembered going down to Port Elizabeth in 1876, and when near Jansenville he was surprised to see a number of these monstrous worms creeping about on the ground, which was then very wet. These worms were quite 4 feet long, and on lifting one of them on his stick both ends hung to the ground; that must have been nearly 6 feet, though of course when lifted on the stick it was stretched out.

"Mr. Bolus said that he had seen a similar thing in 1874 . . . . immediately after excessively heavy rains. The whole of the road for some distance was thinly covered with these worms, there being some hundred or two of them. These worms were about as thick as one's fore finger, and about 5 feet in length. The soil was Karroo soil, and was usually extremely dry. The colour of the worms was somewhat lighter than the ordinary Earthworms, and was of an ash-grey tint. Mr. Trimen, in Natal, had seen large Earthworms of from 2 to 3 feet in length after heavy rains. They were of a green tint, and presented a most unpleasant appearance."

Another piece of information respecting these worms is contained in a letter kindly addressed to me from a gentleman resident in Kleinpoort; of the occurrence of these creatures Mr. de Witt Meulen says, "These worms appear only one, two, or three times a year . . . when the ground has been thoroughly soaked by an abundant downpour of rain. . . . They never seem to return into the earth, but to be killed within six hours by the heat of the sun. . . . The ground here is very hard, chiefly clay, and when any water is found under it it is invariably brackish. I may add that no domestic animal whatever—dogs, pigs, fowls, &c.—touch them."

[1] Reported in 'The Cape Times' for Thursday, May 29th, 1884; see also 'Nature,' Oct. 9th, 1884, p. 570.

The fact that these animals will live in soil impregnated with brackish water is highly interesting; we know of two other species, however, which live among decaying vegetable matter cast up by the sea, and therefore quite salt—these are *Pontodrilus littoralis* and *Pontodrilus marionis*[1]. Such facts may possibly help to get over the great difficulties connected with the geographical distribution of these animals. It was formerly believed that Earthworms and their eggs were killed by immersion in salt water, and it was presumed, therefore, that the facts in their geographical distribution would be of particular value, inasmuch as the species would be indigenous to the countries where they were found[2], and the presence, in two countries separated by the sea, of the same, or at least closely allied genera, would furnish very strong evidence in favour of a land connection having existed formerly between the two regions. Since we find closely allied species, let alone genera, in widely separated countries[3], the occurrence of which is hardly explicable by the interference of man, the facts stated above seem to suggest that the cocoons of Earthworms may, after all, be transported across the sea on floating timber.

External Characters.

The extreme length of *Microchæta rappi* it is difficult to state with certainty; during its lifetime the animal elongates and contracts itself so very much; the accompanying drawing (Pl. XIV.) represents very fairly the average length of the animal, which appears to be between 4 and 5 feet. When killed and placed in spirit it contracted itself to 38 inches. The colour when living is admirably illustrated by Mr. Smit's drawing, which was made from the living animal.

The dorsal surface is dark green, the colour being especially bright for a space of about 3 inches near the anterior end of the body, elsewhere it passes into a duller greenish violet; the ventral surface is of a flesh-red; when placed in spirit the colour after a time faded to a dull grey, but the bright green patch in front, corresponding in fact to the clitellum, remained for a very long time.

The setæ are arranged in two pairs as in the common British *Lumbricus terrestris*, and nearly equidistant from each other. As pointed out by Rapp they are extremely small and inconspicuous, and tend to disappear altogether at the anterior end of the body; this makes it extremely difficult to fix accurately the boundaries of the segments in this region, since, as will be pointed out presently, the mesenteries have lost their

[1] Perrier, Arch. d. Zool. Exp. t. ix.

[2] Except, of course, such anomalies as were evidently caused by the agency of man, *e. g.* the occurrence of *Perichæta* in hothouses in England and the Jardin des Plantes at Paris; these specimens have, no doubt, been imported along with plants from foreign countries.

[3] As an instance of this, the distribution of *Acanthodrilus* may be adduced; there are seven species of the genus known—three from Africa, one from Madagascar, two from New Caledonia, and one from Kerguelen Island, and another, which I hope to describe shortly, came in the same box with the large Earthworm described in the present paper. I have also received examples of three distinct species from New Zealand.

distinctive character, and are metamorphosed into a mass of fibres uniting the pharynx to the parietes, while the external segmentation is not distinct, since most of the segments are, as in other Earthworms, divided again by additional transverse furrows.

In front of the upper row of setæ are a pair of apertures on either side of the body; these are the openings of the segmental tubes; the position of these apertures is the same as that found in *Urochæta*, *Anteus*, *Rhinodrilus*, *Eudrilus*, and *Moniligaster*; in *Lumbricus* and other genera the segmental tubes open in front of the ventral pair of setæ.

When the animal was placed in spirit the orifices of the segmental tubes were rendered very conspicuous by the expulsion through them of a quantity of fluid which settled down as a flocculent precipitate.

The most careful search failed to show any dorsal pores; as, however, these structures are occasionally absent in Earthworms (*e. g.* in *Pontodrilus*), the fact is not remarkable.

The specimen appeared to be fully mature, and the clitellum occupies about twenty segments, from segment ten to thirty inclusive; it is however only developed upon the dorsal surface, and is distinguishable in the living animal, and, to a less degree, after prolonged immersion in spirit, by a light-green colour well shown in Pl. XIV.; on the ventral surface of the body, in the region of the clitellum, the green colour is replaced by a flesh-red, which faded to a yellowish grey under the action of alcohol.

The male generative ducts open on to the eighteenth segment, but I was unable to detect their apertures on the outside of the body; the termination of each vas deferens was, however, plainly visible from the inside.

The position of the apertures is therefore within the clitellum, and *Microchæta* clearly belongs to the intraclitellian group of Perrier.

There are a number of papillæ developed in certain of the anterior segments of the body, which no doubt serve to attach the animals together during copulation; they correspond in every case to the innermost pair of setæ. The presence of such papillæ is very common in Earthworms, and they are frequently provided with special glands. In *Microchæta* the glands of the papillæ are arranged three to each papilla; they are somewhat oval in shape, and conspicuous from their whitish colour; the three glands are in contact with each other, and radiate outwards from the point of opening on to the papilla. These glands are often termed capsulogenous glands, as they are believed to assist in the secretion of the cocoon.

Nephridia.

The nephridia of this worm are very remarkable. Their orifice in front of the upper pair of setæ (*cf.* Pl. XIV.) is noticed and figured by Rapp, who gives the following description of the organs themselves (*loc. cit.* p. 143):— . . . "Runde Oeffnungen, die in ein kleines, unter der Haut liegendes Bläschen führen, es scheinen Schleimabsonderungswerkzeuge (oder Respirationsorgane?) zu sein." From this description it is clear that Rapp did recognize the peculiar form of these organs in *Microchæta.* On opening the body of the animal immediately after it had been killed by immersion in weak spirit a number of long oval sacs, distended by their fluid contents, were apparent in several of the anterior segments of the body, a pair to each segment; it appeared at first that these might be the copulatory pouches, since the rest of the organs—which lies almost under the alimentary canal, and close to the mesenteries, which are here specially thickened and muscular—was invisible; on further dissection, however, these vesicular structures turned out to be diverticula of the duct of the nephridium.

Several of these are displayed in Pl. XV. fig. 6; each consists of (1) a tuft of coiled glandular tubes communicating with (2) a wide, but thin-walled duct which narrows abruptly into a short, thick tube, distinguished from the rest of the duct by its yellow colour; this latter opens on to the exterior by a pore situated just behind the more dorsally placed pair of setæ. The duct of the nephridium, near the external opening, gives off posteriorly a long, oval, cæcal tube; this is supported by a delicate membrane which runs along the whole of its posterior surface, and is attached to the body-wall.

The nephridia of the anterior part of the body, down to about the twenty-seventh ring, have the same structure that has been described; there are a pair to each segment as far forward as that which immediately follows the pharynx, which is bounded in front by the most anterior of the specially thickened mesenteries. In front of this mesentery there are only two pairs of nephridia, which are imbedded among the confused mass of muscular fibres representing the most anterior mesenteries. I am not able to state how many segments are included in this region of the body, unless the setæ really mark the number of segments, in which case there are three.

The internal opening of the segmental tubes, however, is not within the same segment that contains the greater part of the organ, and on to the outer wall of which it opens; it was quite easy to make out that the proximal portion of the tube perforated the mesentery forming the anterior boundary of the segment, and terminated freely within the cavity of the segment in front in a ciliated funnel (Pl. XV. fig. 6); about $\frac{1}{10}$ of an inch, or rather less, of the proximal clear-walled portion of the tube depended freely within this segment. A similar arrangement is usual among Earthworms. In the hinder part of the body, from segment twenty-eight onwards, the form of the segmental organs is a little different. The glandular portion consists, as in the more anterior series, of a tuft of tubules generally disposed in loops, the tubes forming the loop being variously coiled round each other. This part of the organ is situated close to the ventral blood-vessel, and is partly covered by the alimentary canal, as in the more anteriorly placed nephridia; it appears, however, to be proportionally smaller. The duct forms a wide, thin-walled tube, and opens by a thick, short, terminal portion; the duct is, however, prolonged beyond its aperture and towards the dorsal surface in the way shown in fig. 3, Pl. XV. The portion of the duct which lies beyond (above) the aperture evidently corresponds to the vesicular diverticulum of the more anterior nephridia.

The large size of the nephridia ($\frac{3}{4}$ inch) rendered it quite easy to inflate the duct by means of a blow-tube, and to make sure of the connection between the duct and the diverticulum, though this was sufficiently obvious without.

The upper portion of the wide muscular duct of the segmental tubes in this region of the body is thickly covered by a layer of large cells filled with round, clear bodies of a brownish tint; these were so numerous as to obscure the nucleus altogether. The presence of these cells gives a yellowish colour to that part of the nephridium where they exist, the rest being almost colourless. These cells appear to be simply modified cells of the perivisceral cavity; they are also extremely abundant on the intestine, where their occurrence has been long known in the common Earthworm. It is very remarkable to find them only covering the nephridia of the posterior half of the body, and absent from the more anterior series in *Microchæta.* In fig. 3, Pl. XV., are displayed some of the nephridia of the posterior region of the body; the distribution of the "chloragogic" cells is indicated by the dotting on the terminal section of the nephridium; below this region, which ends very abruptly, are hardly any traces of these cells, only a few being visible here and there. The statement that these peculiarly modified perivisceral cells are absent also from the anterior series of nephridia does not of course imply that these latter have no peritoneal covering.

The nephridia of *Microchæta* are, on the whole, similar to those of other Earthworms, but differ by the disproportionate development of the terminal muscular portion of the organ, and also by its large diverticulum. A similar diverticulum is figured by Gegenbaur in *Sœnuris*[1].

In certain of the anterior segments of the body there are a number of structures developed near the orifice of the segmental organs which have some interest in connection with the much debated question of the homologies between the nephridia and the copulatory pouches.

These are represented on fig. 4 of Pl. XV., and more highly magnified in fig. 6. In the thirteenth segment is a single minute whitish body about the side of a milletseed; this body is a cæcal pouch with muscular walls opening on to the exterior of the body in front of the nephridium. In the succeeding segment there are four of these pouches arranged as in the figure, the two innermost being partly fused; in segment fifteen the disposition of these pouches is entirely similar, except that the two innermost are connected together at their upper instead of at their lower extremities; finally, in segment sixteen there is only a single pair of these pouches corresponding to the innermost pair of the two segments immediately antecedent.

[1] "Ueber die sogenannten Respirationsorgane der Regenwürmer," Zeitschr. f. wiss. Zool. Bd. 1852.

On the opposite side of the body an exactly equivalent series of pouches is present. I have ascertained by transverse sections that these structures are, as is stated, cæcal pouches opening on to the exterior of the body.

A second individual of this Earthworm, which was acquired by Mr. Bartlett, and lived for a short time in the Society's Gardens, showed some slight variation in the number of these pouches. On the left-hand side of the body the first segment has two, the second four, one being in reality double, the third and fourth segments three each. On the right-hand side of the body the first segment had two of these pouches, the two next three, and the last two. These variations are not, however, of any importance, I should imagine.

These structures are not peculiar to *Microchæta*, but are represented in a species of *Perichæta*. In *Perichæta aspergillum* M. Perrier[1] figures a series of small accessory bodies developed in the neighbourhood of the copulatory pouches, and I have reproduced in fig. 7 of Pl. XV. M. Perrier's drawing in order to display the close resemblance between the two sets of structures; there can be little doubt that they correspond to each other, and their development in connection with the copulatory pouches in one worm and the segmental organs in the other is, at least, an indication of an homology between these latter, an homology which is undoubtedly supported by other facts. In any case the very close similarity between the copulatory pouch of *Perichæta* (fig. 7) with its accessory pouches, and the segmental organ of *Microchæta* (fig. 6) with a corresponding series of accessory pouches, is worth remarking as a curious coincidence, if no more.

It must also be remembered that true copulatory pouches like those of other Earthworms are absent in *Microchæta*, though their function is probably taken on by the structures already described; and it is not at all likely that the copulatory pouches, were they present, would have escaped attention in two separate individuals, since they are so extremely conspicuous in other Earthworms, even in immature individuals. It is possible that the correspondence between the copulatory pouches and the nephridia of Earthworms is only partial, that is to say, that the nephridia and the copulatory pouches are both derivable from a segmental organ like that of *Microchæta* with a large diverticulum. This hypothesis would explain several of the difficulties which beset the question of the homologies between the two structures; it might for instance account for the presence of a segmental organ and a copulatory pouch opening close together upon the same series of setæ in *Urochæta*. Furthermore it is possible that the small diverticulum of the copulatory pouches found in so many species of *Perichæta* (see fig. 7, Pl. XV.) is a rudiment of a nephridium opening in common with it as in

[1] For a discussion of the homologies between the segmental and the ducts of the generative system, including the copulatory pouches, see Lankester, Quart. Journ. Micr. Soc. 1864; Perrier, Arch. d. Museum, 1872, and other memoirs already cited.

Microchæta; in *Urochæta* and other Earthworms[1] where the nephridium opens upon the same series of setæ as the copulatory pouch, the latter has no such rudiment, which is exactly what would be expected on this hypothesis.

Another fact, which is of some importance from this point of view, is the condition of the spermathecæ in *Ocnerodrilus*[2] as diverticula of the vas deferens.

I am of course quite aware that this is very hypothetical, and I merely make the suggestion for what it is worth.

In any case it is interesting to notice that the structures which no doubt function as spermathecæ are placed behind the testes; it is invariably the case in other Earthworms that the spermathecæ lie anterior to, or at most in the same segments with, the testes.

Circulatory System.

The circulatory system of *Microchæta* presents some peculiarities which, so far as I am aware, have not been recorded in any other Earthworm except *Megascolex cæruleus*[3]. The dorsal vessel, instead of being a simple tube, is composed of two distinct tubes only fused here and there; on Pl. XV. fig. 2, is a drawing of other dorsal and ventral vessels, together with the connecting hearts, slightly diagrammatic. The dorsal vessel, in segment three, is a simple tube; in the succeeding segment it is double, but the two halves are closely bound together, and only recognizable as distinct by the presence of two quite separated blood-clots lying side by side in the apparently single tube; at the hinder margin of the segment a pair of transverse vessels unite the dorsal with the ventral blood-vessel; in segment five the dorsal vessel divides immediately after passing through the mesentery into two separate tubes, which unite at the posterior end of the segment into a much dilated receptacle; with this are connected the two pairs of hearts of the segment; in the following segment, that which contains the gizzard, the dorsal vessel again splits into two halves, which are widely divaricated, but meet and fuse together before giving off the pair of hearts; the arrangement of the vessel in segment seven is precisely similar. In the next segment the dorsal vessel is apparently simple, and forms a very wide chamber, at least double the width of the same vessel in the preceding or succeeding segments; on slitting it open, however, it was found to be divided by a longitudinal septum reaching nearly as far as the posterior extremity; at this point the septum disappears, and the cavity is single; the exit of the two "hearts" is guarded by a valve on either side. In the two succeeding segments the dorsal vessel

[1] *Eudrilus* appears to form an exception to this rule; but the structures described by Perrier as copulatory pouches are altogether so anomalous, that their correspondence with the copulatory pouches of other Earthworms cannot be regarded as certain, as Perrier himself implies.

[2] Eisen, Nova Acta Soc. Reg. Sci. Upsala, vol. x.

[3] F. E. Beddard, "On the Anatomy and Histology of *Pleurochæta*," Trans. Roy. Soc. Edin. vol. xxx. p. 481. This genus is really identical with Templeton's *Megascolex*. At the time when I wrote I had not seen the type-specimens and Templeton's description is too vague to be of any use in recognizing the worm.

is single, and gives off on either side a pair of large "hearts," uniting it with the ventral vessel.

The existence of a double dorsal vessel appears to be an embryonic character, inasmuch as the single dorsal vessel of *Lumbricus* and of *Criodrilus* is formed by the coalescence of two vessels, at first distinct [1].

Alimentary System.

The alimentary canal commences by a large pharynx occupying the anterior three or four segments of the body, which is firmly attached to the body-wall by innumerable muscular bands; the œsophagus is long and narrow, and, as in most other intra- and postclitellian Earthworms, is continued beyond the gizzard; in *Lumbricus* the gizzard marks the posterior boundary of the œsophagus. Two or three segments behind the gizzard is a peculiar dilatation of the œsophagus (see fig. 4 *f*, Pl. XV.), conspicuous by its reddish-purple colour, which is caused by the presence of a rich network of blood-vessels almost entirely covering its surface; on slitting open this section of the œsophagus it was found to have the appearance represented in fig. 5 of Pl. XV.; the epithelium is extremely thin and transparent, and covers an extraordinarily developed plexus of blood-vessels, composed of larger trunks running from end to end, and connected here and there by small transverse branches; no trace of the vascular network could be detected in the rest of the œsophagus—the network disappeared entirely at the junction of this dilatation with both the preceding and succeeding sections of the œsophagus. The existence of a vascular plexus, or rather sinus, within the coats of the alimentary canal has been recorded by Vejdovsky in the Limicolous family Enchytræidæ; in these worms the dorsal vessel, instead of running continuously from one end of the body to the other, ceases to be visible at the commencement of the intestines, and in fact enters the tissues of the organ at this point and forms a continuous sinus entirely surrounding the gut, but lying between its two muscular coats. In the same memoir Dr. Vejdovsky describes two cæcal diverticula from the commencement of the mid gut, exactly at its junction with the œsophagus, which are similarly furnished with a network of vessels within their substance; these are compared to a dilatation occurring at the hinder end of the œsophagus in *Enchytræus ventriculosus* [2], which appears to be very closely similar to the structure I have just described in *Microchæta*; the walls are specially thickened and contain an immense number of clear vessels, which Dr. Vejdovsky presumes, from analogy, to be blood-vessels; he does not particularly describe the minute structure of this vascular dilatation, merely remarking its probable homology with the paired diverticula of other species of *Enchytræus*; Dr. Vejdovsky furthermore suggests that this organ functions as a liver, and corresponds morphologically with the paired cæca so commonly found in the genus *Perichæta*.

[1] Balfour, 'Comparative Embryology,' vol. i. p. 282.

[2] 'Monographie der Enchytraeiden,' Prag, 1879, loc. cit. pl. vi. fig. 4, *ldr*, pp. 33–35.

If this last comparison be just, it is of course impossible to compare the dilation of the œsophagus in *Enchytræus ventriculosus* with that in *Microchæta*, which is clearly a portion of the œsophagus, and has nothing to do with the mid gut; on the other hand it seems to me also possible that the vascular dilatation of the œsophagus in *Enchytræus ventriculosus* may in reality correspond more closely with a somewhat similar structure in *Ocnerodrilus*. In this Annelid Eisen[1] has described a pair of cæca developed from the œsophagus at a considerable distance from the mid gut; he does not, however, make any statements regarding their structure. It seems to me that the œsophageal dilatation of *Microchæta*, as well as these structures just referred to, probably correspond to the calciferous glands of *Lumbricus*.

The remainder of the alimentary canal in *Microchæta* presents no features of special interest.

The intestine is capacious and furnished with a typhlosole which disappears at the hinder end of the body. The typhlosole presents a spongy appearance when examined with a lens, which is due to the immense development of blood-capillaries of various dimensions, which almost entirely fill up its interior; the interstices between the capillaries are occupied by large brown cells, evidently similar to those which clothe the outer surface of the intestine, the blood-vessels, and the segmental organs in the last half of the body. The intestine is unprovided with cæca or with glands of any description, as is remarked by Rapp.

Generative System.

(1) The *clitellum* occupies an unusually large number of segments; it extends from about segment ten to thirty, occupying therefore some twenty segments; it is distinguishable from the rest of the integument by its colour, which is of a bright green: this is well shown in the accompanying Plate (Pl. XIV.); the colour faded to a considerable extent in alcohol, but at the time of writing this (some three months after the worm was placed in spirit) it is still recognizable; the clitellum does not, however, extend very far ventrally; the peculiar green colour ceases at the apertures of the segmental organs and is replaced by a flesh-red. Perrier notices the same disposition of the clitellum in *Anteus*; in that worm, as in *Microchæta*, the clitellum is not developed on the ventral surface of the body. The structure of the clitellum apparently differs from that of *Lumbricus*; the latter has been investigated by Claparède, and more recently by Dr. Horst and Dr. v. Mojsisovics; the statements of the two last-named writers are in harmony with each other, but both differ considerably from the account given by Claparède. According to Claparède the hypoderm layer of the general body-surface is continued over the clitellum, but in that region of the body a glandular layer is interposed between the hypoderm and the layer of transverse muscles; the glandular layer

[1] G. Eisen, "On the Anatomy of *Ocnerodrilus*," Nova Acta Soc. Reg. Sci. Upsala, vol. x. (series 3).

consists of two rows of cells termed respectively the "untere" and "obere Säulenregion;" below this, again, is a vascular layer.

Drs. Horst and v. Mojsisovics interpret the structure of the clitellum differently. According to them the hypoderm layer becomes modified in the region of the clitellum; its cells are considerably longer than elsewhere, and have taken on a glandular character; below these is another layer of cells, which are distinguishable from the upper layer by their larger size, shape, and less granular contents; the upper row of cells corresponds therefore to the hypoderm *plus* the "obere Säulenregion" of Claparède, while the lower layer corresponds to the "untere Säulenregion."

The figures of transverse section of the clitellum given in Dr. von Mojsisovics's paper are not really so very different from those of Claparède, and it is, indeed, difficult to understand why the latter should have insisted upon the distinctness of the hypoderm layer from the "obere Säulenregion," inasmuch as he *figures* the cells of the two regions in some cases in actual contact, and, indeed, hardly indicates a septum of division at any point. It is a curious fact that the ultimate branches of the blood-system only reach halfway up to the outer layer of cells, and terminate precisely where, on Claparède's hypothesis, is the line of division between the hypoderm and "obere Säulenregion," and it is very possible that this fact caused Claparède to distinguish them.

A transverse section through the body-wall of *Microchæta*, in the region of the clitellum, is represented in fig. 8 of Pl. XV. The epidermis of the general body-surface is here unmodified; it is quite impossible to distinguish the cells which form the epidermis of the clitellum from those which are found elsewhere; the same narrow columnar cells, each with an oval nucleus situated near the lower end of the cell, form the chief part of the tissue, while here and there a larger granular cell occurs. The resemblance is in fact so complete that I have not thought it worth while to reproduce the epidermis of the general body-surface in another figure.

The epidermis layer (*e*) is of course covered by the chitinous cuticle (*c*), and is bounded below by a stout membrane, which sends off prolongations both from its upper and lower surface; the former pass upwards between the epidermis-cells and are no doubt similar to the "processes of pigment-cells belonging to the connective-tissue system" which make their way among the epidermis-cells of *Lumbricus* as described by the above-mentioned writers, as also by Prof. Lankester[1] (in the Leech). Beneath the epidermis is the glandular layer of the clitellum (*gl*); the glandular cells of this are imbedded in a network of connective tissue continuous with the membranes which separate the glandular from the hypodermic layer. The structure and arrangement of these glandular cells, again, appear to be different from that characteristic of *Lumbricus*.

In the latter the cells are arranged in a regular fashion in double rows, separated by septa of connective tissue. In *Microchæta* the glandular layer of the clitellum is

[1] "On Intra-epithelial Capillaries in the Integument of the Medicinal Leech," Quart. Journ. Micr. Soc. vol. xx. new ser. p. 303.

rather different; there is no such regularity in its arrangement, and the cells are aggregated into variously sized groups; this appearance is displayed in fig. 8 of Pl. XV. Whether these aggregations of cells are really independent glands or not I am unable to state; it is sufficiently evident, however, that the clitellum of *Microchæta* does differ from that of *Lumbricus*, and I hope to be able to study it more fully at some future time. The description here is of preparations which have been only hardened in strong alcohol; this reagent appears to preserve the structure of the hypodermic cells very well indeed, but as I have not been able to compare its effects on the glandular region of the clitellum with that of other reagents, I am rather afraid of going into any more detailed description of the clitellum, and possibly describing the effects of the reagent instead of the real structure of the cells.

The glandular portion of the clitellum is extremely vascular, and sends off here and there a loop of capillaries which penetrate the hypoderm as in other Earthworms.

(2) The *testes*[1] (Pl. XV. fig. 14, *t*) are two pairs of oval somewhat flattened glands, situated in segments ten and eleven; the anterior pair are rather larger than the posterior; both are enveloped in a membranous sac, and are also firmly attached to the proximal portion of the vas deferens. The testes harbour an immense number of Gregarines. These parasites are constantly found in Earthworms.

(3) The *vasa deferentia* (Pl. XV. fig. 4, *vd*) are two delicate tubes, slightly sinuous, which open into the exterior of the body in the eighteenth segment just to the inside of the opening of the segmental tubes; at its point of aperture the vas deferens of either side is slightly dilated, but there were no traces of any prostate glands such as are so generally met with in Earthworms, especially in the postclitellian and intraclitellian genera. The position of these orifices *within* the clitellum shows that *Microchæta* must be referred to the *Lombriciens intraclitelliens* of Perrier. The vasa deferentia are rather hard to follow; their diameter is almost exactly the same as that of the longitudinal muscle-bundles, and moreover in segment sixteen they appear to run within the latter; at any rate I was unable to see them in this segment, though they were, comparatively speaking, obvious in the preceding and the succeeding segment. In the twelfth segment the vas deferens bends inwards towards the middle line of the body and approaches its fellow of the opposite side; it perforates the mesentery and blends with a long, somewhat oval, solid-looking body lying beneath the testes of its own side, and almost in contact with the corresponding structure of the other side of the body. This structure represents the ciliated funnel of the vas deferens, which is, in this Earthworm, extremely complicated; instead of opening freely into the body-cavity its aperture appeared to be plugged by the testes, to which it was firmly attached by its posterior extremity; a transverse section showed that this structure does really represent the fimbriated aperture of the vas deferens. It contains numerous cavities lined by tall, columnar, ciliated cells, and its compact structure is due to an excessive complication of the folds

[1] Probably the equivalents of the seminal vesicles of *Lumbricus* and not the true testes.

into which the terminal portion of the vas deferens has been thrown; in the segment in front, which contains the anterior pair of testes, there is a similar body, which is attached to the testes of its own side, and also continuous with the terminal portion of the vas deferens lying in segment eleven; the ventral blood-vessel, which elsewhere lies upon the nerve-cord, comes to be some way removed from it in these two segments, in order to make room for the dilated extremities of the vasa deferentia which partly cover the nerve-cord. These structures and their relations to each other are exhibited in fig. 4 of Pl. XV. The arrangement of the terminal apertures of the vasa deferentia, their continuity with the testes, is evidently very favourable for conveying the seminal fluid to the exterior; in many Earthworms the fimbriated openings have no such direct connection with the testes, but lie on the posterior wall, while the testes themselves are attached to the anterior wall of the segment which contains them; in most cases, indeed, the apertures of the vasa deferentia are still further removed from the testes. In *Pontodrilus* the anterior pair of apertures are actually not in the same segment with the testes corresponding to them, but in the one in front.

(4) The *ovaries* (Pl. XV. fig. 4, *o*) are two small bodies attached to the mesentery which forms the anterior wall of segment thirteen; they are supplied with abundant blood-capillaries, which are frequently dilated in their course. Many observers have noticed a similar condition of the blood-capillaries in Earthworms, especially in those supplying the segmental organs; these dilations were visible with a hand-lens as reddish specks in the ovary, and, indeed, enabled me first to find the organ, which is sufficiently small—hardly, indeed, larger than in many small Earthworms.

(5) The position of the *oviduct* (Pl. XV. fig. 4, *od*), with reference to the ovary, is rather anomalous; the terminal aperture, which is very much folded, lies on the anterior side of the same mesentery which bears the ovaries, and consequently in segment twelve; it appears, however, that a portion of the terminal funnel, connected with the rest through the mesentery, opens into the same segment (segment twelve) that contains the ovary, and is bound to it by a membranous sheet; the two oviducts appear to open separately on to the exterior in the immediate neighbourhood of the inner pair of setæ.

(6) *Copulatory Pouches.*—There is no doubt that the small oval sacs (Pl. XV. figs. 4, 6, *c.p*), already described in connection with the segmental organs, represent functionally the copulatory pouches of other Earthworms; but it is rather surprising to find that copulatory pouches of the ordinary size, and arranged in pairs, are absent. Perrier remarks upon the absence of copulatory pouches in another Intraclitellian genus *Titanus*. I have already pointed out that the series of small pouches in segments 13–16 correspond in all probability to quite similar structures in *Perichæta aspergillum.*

In conclusion I may briefly abstract from the foregoing description the generic definition of *Microchæta.*

MICROCHÆTA, gen. nov.

Lumbricus, Rapp, Jahresb. d. Ver. f. vaterl. Naturh. in Würtemberg, Jahr iv. (1848) p. 142.

Setæ arranged in pairs in four series; clitellum occupying about twenty segments (from segment ten to thirty), only developed in the dorsal region. Nephridia opening in front of the dorsal pair of setæ, present in all the segments of the body with the exception of one or two of the most anterior; testes two pairs in segments ten and eleven; vasa deferentia opening on to eighteenth segment, not furnished with a prostate gland or "penis;" ovaries on anterior wall of segment thirteen. Alimentary canal without cæca or special glands.

Copulatory pouches represented by a variable number of small pouches (one to four in each segment) in segments twelve to fifteen, opening on to the exterior in a line with the nephridia and close to them.

EXPLANATION OF THE PLATES.

PLATE XIV.

Microchæta rappi, drawn by Mr. Smit from the living worm. Natural size.

PLATE XV.

c, cuticle; *e*, epidermis; *gl*, glandular layer of clitellum; *d*, dorsal vessel; *n*, nephridia; *c.p*, copulatory pouches; *m*, *m'*, muscular layers of body-wall; *t*, "testes:" *g*, gizzard; *f*, dilated vascular region of œsophagus; *o*, ovary; *ov*, oviduct; *v*, ventral blood-vessel; *h*, "heart;" *v.d*, vas deferens; *v.d.f*, funnel of vas deferens; *p*, mesenteries.

Fig. 1. Dissection of *Microchæta*, to show specially thickened mesenteries of anterior region.

Fig. 2. Main trunk of vascular system in anterior region of body.

Fig. 3. Four segments in posterior region of body, to show the position and form of the nephridia.

Fig. 4. Dissection of the genital region, to show genital glands and their ducts.

Fig. 5. Vascular dilatation of œsophagus cut open by longitudinal incision.

Fig. 6. Four segments of the body which contain the copulatory pouches.

Fig. 7. Diagram of copulatory pouch &c. of *Perichæta aspergillum*, copied from Perrier (Nouvelles Arch. d. Muséum, t. viii. pl. iv. fig. 72).

Fig. 8. Vertical section through clitellum to illustrate its minute structure.

Fig. 9. Muscle-fibres of transverse coat, very highly magnified.

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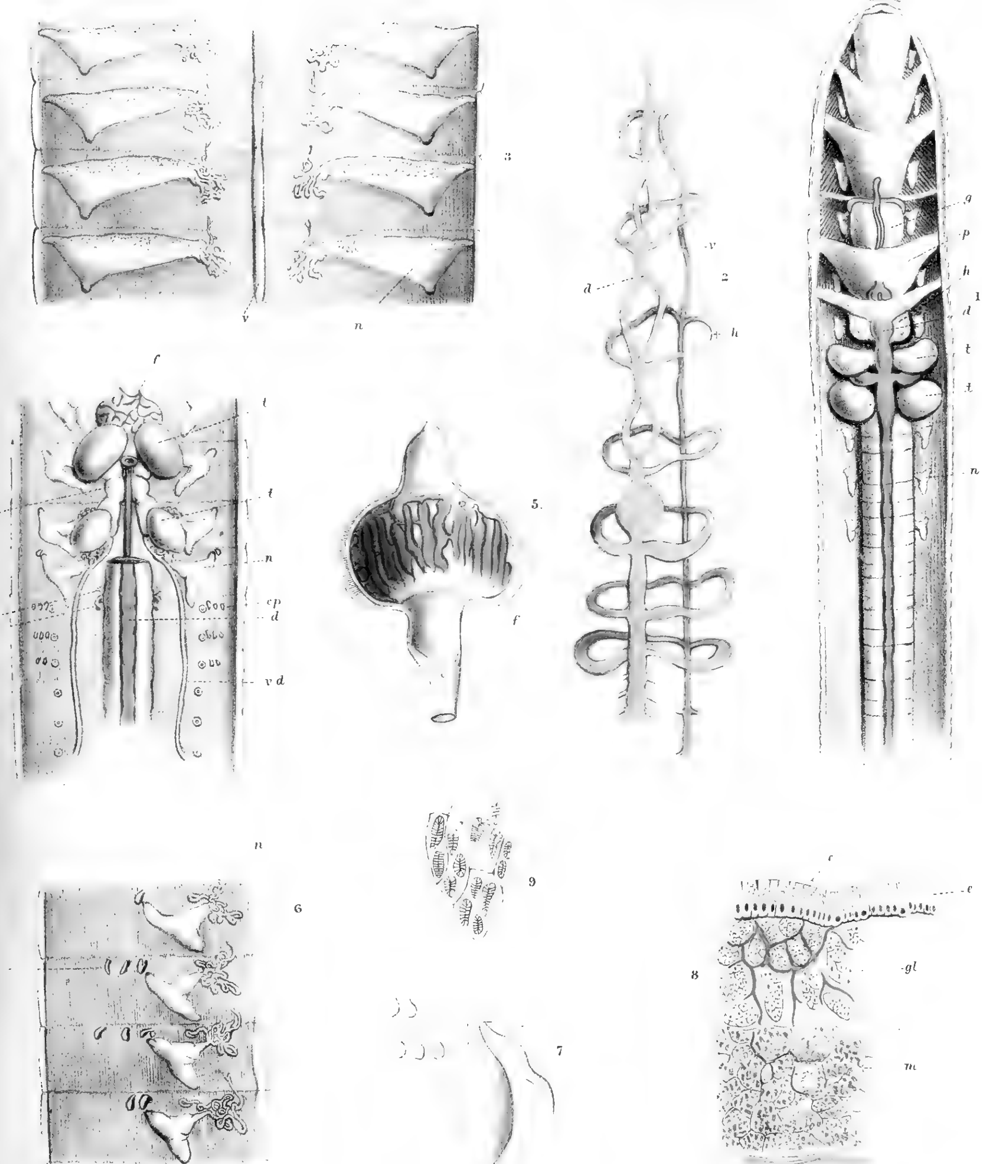

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Continued on page 3 of Wrapper.

V. *On the Crustacea Isopoda of the 'Lightning,' 'Porcupine,' and 'Valorous' Expeditions.* *By the Rev.* A. M. Norman, *M.A., D.C.L., F.L.S., and the Rev.* T. R. R. Stebbing, *M.A.*

Received November 5th, 1884, read December 2nd, 1884.

[Plates XVI. to XXVII.]

Part I.—Apseudidæ, Tanaidæ, Anthuridæ.

Considering the few hauls which have as yet been taken with the dredge at depths greater than 1000 fathoms in the North Atlantic, it is surprising that by far the larger number of families of the Isopodous Crustacea are already known to have their representatives at this excessive depth, while many more were taken in the British expeditions at such lesser though still great depths as a few years ago were almost unassayed.

The families which we now know to descend below 1000 fathoms are:—

Apseudidæ	Genera *Apseudes, Sphyrapus,*
Tanaidæ	Many genera,
Anthuridæ	Many genera,
Anceidæ	*Anceus,*
Cymothoidæ	*Cirolana,*
Idotheidæ	*Chiridothea,*
Asellidæ	*Nannoniscus,*
Munnidæ	*Ischnosoma, Macrostylis,*
Munnopsidæ	*Munnopsis, Ilyarachna, Eurycope;*

and in the Southern Sea the Serolidæ were found by the 'Challenger' over a wide area, descending even to 2040 fathoms.

Apart, perhaps, from the Serolidæ, the most interesting of the abyssal Isopoda are those belonging to the families Munnidæ and Munnopsidæ. These are furnished with antennæ and legs of extraordinary length and delicacy of structure; and, unfortunately, the free use of sieves in washing the ooze on board the British expeditions resulted in the entire mutilation of such specimens as were picked out from them, so that they were for the most part little more than mere memberless trunks.

We shall adopt in the following paper, as far as Tribes and Families are concerned, the arrangement of the Isopoda which has recently been used by that prince among carcinologists, Prof. G. O. Sars, in his recent Catalogue[1] of the higher Crustacea of Norway. The arrangement appears to us more natural in some particulars than those which have preceded it.

Subclass ISOPODA.

Tribe I. *CHELIFERA*, G. O. Sars.

Animal narrow, subdepressed, or subcylindrical, but never compressed.

Head united with the first or, more rarely, with the first and second segments of the peræon, so as to form a short carapace, the surface of which is often areolated with lines of depression. The following segments of the peræon are always distinct, and are often separated by deep constrictions.

The pleon is composed of six segments, the first five of which are usually distinct (but in some cases coalesced into a single segment), and furnished with pleopods, which consist of a basal joint and two unjointed branches (but in those cases where the segments are coalesced, and sometimes otherwise, the pleopods are undeveloped). The last segment is formed by the union of the two last segments of the pleon, and is much larger than the preceding, and carries the uropods.

The eyes, when present, are situated on triangular lobes, at the anterior angles of the carapace.

The upper antennæ are furnished with either one or two flagella.

The lower antennæ are smaller than the upper, and are placed below them. In the genus *Apseudes* they have an articulated antennal scale at the end of the second joint.

The mandibles vary greatly in structure, and sometimes have, and at others have not, a palp.

The first maxillæ have a backward-directed palp, which assists in causing currents of water to pass through the branchial chamber, which is situated under the hinder part of the carapace.

The second maxillæ are developed and setose, or rudimentary and naked.

The maxillipeds are large, with a four-jointed palp, and also a large, membranous, backward-directed branchial palp, which passes into the branchial chamber.

The first gnathopods are largely developed, smaller in the female, but sometimes in the male of great size, chelate.

The second gnathopods in the Apseudidæ are largely developed, with flattened wrist and hand, margined with strong spines, so as to form a most efficient burrowing-instrument; but in the Tanaidæ they are narrow and slender, and adapted for progression.

The peræopods are formed for walking; the two first pair are directed backwards,

[1] G. O. Sars, 'Oversigt af Norges Crustaceer med forelöbige Bemærkninger over de nye eller mindre bekjendte Arter,' 1882.

the last three forwards. Their minute microscopic structure is very varied, since they are furnished with setæ and spines of every kind of complex structure, so that they will be found in their minute armature to afford very reliable specific characters.

Uropods setaceous, consisting of a basal joint and one or two filamentary branches which vary greatly in length.

Respiration by means of a branchial chamber, which is situated beneath the sides of the hinder portion of the carapace. Heart occupying the earlier segments of the peræon. Eggs carried in a pouch beneath the body, which is formed of thin plates, which may either spring from the fourth free segment alone, or consist of four pairs attached to four segments.

Synopsis of the Families of Chelifera.

Upper antennæ with two flagella. Second maxillæ well developed and setose.
Second gnathopods with a large broad flat hand, suited for burrowing . . . . APSEUDIDÆ.
Upper antennæ with a single flagellum. Second maxillæ rudimentary and naked.
Second gnathopods with narrowed joints, and fitted for walking . . . . . TANAIDÆ.

Family I. APSEUDIDÆ.

Animal narrow, produced, depressed, the carapace usually laterally keeled. Segments of pleon well defined, narrower than those of peræon. Rostrum usually well developed, rarely absent. Ocular lobes commonly somewhat pyriform, occasionally taking the form of strong spine-processes.

Upper antennæ situated at the anterior corners of the carapace, with two multiarticulate flagella. Lower antennæ with their bases close together and appressed, lying between and below the upper pair; the second joint of the peduncle is often furnished with an articulated oblong or linear antennal scale, which is ciliated all round; flagellum multiarticulate.

Mandibles well developed, with a three-jointed palp. First maxillæ consisting of two members, and furnished with a backward-directed two-jointed palp, which terminates in two setæ. Second maxillæ three-lobed, the lobes setose and spinose. Maxillipeds with a four-jointed palp and large branchial lamina.

The first gnathopods are strong and chelate, the inner margin of the finger and thumb usually tuberculated in the male and serrate in the female.

Second gnathopods with the three last joints and especially the hand flattened; hand oblong or subovate, surrounded with numerous flattened spines, the number, character, and arrangement of which afford good specific characters; finger very strong, usually toothed; the whole limb is powerfully built and well adapted for digging. Both pairs of gnathopods are usually furnished with a minute, two-jointed palp attached to the coxa—the rudimentary representatives of the often largely developed palps (exopodites) of the Podophthalmous Crustacea.

Peræopods slender, the coxa always very long, more or less covered with setæ and spines, the varied form and structure of which are useful for diagnosis.

Pleopods composed of a peduncle and two setiferous branches.

Uropods two-branched, the inner filament of great length and multiarticulate, the outer shorter, though also multiarticulate.

Synopsis of Generic Distinctions of Apseudidæ.

Lower antennæ with a scale articulated to the end of the second joint.	
First free segment with the epimera conspicuous, spine-formed, porrected. Gnathopods furnished with minute palps . . .	*Apseudes,* Leach.
First free segment with epimera small and not produced forwards. Gnathopods without palps	*Parapseudes*[1], G. O. Sars.
Lower antennæ without a scale.	
Carapace composed of head and two following segments coalesced .	*Sphyrapus,* n. g.

Genus 1. Apseudes, Leach.

=*Eupheus,* Risso, =*Rhœa,* Milne-Edwards.

Animal elongate, gradually attenuating from the first to the last segment; pleon equal in length to $2\frac{1}{2}$ or $3\frac{1}{2}$ last segments of peræon.

Carapace usually furnished with a distinct rostrum, which is very variable in form and often long and acute. Eye-lobes with or without eyes, usually pyriform, rarely taking the form of a large spine. First free segment with the epimera spiniform and inclining forwards. Last segment of pleon never produced to an elongated point, obtusely rounded or truncate at the extremity.

Upper antennæ nearly alike in the sexes, outer flagellum longer than the inner. Lower antennæ with a distinct, movable, antennal scale, ciliated, attached to the second joint of the peduncle.

Epistoma with or without a spine.

Gnathopods of both pairs furnished with a minute and inconspicuous two-jointed palp at their base. The first pair with chelate hands, larger in the male than in the female; second pair with the hand usually ovate, flattened.

Pleopods well developed.

Leach's most erroneous and misleading figure of *Apseudes talpa* was copied through a long series of years into numerous publications as the illustration of this genus. The first fair figure was that which Milne-Edwards gave of his *Rhœa latreillii.* These two species until recently were the only known representatives of the family.

[1] The typical and only known species of this genus is the *Apseudes latifrons,* Grube (Die Insel Lussin und ihre Meeresfauna, p. 75).

Diagnosis of Species of Apseudes *here described.*

No rostrum, front truncate . . . . *obtusifrons.*
Rostrum minute, simple, a mere point.
  Epistoma furnished with a spine . . . . *talpa.*
  Epistoma not furnished with a spine.
    Second gnathopods with an ordinary curved dactylus . . . . *latreillii.*
    Second gnathopods with a curiously twisted dactylus . . . . *uncidigitatus.*
Rostrum long, acute, with a bulb-like swelling on each side of the base.
  Bulbs convex in front.
    Carapace with a pair of large lateral spines . . . . *gracilis.*
    Carapace without lateral spines.
      Hand of second gnathopods ovate, not much longer than broad . *spinosus.*
      Hand of second gnathopods elongated, linear, 3–4 times as long as broad . . . . *simplicirostris.*
  Bulbs concave in front . . . . *lunarifrons.*
Rostrum tridendate, composed of three acute processes . . . . *grossimanus.*

Besides the foregoing species, four other forms have recently been recorded by Prof. G. O. Sars from the Mediterranean—*Apseudes tenuimanus, acutifrons, robustus,* and *echinatus.* The last certainly comes very near to, and may prove to be identical with, the *Apseudes lunarifrons.* A species has also been described by Studer from Kerguelen Island, *Apseudes spectabilis* (Studer, 'Isopoden der Reise S.M.S. 'Gazelle' um die Erde, 1874–76,' 1884, p. 23, pl. i. fig. 9, *a–g*).

1. Apseudes talpa (Montagu).

Cancer (*Gammarus*) *talpa,* Montagu, Trans. Linn. Soc. ix. p. 98, pl. iv. fig. 6.

Apseudes talpa, Leach, Edinb. Encyclop. vii. 1814, p. 404; id. Trans. Linn. Soc. xi. p. 372; id. Suppl. Enc. Brit. i. p. 428; Samouelle, Entom. Compend. p. 109; Lamarck, Hist. Nat. Anim. sans Vertèb. (deuxième édit.) v. p. 290; Latreille, Enc. Méthod. pl. cccxxxvi. fig. 26; Cuvier, Règ. Anim. édit. Latreille, pl. cliv. p. 124; édit. Crochard, Crust. pl. xlii. fig. 1; id. Anim. Kingdom, edit. Henderson, iii. p. 223, pl. xxxvi. fig. 4; Guérin, Icon. pl. xxvii. fig. 6; Lucas, Hist. Nat. des Crust. p. 243; Milne-Edwards, Crust. iii. p. 140; White, Brit. Mus. Cat. Brit. Crust. p. 67; id. Pop. Hist. Brit. Crust. p. 226; Gosse, Marine Zool. i. p. 136, fig. 245; Bate and Westwood, British Sessile-eyed Crust. ii. p. 148; G. O. Sars, Revision af Gruppen Isopoda Chelifera, 1880, p. 10.

? *Eupheus ligioides,* Risso, Crust. de Nice, 1816, p. 124, pl. iii. fig. 7; Hist. Nat. de l'Europe Mérid. v. p. 99; Desmarest, Consid. gén. Crust. p. 285; Milne-Edwards, Crust. iii. p. 142.

Eupheus talpa, Desm. Consid. gén. Crust. p. 285.

? *Apseudes ligioides,* Lucas, Hist. Nat. Crust. p. 243; Lamarck, Anim. sans Vertèb. (2e édit) v. p. 291.

Rostrum triangular, acute. Ocular alæ obtuse. Eyes well developed. Segments of peræon narrower than carapace, each having a short triangular process at the lateroanterior margin, and a strong spine on the middle of the ventral surface. The epistoma is always armed with a similar spine.

The pleon is rather narrow, the first five segments are produced laterally into sharp processes and beset with long plumose hairs; the last segment is much drawn out, and is subequal in length to the whole of the rest of the pleon; it has two small ciliated eminences on each side.

The upper antennæ have the basal joint half as long again as the second and third combined, with both its inner and outer margins partially serrulated; the flagella are shorter than the peduncle, the inner 6-, the outer 13-jointed.

The first gnathopods of the female are moderately strong, scarcely less than the second pair; the hand longer than the wrist, ovate, the finger armed with a tubercle near the base. The uropods are equal in length to half the animal, the peduncle ornamented with many plumose setæ on the outer margin; outer branch composed of seven joints scarcely equalling a fourth part of the inner branch in length. Colour white.

Length about 6 millim.

Montagu procured his types on a *Pecten maximus* at Salcombe, Devon. Spence Bate has found it in Plymouth Sound, and Mr. Cocks at Falmouth. Prof. G. O. Sars has taken it in the Mediterranean (Messina), and Heller in the Adriatic.

Apseudes talpa may be known from *A. latreillii* (1) by the serration of the first joints of the upper antennæ, (2) by the spines which arm the epistoma and the ventral surface of the peræon-segments, (3) by the great length of the terminal segment of the animal.

Montagu's figure, copied again and again by various authors, is altogether misleading and erroneous. Milne-Edwards's figure, taken from one of Colonel Montagu's specimens, though somewhat better, is quite insufficient to distinguish the species. Bate and Westwood were the first to give characteristic drawings of the animal. Fortunately Colonel Montagu's specimens are still preserved in the British Museum, and have been kindly examined for us by Mr. Miers and compared with *A. latreillii*; and there can be no doubt that, as stated in the 'British Sessile-eyed Crustacea,' they belong to the species to which Montagu's name is here assigned.

The *Apseudes talpa* of Lilljeborg, and of the earlier writings of G. O. Sars, is not this species, but *A. spinosa*, M. Sars.

We have not ourselves had the opportunity of examining specimens of *A. talpa*, and the foregoing description has been compiled from those of Sars and Bate and Westwood.

2. Apseudes latreillii (Milne-Edwards). (Plate XVI.)

Rhœa latreillii, M.-Edwards, Ann. des Sci. Nat. 1re sér. xiii. p. 288, pl. xiii. A. figs. 1–8; id. Hist. de Crust. iii. p. 141; Cuvier, Règ. Anim. (édit. Crochard), Crustacés, pl. lxii. fig. 2; Latreille, Cours d'Entomol. p. 403; Lamarck, Anim. sans Vert. (2ième édit.) v. p. 291.

Apseudes latreillii, Bate and Westwood, Brit. Sess.-eyed Crustacea, ii. p. 153; G. O. Sars, "Revision af Gruppen Isopoda Chelifera," Archiv for Math. og Naturvid. vii. 1882, p. 14.

Male. Frontal outline (I. D) in form as the lower part of an escutcheon, the rostrum short but acute, bent downwards at the extremity, and not equalling in length one third of the basal joint of the upper antennæ. Ocular processes not much produced, but pointed and deflexed at the extremity. Eyes conspicuous.

Carapace and peræon-segments (I. D) without spiny armature either on the sides or ventral surface, except that the last segment of the peræon has a large spine-like projection on the middle of its under surface. Sides of segments emarginate, and furnished with a few cilia in front of the place of attachment of the limbs.

Pleon (I. D) with the sides of the segments ciliated, and produced downwards and backwards (I. L) into small but acute points, which, however, occupy such a position that they are hidden when the animal is viewed from above; ventral surface of each segment with a central spine; last segment not much produced, scarcely equalling three preceding segments combined.

Upper antennæ (I. *a.s*) having the basal joint three times as long as broad, both margins flexuous, the outer with a cilium at half its length, and with a brush of cilia at the distal termination; second joint not half as long as the first, narrow at the base, but widening distally; third not half the length or half the breadth of the second; flagellum of thirteen articulations, every other articulation furnished with an olfactory appendage on its inner margin; secondary filament of five articulations.

Lower antennæ (I. *a.i*) having the peduncle equal in length to the first joint of the upper pair, the first joint having a lobe at the base on its inner margin; second bearing the antennal scale, which is 3–4 times as long as wide, ciliated all round, and reaching the middle of the fifth joint; third joint very short; fourth slightly longer; fifth more than twice the length of the fourth; flagellum of seven articulations.

First gnathopods (I. gn^1 ♂) having the basos massive, as broad as long; hand, exclusive of the thumb, as broad as long, a large tooth near the base of the inner margin of the thumb, which beyond this is minutely denticulate and ciliated; the denticulations, when examined under a high power, are found to consist of lancet-shaped processes, which are serrulate on the upper margin (and on both margins in the female); the finger has similar processes, but smaller, finer, and less erect.

Second gnathopods (I. gn^2) have the coxa produced forwards into a triangular, pointed, and ciliated process, by the side of which is a minute two-jointed palp tipped with setæ (the rudimentary exopodite); there is also a similar palp at the base of the first peræopods; meros with a large distal spine below and a smaller distal spine on the back, carpus with two spines on the front, and a spine and bunch of cilia at the distal corner of the upperside; hand with three subequal spines, the more distant rather the larger, these spines alternate with sets of about three cilia, upper margin with two spines at the lower extremity; dactylos strong, with one and sometimes two denticles on the inner edge, and two cilia on the back; close to the base of the dactylos there is a very minute flattened lancet-shaped seta, furnished with rigid cilia on the margin, its peculiar structure and position seem to indicate that it may be a delicate organ of touch.

Last legs (I. *prp*[5]) having the hinder margin of all the upper joints set with long plumose setæ; meros bearing a long spine at the lower corner of the front margin; carpus with three spines on the front, and an oblique row of four spines on its flattened side; hand with a small simple spine at the base and a longer spine on each side of the insertion of the dactylos, also a row of 4–5 spines on the side; these spines, when carefully examined, are found to have their terminal portion channelled, and the edges of the channel denticulately serrated, but the extreme end of the spine is without this serration and is gently curved; but the most remarkable part of this remarkable hand is that the whole palm and distal margin, except when occupied by the spines already described, is beautifully pectinated with a row (about 30) of closely placed lancet-shaped spinelets, which, under a high power, are found to be exquisitely serrulated on both margins; finger long and slender, subequal in length to the hand, unguiculate, with a minute cilium at the origin of the unguis and a cilium on the middle of the upper margin.

Uropods (I. Pl. V.) having the outer branch 4-jointed, first very short, second and third subequal, and each more than double the length of the first, fourth nearly as long as the second and third combined; inner branch very long, of about 32–36 articulations.

The female differs from the male in having the first pair of legs of much less robust character, especially as regards the hand, which is feebler and narrower (I. *gn*[1] ♀); the thumb without the tooth and with the serrated-edge lancet-processes excessively transparent; there is also a bunch of long cilia without, and a line of short cilia within the thumb.

Length 7 millim., or $\frac{3}{10}$ of an inch.

Apseudes latreillii has not been taken in any of the Atlantic dredging expeditions; but it has seemed to us desirable, indeed necessary, that this species and *A. talpa* should be carefully described in order that they may be distinguished from each other and from the species first recorded in this paper, as well as from the many more allies which it is probable will before long be brought to light.

Our description is chiefly drawn up from specimens dredged by A. M. Norman in Guernsey, in Brelade Bay, Aug. 10, 1865. Some of these were placed in Bate and Westwood's hands, when they were preparing their work, and they are erroneously referred to by them as belonging to *A. talpa.* The specimen of this species which constituted the type described and figured by Bate and Westwood as *A. latreillii* is also in our collection. It is a female, and was taken on the Northumberland coast.

Professor G. O. Sars has taken it at Goletta and Naples.

3. Apseudes spinosus (M. Sars). (Plate XVII. fig. i.)

Rhœa spinosa, M. Sars, Overs. over Norsk-Arktiske Region förekom. Krebsdyr (Vidensk. Selsk. Forhandl. 1858), p. 30.

Apseudes talpa, Lilljeborg, Bidr. till Känn. Sverige och Norrige förekom. Isopodernas och Tanaidernas Familij, 1864, p. 9; G. O. Sars, Nye Dybvandscrustac. fra Lofoten (Vidensk. Selsk. Forhandl. 1869), p. 45 (nec *A. talpa,* Montagu, nec *A. talpa,* Bate & Westwood).

Female (i. d). Frontal region much produced into a long acute rostrum, nearly half as long as the long basal joint of the upper antennæ; this rostrum is expanded greatly towards the base into rounded lateral bulb-like lobes, and deeply excavated centrally above (i. l), the sides being as it were upturned.

Ocular processes or alæ rather shorter than usual, broadly triangular, no vestige of eyes.

Carapace widening rapidly behind the rostrum, forming nearly a square; lateral margins slightly sinuous, and produced to a point in front, at the ocular suture.

First two free peræon-segments as broad as the carapace; third narrower but longer, the two following of still less width, but greater length, the last somewhat narrower and much shorter than the two which precede it; the antero-lateral margins of all these segments are produced outwards into conspicuous triangular pointed processes beset with verticillately plumose setæ; each segment of peræon and pleon has a central spine on the underside, and there is also a long acute spine upon the epistoma (i. l).

Pleon having the first five segments short, their epimera (i. pl.) produced directly outwards into greatly developed and conspicuous spike-like processes, each furnished with eight or ten very long verticillately plumose setæ; these setæ protrude directly over similar setæ of the pleopoda, and thus with them form a dense and elegant mass of plumage on each side of the pleon. The sixth segment is very long, equalling the united length of the five segments preceding, a little irregular in outline, without being decidedly spined; from small protuberances issue verticillately plumose setæ, the segment narrows before reaching the points of attachment of the uropods, and then starting from a small ciliated tooth it widens rapidly for the attachment of the uropods, and subsequently ends obtusely.

The upper antennæ (i. d) have the basal joint long and narrow, about five times as long as broad, with two longitudinal grooves on the upper surface which leave, as it were, a central and lateral rib, basal portion of inner margin finely serrated, in advance of this and at a point where the joint narrows a group of cilia spring; second joint about one third as long as the first, stout, distally dilated; third somewhat shorter and much thinner than second; flagellum longer than the peduncle, its articulations 20–22; secondary appendage more than half the length of the flagellum, consisting of 10 long articulations.

The lower antennæ (i. *a.i*) having the first short joint internally lobed, inner margin of the lobe bearing minute spines; second joint two fifths the length of the first joint of the upper antennæ, the inner margin spined like the lobe just mentioned; third very short; fourth and fifth subequal to each other; antennal scale small, narrow, not quite reaching the end of the fourth joint; flagellum of 12–15 articulations.

The first gnathopods (I. L) have the basos short and broad, with a tooth on the middle of the upperside, and a curved spine below the centre of the front; the narrow and rather sinuous meros has a spine at the inferior extremity; the wrist widens towards the hand, and has its front margin angulated and armed with two teeth (which are more easily seen when viewed from the inner face); hand (I. gn^1) broad and rather massive, thumb short and broad, with a large tooth-process in the middle, which fits into the cavity of the overarching finger, which is also furnished with a small tooth situated nearer the base than that of the thumb; distal portion of both finger and thumb slightly denticulate on the edge, the former also with a row of cilia within the margin; both finger and thumb tipped, as usual, with horny-looking nails.

In the second gnathopods (I. D and I. L) the meros has distally a spine on each margin; the carpus a distal spine on the back, and two on the front margin; the hand one or, more rarely, two distal spines above, and four or, more rarely, five spines on the palm; all these spines are more slender than is usual in this genus in similar positions. The finger has a central cilium on the back, and two or three minute teeth on the impinging edge.

The last peræopods (I. prp^5) have the ultimate joints much produced and narrower than usual; hand four times as long as broad, with two simple slender spines near the base, and one on each side of the finger, a curved pectination sweeps semispirally round the joint from the base to the extremity, where it forms a crest round the finger; the pectination consists of a series of (60 or 70?) closely packed lancet-shaped processes, which are themselves serrulated on the upper margin; finger remarkably long, slender, and acute, nearly as long as the hand.

Length half an inch, or 12 millim.

The specimen described appears to be a female, as it has scale-like appendages to the inner base of the second, third, and fourth legs, which we take to be the commencing development of the egg-pouch. The side view of the head, however (I. L), is taken from a fragment which, from the greater development of the gnathopods, is probably a male.

The specimens just referred to were taken in the 'Porcupine' Expedition in 1869 S.S.W. of Ireland, in 725 fathoms (Station 36, lat. 48° 50′ N., long. 11° 9′ W.), and are identical with a Swedish specimen, for which we are indebted to Professor Lilljeborg.

We (A. M. N.) have since, in 1878 and 1879, dredged this species in great abundance in some of the Norwegian fiords, more especially near Lervig, at the mouth of the Hardanger Fiord, in 180 fathoms, and near Drobak in the Christiania Fiord.

4. APSEUDES UNCIDIGITATUS, n. sp. (Plate XXI. fig. I.)

This pretty little species, which has the limbs elegantly banded and mottled with umber-brown, in many respects resembles *A. talpa*, but in some points differs from all other known members of the genus. Thus the dorsal surface is almost smooth, instead of being much waved and indented as in other species, while the second segment of the peræon is much more closely soldered to the first than usual, and thus becomes almost a part of the carapace, an approach being thus made in this species to that soldering of two peræon-segments to the cephalon which is more fully carried out in the new genus *Sphyrapus* of this Memoir.

Frontal region (I. C) in the form of the base of an escutcheon inverted, the rostrum almost evanescent, and only represented by a small point; frontal region scarcely extending one fourth the length of the basal joint of the upper antennæ.

Ocular processes or alæ curving a little round the upper antennæ, acutely pointed, and projecting forwards beyond the very short rostrum. No appearance of eyes.

The carapace (I. D) has nearly parallel sides, not expanded at the point of origin of the gnathopods. Peræon-segments remarkably even in breadth and length, though each successively very slightly narrower than the preceding; base of second peræon-segment a little excavated on the sides in the neighbourhood of the coxal spine; the hinder corners of the segments are sharply angled, those of the penultimate and antepenultimate produced backwards into minute spine-points; antero-lateral margins not spined, rounded, having a few very minute cilia; no spines on the ventral surface, except a central spine on the last segment.

The pleon (I. L) has the epimera of the five first segments produced into spiny points, which are directed backwards and are visible from above; they bear a few minute cilia, which, however, are so small as only to be seen when looked for with the microscope, each segment has also a ventral spine (I. L). Last segment equalling in length 2–3 of those which precede it.

The antennæ are very similar to those of *A. talpa*; the upper (I. *a.s*) have the flagellum nine-jointed, and the secondary appendage five-jointed; the olfactory filaments are very long, that attached to the antepenultimate articulation far overtopping the end of the flagellum. The lower antennæ (I. C. V.) have the antennal scale ovate, reaching the end of the fourth joint of the peduncle, the filament is six-jointed.

The first gnathopods (I. gn^1) show some resemblance to those of the young male of *A. talpa*. The basos is short and thick, the wrist long and parallel-sided; the hand short, widening rapidly, and triangular, the thumb portion not projected forward, but thrust out laterally, having a central tooth, a group of cilia at the base, and a line of cilia edging the distal part, which is not denticulated; finger with several long cilia at half its length on the back, while the central portion of the inner side is denticulate and ciliate.

The second gnathopods (I. gn^2) are remarkably strong, the last joints much expanded, and the spines robust; meros with a single spine on the lower margin; carpus with two spines on the lower, and a distal spine on the upper margin; hand with two spines above and four on the palm, cilia alternate with these palm-spines; finger contorted, at first curving downwards, and then at half its length bent backwards, in the middle of its outer margin a long slender spine and a minute cilium, on the inner side a single denticle.

Last peræopod (I. *prp*[5]) short, the joints broadly flattened, basos scarcely more than twice as long as broad, not spined or setose; ischium minute, rudimentary, meros with three long plumose setæ on the back, and six long simple cilia and a distal spine on the front margin; carpus ovate, with five long plumose setæ on the back, and four long spines and about seven simple long cilia on the front margin; there are also two spines on the side, the spines of the front margin are serrulate on the edge towards their terminations[1]; hand ovate, rounded at the extremity, not more than two and a half times as long as broad, with four long serrulate-edged spines on the distal part of the back, and one similar spine on the palm, the whole of the palm and rounded end of the joint pectinately fringed with closely-set lancet-shaped spines; these spines differ from those of allied species in being longer, acutely pointed at the extremity, and serrulate on *both* sides; finger slender.

Length 6 millim., or about a quarter of an inch.

Dredged in the Mediterranean off the African coast by the 'Porcupine' in 1870, Station 40. The depth we are not able to give, as there were three dredgings at this station which were in 51, 152, and 510 fathoms.

A very remarkable character in this species is the twisted character of the finger of the second gnathopod (I. *gn*[2]). The first impression on seeing such a form was that it was a monstrosity, an impression only removed when it was found that the fingers of this pair of legs in the two specimens procured were all of identical structure.

5. Apseudes obtusifrons, n. sp. (Plate XVIII. fig. II.)

Frontal region (II. D) not only truncate, but even emarginate, without any indication of a rostrum, the anterior margin being folded underneath instead of porrected.

Ocular processes narrow, much produced, terminating in attenuated spine-points.

Carapace square in its front portion, but expanding with arched sides at the first coalesced peræon-segment; the second peræon-segment very similar in form to the coalesced first segment, though distinctly articulated; coxal spiny process very long and acute. Each of the remaining peræon-segments has a pair of acute anterior lateral spine-like points projected at right angles to the body; while the epimeral processes, which overhang the coxæ of the limbs, have a small spine on the front side. The epistoma bears an acute spine (II. L), and a median spine arms the under surface of the last two segments.

[1] It requires a $\frac{4}{10}$- or $\frac{1}{4}$-inch object-glass to show the structure of these and similarly curiously formed spines referred to in these descriptions.

The pleon has the epimera produced into small spines, which are more conspicuous on the two anterior segments. Sixth segment as long as three preceding, its termination truncate and emarginate.

The upper antennæ have the large basal joint three-sided, and partially serrulate on the upper edge.

The first legs have the basos short and distally thickened, with a small tooth on the hinder margin; hand (II. gn^1) not unlike that of *A. simplicirostris*, the basal portion broadly triangular, the thumb inclining outwards, with a tooth rising in the hollow to meet the overreaching finger, the nails of both thumb and finger long.

The second legs (II. gn^2) are long, the basos produced, meros with one infero-posteal and two infero-anteal spines; carpus with three spines on the hinder and four on the front margin; hand with four spines confined to the distal half of the hinder margin, and seven front spines, the first of which is minute, the rest subequal; finger with three minute teeth on its edge. All the spines of the limb are of slender character, and there is a total absence of the cilia, which in most allied species take part with the spines in the garnishing of the lower joints of this limb.

All the remaining limbs are remarkable as differing from those usual in the genus by their more delicate and simple structure, there being a marked absence of that elaborate and diverse ornamentation of spines, setæ, and cilia so characteristic in the genus. This will be evidenced in the following description of the last pair of legs.

The last legs (II. prp^5) are slender and delicate in structure; the basos narrow and long, and perfectly glabrous (without spines, setæ, or cilia), is as long as the three following joints combined; ischium very short; meros shorter than carpus, the former with one, the latter with two cilia at distal extremity of front; hand long, narrow, about six times as long as broad, and subequal in dimensions to the wrist, with a single slender spine midway on the front margin, and two long, slender, simple spines at the origin of the very long and very slender finger, which has a small cilium at one third its length on the outer, and a more distant toothlet on the inner margin.

The pleopods, with one exception, were abraded in our specimen, the one that remained was a very delicate slender organ.

Length 6 millim.

A single example was dredged in the 'Porcupine' Expedition of 1870, just west of the African side of the Straits of Gibraltar, in 128 fathoms (Station 37, lat. 35° 50′ N., long. 5° 26′ W.; bottom temperature 54° Fahr.).

6. Apseudes lunarifrons, n. sp. (Plate XVII. fig. II.)

? *Apseudes echinatus,* G. O. Sars, "Isopoda chelifera," Archiv for Math. og Naturvid. vii. 1882, p. 13.

A remarkable species on account of the great irregularity of the dorsal surface of carapace and peræon, and of the lateral margins of the segments of the latter.

The carapace is mapped out into no less than twelve distinct areas above, exclusive of the epimera of the first legs, which, as usual, are folded inwards, covering a portion of the under surface; second segment divided into three areas, the epimera being distinctly parted off from the central portion.

Frontal region (II. C) furnished with an acute rostrum of considerable length; at the base the rostrum widens greatly, spreading out on each side into a semilunar process, the horn and hollow side of which points forward, whilst the arc forms the external margin; on each side of this the boundary lines of the alar processes slope rapidly backwards, until ultimately the front margin of the carapace juts outwards and forwards into an acute lobe; behind this, again, another lobe throws out a lateral acute point (II. D. L), while in front the alar process projects considerably and terminates in an acute point; thus the carapace when viewed from above presents three spine-like processes on each side.

Second (first free) segment with the forward-directed coxal spine-like process acutely terminated. The remaining segments of the peræon have the epimeral processes, which are produced over the coxæ, furnished with a spine on the hinder angle, the three last segments have also a minute spine on the front angle of the epimera, the side of each segment is also armed in front of these epimeral processes with a large outwardly directed spine-like process. The epistoma (II. C. L) is furnished with a long spine, and each of the free segments of the peræon has on the ventral surface two spines on the median line, the anterior of which is very much smaller than the posterior; on the three front segments these spines curve backwards, and on the three last they curve forwards.

The spine-like lateral processes of the five first segments of the pleon are very large and at nearly right angles to the pleon, ornamented with long plumose hairs, the feathering in many cases, perhaps in all, ending in a sort of lapell or bunch of hairs. The last segment equals in length about four of those preceding, and has the peculiarity of a conspicuous lateral spine on each side, a little in front of the attachment of the uropods; fine slightly plumose hairs also spring from many parts of the surfaces, both dorsal and lateral. On the under surface each of the abdominal segments bears (instead of the usual central spine) a pair of tubercular processes, one on each side of the median line, and just within the bases of the pleopods.

The upper antennæ are wanting, except a fragment of the stout basal joint, on the inner side of which there is a short triangular spine.

The lower antennæ are slender, the articulations short, but of nearly the same relative lengths as in allied forms; the flagellum consists of 9–10 articulations.

The first gnathopods (II. gn^1) have the basos short and broad, its front margin produced about the middle into a curved spine-like tooth; meros flask-shaped, with the neck adjoining the basos; wrist narrow, greatly elongated, more than six times as long as broad, widest distally; hand with a very long thumb and finger, closely resembling the corresponding parts in the female of *Apseudes talpa.*

Second gnathopods having the basos strongly built, and of uniform width throughout; following joint short; the rest of the limb imperfect.

The condition of the last legs (II. prp^5) is also such that we are unable to describe the garnishing of cilia, setæ, and spines as accurately as has been done in the case of other species. The basos is long; carpus longer than either meros or hand, which are subequal to each other, these three joints flattened. Carpus having a vertically-plumose seta infero-anteally; hand ovately rounded distally, with three or four small cilia on the hinder border; front margin naked on the first third, then a long spine; beyond this this margin is pectinately spined, the pectination, as usual, extending round the extremity, there is also a long spine above the insertion of the finger; finger long, slender, and gently curved. The coxæ of this and of the two preceding pairs of feet are distinctly protruded as joints beyond the coxa-like looking epimera (the limbs thus looking as though they were eight-jointed), and are armed behind with a curved spine; the coxa of the third legs has also a curved sharp spine, but this is on the front side, and directed forwards, like the characteristic process of the second legs.

Length one third of an inch.

A single example from the 'Porcupine' Expedition in 1870, dredged in the Mediterranean off the coast of Algeria (Station 50, 51–510 fathoms).

7. APSEUDES SIMPLICIROSTRIS, n. sp. (Plate XVIII. fig. I.)

Male. Frontal region (I. D) produced into a long, gradually attenuated, rostral spine, inclining downwards; though long as compared with the carapace, the rostrum is scarcely more than one third the length of the very long basal joint of the upper antennæ; the frontal region has a minute projection on each side of the base of the rostrum.

Ocular processes wide and short, but produced apically into a point, which, however, is so bent down as not to be visible from above.

Carapace having the cephalic portion narrow, the sides without any of the projecting angular processes which are present in *A. lunarifrons* (which is perhaps its nearest ally), and gradually converging towards the frontal region; the soldered first thoracic segment, however, suddenly widens, the sides being boldly arched, and here is the greatest width of the body.

Peræon remarkable on account of the irregularity of outline of the sides; each of the last four segments has its anterior portion narrow, and is behind considerably expanded over the coxæ; the third and following segments have each a pair of laterally directed spine-like processes, those of the third and seventh segments being smaller than the others; the fourth segment has also one pair, and the fifth and sixth two pairs of tubercular sharp processes on the sides in front of the spines. Beneath, the epistoma carries an acute spine, as does each segment of the peræon, except the last, which, in the same position, carries a large and stout process (I. L), nearly as thick as the basos of a peræopod, and two or three times as long as the ventral spines—the male organ.

Pleon with the epimera prolonged into acute processes, which are directed at first outwards, and ultimately backwards; these as well as the spines of the peræon are perfectly glabrous, and free from ciliation; beneath, each of the first five segments bears an acute spine; the sixth segment is very long, almost equalling the rest of the pleon, smooth, extremely truncate, but a little exserted in the middle.

Antennæ unusually long; the upper with the joints of the peduncle bearing nearly the same proportion to each other as usual; the first very long, cylindrical, but slightly angular, glabrous; filament of twenty-four articulations. Scale of lower antennæ (I. *a.i*) very narrow and linear, its marginal setæ few and distant, only twelve in all.

Mandibles with a greatly developed palp (I. *m*).

The first gnathopods (I. L and I. gn^1) have the basos oblong, stout, and strong; the meros is triangular, embracing within the base of the triangle the apex of the triangular carpus, which about equals the basos in length, and only has three distant cilia on the front margin; hand with the thumb projected laterally, so that its margin is scarcely more advanced than the base of the finger; near the base of the thumb is a projecting semicircular process, which is centrally hollowed, containing, as it were, a small pocket; a long, narrow, acute, conical process near the base of the impinging margin; beyond this the margin is crenated; on one side this crenated margin is furnished with a close, regular series of short, stiff, spatulate hairs (I. $gn^1 1^*$), on the other with a series of minute, flattened, jagged-edged, upright, microscopic teeth, one such tooth occupying each crenation; the finger is well arched, close to its base are two rounded tubercles, and the rest of the inner margin is slightly crenately waved, each sinus thus formed carrying a short, stumpy, spine-like tooth.

Second gnathopods (I. L and I. gn^2) of weaker structure than usual, the pectinated spines of the more distal joints assuming almost the form of stout cilia, while the cilia on the other hand are so stout as almost to become spines; basos with a tooth near its origin; ischium very short; meros with a row of cilia passing obliquely along the side, and terminating distally above, three or four setæ also at the distal front corner; wrist longer than either meros or hand, its margins furnished with numerous greatly developed cilia (20 on hinder, 15 on front margin), the front margin also bears two slender spines, one near its centre, the other terminal, the distal side of these spines is pectinated; hand bearing cilia and spines of similar structure and size to those of the wrist, of the former there are eleven on the hinder and six on the front margin, together with four spines; finger with two minute cilia on the outer and three denticles on the inner margin.

Last peræopods not furnished with plumose setæ, or with a pectinated margin to the hand, the whole limb of very simple structure. Basos long and narrow, naked; ischium very short; meros four times as long, smooth, except that there are three or four minute cilia terminally; carpus equal to two preceding joints combined, with only four minute, slender, simple spines on the front margin, and three cilia at the end; hand (I. prp^5) shorter than wrist, smooth on the back, below with four slender slightly serrated spines, alternately with four others which are simple and very small, at the termination a cluster of about eight small spines round the base of the remarkably long and very gradually attenuating finger.

Length 15 millim., or three fifths of an inch.

The single specimen here described was taken in 1263 fathoms, about one hundred miles directly south of Rockall, 'Porcupine' Expedition 1869. Station 22, lat. 56° 8′ N., long. 13° 34′ W.

The type has some curious irregular developments in one or two parts. The third leg has a curious outgrowth, the upper portion of the basos being prolonged backwards into a large double tooth (Pl. XVIII. fig. I. prp^3), the corresponding portion of the opposite limb being entirely devoid of any such excrescence; and the lateral spines of the segment to which these limbs are attached are not symmetrically placed, the spine on the same side as the excrescence being in an abnormal position. The first legs also present another, though less conspicuous, want of uniformity, the wrist on one side having the distal margin nearly straight on both faces of the hand, while the other wrist has these margins somewhat deeply excavated.

8. Apseudes grossimanus, Norman. (Plate XIX.)

Apseudes grossimanus, Norman, MS. Proc. Royal Soc. no. 125 (1870), p. 157.

Frontal region armed with three porrected spines, the central or rostral spine long and very acute, nearly two thirds as long as basal joint of upper antennæ.

Ocular processes short, bluntly rounded distally, and thus differing from those of all the other species here described.

Carapace very short and broad, with a strong tooth-like process on each side in front of coalescence of the first peræon-segment.

The peræon has a pair of lateral spine-like processes to each segment, and the epimera of the second and two following legs also bear a spine at the hinder margin. Beneath there is a spine on the epistoma (I. L) and on each peræon-segment, but in the male the spine of the last segment is exchanged for a large male organ similar to that described under *A. simplicirostris.*

Pleon having the epimera produced outwardly into acute processes, which bend backwards at the end; beneath each has a central spine; last segment equal in length to four or five preceding, cylindrical, with two pairs of very small cilia on the back, and a little tubercle on the median line between the bases of the uropods.

The upper antennæ have the first joint long, not flattened out, rather wider at the base, lower parts of the inner margin slightly denticulate, towards its extremity two long cilia, and beyond these a tactile seta, outer margin with three or four minute tactile setæ, and about as many simple cilia: second joint with four long plumose (tactile?) setæ and two simple cilia; third with two simple cilia; flagellum with 17–21, secondary appendage with 9 articulations; olfactory filaments of great length, attached to alternate articulations of the flagellum.

The lower antennæ have the scale long and linear, reaching beyond the fourth joint, with only six marginal setæ (one on the inner, two on the outer margin, and three apical): last joint of peduncle bearing two simple cilia at its end and four tactile setæ, two of which are much larger than the others; flagellum of 9–13 articulations.

The first gnathopods in the male (I. L) have the basos broad, attached to the coxa by a narrow neck, terminating in a tooth at the lower front angle, and having a similar tooth somewhat higher up upon the same margin; meros triangular, very narrow at the base and rapidly widening, a very large tooth-process on the front margin, articulating with the wrist in a splice-like manner, the lower angle being produced and underlying the wrist, the latter joint is narrowed at the base and lies on the produced tongue of the meros, and bears four cilia and a tooth-process on the front margin; hand in general form as that of *A. simplicirostris*, but the portion before the thumb is larger, while the thumb itself is less laterally directed; the outer margin of thumb carries about seven cilia, and its inner margin has two processes, of which the basal is tubercular, the second large and wide, much elongated, and beyond these processes the edge bears a closely packed series of microscopic flat inclined teeth, by the side of which are about eight stiff cilia (not spatulate as in *A. simplicirostris*); the finger has a tubercle on the inner margin near the base, is then hollowed for the reception of the large tooth of the thumb, and beyond this is set with numerous short spine-like teeth. The same gnathopod in the female (I. gn^1 ♀) is like that of the male in its general character, but is much more slender, the hand much less strong, the thumb and finger meeting throughout their entire length, without the large tubercular processes, while the whole margin of the thumb is set with microscopic teeth and cilia similar to those which occupy only the distal portion of the thumb in the other sex.

The second gnathopods (I. gn^2) have the coxal spine narrow and acute, the basos unarmed, ischium very short, meros with a terminal cluster of cilia above, and below with a distal spine and numerous long cilia on the margin; carpus and propodos subequal and shorter than meros, the former with numerous long cilia on both margins and also two spines on the front margin; propodos with numerous long cilia on both margins (about 8 on the palm), and 5–6 spines on the palm and one distal spine on the back; dactylus bearing on its edge six spinules (I. gn^{2*}), which have little cilia near their tips. The spines of carpus and propodos, examined under a high power, are found to have a peculiar character, the carpal spines are spatulately hollowed at their terminations, while the spines of the palm are mucronately attenuated at their apices, the attenuated flexible distal portions being exquisitely pectinately ciliated (see enlarged figure).

Last legs (I. *prp*[5]) slender; basos long and narrow, with only 6–7 short and delicate plumose setæ on the hinder margin; ischium very short, naked; meros about three times as long, with only two or three small cilia at the termination in front; wrist equal in length to two preceding joints combined, with about ten long cilia on the front margin; propodos a little shorter than carpus, with four cilia on front margin, these cilia are suddenly attenuated at their apices, and a series of minute sharp spinules, which are bulbously enlarged at the base, fill up the spaces between the origins of the cilia. These spinules do not actually touch each other, they are pectinated on the sides as in other allied species; they do not extend round the termination of the joint, but at the termination of the hinder margin there is a group of minute pectinate spinules, together with two long and one short flagellated spines. Dactylus very long and slender, with two cilia on the back, and one minute denticle near the base on the inner side; its unguis very long.

Pleopoda (I. *plp*) largely developed, with long peduncles.

Length half an inch.

Dredged off the Portuguese coast, in 740 fathoms, 'Porcupine,' 1870, Station 17 *a*, lat. 39° 39′ N., long. 9° 39′ W.; also off the south-west coast of Ireland, in 90 fathoms, 'Porcupine,' 1869, Station 6, lat. 52° 25′ N., long. 11° 40′ W.

9. Apseudes gracilis, n. sp. (Plate XX.)

The carapace (I. D) has the frontal margin produced into a long slender acute rostrum, which is half as long as the basal joint of the upper antennæ, and has a bulbous process on each side at its origin; ocular processes or alæ having their outer sides prolonged into an acute spine-like termination projecting forwards and slightly outwards. On each side of the carapace, at the junction of the first coalesced segment of the peræon with the cephalon, there is another pair of spinous processes closely assimilating in form to those of the alæ just described.

The peræon (I. L) has the segments remarkably long, more produced than in any other known species, especially the last four; each segment bears a pair of lateral acute spinous processes, and in front of these a pair of small tubercles, while on the ventral surface there is a large acute curved spine near the hinder margin, and near the front margin a small tubercle bearing two or three minute cilia. The epistoma is tumid, arched, carinate, and armed with a small spine near the mouth.

The pleon (I. L) is of great length, the five front segments subequal, and each as long as the first free segment of the peræon; epimera only slightly produced, terminating in small spines, a central ventral spine on each segment; last segment (I. PL) as long as the preceding three, having a number of minute tubercles about it, termination slightly emarginate, with a small rounded projection occupying the centre of the emargination.

Upper antennæ (I. *a.s*) with the basal joint moderately stout, a tactile seta halfway up the outer margin; second and third joints subequal, their combined length scarcely more than half that of the first joint; filament consisting of about 17, secondary appendage of 4, articulations.

Lower antennæ (I. *a.i*) reaching to the end of the peduncle of the upper; the scale smaller than usual, only reaching to the middle of the fourth joint, and bearing only four setæ, two on the exterior margin and two apical, and none on the interior margin.

The first gnathopods (I. gn^1) are slender and weak, and without much character; wrist very long, two and a half times as long as meros, with many cilia on the front margin; hand with the basal portion slender, and scarcely wider than the wrist; thumb and finger long, without any tubercular processes on the inner margin, the distal portion of that of the thumb bearing a series of microscopic flattened teeth, and short, stiff, obtusely ending cilia; finger having about five short stumpy spine-like teeth just before the unguis commences.

Second gnathopods (I. gn^2) strongly built, basos naked; meros having the front margin ciliate, and bearing a distal spine, upper margin with a distal bunch of cilia; wrist unusually short, scarcely more than half the length of meros, above with many cilia and a large distal spine, below with four cilia and two or three spines; hand widely ovate, rather longer than the wrist, upper margin with two spines and a few cilia; palm closely set all round with ten stout spines, but no cilia; all the spines of the limb are stout, but quite simple in character; finger strong, with four denticulations on the margin.

Last peræopods (I. prp^5) slender, basos naked, the three succeeding joints having one or two minute cilia on the front margin, except that the carpus (which is slightly longer than the meros and hand, which are subequal to each other) has a long slender distal spine on the front; hand with a distal spine above, and two slender spines on the palm, and passing obliquely across the last half of the joint, commencing beyond the middle of the palm and terminating at the upper margin of the origin of the finger, is a pectinated series of lancet-shaped spines, of which the margins are apparently simple. Finger of most unusual length, half as long again as the hand, the unguis especially being very greatly produced.

Pleopods (I. *plp*) greatly developed, the peduncle long.

Uropods with one branch consisting of about 7, the other of 18, articulations.

The foregoing is a description of the females, one of which has incipient growths of the marsupial sac at the base of the 2nd, 3rd, 4th, and 5th peræopods.

The males, which are known by the cylindro-columnar sexual organ situated between the last peræopods, where it takes the place of the ventral spine of the other sex, differ in having the lateral spines of the peræon-segments, and both epimeral and ventral spines of the pleon, so much reduced in size as to become almost obsolete, while the ventral spines of the earlier segments of the body are as large as in the female, and the hand of the first legs is not more largely developed than in the other sex. All these points are contrary to what is usual, and not what might have been expected to characterize the male.

The figure (I. *gn*[1]*) represents a monstrous outgrowth of the thumb in one of the specimens, showing a tendency to three terminations of the thumb instead of one.

Length half an inch.

Specimens or fragments of *Apseudes gracilis* were procured in three of the dredgings of the 'Valorous' Expedition in 1875; the localities were:—

Station 9, lat. 59° 10′ N., long. 50° 26′ W., 1750 fath., Davis Strait.
Station 12, lat. 56° 11′ N., long. 37° 41′ W., 1450 fath., North Atlantic.
Station 16, lat. 55° 10′ N., long. 25° 58′ W., 1785 fath., North Atlantic.

It would thus appear to be confined to the greatest depths in the abyss of the Northern seas.

Genus 2. SPHYRAPUS[1], n. g.

Animal less elongated than in the other genera, widest at the hinder part of the carapace, thence gradually narrowed behind. First two segments of peræon coalesced with the cephalon into a carapace, furnished with a simple rostrum. Epimera of gnathopodal segments not produced forwards. Last segment of pleon often produced to an acute point.

No eyes. The alæ minute, triangular.

Upper antennæ with the basal joint of great size, long and broad, inner flagellum sometimes rudimentary. Lower antennæ without the scales generally characteristic of this family; slender.

First gnathopods bulky, with the hand (in the male) set on the wrist, like a hammer at right angles to its handle, and hence the generic name.

Typical species—*Sphyrapus malleolus*, n. sp.

The chief characters in this genus are the absence of the scale in the lower antennæ and the conjunction of the second peræon-segment with the carapace.

Diagnosis of the Species of Sphyrapus.

Last segment of pleon not produced.
  Epimera of pleon obtusely rounded . . . . *anomalus.*
  Epimera of pleon angularly pointed . . . . *serratus,* G. O. Sars[2].
Last segment of pleon produced to an elongated point behind.
  Second segment of pleon with greatly developed, outspread lateral processes . . . . *malleolus.*
  Second segment of pleon with lateral spines not exceeding in size those which are present also on the other segments . . . . *tudes.*

[1] σφῦρα a hammer, πούς a foot. [2] "Habitat in magno abysso areæ frigidæ maris Norvegiæ et glacialis."

1. Sphyrapus malleolus, n. sp. (Plate XXII. figs. ii., iii.)

Rostrum short and obtusely pointed. Ophthalmic processes (iii. D ♀) minute, shaped like a baker's cap, and more easily seen from below (ii. *aa*) than from above. The confluent segments are both wider than the head, and the second wider than the first; to the rear of these the animal tapers irregularly, the centre peræon-segment being narrower than its neighbour, as is also the case in *S. tudes*, and the pleon tapers more suddenly than the peræon as far as the base of the sixth segment, the sides of which diverge to the point of insertion of the uropods, and then suddenly converge to a central and somewhat upturned, much produced, apical process (iii. Pl.). Of the peræon-segments the last two are the shortest. The first five segments of the pleon are nearly equal in length to one another; only the second has lateral spine-like processes, but here they are large, produced, and very conspicuous.

The upper antennæ (ii. *aa*) have the basal joint large, in the male stout, shorter than the cephalic plate, in the female dilated at the base, longer than the cephalic plate, in both ciliated on the margins; the second joint is short, dilated distally; the third is about half the length and breadth of the second; the flagellum consists of one long succeeded by four short articulations; the secondary appendage is rudimentary, and represented by only one minute articulation.

The lower antennæ have the basal joint as broad as it is long, the three following joints short, the fifth long and slender, carrying on the outer side two pear-shaped vesicles; the flagellum is three-jointed, the second and third joints furnished with long cilia.

The first gnathopods (ii. gn^1) have the soldered coxal portion folded beneath; the basos broad and short, the ischium wanting; the meros narrow at the base, then dilated, and ending in a point; the carpus in the male is a little longer than the meros, which it overlaps; it is pointed distally, its sinuous margins are nearly parallel; upon it the huge hand is set hammer-wise. In shape the hand is roughly triangular; a line from the base of the finger to the stout horny thumb may be considered the base of the triangle; along this (palm) margin is set a row of flat little teeth, all but one or two of them lying closely side by side; one of the sides of the triangle runs from the thumb-nail backwards, receiving the wrist in a sinuosity about the middle, the remaining side is formed by the curved line running from the hinder extremity of the last-described side to the base of the finger; the finger, which is short and stumpy, with a nail like the thumb-nail, doubles closely down upon the palm. In the female (iii. gn^1) the wrist is considerably longer than in the male, and is of the same breadth at both ends, but has a narrow neck near its base; the hand in this sex is attached to the wrist by the apex of the triangle; the thumb is a long process projecting from the base of the triangle, and causing the finger to project in like manner, and the hand is thus of very different form from that of the male, being ovate; the inner margins of both thumb and finger are irregular; the thumb is truncate and has the horny nail set close to the outer margin; the nail of the finger closes down into the cavity within the thumb-nail and on the truncated end of the thumb.

The second gnathopods (II. gn^2) resemble those of *Sphyrapus tudes*, but the basos is narrower, being only slightly broader than the following joints; the meros has one distal spine on the front margin, the wrist a row of five spines, and the hand the same number; the finger is much curved, slender, and its margin smooth.

In the first peræopods (II. prp^1) the wrist is a little dilated, the hand flat, long, curved, with seven slight spines on the front margin, and much ciliated on both margins.

The second peræopods (II. prp^2) are shorter than any except the last; the third (II. prp^3) have the hand short, distally dilated, and then surrounded by a fence of biserrate spines of varying lengths. The fourth and fifth (II. prp^5) pairs are similar in form, but the fifth is smaller than the fourth; the wrist is longer than the hand, which is small, ciliated, and having two long spines near the base of the finger.

The uropods (III. D ♀) have the peduncle as long as the segment minus its produced apex, and a little dilated distally; the inner branch is long, with about 15 articulations, which vary irregularly in length; the outer branch is very slight, and composed of 3 articulations. Judging from the spirit-preserved specimens the uropods in this species would seem to be carried divergently, not following behind parallel to each other.

Sphyrapus malleolus may at once be distinguished from its allies, not only by the form of the gnathopods, but by the rudimentary condition of the inner flagellum of the upper antennæ, which is reduced to an unjointed minute tubercle, and by the spine-formed wings of the second segment of the pleon.

The species has been procured in the abyss of the North Atlantic in four dredgings:—

1. 'Porcupine,' 1869, Station 22, lat. 56° 8′ N., long. 13° 34′ W., 1263 fathoms.
2. 'Porcupine,' 1869, Station 24, lat. 56° 26′ N., long. 14° 28′ W., 109 fathoms.
3. 'Porcupine,' 1870, Station 17 *a*, lat. 39° 39′ N., long. 9° 39′ W., 740 fathoms.
4. 'Valorous,' 1875, Station 11, lat. 57° 11′ N., long. 37° 41′ W., 1450 fathoms.

The first two of these localities are to the south of Rockall, and may be considered to be within the bounds of British seas; the third is to the west of Portugal; the last lies directly south of the southernmost point, Cape Farewell, of Greenland.

2. SPHYRAPUS TUDES, n. sp. (Plate XXII. fig. I.)

The carapace (I. D) has a short triangular rostrum, from which it slopes gently backwards to the insertion of the small bulbous, apicate, ophthalmic processes. Behind these the lateral margins are slightly convex; the two peræon-segments, which are coalesced with the head, are successively wider; the coxal portion of the first has a large ventral fold. Behind the cephalic region the animal gradually tapers to the last pleon-segments, except that the central (fourth) peræon-segment, which carries the shortest pair of legs, is also a little narrower than that which follows it.

The first five segments of the pleon are short, produced on either side into long narrow processes pointing backwards and downwards (I. L), so as not to be seen from above; the sixth segment (I. *ur*) widens a little from the base, not far from which the caudal appendages are inserted; beyond their insertion it is narrowed, and a small globose portion ends in a produced apex; the whole length of the segment nearly equals that of all the five which precede it; beneath it has a nearly circular opening with two opercular valves opening sideways, as in the genus *Apseudes*.

The upper antennæ (I. *aa*) have the basal joint about two thirds the length of the cephalic plate, rather stout, carrying two rows of divergent cilia; the second joint is of less breadth and short; the third still narrower and very short. The flagellum has seven articulations, some of which carry fine, glass-like, two- or three-jointed olfactory appendages; the secondary filament has three articulations.

The lower antennæ have the basal joints something like the ophthalmic processes in size and shape; the three following joints are short, the fifth as long as the four which precede it taken together; the flagellum has four slender articulations, and slightly exceeds in length the last joint of the peduncle.

The first gnathopods (I. gn^1) have the basos bulky, with a small spine on the hinder margin, the ischium wanting, the meros small, the wrist large, irregularly oblong, but very narrow at its articulation with the meros. The great hand is set on at right angles to the wrist, like the head of a hatchet or hammer; it has a narrow oblong elongated thumb, so curved backwards at the base as if it were out of joint, and into the cavity thus formed a blunt tooth projects from the inner side of the finger; the thumb is distally truncate, with its horny unguis set nearest to the external margin. A similar unguis on the finger closes down within this.

The second gnathopods (I. gn^2) are very like the corresponding limbs in *Apseudes*; the basos is bulky and twice as long as broad, the ischium so short as to be almost linear; the meros much shorter than the wrist, carrying one distal spine on the front margin; wrist long and narrow, ciliated on the back, and having a row of spines (four) with intervening solitary setæ in front; these spines gradually increase in size distally: the hand is about two thirds the length of the wrist, and, like it, is ciliated on the back, where it also has two small distal spines; in front is a graduated row of about four spines; the finger is furnished with one or two small denticles on its inner margin. In the specimen described one of the gnathopods of this pair had five spines in the row on the wrist and three on the hand, while the other had four on each of the joints.

In the first peræopods (I. prp^1) the basos has a small spur near the base of the front margin and a large spur near the distal end of the dorsal margin; the ischium is very minute, the meros and carpus are equal in length, ciliated on both margins, with one or two stumpy spines on the front; the hand is large, flat, narrow, slightly curved, with long cilia on the back, and short graduated spines with intervening cilia on the palm; the slender finger is set well back, and has an adjoining spine close to it, and of almost equal length.

The second peræopods (I. *prp*^{2}) have the basos armed with two strong spurs on the upper margin.

The third peræopods (I. *prp*^{3} and I. *prp*^{3*}) are distinguished by a group of finely biserrate spines upon the hand surrounding the base of the finger.

The following pair (I. *prp*^{4}) have a spur on the back of the basos. Both this and the last pair (I. *prp*^{5}) have the wrist longer than the hand, and fully ciliated on both margins, the hands straight; the finger slender and shorter than the hand.

The uropods have their peduncles curving a little inwards and distally dilated; the longer branch consists of eight or nine articulations, which are alternately longer or shorter, but the first two much stouter than those which follow; the shorter outer branch is made up of three very narrow articulations, of which the last is the longest.

The length of the animal (antennæ and uropods not included) is three tenths of an inch.

In the female the gnathopods differ greatly from those of the male, the sex which we have described, and are very like in form to the gnathopods which we have figured of *Sphyrapus anomalus*; the form of the segments of the pleon will at once distinguish it from that species.

This species was dredged by the 'Porcupine' in 1869, in 420 fathoms, to the south of Rockall, Station 23 *a*, lat. 56° 13′ N., long. 14° 18′ W.

3. SPHYRAPUS ANOMALUS, G. O. Sars. (Plate XXI. fig. II.)

1869. *Apseudes anomalus,* G. O. Sars, Undersögelser over Christianiafjordens Dybvandsfauna, p. 45.

Sphyrapus anomalus, G. O. Sars, "Isopoda chelifera," Archiv for Mathem. og Naturvid. 1881, Bd. 7, p. 19.

Head and sides of peræon and pleon (II L) not spined. Last three segments of peræon much constricted anteriorly. First segment of body (head and first and second of peræon coalesced) smooth above, side margins evenly arched, produced in front into a large frontal lobe (II. C), terminating in a simple rostrum, the extremity of which is minutely nodulous; at the sides there is also the small ophthalmic process at the base of the upper antennæ. Pleon having the sides of the segments rounded, with a very minute point at hinder corner. Telson subtriangular (II. *urp*), extremity not produced, terminating obtusely, with a little dorsal tubercle bearing two small setæ. Upper antennæ (II. *aa*) having a secondary flagellum of three articulations. Lower antennæ having last joint of peduncle very long, the flagellum equal to it in length and composed of four articulations. First gnathopods (II. *gn*^{1}) with the hand as long as the two preceding joints, elongated-ovate; finger and thumb long, forcipiform. Second gnathopods (II. *gn*[2]) with wrist nearly twice as long as the hand, with two spines on distal portion of front, and one on dorsal margin; hand with five large and long spines on palm and two on the back; finger scarcely larger than the spines of hand, with three denticles on the edge. Uropods (II. *urp*) with the peduncle not extending beyond the telson; inner ramus long, with ten articulations, outer short, two-jointed.

Length 4 millim.

Sars thus describes the male:—

"*Mas adultus* a femina valde diversus. Corporis ejus forma multo magis elongata et angustior. Antennæ superiores longiores, flagello interno articulis 2 ultimis pedunculi junctis multo (fere duplo) longiore et 7-articulato, articulis omnibus ad apicem papillis olfactoriis numerosissimis et fasciculatis instructis. Partes masticationis quam in femina multo debiliores et fere omnino rudimentares. Pedum paria 2 anteriora forma ab iisdem feminæ valde diversa et insolito modo elongata. Primum par corporis longitudinem, abdomine excepto, æquans, articulo basali permagno et tumido, sequentibus 2 valde elongatis et angustissimis junctis manu plus duplo longioribus, digitis valde forcipatis et intus dentatis; secundum etiam par longitudine insueta insigne et primo pari nonnihil longius, articulo basali fortissimo, penultimo maxime elongato triplam antecedentis assequente longitudinem, margine postico spinis 7 validis armato. Pedes abdominales structura fere eadem ac in femina sed multo longiores, setis pluribus et longioribus obsiti.

"*Mas junior* feminæ corporis forma simillimus sed pedum 2 paribus anterioribus multo robustioribus et pedibus abdominalibus longioribus insignis.

"Habitat sat frequens in sinu Christianiensi ad Vallö in prof. 60–150 orgy. adque Holmestrand prof. 40–50 orgyar."

Sphyrapus anomalus was not procured in the expeditions to which this memoir has especial reference. The description and figure of the female are derived from type specimens, for which we are indebted to Prof. G. O. Sars.

Family II. TANAIDÆ.

Animal produced, narrow, nearly parallel-sided; pleon scarcely, if at all, narrower than the peræon; there is no spiny armature of either peræon or pleon.

Carapace truncate in front, or with only a very minute and quite simple rostrum. Ocular alæ and eyes present or absent.

Upper antennæ simple, without any second flagellum, placed close together in the middle of the head; the single flagellum sometimes altogether absent, generally rudimentary, rarely well developed in female, but multiarticulate in male. Lower antennæ arising below the upper, not furnished with any scale, more slender than the upper pair; flagellum usually rudimentary, more rarely well developed.

Mandibles of varied structure in the different genera, but always without a palp.

First maxillæ furnished with a backward-directed palp, terminating in two setæ. Second maxillæ only represented by minute, rudimentary, naked lobes.

Maxillipeds with a falciform palp within the branchial chamber.

First gnathopods usually well developed, with the upper visible joint large and very tumid, the hand strong and chelate. In the male the whole limb, and especially the hand, assumes prodigious proportions, its base so encroaching upon neighbouring organs that in the adult the whole of the mouth-organs become more or less absorbed.

Second gnathopods not differing greatly in character from the peræopods, the three last joints not flattened, suited for progression.

Gnathopods not palpigerous.

Pleopods generally composed of a basal joint and two short setiferous lobes; rarely altogether absent.

Uropods either simple or furnished with two filaments; in the latter case the outer filament is always short, never consisting of more than three articulations, usually of one or two.

Fritz Müller was the first to observe the remarkable change in the characters of the adult male of certain members of this family, especially of the genus *Leptochelia*, the genus to which the species called *Tanais dubius* by Fritz Müller belongs. He writes:—"In our *Tanais*, the young males up to the last change of skin preceding sexual maturity resemble the females, but then they undergo an important metamorphosis. Amongst other things, they lose the movable appendages of the mouth even to those which serve for the maintenance of the respiratory current; their intestine is always found empty, and they appear only to live for love. But what is most remarkable is, that they now appear under two different forms. Some acquire powerful, long-fingered, and very mobile chelæ, and, instead of the single olfactory filament of the female, have from 12 to 17 of these organs, which stand two or three together on each joint of the flagellum. The others retain the short thick form of the chelæ of the females; but, on the other hand, their antennæ are equipped with a far greater number of olfactory filaments, which stand in groups of from five to seven together. . . . I have examined thousands of them with the simple lens, and I have also examined many hundreds with the microscope, without finding any differences among the females, or any intermediate forms between the two kinds of males"[1].

We are not aware that Fritz Müller's observations which led him to believe in two forms of the males in *Tanais* (*Leptochelia*) have received confirmation from any subsequent writer except Dr. Dohrn, who has described two forms of the male in *Tanais dubius*[2]; but in this Prof. G. O. Sars has stated his opinion that the two males belong

[1] Fritz Müller, 'Facts and Arguments for Darwin' (Dallas), pp. 20–22.

[2] Dohrn, 'Untersuchungen über Bau und Entwickelung der Arthropoden.'

to different species, which, indeed, he assigns to distinct genera, holding that, while Dohrn's pl. xxvii. figs. 6–18 belong to the *Leptochelia dubia* of Kröyer, pl. xxvii. fig. 17 (forma altera maris) must be distinguished, and accordingly naming it *Heterotanais anomalus*.

The subject is one of great interest, and we trust, at no distant period, will receive full elucidation.

It has been long known, as observed by Agassiz, Clark, and Hagen, that two distinct forms of the adult male exist in the freshwater Crayfish of the United States belonging the genus *Cambarus*; and Dr. Hagen suggested that of these forms the less differentiated, which in many respects much more closely resembled the female, were sterile, while the more highly developed and specialized form was the fertile male. Within the last few months an entirely new light has been thrown on the connection of these two forms by Mr. Walter Faxon[1]. He has kept in confinement the highly-specialized males together with females, and succeeded in breeding them freely. It will be well now to quote his own words:—"After pairing, three of the males moulted, and were thrown, while in a soft-shelled state, into alcohol, together with their exuviæ. An examination of these specimens now reveals the fact that the soft-shelled specimens are all of the 'second form' (*i. e.* that which is less differentiated, and more like the female); their exuviæ of the 'first form' (*i. e.* the highly specialized male). After attaining the 'first form,' and after pairing, the same individual has reverted to the 'second form.' It is now clear that we are not dealing with a case of true dimorphism, such as is well known among insects and plants, but it appears probable that the two forms of the Crayfish are alternating periods in the life of the individual, the 'first form' being assumed during the pairing-season, the 'second form' during the intervals between the pairing-seasons. It is to be inferred that before the animal is again capable of reproduction another moult will bring it again into the 'first form.' The fact that large collections made at one time and place often contain only one, or a great preponderance of one, form is now explained."

Mr. Faxon has also observed this same phenomenon in the case of another species, the *Cambarus propinquus*, Girard. He remarks, in conclusion, that the "males of extraordinary size which I have seen are all of the 'first form.'" Do these very old individuals cease to moult? Do they become permanently capable of reproduction?

Among the Cumacea the males do not attain their most distinctive characters until ready for breeding. While young, and up to a period when, from their size, we might suppose them to be mature, not only in the deficiency of those organs which, directly or indirectly, might be presumed to be connected with the generative functions, do they present features which assimilate to the female, but even in the form and armature of

[1] Faxon, "On the so-called Dimorphism in the Genus *Cambarus*," American Journal of Science, vol. xxvii., January 1884.

the carapace. The genus *Iphinoe* has a carapace crested with serræ, the pleon is greatly elongated in the female, and the lower antennæ are quite rudimentary, consisting of a basal and an extremely minute second joint; the pleon is without any pleopods. The adult male has no spines on the crest of the carapace; the lower antennæ are of extraordinary length, consisting of a well-developed five-jointed peduncle and a very long filament, which extends the whole length of the body, and is tucked away between the bases of the five pairs of largely-developed and well-ciliated pairs of swimming pleopods, and unquestionably are used as organs of sensation. Now, ordinarily, as the male approaches maturity, not in one moult, but in two or more, as is commonly the case in males among Amphipoda as well as Isopoda, the antennæ become large and the pleopods more developed; and examples are commonly found with imperfect pleopods present but naked, and the carapace still retaining the serrated crest characteristic of the female. At the final moult, when the pleopods attain maturity and are densely ciliated, and all other features of the specialized male are developed, the carapace loses its serrated crest. We have examined a large number of the species most common on our coast, *Iphinoe trispinosa*, Goodsir, but have not as yet met with a *fully-developed* male retaining the serræ of the carapace. My friend Prof. G. O. Sars [1], however, has figured two forms of the male in an allied species, *Iphinoe serrata*, Norman, the one being the normal male with smooth carapace, the second (pl. xxviii. fig. 3) with a serrated crest, as in the female, constituting a "forma altera maris."

It is possible that this second form may correspond to the state of *Cambarus*, which, after the discharge of the sexual functions, moults, and retakes a form which approaches nearer to that of the female.

In the case of the Isopodan genera *Leptochelia* and *Anceus* in the moult which precedes sexual intercourse, grasping-organs of enormous size are developed, which require so large a space of the animal's body for their articulation, that the mouth is to such an extent encroached upon, that the mandibles and maxillæ are altogether aborted, and the Crustacean thus loses all power of taking food. It seems obvious, therefore, that it cannot long exist in this condition, and that one of two things must take place. Either, having discharged its sexual functions, it must soon afterwards die, or it must moult again, and at that moult cast off its exaggerated limbs, and retake such as are of moderate dimensions, together with the mouth-organs. Mr. Faxon's discovery seems to give strength to a view that the latter of these events may take place in the life-history of these very interesting male Crustaceans.

[1] G. O. Sars, "Nye Bidrag til Kundskaben om Middelhavets Invertebratfauna.—II. Middelhavets Cumaceer," Archiv for Mathematik og Naturvidenskab, 1878.

Synopsis of Genera of Tanaidæ.

A. Pleon not segmented, the first five segments coalesced. No pleopods. Uropods imperfectly biramose, external branch a conical process, inner 2-jointed, half as long as pleon. No eyes. Upper antennæ 4-jointed. Gnathopods with the basal portion of unusual form, composed of two distinct segments, oblong, tumid; hand small and weak . . . . *Anarthrura*, G. O. Sars.

B. Pleon segmented, but no pleopods.

(*a*) Uropods imperfectly biramous, external branch tuberculiform, inner 2-jointed, minute. No eyes. Upper antennæ 4-jointed. Gnathopods of usual form. Hinder peræopods with basal joint constricted in its upper portion . . . . *Strongylura*, G. O. Sars.

(*b*) Uropods consisting of a single branch, a basal joint constituting the peduncle, and a second conical joint representing the branch. No eyes. Upper antennæ 4-jointed. Gnathopods strong, of the usual form. Peræopods slender, with a long finger terminating in a long nail; the anterior pairs more spined than the posterior, the latter not having the basal joint constricted above . . . . *Tanaella*, n. g.

(*c*) See ***Pseudotanais*** and ***Leptognathia***, further on.

C. Pleon segmented; pleopods only three pairs, which are densely setose. Uropods short, simple, the single branch composed of 2–3 joints. Eyes. Upper antennæ 3-jointed, with rudimentary flagellum. Hinder peræopods with a curved, hamate, strong finger . . . . *Tanais*, Aud. & M.-Edw.

D. Pleon segmented; pleopods all developed, but rudimentary, and not setose in female. No eyes.

(*a*) Uropods very short, branched, inner 2- (♀), 3- (♂) jointed, outer 1- (♀), 3- (♂) jointed. Segments of peræon divided by deep instrictions. Gnathopods alike in the sexes, of usual form. Peræopods with a long finger. "Mandibulæ bene evolutæ, acie serrulata, lamella secundaria m. dextræ valde exstante, processu molari sublaminari, inermi" . . . . *Cryptocope*, G. O. Sars.

(*b*) Uropods moderately long, with unequal 2-jointed branches. Gnathopods not strong, of the usual form. Peræopods, hinder pairs with long finger. "Mandibulæ bene evolutæ, corpore sat elongato, processu molari cylindrico, apice truncato et denticulis acutis cincto" . . . . *Haplocope*, G. O. Sars.

E. Pleon segmented. Pleopods all developed and ciliated. No eye-lobes or eyes.

(*a*) Pleopods developed and ciliated, or altogether absent in female. No ocular lobes; eyes present or absent. Upper antennæ 3-jointed, nearly alike in sexes. Gnathopods alike in sexes; hand elongated, fingers narrow and acuminate. First peræopods with very long setiform finger. Hinder peræopods with penultimate joint expanded, and furnished with a knife-like spine, finger short. Uropods biramous, branches 2-jointed. Marsupial pouch formed of only two lobes . . . . *Pseudotanais*, G. O. Sars.

(*b*) Upper antennæ with three articulations in female; in male much larger, with a 4-jointed flagellum. Gnathopods nearly alike in both sexes, not very strong; hand narrow, fingers simple. First peræopods with a setiform finger; the hinder pairs short, with their basal joints very tumid. Uropods branched, each branch 1–2-jointed. Marsupial pouch of usual character, composed of eight laminæ . . *Typhlotanais*, G. O. Sars.

(*c*) Upper antennæ in female 4-jointed, in male much larger; flagellum 4-jointed, with large fascicles of sensitive cilia. Gnathopods in female moderately strong, hand dilated, fingers strong, the thumb serrulated; in male more slender, with simple fingers. Peræopods little differing from each other, more or less spinous. Pleopods sometimes not developed in female. Uropods 2-branched, inner 2- (♀), 3- (♂) jointed; outer 1–2-jointed, or sometimes a mere tubercle . . . . *Leptognathia*, G. O. Sars.

F. Pleon segmented. Pleopods all developed and ciliated. Ocular lobes and eyes present.

(*a*) Upper antennæ in both sexes with a well-developed flagellum of about four joints, the flagellum in male with fascicles of sensitive cilia. Gnathopods of usual form in female; finger and thumb strong, the latter with tuberculated palm; in male largely developed, oblong, finger and thumb curved, forcipiform, both strongly toothed within. Peræopods much spined, the spines very variable in structure. Uropods 2-branched, inner multiarticulate (8–9-jointed); outer 2-jointed. No eyes . . . . *Alaotanais*, n g.

(*b*) Upper antennæ 3-jointed in female, 6-jointed in male, and furnished with bundles of sensitive cilia. Gnathopods not very dissimilar in the sexes; hand oblong, fingers short. Peræopods of first pair slightly differing from the rest, with a long setiform finger; hinder pairs with first joint rather swollen. Uropods with two subequal 2-jointed branches . . . . *Paratanais*, Dana.

(*c*) Upper antennæ with three joints and rudimentary flagellum in female; narrow and elongated, with a more or less developed flagellum in male. Gnathopods in female of the usual structure; but in the male imperfectly chelate, without any finger, or the finger very short and immovable.

Uropods biramous, inner branch 4–5-jointed, outer minute, but distinctly 2-jointed . . . . *Heterotanais*, G. O. Sars.

(*d*) Upper antennæ conical, 3-jointed, and with a rudimentary flagellum in female, much more elongated and with a multiarticulate flagellum furnished with fascicles of sensitive cilia in male. Gnathopods in female strong, of the usual form; in male greatly elongated; hand very large, oblong, with elongated, curved, forcipiform fingers, the immovable one tuberculated on inner margin. Uropods 2-branched, inner branch multiarticulate, outer very small and rudimentary, consisting of only a single joint . . . *Leptochelia*, Dana.

For full accounts of the foregoing genera, and especially for descriptions of the mandibles, which afford valuable diagnostic characters, reference should be made to Sars's Monograph.

The following is a list of all the species of this family which have, up to the present time, been discovered in the North Atlantic, under which title we include that portion of the ocean and its seas which lies north of lat. 35° N.:—

List of Tanaidæ *of the North Atlantic.*

Genus 1. Tanais, M.-Edwards, = *Crossurus*, H. Rathke.

1. *Tanais vittatus* (Rathke), = *Tanais tomentosus*, Kröyer.
   Hab. Britain; Denmark; Norway; N.E. America.
2. *T. cavolinii*, M.-Edw.
   Hab. Mediterranean and Adriatic.
3. *T. dulongii* (Audouin).
   Hab. Britain; Mediterranean.

Genus 2. Leptochelia, Dana.

1. *Leptochelia savignii* (Kröyer), = *Tanais edwardsii*, Kröyer, ♀, = *Leptocheliaalgicola*, Harger.
   Hab. Britain; Mediterranean; Madeira.
2. *L. neapolitana*, G. O. Sars.
   Hab. Naples.
3. *L. rapax*, Harger.
   Hab. N.E. America.
4. *L.? filum* (Stimpson).
   Hab. N.E. America.
5. *L. dubia* (Kröyer), = *Leptochelia algicola*, Harger.
   Hab. Mediterranean; N.E. America; Brazil.

Genus 3. Alaotanais, Norman & Stebbing.

1. *Alaotanais serratispinosus*, Norman & Stebbing.
   Hab. North Atlantic; abyssal.

2. *A. hastiger*, Norman & Stebbing.
   Hab. North Atlantic; abyssal.
3. *A. lævispinosus*, Norman & Stebbing.
   Hab. North Atlantic; abyssal.

Genus 4. Heterotanais, G. O. Sars.

1. *Heterotanais örstedi* (Kröyer), = *Tanais curculio*, Kröyer, ♂, = *Tanais balticus*, Fr. Müller, ♀, = *Tanais rhynchites*, Fr. Müller, ♂.
   Hab. Norway; Sweden; Denmark; Baltic Sea.
2. *H. limicola* (Harger).
   Hab. N.E. America.
3. *H. anomalus*, G. O. Sars, = *Tanais dubius* (forma altera maris), Dohrn.
   Hab. Mediterranean.

Genus 5. Paratanais, Dana.

1. *Paratanais batei*, G. O. Sars, = *Paratanais forcipatus*, Bate & Westwood (not *Tanais forcipatus*, Lilljeborg).
   Hab. Britain; Norway; Mediterranean.

Genus 6. Typhlotanais, G. O. Sars.

1. *Typhlotanais finmarchicus*, G. O. Sars.
   Hab. Finmark.
2. *T. assimilis*, G. O. Sars.
   Hab. Norway.
3. *T. tenuicornis*, G. O. Sars.
   Hab. Norway.
4. *T. microcheles*, G. O. Sars.
   Hab. Norway.
5. *T. cornutus* (G. O. Sars).
   Hab. Finmark.
6. *T. messinensis*, G. O. Sars.
   Hab. Mediterranean.
7. *T. brevicornis* (Lilljeborg).
   Hab. Norway; Denmark.
8. *T. æquiremis* (Lilljeborg), = *Tanais depressus*, G. O. Sars.
   Hab. Sweden; Norway.
9. *T. tenuimanus* (Lilljeborg).
   Hab. Norway.
10. *T. penicillatus*, G. O. Sars.
   Hab. Norway.

Genus 7. Leptognathia, G. O. Sars.

1. *Leptognathia longiremis* (Lilljeborg), = *Tanais islandicus*, G. O. Sars.
   Hab. Sweden; Norway; Iceland.

2. *L. breviremis* (Lilljeborg).
Hab. Sweden; Norway.
3. *L. brevimana* (Lilljeborg).
Hab. Sweden; Norway; Mediterranean.
4. *L. laticaudata,* G. O. Sars.
Hab. Norway; Mediterranean.
5. *L. gracilis* (Kröyer).
Hab. Spitzbergen.
6. *L. graciloides* (Lilljeborg).
Hab. Sweden.
7. *L. rigida* (Bate & Westw.).
Hab. Britain.
8. *L. cæca* (Harger).
Hab. N.E. America.
9. *L. filiformis* (Lilljeborg).
Hab. Sweden; Denmark; Norway.
10. *L.*? *manca,* G. O. Sars.
Hab. Norway.

Genus 8. Pseudotanais, G. O. Sars.

1. *Pseudotanais forcipatus* (Lilljeborg).
Hab. Sweden; Denmark; Norway.
2. *P. macrocheles,* G. O. Sars.
Hab. Norway; Finmark.
3. *P. lilljeborgii,* G. O. Sars.
Hab. Finmark.
4. *P. mediterraneus,* G. O. Sars.
Hab. Mediterranean.

Genus 9. Cryptocope, G. O. Sars.

1. *Cryptocope abbreviata* (G. O. Sars).
Hab. Norway.
2. *C. vöringii* (G. O. Sars).
Hab. North Atlantic, to the west of Norway; abyssal.

Genus 10. Haplocope, G. O. Sars.

1. *Haplocope angusta,* G. O. Sars.
Hab. Norway.

Genus 11. Strongylura, G. O. Sars.

1. *Strongylura cylindrata,* G. O. Sars.
Hab. Norway.
2. *S. arctophylax,* Norman & Stebbing.
Hab. Between Ireland and Rockall; abyssal.

Genus 12. TANAELLA, Norman & Stebbing.

1. *Tanaella unguicillata,* Norman & Stebbing.
Hab. North Atlantic; abyssal.

Genus 13. ANARTHURA, G. O. Sars.

1. *Anarthura simplex,* G. O. Sars.
Hab. Norway.

Very few members of this family have as yet been noticed beyond the seas included in the North Atlantic; and when we see what Prof. G. O. Sars has done in Norway, we cannot doubt that a large number of forms remain to be discovered in British seas; indeed our own collections contain much material which awaits examination.

Genus 1. ALAOTANAIS [1], n. g.

Animal elongated; carapace narrowed in front, without distinct ocular lobes. Pleon not wider than peræon, consisting of six segments, the first five subequal; the last usually more or less shield-shaped. No eyes.

Upper antennæ in female with three-jointed peduncle and flagellum of several joints; in the male flagellum furnished with tufts of sensitive cilia.

Mandibles strong, apices strongly toothed, molar process large and strong.

Maxillipeds present in the male.

Gnathopods in female of the usual form, but strongly built, the hand more or less twisted, the thumb toothed on the inner margin; in male greatly developed, in form as in *Leptochelia*; hand very large, oblong, finger and thumb meeting only at the nails, the inner margins of both bearing strong, blunt teeth.

Peræopods spinous, the spines complex, and varying greatly in structure in the different species, thus affording excellent diagnostic characters.

All segments of the pleon developed, and furnished with ciliated pleopods.

Uropods two-branched, inner branch long and multiarticulate (8–9-jointed in the species known); outer branch 2-jointed.

Marsupial pouch composed of eight lamellæ, which are attached to the first four free segments of the body.

The species which belong to this genus are among the largest known forms, and live in the abyss of the ocean in from 370 to 1750 fathoms.

1. ALAOTANAIS SERRATISPINOSUS, n. sp. (Plate XXIII. fig. I., Plate XXIV. fig. I.)

Head with a small rostrum, and forming with the coalesced first peræon-segment a rather elongated carapace, widest in the middle, with the coxal regions of the first

[1] ἀλαός, blind, and Tanais.

gnathopods clearly defined, and the ocular processes in the form of minute isosceles triangles, projecting at the sides of the head between the upper and lower antennæ.

The first of the six following peræon-segments is much the shortest, and subcarinate anteriorly on the ventral surface; the rest are subequal.

The pleon has the first five segments subequal, and all of them shorter than the first free peræon-segment; the last (sixth) segment is longer than two of its predecessors, contracted behind the place of insertion of the uropods, and ending with two slight emarginations, separated from each other by a minute central apex.

The upper antennæ (XXIII. I. *aa*) lie close together, and, seen from above, completely conceal the lower, which are both shorter and more slender. The upper consists of seven articulations, the basal stout and long and slightly bulbous at its origin, the second rather more than one third the length of the first, the third still shorter and much thinner, and the first of the flagellum is longer than the three terminal joints combined. The lower antennæ are slightly longer than the first joint of the upper, and consist of nine articulations, all very slender except the short basal one; the third is the shortest of those belonging to the peduncle.

The first gnathopods (XXIII. I. gn^1) have the first joint massive, and having the appearance, when viewed from below, of the human forearm near the elbow when folded so as to make the muscles stand well out; the next joint is indistinctly articulated, small, and concealed in some positions of the limb; the third is also small, scarcely visible except on the inner side of the limb; the wrist is large and subovate; the hand is also large and strong, with a powerful finger curving over the indented margin of the large thumb, and the horn-coloured nails of the finger and thumb overlap; the margin of the elongate thumb for some distance from the base is minutely beaded, the remainder of the thumb-edge slopes down to the upturned nail in five irregular blunt teeth, while two or three hairs spring from the side of the thumb; the inner margin of the finger is a little wavy where it passes over the beaded portion of the thumb-margin.

The six following pairs of walking-legs are all slight in structure, the coxal portion and ischium exceedingly small, the basos the longest portion of the limb, the wrist elegantly set with divergent rows of spines. The first three are differentiated from the last three, not merely by the usual tendency to point backwards, while the others tend to point forwards, but by remarkable microscopic differences of the hands and fingers. In the first three (I. gn^2) the hand has a small straight dagger-like spine for its finger, ending in a more or less curved, very slender nail, and is almost hidden in a crowd of other spines, some almost as long as, and some shorter than, the finger, but all more or less finely serrated; the shortest of these spines is hooked at the end, and while smooth on one margin, has on the other six very pronounced teeth at right angles to its length; adjoining this is another and longer spine, conspicuously serrated on both edges; in the rest of the spines and in the finger itself the serration is of extreme tenuity. In the last three pairs of legs (I. *prp*^{4}, I. *prp*^{4*}) the finger in like manner issues from a crowd of finely serrated spines, but it greatly exceeds them all in length, and is itself ornamented with a set of spines round its distal end, which shade off into lines of finer and finer spinelets running backwards towards its base; from the midst of the distal circlet of spines springs a long wavy spine-nail.

The first four free peræon-segments carry the small plates which are destined to be developed into the incubatory pouch.

The first five segments of the pleon bear each a pair of pleopods, consisting of a peduncle and two much ciliated branches, of which the inner has one pair of setæ springing from a prominent angle not far from the base of the plate (I. *plp* and I. *plp**).

The uropods (I. T) spring from the widest portion of the last caudal segment, the peduncle not reaching beyond the termination of the segment; the inner ramus consists of nine articulations, and is about as long as the antennæ; the outer ramus is minute, and composed of two articulations, which are together not so long as the first of the inner filament. This latter has the alternate joints slightly ciliated.

Length of a large specimen 8·5 millim., or about one third of an inch.

This species was procured in the 'Porcupine' Expedition of 1869, Station 19, lat. 54° 53′ N., long. 10° 56′ W., 1360 fathoms, and Station 30, lat. 56° 24′ N., long. 11° 49′ W., 1380 fathoms; and, subsequently, by the 'Valorous,' Station 15, in lat. 56° 11′ N., long. 37° 41′ W., at a depth of 1450 fathoms, on a bottom of globigerine mud and pebbles.

2. Alaotanais hastiger, n. sp. (Plate XXIII. fig. II.)

This species comes very near to the last. It differs from it in having the eye-processes relatively larger, and in the massiveness of the hand and finger of the first gnathopods (II. *gn*^{1}); in these organs all the parts are thickened and strengthened, without any proportionate increase in length. The effect of this is to make the inner edge of the thumb and finger overlap when closed all along the line, except for a small triangular space near the root of the thumb.

The uropods have the inner branch nine-, the outer two-jointed.

But the characters which at once distinguish this species from all others known to us are to be found in the microscopic armature of the limbs. All the peræopods are everywhere beset with long, very slender spines, the whole of which, under high powers, are found to be covered with minute prickles. There are no toothed spines, such as are found in *Alaotanais serratispinosus* (Pl. XXIII. fig. 1, *gn*^{2}), the corresponding limb to which in *A. hastiger* has the finger long, narrow, and curved, and surrounded by a series of long, very slender spines, which all have the character of being beset irregularly all round with little prickles.

The hinder peræopods (II. *prp*^{5}) have a finger which, so far as we are aware, is absolutely unique in structure: the propodos is cleft at the end to some depth, the cleft portions are rounded at the extremities and crenated or serrulated; the finger articulates at the base of the cleft, and is exactly spear-shaped, with serrated edges. A comparison of II. prp^5 with the figures of the hinder peræopods of *Alaotanais serratispinosus* (I. prp^4 and I. prp^{4*}) will at once give characters sufficient to distinguish these species.

The carapace, seen from above, is much narrower in front than behind, and has a short rostrum; the sides are very flexuous, and present two constrictions (II. C).

The telson is shield-shaped; the upper corners of the shield (that is, the sides of the base of the telson) are very protuberant (II. Pl.

Length 5 millim.

A single specimen, a female, taken in the 'Valorous' Expedition, Station 9, lat. 59° 10′ N., long. 50° 25′ W., 1750 fathoms.

3. ALAOTANAIS LÆVISPINOSUS, n. sp. (Plate XXIV. fig. II.)

Male. The carapace is similar to that of *Alaotanais serratispinosus*; the peræon-segments bear the same proportion to each other, but they are not to the same extent parallel-sided (II. D); viewed dorsally, a broad and deep constriction marks the separation of each from its successor, each segment being tumid laterally. The five first segments of the pleon are closely adpressed dorsally, with a very slight diminution in width from the first to the last. The sixth segment is a little narrower than its predecessors, and equal to two of them united in length. The uropoda are inserted about midway of the length; the remainder of the segment lying beyond them is much narrowed, with a rounded termination.

The upper antennæ (II. *aa*) have the first joint long and stout, with the usual row of hairs on the outer side near the distal end; the second joint is much shorter, but of nearly equal thickness; the third very short; the flagellum demands attention. The first joint, which is nearly as long as the last of the peduncle, has a remarkable protuberance on the underside, bearing a dense tuft of sensitive (olfactory ?) cilia, which are longer than the first joint of the peduncle; the second joint is minute, and from its distal termination spring two long olfactory organs. They are nearly four times as long as the final articulation of the antenna, and are composed of many (apparently six) cylindrical, smooth joints. The last joint still smaller, with one or two cilia. The lower antennæ are not unlike in character to those of *L. serratispinosus*.

In a side view the cephalothorax is almost entirely hidden by the greatly developed gnathopods (II. L), the general character of which is similar to those of *Leptochelia edwardsii*. The basos is a substantial joint as broad as it is long, the next insignificant, the following forms as it were a clasping-socket for the wrist, which is more than twice as long as the basos, though not so broad; in shape it is almost flask-like, the bent neck fitting into the meros. A narrow neck at the base of the hand (II. gn^1) unites this portion of the limb to the wrist; the hand, with its greatly projected thumb, is considerably longer than the extended wrist upon which it doubles back, the sinuosities of the meeting margins of the two to some extent corresponding. The wrist is ciliated on the upper margin, the hand finely serrated along the greater part of the curved margin which precedes the articulation of the finger; both thumb and finger have horn-coloured overlapping nails, but when the finger is closed there is still a large gap left between the greater extent of the inner margins; from that of the thumb there arises a small tooth, and then, nearer to the nail, a larger one with two cilia springing from its side; the finger is furnished with a small tooth nearly opposite to this one, and another nearer to its own base, so that the two teeth on the thumb are opposed to the cavity between the two teeth of the finger.

The second gnathopods and first and second peræopods are, as usual in this group, as nearly as possible alike to each other; it may be noticed, however, that in the second gnathopod (II. gn^2) the basos is rather more curved, the bulky basos of the preceding gnathopod almost necessitating this differentiation. In the present species the basos is long and slender, the ischium minute, the meros much like the basos, but only half the length or less; the carpus still shorter, with two rows of spines in front diverging towards the distal end; the hand narrow, equal in length to the wrist, and similarly ornamented; the finger sharp, a little curved, not so long as the hand; two or three quite simple spines spring from the end of the hand, and are as long as the finger. In the three posterior peræopods (II. prp^5) the meros is shorter, wider at the middle than at the base, and slightly decurrent, the slender curved finger with its fine sharp nail is even longer than the hand, and the spines at the end of the hand are short and flattened and simple, not one third as long as the fingers; none of the spines of the peræopods in this species are either serrulate, dentate, or covered with prickles.

The pleopods (II. *plp*) have very long and densely plumose setæ.

The uropods (II. *urp*), on a moderately stout peduncle, carry a long multiarticulate inner ramus and a short two-jointed outer one. Of the two minute joints of which the shorter ramus consists the second is twice as large as the first, but the total length scarcely exceeds that of the first articulation of the longer ramus; the latter is imperfect, but six articulations remain.

All along the back of the animal, from head to telson, minute upright hairs are visible.

Length 5·5 millim.

A single specimen, an adult male, was taken in the 'Porcupine' Expedition, 1869, Station 1, lat. 51° 51′ N., long. 11° 50′ W., in 370 fathoms—that is, off Valentia, in the south-west of Ireland.

Genus 2, Strongylura, G. O. Sars.

Animal elongated, subcylindrical, slightly narrower in the middle; integument very hard. Cephalic segment moderately large, attenuated in front, without distinct ocular lobes. Pleon larger than usual, perfectly cylindrical, smooth, composed of six evenly arched segments, the last cupuliform. No eyes.

Upper antennæ in female 4-jointed. Lower antennæ much more slender, distinctly 6-jointed, and having a rudimentary flagellum ("flagello rudimentario excepto, distincte 6-articulatæ").

Mandibles well developed, with the edge curved inwards and sparingly denticulated: molar process moderately large, laminar, finely crenulated apically.

Gnathopods strong, formed as usual.

Ambulatory feet slender and long, the fingers narrow; hinder pairs slightly different, more spined, and with the basal joint much constricted in its upper part.

Pleopods entirely absent in the female.

Uropods very short, biramous; external branch very minute, tuberculiform.

The above characters constitute the definition of the genus as given by its author.

Strongylura arctophylax, n. sp. (Plate XXIV. fig. iii.)

This is a neat compact little species with shining hard integument. The carapace is comparatively short (iii. d), the anterior margin forms an obtuse angle. The first free peræon-segment is as wide as the carapace at its widest part; the succeeding five segments gradually diminish in width backwards, the last being of the same width as the first five pleon-segments. These are short, close-set, and with their edges folded under the animal, so as to be visible ventrally (iii. pl.), where there is no sign of any pleopods. The sixth segment of the pleon is as long as three of those that precede it, and as broad or even a little broader in the anterior portion; but the latter half narrows rapidly to the rounded termination. The uropods are set on well underneath on each side of the almost circular anal opening.

The upper antennæ (iii. *a.s*) have the large first joint of no very great length, considerably wider at the base than distally; the second joint is not half the length of the first, and increases in width distally; the third is half the length of the second and narrower; the flagellum appears to be a single conical piece, equalling in length the two preceding joints ot tne peduncle, and ending in two long setæ.

The lower antennæ (iii. *a.i*) are, as usual, much more slender than the upper, but their length is not greatly inferior; the last joint of the peduncle is longer than its two predecessors combined (the latter being short); it is thin and much curved; from it springs the uniarticulate flagellum, terminating in one long and two short setæ; in other respects resembling that of the upper antennæ, but being of much smaller size.

The first gnathopods (III. gn^1) are compact, with a certain uniform squareness about all the joints; the basos, meros, and carpus are subequal in length; the two latter lie closely side by side; the hand carries a thick short finger clasping closely down upon a thick short thumb; both end in stumpy horn-coloured nails.

The following six pairs of legs are very slender and small, divided, as in other Tanaidæ, into two sets of three. In the first set (III. gn^2) the basos is rather longer, in the second (III. prp^4) it is distally rather thicker. In all of them the ischium is very small, the meros and carpus about equal in length; the propodos thinner and longer than either, with finely pointed curved fingers. At the distal end of the hand there is a curious short serrate spine above the convex upperside of the finger.

The uropoda (III. Pl. and III. Pl.*) are very short, and consist of a short thick peduncle with a two-jointed inner ramus diminishing in thickness distally but not to a fine point; the first joint is about the same length as the peduncle, the second shorter, terminating in four long divergent hairs; the outer ramus is uniarticulate, rather longer than the first joint of the inner ramus and terminating in one or two hairs.

Length 4 millim.

A single specimen was dredged in the 'Porcupine' expedition of 1869, midway between Ireland and Rockall, in 1380 fathoms. (Station 30, lat. 56° 24′ N., long. 11° 49′ W.)

The foregoing description was written years ago, long before the publication of Prof. G. O. Sars's monograph. The genus which we had described for it is undoubtedly the same as *Strongylura*, to which therefore we assign it, and it is not improbable that our *S. arctophylax* may ultimately prove to be the same as the typical *S. cylindrata*; but apparently that species is of more elongate and drawn-out form: "Corpus gracile, plus 8-ies longius quam latius. . . . Corpus posticum tertiam corporis longitudinis partem nonnihil superans, segmento terminali antecedentibus 4 junctis longitudine æquali." We therefore deem it better to retain the name we had proposed, as further comparison may show other distinctive features; moreover, there are apparently differences in the antennæ, and the outer branch of the uropods, though consisting of only a single joint, could scarcely, we think, have been designated by Prof. Sars as tuberculiform. *Strongylura cylindrata* was taken on the coast of West Norway.

Genus 3. Tanaella, n. g.

Animal elongated, subcylindrical, nearly parallel-sided; integument very hard, polished and shining. Carapace moderately large, constricted slightly in the middle, widening again forwards, slightly rostrate; no distinct ocular lobes. Pleon subequal to last three segments of peræon, perfectly cylindrical, smooth, composed of six evenly arched segments; the telson equal to at least four in length, cupuliform.

Eyes none.

Upper antennæ in female strongly built, four-jointed; lower pair more slender, seven-jointed, the last rudimentary.

Gnathopods strong, of the usual form.

Peræopods slender, with a long finger, terminating in a long nail; the anterior pairs more spined than the posterior, the latter not having the basos markedly constricted in its upper half.

No pleopods.

Uropods conical, having only a single branch without any vestige of an outer one, composed of two joints. The first represents the peduncle, the second the branch; the latter is nearly twice as long as the former.

The only other genus of this family which has the uropods consisting of a single branch is *Tanais*, from which this is at once distinguished by the absence of pleopods and other characters.

To *Strongylura* it has perhaps the closest affinity, and we have followed the wording of the description of that genus, as given by Sars and quoted in this paper, in order to bring out the points of difference. In *Strongylura* the uropods are two-branched; in *Tanaella* they are one-branched.

TANAELLA UNGUICILLATA, n. sp. (Plate XXIV. fig. IV.)

The rostrum (IV. D) is short and not acute; the eye-processes are difficult to observe in the single specimen obtained; they seem to be set back in a kind of socket. The carapace is longer than wide, the hinder portion bulging laterally, so that the diameter is there greater than in the succeeding segments of the parallel-sided peræon. Of the free peræon-segments the sixth is scarcely longer than the first, the second is longer than either, and the third, fourth, and fifth longer than the second. The first five pleon-segments increase very slightly in width distally. The last segment is also, in its anterior portion, rather wider than the fifth, and in length fully equals that of the four preceding taken together; from the attachment of the uropods it narrows rapidly to an almost pointed termination.

The upper antennæ (IV. L*) are short and thick, the first joint shorter than usual, stout and curved; the second is shorter, and thick in proportion to its length, and is furnished at its end with a stiff spine, which lies parallel with and close to the short third joint, which it just equals in length; flagellum uniarticulate, short and conical, ending in a tuft of setæ.

The lower antennæ (IV. L*) are thin, but not much shorter than the upper; the first joint not distinguishable in the specimen examined, the second and third short, the fourth longer, the fifth rather longer than the fourth, with two long hairs near the end; the flagellum consists of one rather long and thin articulation, followed by a minute tufted one.

The first gnathopods (IV. L*) have the basos with the rounded lobe, so usual in this group, greatly developed; the meros lies almost entirely on the inner side of the wrist; the wrist is large and bulky; the hand united to the wrist by a thick neck, the rest of the joint being broad and stout, with a short broad thumb, the inner margin of which is minutely toothed, and at about one third of its length slopes down rather suddenly to the little upturned nail; there are two or three small teeth on the inner margin of the finger, notably one near its root.

The following six legs are slightly built, with long slender nails. In the first three pairs the finger (IV. *prp*[1]) exceeds the hand in length, and is minutely fringed or pectinate, and rises from the midst of spines similarly ornamented. In the last three pairs the finger (IV. *prp*[3]) is not quite so long as the hand, and opposite to its concave curvature there is, at the distal end of the hand, a short serrated slightly curved spine. The short meros and the longer carpus have each a long incurved spine at the distal end.

The uropods (IV. PL) consist of a short rather stout peduncle and a single conical uniarticulate ramus, which is more than twice as long as the peduncle, and bears two long setæ at the blunted apex.

There is no trace of pleopods on the first five segments of the pleon; these segments bulge out ventrally.

Length 3 millim.

The type and only specimen was dredged in 1869 by the 'Porcupine' in 96 fathoms, on the slope of the English Channel. (Station 35, lat. 49° 7′ N., long. 10° 57′ W.)

Tribe II. *FLABELLIFERA*, G. O. Sars.

Family ANTHURIDÆ.

Animal greatly elongated, narrow, nearly cylindrical or depressed; head much shorter than following segment. Mouth-organs adapted for suction; first gnathopods the larger, subchelate; second gnathopods and first peræopods not very unlike in general form to the first gnathopods, but more slender; remaining peræopods adapted for walking. First pleopods large, expanded, and covering (generally in female) the remaining pleopods. Telson linguiform; uropods, outer branch one-jointed, and so articulated as to arch more or less over the back of telson, inner branch two-jointed.

This family consists of Isopods of remarkably elongated form, composed of segments which are cylindrical or slightly depressed, those of the peræon (except, in some cases, the last) being much longer than they are broad. The head is more or less quadrate, shorter than the following segment, and having the eyes, when present, at the anterior angles. The pleon sometimes has all the segments, except the telson, completely, at other times partially coalesced; at other times, again, they are all distinctly separated. The telson is linguiform, rarely lanceolate, with the termination rounded or truncate.

The upper antennæ are situated at the exterior angle of the head, and the lower take a very unusual position in having their bases closely appressed together, and occupying a central position between and below the origin of the upper pair. The upper pair consist of a three-jointed peduncle and short, sometimes rudimentary, flagellum in the female; but in the male the flagellum is, in some species, enormously developed into a long brush-like appendage as long as half the animal, and composed of very numerous and thick articulations, which are densely setose. The lower antennæ consist of a five-jointed peduncle and short flagellum. The mouth-organs are all formed to serve purposes of perforation and of suction, and not of mastication; these organs, as they exist in *Cyathura carinata*, Kröyer, have been minutely and admirably described and figured by Schiödte [1]. In this and allied forms the mandible is apparently used as a saw, the outer portion of the jaw being strong, slightly dentate at the extremity, and giving support to a semicircular under portion, which is finely serrate on its sharp edge, while the first maxillæ are somewhat pyriform, the base being the thicker portion, and the extremity is again moderately expanded and terminates in rows of four or five teeth. But in a second group of this family (*Paranthura*) the mandible is aciculate, terminating in a single styliform point, with the under portion of delicate structure and sharp unserrated edge, the whole being evidently used as a lancet; and the first maxillæ are spear-like, very long and slender, with the distal edges finely toothed.

The first gnathopods have strongly developed basos and ischium, the meros short but wide, the carpus minute and triangular; the propodos pear-shaped or more or less triangular, its base very wide, attached to the carpus, but its upper portion, as a rounded lobe, rests on and finds support from a cup-like receptacle in the expanded portion of the meros. The dactylus is usually as long as the palm of the propodos, on which it closes.

The second gnathopods and first peræopods are usually alike in structure, and in general form resemble the first gnathopods, but are much more slender. The remaining peræopods are constructed for walking.

The first pleopods have the outer rami greatly developed, and these together form a kind of operculum, which in the female reaches to the extremity of the five first segments of the pleon, and conceals and protects the remaining pleopods which lie beneath it.

The uropods have an arrangement which is unique among Crustacea, inasmuch as the outer ramus, which has only a single joint, instead of, as is usually the case, arising

[1] "Krebsdyrenes Sugemund," Naturhistorisk Tidsskrift, 3 R. 10 B. (1875), p. 211, tab. iv.

at the side of and underlying the telson, is here so articulated that it more or less arches over and partially conceals the telson; the inner branch consists of two broad joints and underlies the telson. It is to the fancied resemblance of this peculiarly constructed tail to the opening of the petals of a flower that we owe the name of the genus, *Anthura* (*ἄνθος*, a flower; *οὐρά*, a tail). Bate and Westwood, remarking on the structure, write:—"The apparatus when open forms a concave cup-like disc; and when at rest, from being affixed vertically, the outer plate falls back and shuts down upon the dorsum of the middle tail-plate, like the two wings of a closed triptych."

Synopsis of Genera of Anthuridæ.

Section A. Labium terminating in two rather broad rounded lobes. Mandibles having the jaw furnished with a somewhat falcate projecting process below, well arched and terminating in two or three blunt inconspicuous teeth above; a thin blade with semicircular saw-toothed edge unites the falcate process below and the arching termination of the mandible above; this blade, when highly magnified, is seen to have a serrated edge: the serrations are usually few, about five, but in the genus *Cyathura* they are very numerous, and here the general appearance reminds us strongly of an arc of a circular saw. First maxillæ simple, without exterior limb or palp, subpyriform; rounded below, then gradually tapering, but ultimately slightly expanding and bending forwards, terminate in conspicuous and well-developed teeth. Second maxillæ without palp, with the distal extremity slightly cleft. Maxillipeds consisting of two to five joints, which are broad and flattened.

1. Five earlier segments of pleon coalesced into a single segment in female, distinct in male. Flagella of antennæ of both pairs in female few-jointed, of upper pair in male greatly developed and multiarticulate. Maxillipeds two-jointed . . . . *Anthura*, Leach.
2. Five earlier segments of pleon coalesced into a single segment (at least dorsally) in the female. Flagella of antennæ of both pairs rudimentary (that of the upper pair in the male not greatly developed ?). Maxillipeds three-jointed . . . . *Cyathura*[1], n. g.
3. Segments of pleon very short, but distinct in female. Flagella of antennæ of both pairs many-jointed, of upper pair in the male developed into a remarkable brush-like organ nearly equal in length to half that of the animal, and composed of very numerous, short, broad, and densely ciliated joints. Maxillipeds five-jointed, second joint very short . . . . *Anthelura*[2], n. g.
4. Segments of pleon quite distinct and fully half as long as broad; pleopods alike, the first pair not covering or concealing any of the

[1] *κύαθος*, a cup, and *οὐρά*, a tail.

[2] *ἀνθήλη*, a blossom, and *οὐρά*, a tail.

following. Uropods with outer branch long and narrow, not arching over the telson; telson narrow and lanceolate. The whole animal greatly drawn out and vermiform. Flagella of antennæ of both pairs many-jointed. Maxillipeds five-jointed . . . . *Hyssura*[1], n. g.

Section B. Labium gradually tapering and acuminate, terminating in two points. Mandibles without teeth, forming an acutely-pointed lancet-like organ, and the saw-like process characteristic of the genera of Section A is here represented by the expanding lobes of the base of the lancet, which form a channel through which, when the incision has been made, the liquid may be sucked. First maxillæ take the form of a greatly produced, very narrow, spear-like organ, which towards the point is channelled on one side and finely serrated at the margins, thus constituting an admirably adapted instrument for deeply probing the wound where the lancet-like and more cutting mandible has first made the incision. Maxillipeds are of great length, and consist of three or four joints, of which the first is more than twice the length of the rest combined.

5. Segments of pleon distinct in the female. Lower antennæ with a rudimentary flagellum. Upper pair having the flagellum in the male greatly developed into a long brush-like organ . . . . . . *Paranthura*, Bate & [Westw.

6. Segments of pleon distinct in the female. Antennæ of both pairs in both sexes with many-jointed flagella (that of the upper pair not greatly developed in the male ?) . . . . *Calathura*[2], n. g.

Genus 1. Anthura.

1. Anthura gracilis (Montagu). (Plate XXV. figs. iii., iv.)

1808. *Oniscus gracilis*, Montagu, Trans. Linn. Soc. ix. p. 103, pl. v. fig. 6.

1813. *Anthura gracilis*, Leach, Edinb. Encyclop. vii. p. 404; Trans. Linn. Soc. xi. (1815) p. 366; Desmarest, Consid. Crustac. p. 291, pl. xlvi. fig. 13; Guérin-Méneville, Icon. Reg. Anim. pl. xxx. fig. 6; White, Pop. Hist. Brit. Crust. p. 225, pl. xii. fig. 4; Gosse, Marine Zoology, i. p. 248; Bate and Westwood, Brit. Sessile-eyed Crust. ii. p. 160.

Segments of peræon with well-marked dorso-lateral keels; telson abruptly truncate and crenulated at the extremity.

Head square, slightly produced at the centre and sides of the front margin.

Peræon: first segment the longest, second to fifth subequal, sixth rather shorter, seventh shortest of all, all bearing keels on each side on the back, and having a central longitudinal keel on the ventral surface.

Pleon in female having the five first segments indistinguishable and coalesced into a single segment, which is equal in length to the last segment of the peræon. In the

[1] ὑσσός, a javelin, and οὐρά, a tail.

[2] κάλαθος, a cup, and οὐρά, a tail.

male (III. D, ♂, and III. Pl. V, ♂) these segments are much more developed and distinct, though the segmentation is incomplete, and are equal in length to the last two segments of the peræon.

Telson and uropods so constructed and uniting as to resemble nearly a cylinder, with one side (the dorsal), as it were, cut obliquely away. The telson has the apex truncated, and is of the same length as the inner branch of uropods. Outer branches of uropods nearly meeting at their bases dorsally, broadly lanceolate, curved, rather longer than the first joint of the inner branch; end of telson and margin of both branches of uropods crenated.

Eyes distinct, black.

Antennæ: upper in female shorter than lower, with a flagellum consisting of one long articulation, which terminates in a tuft of setæ; lower with second joint of peduncle greatly expanded distally; third very small, fourth rather longer, fifth equal length of third, flagellum four-jointed. In male (III. D, ♂) the upper antennæ are much more developed, and as long as the two first segments of the body, and furnished with a thick flagellum of numerous articulations.

First gnathopods (IV. gn^1 ♀) with an ovate or pyriform hand, which has the upper proximal portion well rounded; palm with a well-developed process projecting forwards near the base; finger strong, unguiculated, the unguiculus black; front margin of wrist, hand, and finger crenulated.

Second gnathopods with the two upper joints subequal, the third short, strongly lobed posteriorly; fourth very minute, triangular; fifth as long as upper joints, and equal to third and fourth together, nearly parallel-sided; front margin pectinated, and bearing a single distal spine; finger rather more than half length of hand, strong, apparently not capable of closing on the hand, itself unguiculate and having a spine at the base of the unguiculus.

Last peræopods with basos and ischium subequal, two following joints rather shorter and subequal to each other; fifth as long as upper joints, and having the palm pectinated and bearing a single distal spine; finger half as long as fifth, unguiculate, a spine at the base of the unguiculus.

Length 8 millim.

Coasts of Devon and Cornwall. The specimens examined were found by T. R. R. S. at Torquay.

It will be seen from the foregoing description that the male, which was not previously known, differs from the female in the greatly developed flagellum of the upper antennæ and in the more produced and segmental character of the pleon. We think it probable that the male has not fully attained its several characters, and that when quite mature the antennæ would have the flagella even more developed and ciliated.

2. Anthura tenuis (Harger).

1878. *Ptilanthura tenuis*, Harger, Amer. Journ. Sci. ser. 3, vol. xv. p. 377; Proc. Unit. Stat. Nat. Mus. 1879, vol. ii. p. 162; Report Unit. Stat. Commis. Fish and Fisheries, pt. vi. for 1878 (published 1881), p. 406, pl. xi. fig. 71, *a–e*.

It is probable that the male of *Anthura gracilis* which we have just described and figured is the immature animal, and that, after the exuviation which should bring it to its perfect state, the upper antennæ would have a plumose flagellum. If that supposition be correct, then it would bear a great resemblance to Harger's figure of *Ptilanthura tenuis*; moreover, *A. gracilis* has slight depressions on the back of the segments, as described and figured by Harger, and, although that author does not mention the keeled character of the margins of the peræon-segments, it seems to be shown in the figure. But, notwithstanding these resemblances, *A. tenuis* is clearly distinguished by the form of the telson, which is described as "about as long as preceding five segments, elongate-ovate and obtusely pointed behind." Mr. Harger's description of the palp of the mandible being of only one joint is probably a mistake; the palp might easily have been damaged in dissection and produced a false impression.

Genus 2. Cyathura.

Cyathura carinata (Kröyer). (Plate XXVII. fig. iii.)

1844. ? *Anthura gracilis*, Dekay, Zool. New York. Crust. p. 44, pl. ix. fig. 34 (but not *A. gracilis*, Montagu).

1847. *Anthura carinata*, Kröyer, Naturhist. Tidssk. 2 ser. ii. p. 402, and Voyage en Scand. pl. xxvii. fig. 3; Schiödte, Krebs. Sugem., Naturh. Tidssk. 3 ser. x. p. 211, pl. iv. figs. 1–14, and Ann. Nat. Hist. 4 ser. xviii. (1876) p. 253; Meinert, Crust. Amphip. et Decap. Daniæ, Naturhist. Tidss. 3 ser. xi. (1877) p. 77, and xii. (1880) p. 470.

1856. *Anthura polita*, Stimpson, Proc. Acad. Nat. Sci. Phil. vol. vii. p. 393; Harger, Proc. Unit. Stat. Nat. Mus. 1879, vol. ii. p. 162; Harger, Report Marine Isopoda of New England &c., Rep. Unit. Stat. Comm. Fish and Fisheries, pt. vi. for 1878, p. 398, pl. xi. figs. 68, 69.

1874. *Anthura brunnea*, Harger, Rep. Unit. Stat. Comm. Fish and Fisheries, pt. 1, p. 572 (278); Verrill, l. c. pt. 1, p. 426 (132).

Body of uniform width throughout. Head broader than long, with slight central and lateral projections in front.

Peræon: first segment the longest; second to fifth subequal to each other, and scarcely longer than broad, and of equal breadth throughout; sixth and seventh equal to each other, and rather shorter than the preceding. The peræon is keeled below, and the third to the fifth segments have a slight pit on the anterior part of their dorsal surface.

Pleon with the five first segments, in the female at any rate, completely coalesced into a single segment, which is equal to the last of the peræon in length; sixth segment very minute.

The telson (III. PL.) is ovate, but very obtusely angled at its termination. Uropods having the outer branches arching but not nearly meeting over the telson, transversely lanceolate, curved; inner branches longer than telson, their second joint broader than long; the margins of telson and both branches of uropods are not serrulated, but fringed with feathered cilia.

Eyes minute, black.

Antennæ: upper (III. *a.s*) having first joint of peduncle very broad, second as long as the first, but much narrower, having long setæ on the outer margin; third two thirds as long as the second; flagellum minute, about half the length of the last joint of the peduncle, and consisting of four very minute articulations. Lower antennæ (III. *a.i*) with a broad and thick peduncle and a rudimentary flagellum; the second joint of peduncle not markedly widened at the extremity; the three following joints thick, subequal, but the last rather the longest; flagellum not half the length of the last joint of peduncle.

First gnathopods (III. gn^1) strongly formed; two upper joints very massive, the first broader than long; meros of the usual cup-shaped form characteristic of the family; carpus minute, triangular, with the distal margin produced into a setose lobe; hand pyriform, the palm bearing a tubercular process near the middle; finger simple. The margin of the wrist and palm of the hand are setose.

Second gnathopods very setose; carpus small, and narrower (as usual) than meros, but produced below into a rounded lobe; hand broad, much curved; palm finely crenated, and carrying a distal spine, which, when seen under a high power, is found to have its further margin beautifully pectinated; finger strong, as long as palm (on which, however, it does not seem capable of closing), unguiculate; the unguiculus minute, surrounded at its base with a tuft of hair.

Last peræopods setose; carpus very short; propodos equal in length to two preceding joints, and twice as long as broad, front margin minutely crenulated and furnished with a distal spine; finger strong, round, about two thirds as long as propodos, furnished with a minute unguiculus, which is surrounded with a tuft of hairs.

Length 20 millim.

Habitat. On the coasts of New Jersey, Connecticut, and Massachusetts (*Harger and Verrill*); Greenland (*Kröyer*); Denmark (*Schiödte and Meinert*).

Our description is drawn up from specimens kindly sent to us, named *Anthura brunnea*, by Mr. S. I. Smith, the talented carcinologist of Yale College. There can be no doubt, we think, that it is the *A. carinata* of Kröyer. Harger calls attention to certain points in which the description of Kröyer does not seem to agree with the American specimens; but if the figures of the parts so described which are given in the 'Voyage en Scandinavie' &c. be examined, the apparent discrepancies seem to disappear.

Genus 3. Anthelura.

1. Anthelura elongata (Norman). (Plate XXV. figs. i., ii.)

Paranthura elongata, Norman, MS. in Proc. Roy. Soc. No. 125, p. 157.

Head with the sides rather rounded. Second segment of peræon narrowed, but not greatly constricted behind; the four following segments of nearly equal width, smooth; last fully half the length of penultimate, which latter is much shorter than the fifth. Pleon (fig. ii. pl., ♀) with all the segments well defined; length of pleon, exclusive of telson, equal to that of the two last peræon-segments. Antennæ (fig. ii. c, ♀) having the peduncles of both pairs flattened; last joint of peduncle of inferior antennæ not larger than the inner margin of the third joint; second joint triangular, its inner margin straight and touching the corresponding part of the opposite limb; flagella of both pairs many-jointed.

First gnathopods (fig. i. gn^1 and gn^{1*}) not strong; hand not large, pyriform, attached by half its underside (not by its base) to the upper face of the triangular wrist, the infero-distal extremity of which stretches forward to receive it; palm occupying the whole of the unattached portion of the margin of the hand, but, from the peculiar mode of attachment of that joint, only equal to half of its total length, having a few scattered setæ; finger slender, much longer than the palm, and impinging, when closed, upon the wrist; meros very short, but greatly produced on the back into a sheath-like process, which is strongly angled above and distally hollowed to receive the rounded free base of the hand.

Second gnathopods (fig. i. gn^2) and first peræopods (fig. i. prp^1) resembling in general character the first gnathopod, but smaller, and the back of the sheath-formed meros rounded and not angled. Remaining peræopods having all their joints broad and flattened; hand and nail subequal (fig. i. prp^5), and only slightly longer than the wrist, the four last joints being subequal in length, hand having two and the wrist three to five long subequal spines on the front margin.

Uropods (fig. ii. pl., ♀) with the outer branch arching over the telson, its margin crenated; inner branch scarcely longer than the telson, broadly rounded at the extremity; the second joint at least as long as the basal portion; margins plain. Telson narrowly linguiform, and rounded at the extremity.

The male has the upper antennæ (fig. i. c, ♂) greatly developed, as long as the four first segments of the body; the flagellum remarkably thick, and looking out of all proportion to the peduncle which supports it, composed of very numerous short joints, which are densely ciliated, so that the entire member forms a long brush. All the legs are more elongated and slender than the corresponding parts in the female, though in general structure closely resembling them. The first pleopods (fig. i. pl. l, ♂) are fringed with long and beautifully plumose setæ, and do not close so tightly over the more fully developed succeeding pleopods. The extremities of the uropods are also setose, and it is evident that the entire structure of the animal is more adapted for active locomotion than that of the female.

Length of female 13 millim. (or half an inch), of male 17 millim.

Taken by the 'Porcupine' expedition in 1870, in 740 fathoms, off the coast of Portugal. (Station 17 *a*, lat. 39° 39′ N., long. 9° 39′ W.)

The specific name has reference to the elongated pleon with its well-marked segmentation.

2. ANTHELURA ABYSSORUM, n. sp. (Plate XXVII. fig. II.)

Head and peræon of nearly equal width throughout; second segment of the latter scarcely at all constricted behind. The whole of the segments smooth above, and devoid of all furrowing and pitting; last segment of peræon half as long as the preceding segments of pleon (II. Pl., D), very clearly defined, and (exclusive of telson) subequal in length to penultimate segment of peræon.

The antennæ (II. C, D) have the joints of the peduncle in both pairs flattened, the lower pair touching each other with the compressed inner margins, and appearing between the upper pair, as in *Anthelura elongata*; flagella of both pairs many-jointed.

First gnathopods (II. gn^1) having basos short and very thick; ischium scarcely longer, and not so broad; cup of meros well rounded; carpus small as usual, bearing five or six spine-like setæ; hand about twice as long as greatest breadth; palm concave, bearing about eight slender spine-like setæ.

Second gnathopods (II. gn^2) having basos and ischium more slender than in first pair; meros of similar form; carpus edged with several spine-like setæ and one spine; hand elongate-ovate, palm with three spines and a few setæ.

Last peræopods (II. prp^5) having the propodos half as long again as the carpus, and the dactylos subequal to the carpus; carpus and propodos each furnished with two forked spines on their anterior margin.

First pleopods large, covering the whole of the remaining pleopods, against which they are closely pressed.

Uropods (II. Pl. D and II. Pl. L) with outer and upper plates wide apart dorsally, broadly triangular or spear-shaped, longer than wide, and as long or nearly as long as the inner plate, which is very similar in form but narrower, with well-rounded extremity; both are tipped with a few setæ, which are, however, very easily abraded.

Telson much depressed, broadly lanceolate, apex rather acute, about equal in length to the uropods.

Length 9 millim. (or about three sixteenths of an inch).

Dredged by H.M.S. 'Valorous' in 1875 (Station 8), in 1750 fathoms, near the entrance of Davis Strait, lat. 59° 10′ N., long. 50° 25′ W.

The forked spines which are found on the hand of the last peræopods in this species are of unusual character. Somewhat similar cleft spines occur on the wrist and hand of second gnathopods of *A. elongata*; but in the latter case the two divisions of the forked spines are both directed upwards, while in the former the chief prong is erect; the branch is strongly divergent.

Genus 4. Hyssura.

Hyssura producta, n. sp. (Plate XXV. fig. v.)

General form very narrow and linear. Head rather outspread, flattened, shorter and somewhat wider than first peræon-segment; following segments slightly but gradually increasing in length to the fourth segment of the peræon, which is of about the same length as each of the two following; last segment two thirds the length of the penultimate. Pleon (fig. v. pl.), exclusive of telson, as long as the penultimate segment of the peræon; telson more than half that length. Pleon consisting of six distinct segments and a telson; first five segments furnished with a pair of pleopods fitted for swimming, sixth carrying two-branched uropods.

Upper antennæ with basal joint scarcely longer than broad, second and third subequal to each other, and rather shorter than first; flagellum three-jointed, not quite so long as the two last of peduncle. Lower antennæ (fig. v. c), as seen from above, closely approximated, their general appearance being very much those of *A. elongata*, bent outwards from the fourth joint, which is the longest; fifth half the length of fourth; flagellum of six articulations.

First gnathopods (fig. v. gn^1) having basos and ischium strongly formed and of nearly the same length; meros short, produced on the back, and there forming a small simple cup with rounded base for the reception of the base of the hand; carpus minute, triangular, with a produced point, which carries a single seta projecting forwards over the base of the palm of the hand: hand twice as long as the united length of meros and carpus, and equal in length to the basal joint of the limb, resting on the carpus and fitting into the cup of the meros; it tapers gradually, the palm not defined, crenated, and bearing three or four spines; finger much curved, and rather shorter than that portion of the hand which projects beyond the carpus.

Second gnathopods and first peræopods, if anything, larger than the first, and of nearly similar form; but the carpus is more produced below, the lobe projecting over the palm being larger, and the palm of the hand is more strongly crenated than the first pair, the notches alternating with slender forked spines.

Third and fourth peræopods (fig. v. prp^4) with the basos and ischium narrow; meros and carpus shorter and subequal to each other in length; the limb is greatly constricted at the junction of ischium and meros; meros very narrow at first, and widening distally;

carpus subquadrate ; propodos rather longer than carpus, parallel-sided, with one infero-distal spine ; dactylus large, longer than propodos, unguiculate.

The last segment of the peræon in the type specimen has no legs, nor can we see any sign of scars where they would have been attached, and the specimen was otherwise quite perfect.

Uropods (fig. v. pl.) with both branches narrowly lanceolate, equal-lengthed, and tipped with tufts of setæ; outer branch over the inner, very narrow, showing no tendency to arch over the back, as is usual in the genera *Anthura* and *Paranthura*, nearly parallel-sided, with a narrowly rounded apex; inner rather wider than outer, but also narrowly lanceolate, its inner margin straight, the outer margin sloping away near the apex to meet it; first joint short, second nearly three times its length.

Telson very narrow, elongate-lanceolate, apex acute and terminating in a little tuft of setæ, otherwise perfectly smooth and glabrous.

Length about a quarter of an inch; the form very narrow in proportion to its length.

A single specimen, dredged in the North Atlantic by H.M.S. 'Valorous' in 1875 (Station No. 11, lat. 56° 11′ N., long. 37° 41′ W., in 1450 fathoms.)

Genus 5. Paranthura.

1. Paranthura nigro-punctata (Lucas). (Plate XXVI. fig. ii.)

1840. ? *Anthura gracilis*, M.-Edwards, Hist. des Crust. iii. p. 136, pl. xxxi. fig. 3 (probably; but not *A. gracilis*, Mont.).

1846. *Anthura nigropunctata*, Lucas, Explor. Scient. de l'Algérie, Anim. Artic. p. 64, pl. v. fig. 9.

1866. *Anthura nigro-punctata*, Heller, Verhandl. d. k.-k. zool.-botan. Gesellschaft in Wien, 1866, p. 732.

1866. *Paranthura costana*, Bate and Westwood, British Sessile-eyed Crust. ii. p. 165.

1870. *Paranthura costana*, Dohrn, Untersuchungen ü. Bau und Entw. der Arthropoden (erstes Heft), 1870, p. 91, pl. ix.

Peræon smooth above (neither keeled nor pitted), the first six segments subequal in length to each other; body narrowed at the hinder portion of the first and second peræon-segments; last segment about half the length of penultimate.

Pleon distinctly segmented, portion anterior to the telson equal to penultimate segment of peræon.

Telson linguiform. Uropods wide apart above, scarcely at all arching over telson; outer branch small, narrow, lanceolate, shorter than inner; inner as long as the telson, its second joint as long as the first; both telson and uropods are setose, especially at their terminations.

Eyes very distinct, black.

Antennæ: upper (fig. II. *a.s*) with joints of peduncle subequal in length; flagellum 5–6-jointed, equal in length to half the peduncle; lower (fig. II. *a.i*) strong, subpediform; flagellum reduced to a single articulation, which, however, is flattened, nearly as long as last joint of peduncle, and furnished along the side with a dense pencil of hairs.

Feet: all very like in form to the same members of *C. brachiata*; but the palm of the first gnathopods (II. gn^1) is furnished with a small tubercular process at the base.

Length 13 millim.

Habitat. Coast of Algeria (*Lucas*); Adriatic (*Heller*!); Guernsey (*A. M. N.*!).

This species is at once distinguished from all the others known to us by the peculiar character of the flagellum of the lower antennæ, which consists of a single flattened joint, strongly ciliated along the edge.

We have had the opportunity of comparing Adriatic specimens kindly sent to us by Professor Heller, with the examples collected in Guernsey by A. M. N., and which were described by Bate and Westwood in their work.

Bate and Westwood have doubtfully referred the *Oliska penicillata* of Risso ('Crustacés de Nice,' 1816, p. 137, pl. iii. fig. 10, and 'Hist. Nat. Europ. Mérid.' v. p. 113) to this species; but *Oliska*, we think, cannot be synonymous with *Anthura*. The description of the telson ("sa queue est triangulaire, et *terminée par deux long filets soyeux et penicillés*") does not at all agree. Risso's genus must remain in obscurity until something like it shall have been rediscovered in the neighbourhood of Nice.

Another *Anthura* (*A. filiformis*) has been described and figured by Lucas ('Anim. Artic. de l'Algérie,' p. 63, pl. v. fig. 8) from the Algerian coast. It is characterized thus:—"A. *fusco-ferruginea; capite parvo, utrinque sulcato, antice acuto; segmentis thoracis elongatis, angustis, profunde sulcatis, fortiter punctatis; abdomine elongato, segmento primo quinquescissurato, secundo angusto, fortiter carinato.*" The telson is linguiform and bears a central keel, the uropods are represented as very like in form to those of *A. nigro-punctata*, and the lower antennæ have a flagellum of about six articulations. It would seem to be a well-marked species.

Grube has described another Mediterranean *Anthura*, found at Cherso, under the name of *A. laurentiana* ('Ein Ausflug nach Triest und den Quarners,' 1861, p. 138). In 'Die Insel Lussin und ihre Meeresfauna,' 1864, p. 76, the same author has recorded *A. gracilis* from the Adriatic; but since he specially refers to M.-Edwards's figure, we may conclude that the species named by him is not *A. gracilis*. On the other hand, his description of *A. laurentiana* agrees very fairly with that of the true *A. gracilis*, except the important character "*corpus subteres . . . . dorso haud sculpto.*"

2. Paranthura tenuis, G. O. Sars. (Plate XXVII. fig. 1.)

1872. *Paranthura tenuis,* G. O. Sars, Bidrag til Kundskaben om Dyrelivet paa vore Havbanken, Vidensk. Selsk. Forhandl. 1872, p. 89.

Head with the sides scarcely convex, almost parallel. Peræon with three first segments strongly keeled below; back of all the segments perfectly smooth; second segment contracted as usual behind, but only slightly so; last two thirds the length of the penultimate. Pleon (I. Pl. D) well developed, and its segmentation distinct, as long as the penultimate segment of peræon.

Antennæ (I. *a.s* & I. *a.i*) short and thick, not longer than the head; peduncles of both pairs stout and strong, and their flagella very minute, about equal in length to the last joint of peduncle.

First gnathopods (I. gn^1) stout and strong; basos very thick, not twice as long as broad; ischium slightly longer; meros produced anteriorly as usual to form a cup for the reception of the base of the hand, the bottom of the cup free from any appearance of angularity; wrist very minute; hand subtriangular, palm furnished with a small, tubercular, thumb-like projection at the proximal angle, and is margined with spines; finger strong, curved, equal in length to the palm. The hinder pairs of peræopods (I. prp^4) have the basos subequal to the ischium, neither of these joints being more than three times as long as broad; meros subtriangular, rather more than half as long as ischium; wrist triangular, minute, so small that the hand and meros meet behind it; hand long-ovate, three to four times as long as broad, anteriorly furnished with three equal spines; these spines have a cilium springing from their side, and there is a similar cilium-furnished spine on the wrist; finger curved, as long as the hand.

Telson (I. Pl. D) broadly spear-shaped. Uropods with the outer and upper branch short, but very wide, so that combined they form a complete dome overhanging the telson; inner branch long, narrow-lanceolate, projecting considerably beyond the telson, terminating in a bunch of long setæ.

Length 14 millim.

One specimen from the 'Porcupine' Expedition, 1870 (Station 22, off Lisbon, lat. 38° 15′ N., long. 9° 33′ W., in 718 fathoms).

Professor G. O. Sars has kindly sent us one of his type specimens, taken in 150–200 fathoms off the Island of Hvitingsoe, near Bergen, in Norway. This specimen, which is very small (6 millim.) closely agrees with the 'Porcupine' example, except that the thumb-like tubercular process of the palm of the hand is more developed.

Genus 6. Calathura.

Calathura brachiata (Stimpson). (Plate XXVI. fig. I.)

1854. *Anthura brachiata,* Stimpson, Marine Invertebrata Grand Manan, p. 43; 1873. S. I. Smith, United States Fish and Fisheries Report (Invertebrate Animals of Vineyard Sound), p. 573.

1872. *Paranthura norvegica,* G. O. Sars, Bidrag til Kundskaben om Dyrelivet paa vore Havbanken, Vidensk. Selsk. Forhandl. 1872, p. 88.

1875. *Anthura arctica,* Heller, Crustaceen, Pycnogoniden und Tunicaten der k.-k. Österr. Ungar. Nordpol Expedit. p. 14, pl. iv. figs. 9–12; 1876. G. O. Sars, Prodrom. descrip. Crust. et Pycnogon. in exped. Norveg. 1876, in Archiv for Mathemat. og Naturvidenskab, p. 347.

Peræon having each of the five first segments nearly or quite twice as long as broad, slightly carinated on each side above; three first strongly keeled below, first of equal breadth throughout, second greatly constricted behind, so that here is the narrowest part of the whole body; third, fourth, and fifth segments gradually but only slightly widening, and with the last of these the body attains its greatest diameter; anterior margin of third segment slightly four-lobed, the lateral lobes produced outwards as small protuberances; fourth, fifth, and sixth segments with a central longitudinal dorsal impression anteriorly; last segment of peræon short, about one third the length of the penultimate.

Pleon very short, the whole (exclusive of telson) scarcely equalling the length of the penultimate segment of the peræon, but with the segments clearly distinguishable.

Both pairs of antennæ with the joints of their peduncles rounded, last joint of peduncle of inferior pair twice as long as the third; flagella of both pairs multiarticulate.

First gnathopods (fig. I. gn^1) strong; the hand large, ovate or somewhat triangular, united by the lower part of its base to the little wrist, and with the proximo-dorsal portion produced backwards into a large rounded lobe, which is received into a socket formed by the concave rounded lobe developed on the meros; palm occupying the entire length of the lower margin of the hand, slightly concave, edged with spines, each of which is found, when examined with a high power, to be itself margined with very minute spinules and to be tipped with a cilium.

Second gnathopods (fig. I. gn^2) and first peræopods of nearly similar form to the first, but more slender, and the lobe at the base of the hand much less developed.

The hinder peræopods are longer and more slender (fig. I. prp^4), not subchelate; hand and finger long and slender, subequal to each other, and each two to three times as long as the wrist; front margin of hand edged with fine down, and furnished with about six spines set at equal distances; these spines are themselves spined on the edge.

Uropods (fig. I. Pl. D) with the outer plate, which arches over the telson, short and wide, much broader than long, and somewhat retuse, with a minutely dentated margin; inner plate much longer, subequal to the telson, sharply keeled on the underside; the second joint ovate and much shorter than the first, the inner margin smooth or very slightly crenulated.

The telson is shortly spear-shaped, the apex rather blunt.

Length of a large specimen one inch and an eighth, this being the largest known species of the family.

The type specimen of *C. brachiata* was dredged by Stimpson "on a shelly and somewhat muddy bottom in 20 fathoms, off the northern point of Duck Island, New Brunswick." We have been favoured with specimens by Mr. Whiteaves which were dredged in 200 fathoms in the Gulf of St. Lawrence; with others from Mr. S. I. Smith, which were procured in the Bay of Fundy; with a type specimen of *Paranthura norvegica* from Professor G. O. Sars, which was dredged in 150–200 fathoms near Stadanger, in Norway; and the same kind friend has also sent us one of the "*Paranthura arctica*" dredged by the 'Vöringer' in 1876 (Station 48; lat. 64° 36′ N., long. 10° 21′ W.), in 299 fathoms.

It was taken in many of the dredgings of the 'Porcupine' expedition:—

1869.—Station	30,	lat. 56° 24′ N.,	long. 11° 49′ W.,	1360 fathoms.
,,	36,	,, 48° 50′ N.,	,, 11° 9′ W.,	725 ,,
,,	47,	,, 59° 34′ N.,	,, 7° 18′ W.,	542 ,,
,,	65,	,, 61° 10′ N.,	,, 2° 21′ W.,	345 ,,
,,	88,	,, 59° 26′ N.,	,, 8° 23′ W.,	705 ,,
1870.—Station	1,	,, 48° 38′ N.,	,, 10° 15′ W.,	567 ,,

Calathura brachiata has thus been traced from the east coast of America, across the Atlantic, between Shetland and Faroe, off Norway, Scotland, and Ireland, and between the south of England and the Bay of Biscay.

It may always be at once distinguished by the impressed marks on the fourth and two following segments of the peræon and the form of telson and uropods.

Postscript, *June* 1, 1886.

The foregoing paper was sent to the Society in the autumn of 1884: since that time some important papers on the Isopoda Chelifera have been published.

1. C. Claus, "Ueber *Apseudes latreillii*, Edw., und die Tanaiden" ('Arbeiten aus dem zool. Inst. der Univ. Wien und der zool. Stat. in Triest,' Tom. v. Heft iii., 1884). This is a morphological paper dealing with the general structure of the body and its limbs. The species on which the observations are based is called *Apseudes latreillii*, Edw. It is certainly not that species as understood by other authors, and comes nearest to *A. acutifrons*, G. O. Sars. It, however, is distinguished from *A. acutifrons* in the rostrum being rather wider at the base, the ocular alæ of quite another form, wider and larger, and containing conspicuous eyes, and in slight differences in the lower antennæ and other parts. The second gnathopods are altogether different, the front margin of the wrist being furnished with three, and that of the hand with six large spines. We would suggest the name *Apseudes hastifrons* for this form.

2. G. O. Sars, 'Den Norske Nordhavs-Exped. 1876–8; XIV. Zoologi; Crustacea, I.,' 1885. In this admirable work the author fully describes and illustrates the following species:—*Sphyrapus serratus*, G. O. Sars; *Leptognathia longiremis*, G. O. Sars; *Typhlotanais cornutus*, G. O. Sars; and

Cryptocope vöringii, G. O. Sars; which he had previously briefly characterized, and which have been referred to in the foregoing memoir.

3. Lastly, we have this day received from the author a copy of Professor Sars's latest work, 'Nye Bidrag til Kundskaben om Middelhavets Invertebratfauna.—III. Middelhavets Saxisopoder (Isopoda Chelifera),' 1886. The Mediterranean Chelifera, which had been first made known in his 'Revision af Gruppen Isopoda Chelifera' (1880), and already mentioned by us, are here fully described and illustrated in fifteen plates.

The description and figures given in this work enable us to say positively that the *Apseudes* which we have described under the name *lunarifrons*, and which we doubtfully referred to *A. echinatus*, G. O. Sars, is that species, and our own name must consequently give place to the earlier one of Prof. Sars.

Prof. G. O. Sars makes it a character of the genus *Sphyrapus* that the second gnathopods are not furnished with a palp, such as is present in *Apseudes*; but our own observations do not agree with his, inasmuch as in the type species *Sphyrapus malleolus*, and also in *S. tudes*, a palp is unquestionably present on this limb.

EXPLANATION OF THE PLATES.

PLATE XVI.

I. D.	*Apseudes latreillii*	(M.-Edwards),	viewed dorsally.
L, ♂.	"	"	male, viewed laterally.
a.s.	"	"	upper antenna.
a.i.	"	"	lower antenna.
m.	"	"	mandibles.
mx^1.	"	"	first maxilla.
mxp.	"	"	maxilliped.
gn^1 ♂.	"	"	first gnathopod, male.
gn^1 ♀.	"	"	first gnathopod, female.
gn^2.	"	"	second gnathopod.
prp^3.	"	"	third peræopod.
prp^5.	"	"	last peræopod.
plp.	"	"	pleopod.
Pl. V.	"	"	pleon, viewed from below.

PLATE XVII.

I. D.	*Apseudes spinosus*,	M. Sars,	female, viewed from above.
L.	"	"	side view of carapace and gnathopods of male.
a.i.	"	"	lower antenna.
gn^1.	"	"	hand of first gnathopods of male.
prp^3.	"	"	third peræopod, extremity.

I. D. *prp*[5].	*Apseudes spinosus*, M. Sars,	female, last peræopod.
Pl.*.	,, ,,	lateral process of segments of pleon.
II. D. L.	*Apseudes lunarifrons*, n. sp.,	dorso-lateral view, female.
C.	,, ,,	front of carapace, seen from above.
C. L.	,, ,,	part of carapace, seen from the side, to show the mouth-organs.
gn[1].	,, ,,	first gnathopod.
prp[1].	,, ,,	first peræopod.
prp[3].	,, ,,	third peræopod.
prp[5].	,, ,,	last peræopod.

PLATE XVIII.

I. L.	*Apseudes simplicirostris*, n. sp.,	seen from the side.
D.	,, ,,	head and peræon from above.
m.	,, ,,	palp of the mandible.
a.i.	,, ,,	scale of the lower antenna.
gn[1].	,, ,,	first gnathopod from the inner side.
gn[1]*.	,, ,,	finger and thumb, more magnified.
gn[1]**.	,, ,,	palp of the first gnathopod.
gn[2].	,, ,,	hand and finger of second gnathopod.
gn[2]*.	,, ,,	palp of the second gnathopod.
prp[5].	,, ,,	termination of last peræopod.
prp[3].	,, ,,	abnormal growth of a third peræopod.
II. D.	*Apseudes obtusifrons*, n. sp.,	seen from above.
L.	,, ,,	seen from the side.
C. L.	,, ,,	one side of the carapace seen from below.
o.c.	,, ,,	the ocular process seen from above.
gn[1].	,, ,,	first gnathopod.
gn[2].	,, ,,	second gnathopod.
prp[5].	,, ,,	the last peræopod.

PLATE XIX.

I. L.	*Apseudes grossimanus*, Norman,	male, seen from the side.
C.	,, ,,	carapace seen from above.
a.s.	,, ,,	peduncle of upper antenna.
l.	,, ,,	labium.
m.	,, ,,	mandibles.
mx[1].	,, ,,	first maxilla.

I. mx^2.	*Apseudes grossimanus*, Norman,		second maxilla and setæ, more highly magnified.
mxp.	,,	,,	maxilliped, and inner margin more highly magnified.
gn^1 ♀.	,,	,,	first gnathopod, female, and inner margin of thumb greatly magnified.
gn^2.	,,	,,	second gnathopod, finger, and peculiar spine, highly magnified.
prp^5.	,,	,,	last legs, with hand and its hairs, more highly magnified.
plp.	,,	,,	pleopod.

PLATE XX.

I. L.	*Apseudes gracilis*, n. sp.,		viewed laterally.
D.	,,	,,	anterior portion, from above.
Pl.	,,	,,	last segments of pleon.
a.s.	,,	,,	upper antenna.
a.i.	,,	,,	lower antenna.
m.	,,	,,	mandible.
gn^1.	,,	,,	first gnathopod.
gn^{1*}.	,,	,,	side view of mouth-organs, and an abnormally developed first gnathopod.
gn^2.	,,	,,	second gnathopod.
prp^5.	,,	,,	last peræopod.
plp.	,,	,,	pleopod.

PLATE XXI.

I. D.	*Apseudes uncidigitatus*, n. sp.,		viewed dorsally.
L.	,,	,,	viewed laterally.
C.	,,	,,	carapace from above.
C. V*.	,,	,,	carapace from below.
a.s.	,,	,,	upper antenna.
gn^1.	,,	,,	first gnathopod.
gn^2.	,,	,,	second gnathopod.
prp^1.	,,	,,	first peræopod.
prp^2.	,,	,,	second peræopod.
prp^3.	,,	,,	third peræopod.
prp^4.	,,	,,	fourth peræopod.

I. prp^5. *Apseudes uncidigitatus*, n. sp., fifth peræopod.
II. L. *Sphyrapus anomalus* (G. O. Sars), viewed laterally.
C. ,, ,, carapace from above, and end of rostrum, more highly magnified.
a.a. ,, ,, upper and lower antennæ.
gn^1. ,, ,, first gnathopod.
gn^2. ,, ,, second gnathopod.
prp^5. ,, ,, last peræopod.
urp. ,, ,, uropods.

PLATE XXII.

I. D. *Sphyrapus tudes*, n. sp., dorsal view.
L. ,, ,, lateral view.
a.a. ,, ,, upper and lower antennæ, with eye-processes, seen from below.
m. ,, ,, mandible.
mx. ,, ,, maxilla.
mxp. ,, ,, maxilliped.
gn^1. ,, ,, first gnathopod.
gn^2. ,, ,, second gnathopod.
prp^1. ,, ,, first peræopod.
prp^2. ,, ,, second peræopod.
prp^3. ,, ,, third peræopod.
prp^{3*}. ,, ,, third peræopod, hand, and dactylus, more highly magnified.
prp^4. ,, ,, fourth peræopod.
prp^{4*}. ,, ,, fourth peræopod, hand, and dactylus, more highly magnified.
prp^5. ,, ,, last peræopod.
prp^{5*}. ,, ,, last peræopod, hand, and dactylus, more highly magnified.
ur. ,, ,, telson and uropods from below.
II. D. L, ♂. *Sphyrapus malleolus*, n. sp., male, seen obliquely from above.
a.a. ,, ,, antennæ, seen from below.
m. ,, ,, mandible.
gn^1. ,, ,, first gnathopod.
gn^2. ,, ,, second gnathopod.
prp^1, prp^2, prp^3, prp^5. ,, ,, first, second, third, and last peræopods.

III. D, ♀.	*Sphyrapus malleolus*, n. sp., female, seen from above.			
Pl.	,,	,,	terminal segments of pleon, with pleopod and base of uropods, seen from the side.
gn[1].	,,	,,	first gnathopod.
gn[1]*.	,,	,,	first gnathopod, a malformation or reproduction.

PLATE XXIII.

I. D.	*Alaotanais serratispinosus*, n. sp., seen from above.		
L.	,,	,,	carapace viewed laterally.
mxp.	,,	,,	maxilliped.
aa.	,,	,,	antennæ of both pairs.
gn[1].	,,	,,	first gnathopod.
gn[1]*.	,,	,,	finger and thumb of first gnathopod.
gn[2].	,,	,,	propodos and dactylus of second gnathopod.
prp[4].	,,	,,	fourth peræopod.
prp[4]*.	,,	,,	propodos and dactylus of fourth peræopod, highly magnified.
plp.	,,	,,	pleopod, seen from within.
*plp**.	,,	,,	pleopod, from outer side.
T.	,,	,,	end of pleon, underpart viewed obliquely.
II. L.	*Alaotanais hastiger*, n. sp., seen from the side.		
C.	,,	,,	outline of carapace, from above.
C*.	,,	,,	portion of carapace, seen from the side, showing shape and position of the eye-process.
Pl.	,,	,,	pleon, viewed dorsally.
gn[1].	,,	,,	thumb and finger of first gnathopod.
prp[2].	,,	,,	second peræopod.
prp[5].	,,	,,	last peræopods, terminal joints, viewed from the front.

PLATE XXIV.

I. D.	*Alaotanais serratispinosus*, n. sp., dorsal view.		
Pl.	,,	,,	end of pleon, from above.
gn[1].	,,	,,	first gnathopod, exterior lateral view.
II. L.	*Alaotanais lævispinosus*, n. sp., side view.		
D.	,,	,,	viewed from above.

II. *aa.* *Alaotanais lævispinosus*, n. sp., antennæ, inner faces.
mxp. ,, ,, half of maxilliped.
*gn*¹. ,, ,, hand and finger of first gnathopod.
*gn*². ,, ,, second gnathopod.
*prp*⁵. ,, ,, last peræopod.
plp. ,, ,, pleopod.
urp. ,, ,, terminal segment of pleon, and portion of uropod.

III. D. *Strongylura arctophylax*, n. sp., seen from above.
a.s. ,, ,, upper antenna.
a.i. ,, ,, lower antenna.
*gn*¹. ,, ,, first gnathopod.
*gn*². ,, ,, second gnathopod.
*prp*⁴. ,, ,, fourth peræopod.
Pl. ,, ,, pleon, underside.
Pl*. ,, ,, end of pleon, viewed laterally.

IV. D. *Tanaella unguicillata*, n. sp., seen from above.
L. ,, ,, seen from the side.
L*. ,, ,, carapace, more magnified, seen from the side.
Pl. ,, ,, underside of pleon and uropods.
*prp*¹. ,, ,, end of first peræopod.
*prp*³. ,, ,, fourth peræopod.

PLATE XXV.

I. D, ♂. *Anthelura elongata* (Norman), viewed dorsally (male).
C, ♂. ,, ,, head of male, with antennæ and first segment of peræon.
*gn*¹. ,, ,, first gnathopod, outer side.
*gn*¹*. ,, ,, first gnathopod, terminal portion of the same, inner side.
*gn*². ,, ,, second gnathopod.
*prp*¹. ,, ,, first peræopod.
*prp*⁴. ,, ,, fourth peræopod.
*prp*⁵. ,, ,, fifth peræopod, terminal joints.
C, L. ,, ,, lateral view of head, with mouth-organs and basal joints of antennæ.
Pl. L, ♂. ,, ,, pleon, seen from the side.
Pl. D, ♂. ,, ,, pleon, seen from above.

II. C, ♀.	*Anthelura elongata* (Norman)		(female), head with antennæ, seen from above.
Pl, ♀.	,,	,,	(female), pleon, seen from above.
III. D, ♂.	*Anthura gracilis* (Montagu),		male, viewed dorsally.
Pl. V, ♂.	,,	,,	,, pleon, seen from below.
IV. gn^1 ♀.	,,	,,	female, first gnathopod.
V. D.	*Hyssura producta*, n. sp.,		seen from above.
C.	,,	,,	head and antennæ.
gn^1.	,,	,,	first gnathopod.
prp^4.	,,	,,	fourth peræopod.
Pl.	,,	,,	pleon, viewed dorso-laterally.

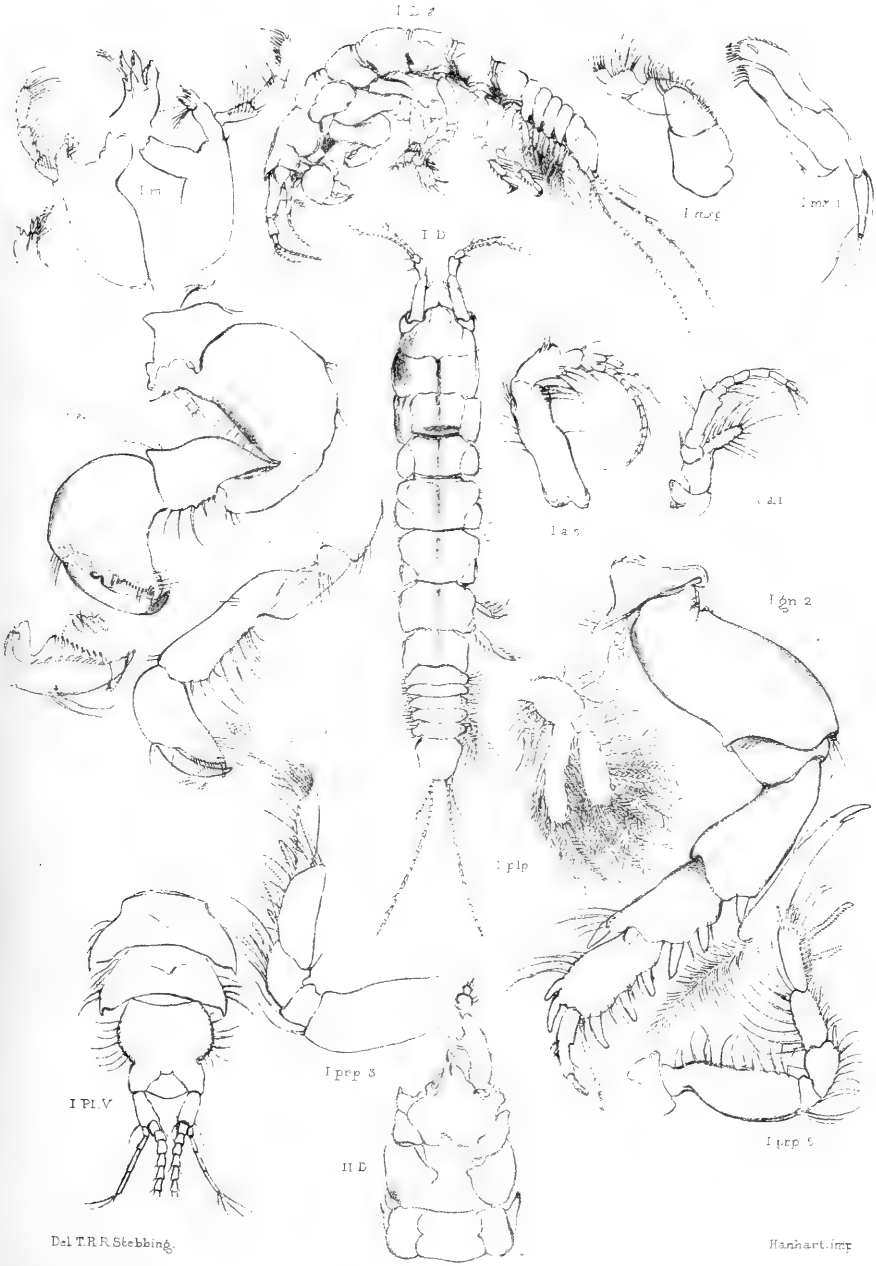
PLATE XXVI.

I. D, ♀.	*Calathura brachiata* (Stimpson),		female, from above.
a.s.	,,	,,	upper antenna.
a.i.	,,	,,	lower antenna.
m.	,,	,,	mandible.
lbr.	,,	,,	labrum (?).
lbi.	,,	,,	labium.
mx^1.	,,	,,	first maxilla.
mxp.	,,	,,	maxillipeds.
gn^1.	,,	,,	first gnathopod.
gn^2.	,,	,,	second gnathopod.
prp^4.	,,	,,	fourth peræopod.
plp^1.	,,	,,	first pleopod.
plp^2.	,,	,,	second pleopod.
Pl. D.	,,	,,	telson and uropods, from above.
Pl. V.	,,	,,	pleon, seen from below.
L, ♀.	,,	,,	a female, natural size, viewed laterally.
II. D, ♀.	*Paranthura nigro-punctata* (Lucas),		gravid female, from above.
a.s.	,,	,,	upper antenna.
a.i.	,,	,,	lower antenna.
gn^1.	,,	,,	first gnathopod.
gn^2.	,,	,,	second gnathopod.
prp^1.	,,	,,	first peræopod.
prp^4.	,,	,,	fourth peræopod.

PLATE XXVII.

I. L.	*Paranthura tenuis*, G. O. Sars,		viewed laterally.
C, L.	,,	,,	head viewed laterally, and more magnified.

I. Pl. D.	*Paranthura tenuis*, G. O. Sars,		pleon, from above.
a.s.	,,	,,	upper antenna.
a.i.	,,	,,	lower antenna.
gn^1.	,,	,,	first gnathopod.
gn^2.	,,	,,	second gnathopod.
prp^1.	,,	,,	first peræopod.
prp^4.	,,	,,	fourth peræopod.
II. L.	*Anthelura abyssorum*, n. sp.,		side view.
C, D.	,,	,,	head, from above.
Pl. D.	,,	,,	pleon, from above.
Pl. L.	,,	,,	pleon, from the side.
a.s.	,,	,,	upper antenna.
a.i.	,,	,,	lower antenna.
gn^1.	,,	,,	first gnathopod.
gn^2.	,,	,,	second gnathopod.
prp^5.	,,	,,	fifth peræopod.
III. *a.s.*	*Cyathura carinata* (Kröyer),		upper antennæ, with last joints more highly magnified.
a.i.	,,	,,	lower antennæ, with last joints more highly magnified.
lbi.	,,	,,	labium.
m.	,,	,,	mandible and palp.
mx^1.	,,	,,	first maxilla, and termination more highly magnified.
mxp.	,,	,,	maxillipeds.
gn^1.	,,	,,	first gnathopod.
Pl.	,,	,,	end of telson.



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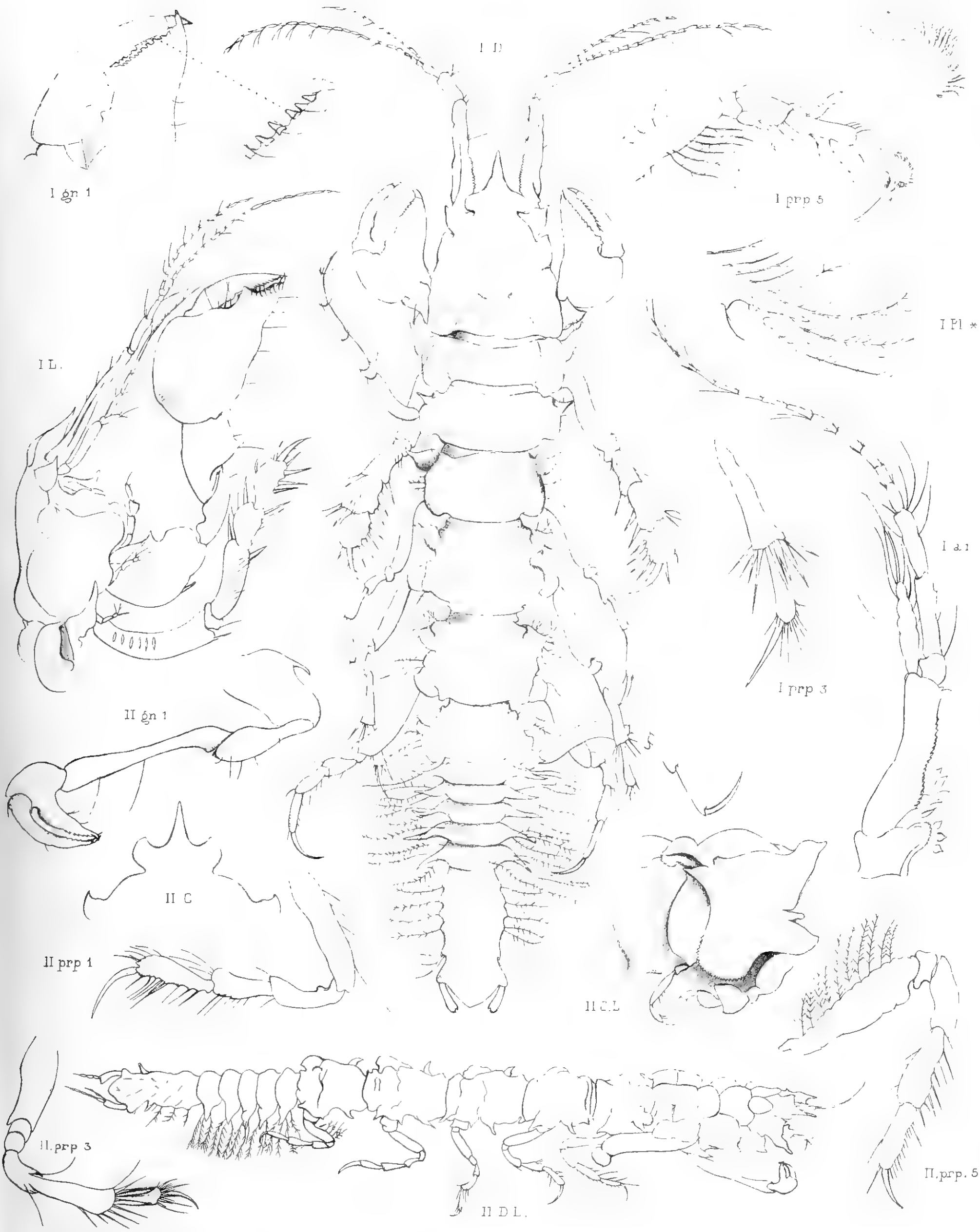
Apseudes latreillii.



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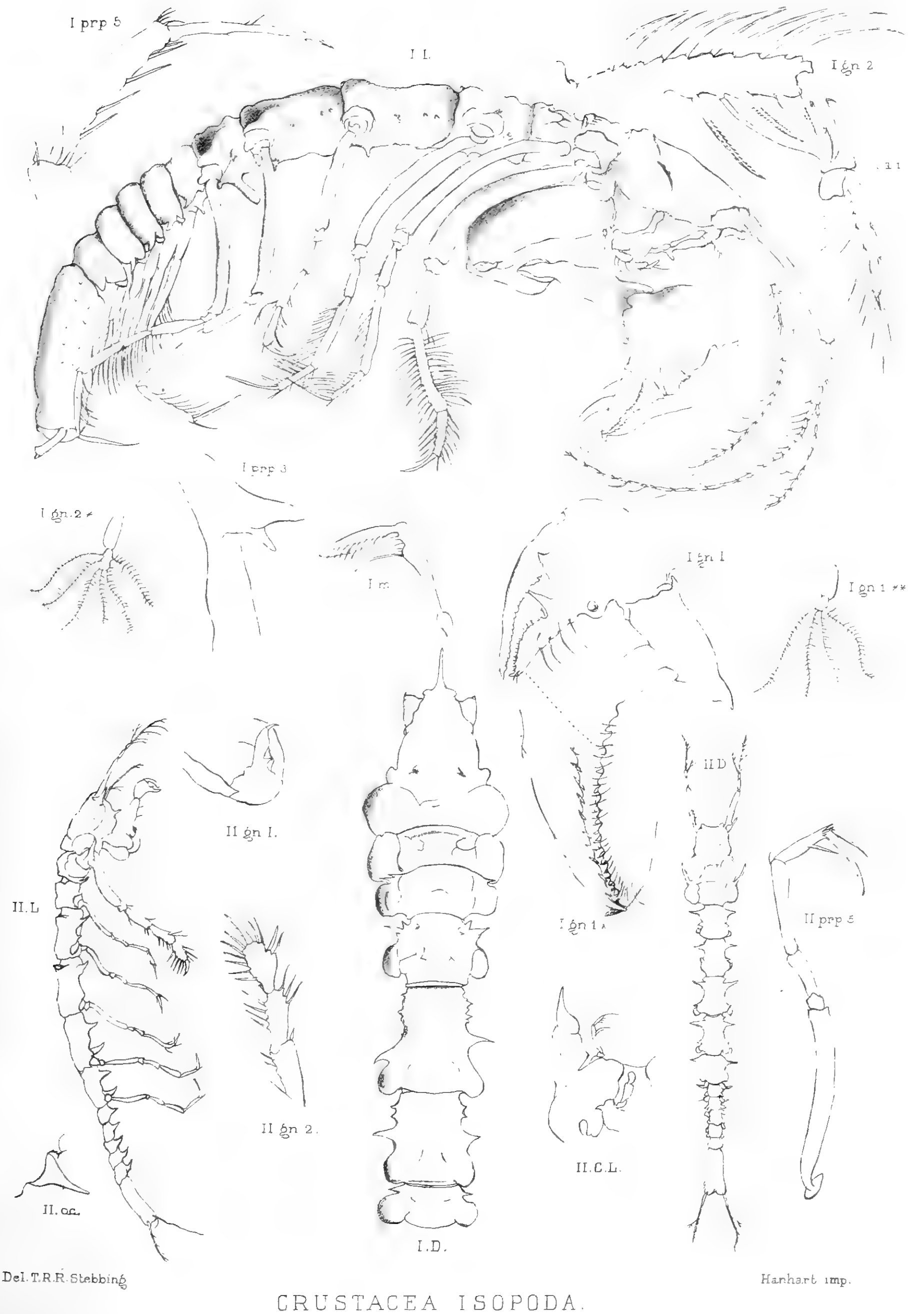

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CRUSTACEA ISOPODA.

I. Apseudes simplicirostris. II. A. obtusifrons.

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CRUSTACEA ISOPODA

Apseudes grossimanus

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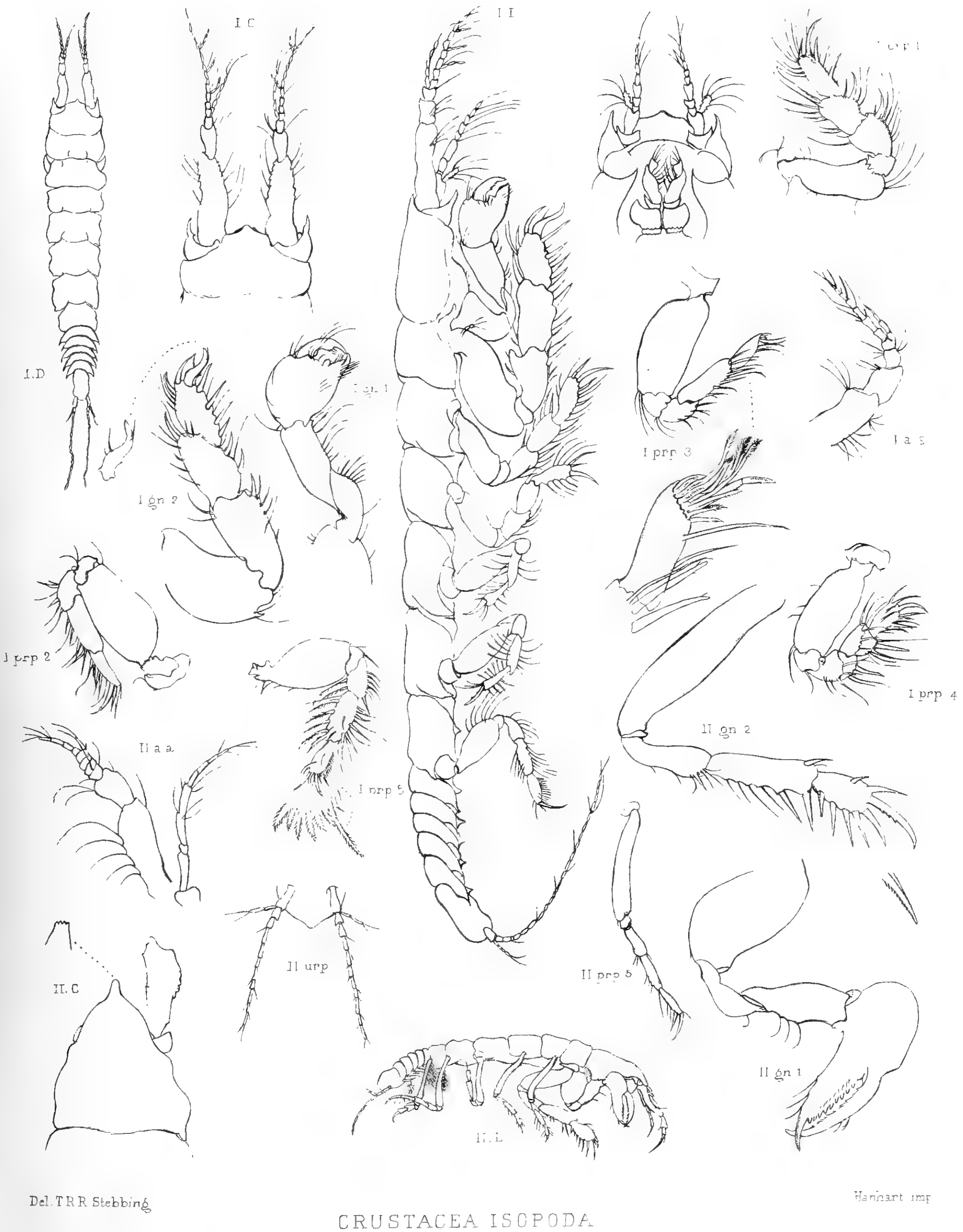
Apseudes gracilis.



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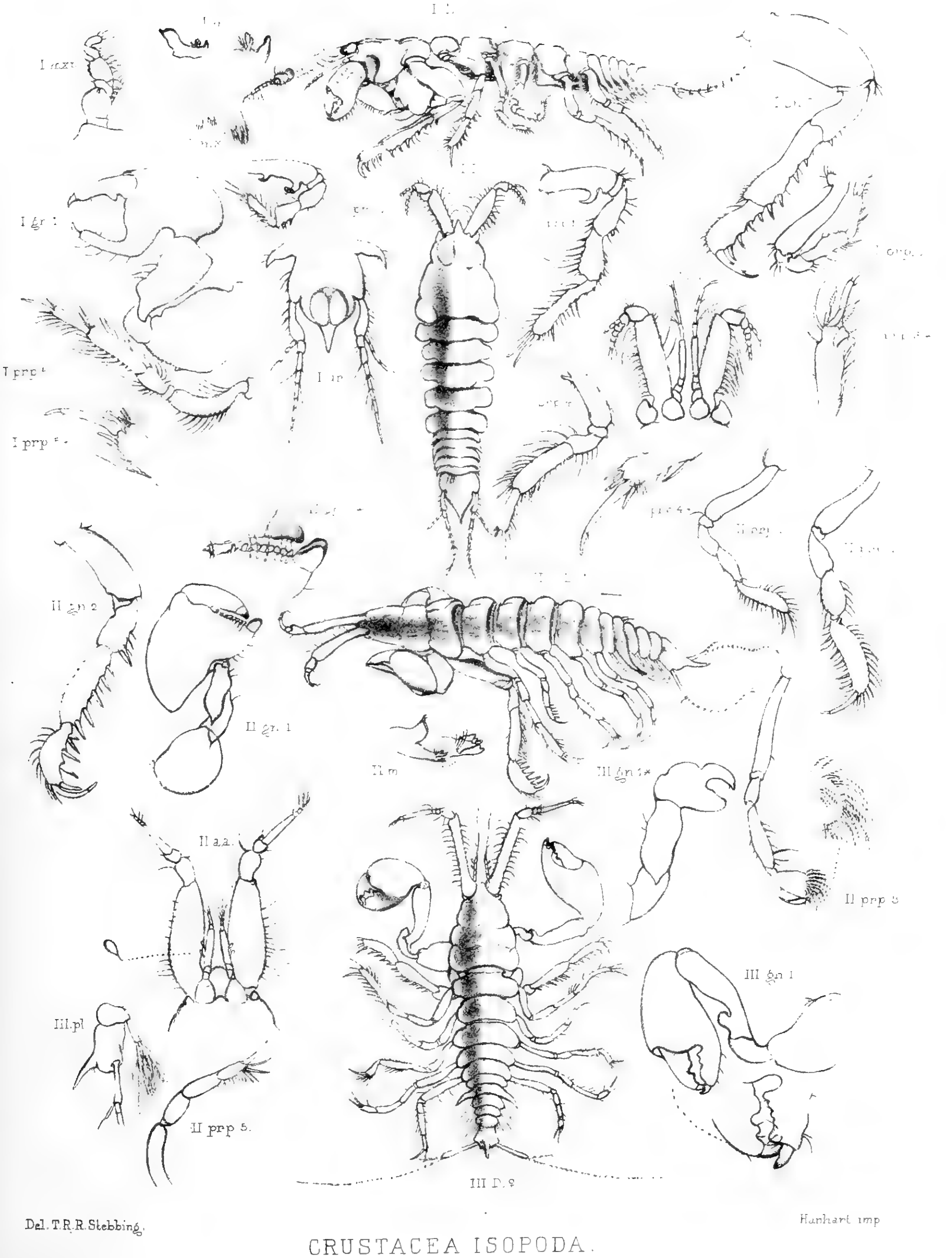
I. Apseudes uncidigitatus. II. Sphyrapus anomalus.



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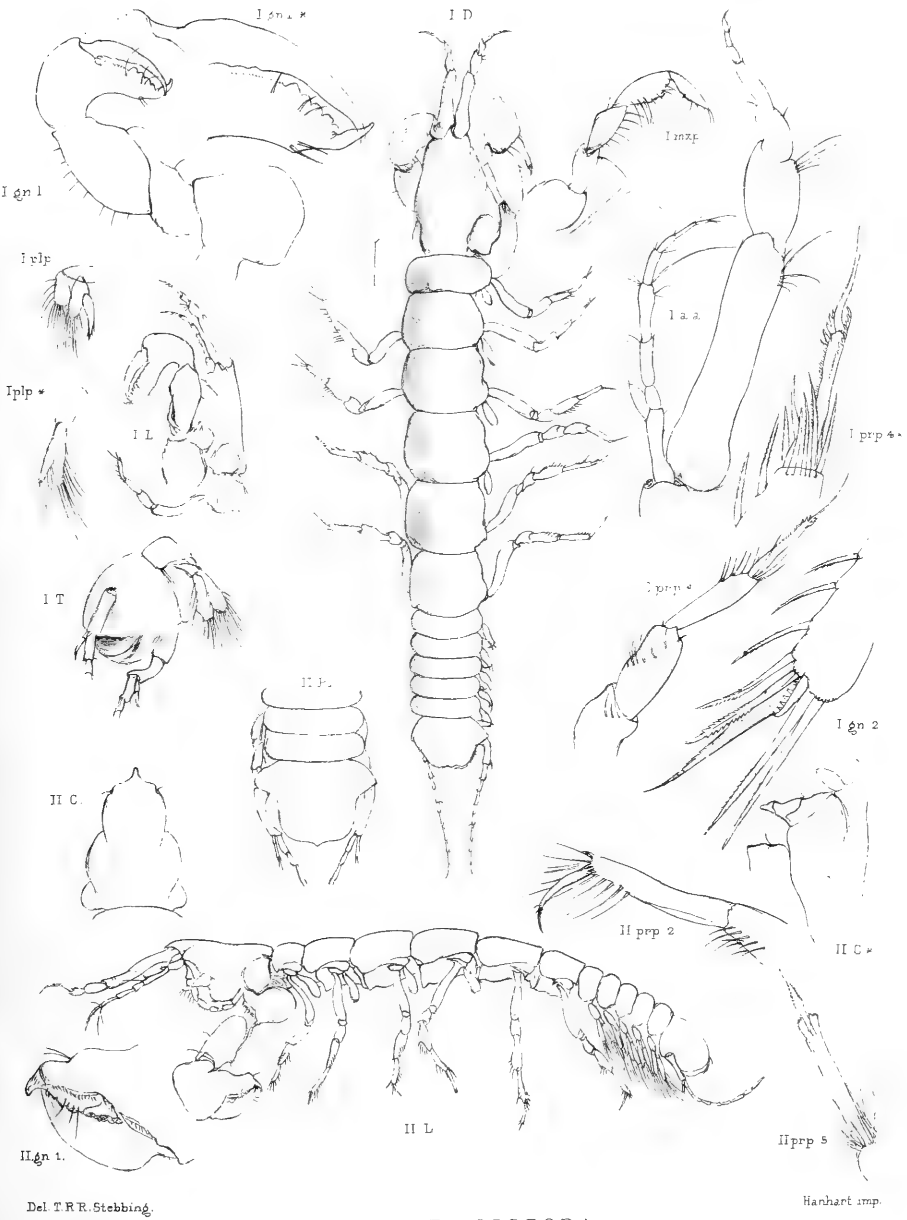
I. Sphyrapus tudes. II. S. malleolus. ♂ III. S. malleolus. ♀.



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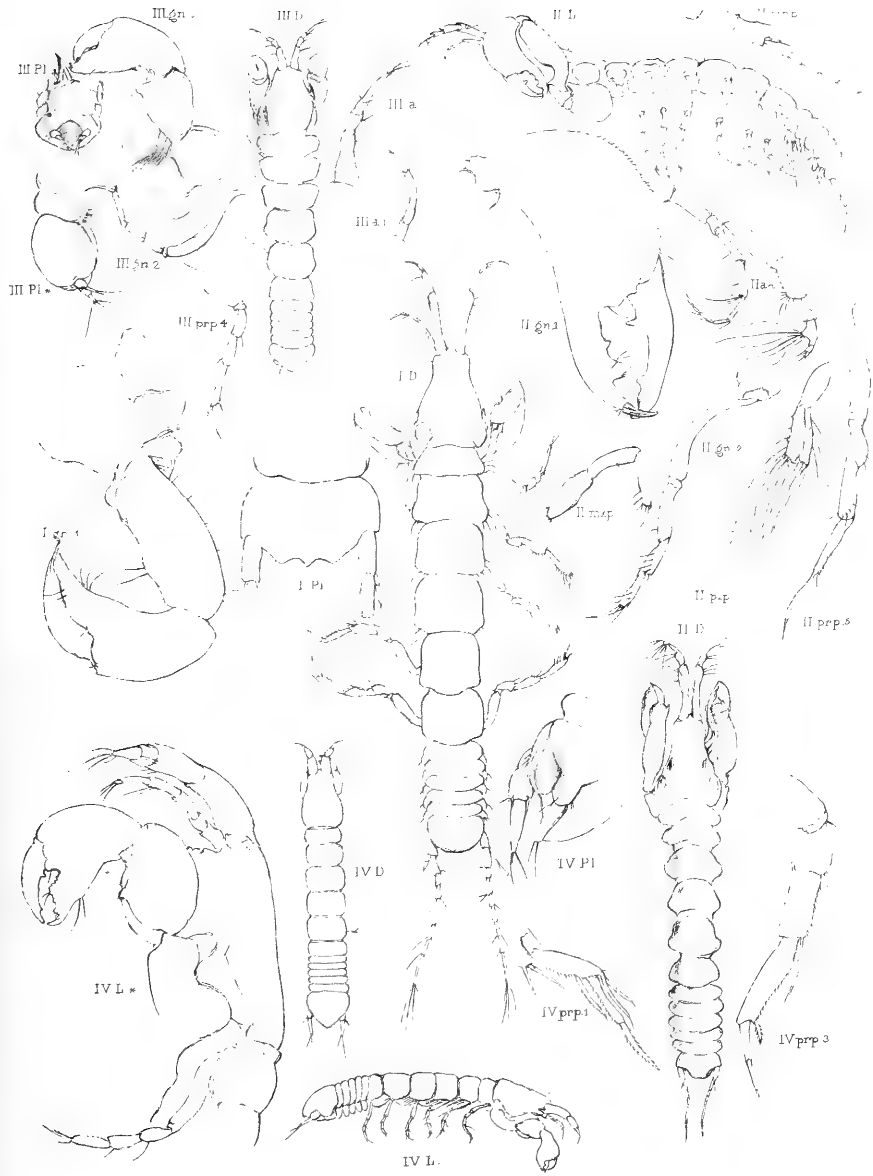

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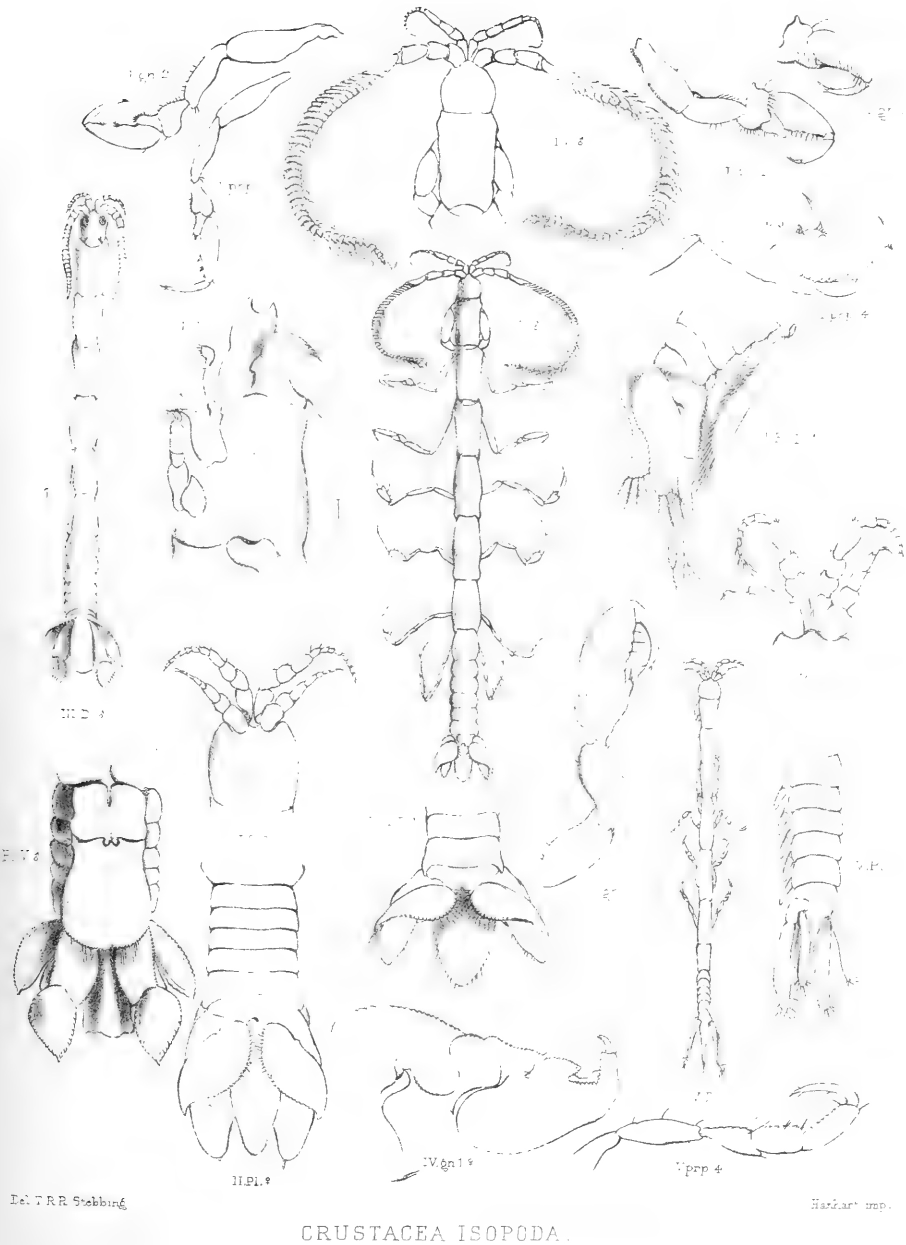

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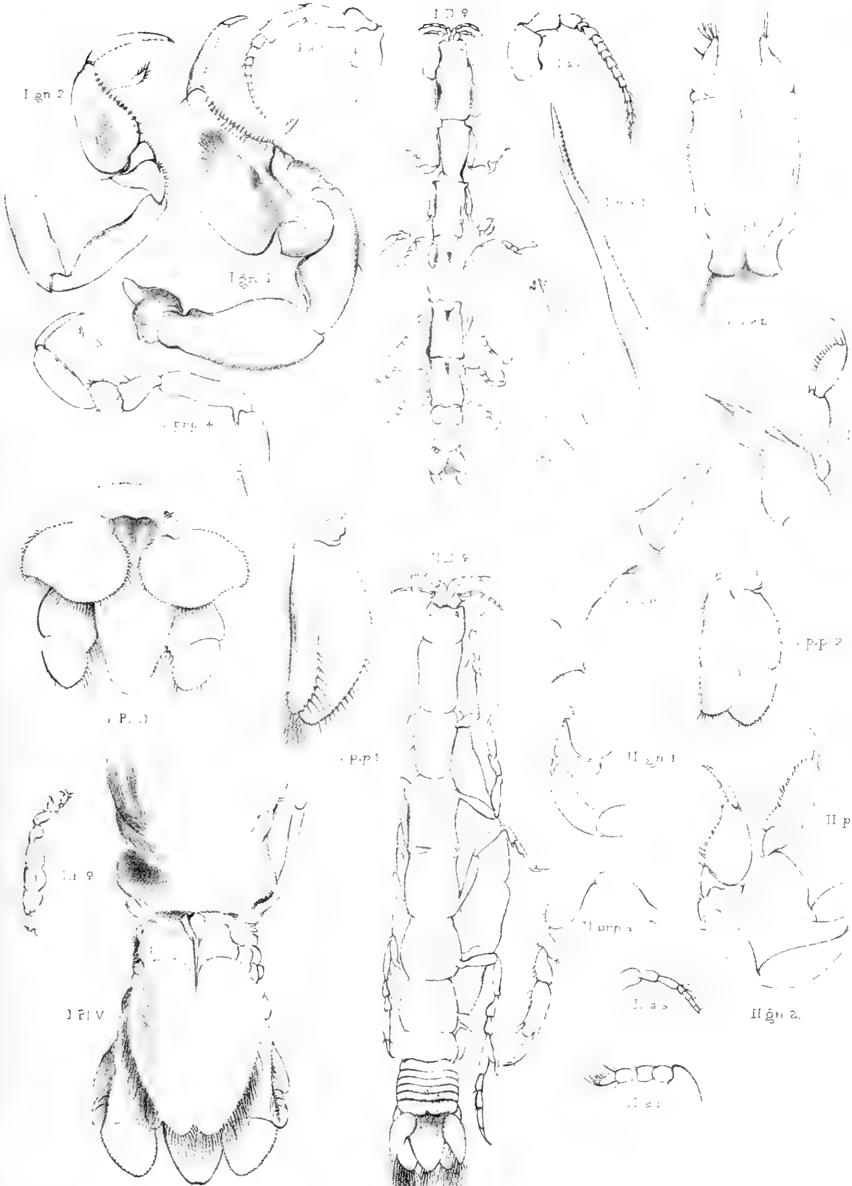
I. Anthelura elongata, ♂ *II. A. elongata* ♀ *III. Anthura gracilis*, ♂
IV. A. gracilis ♀ *V. Hyssura producta*.



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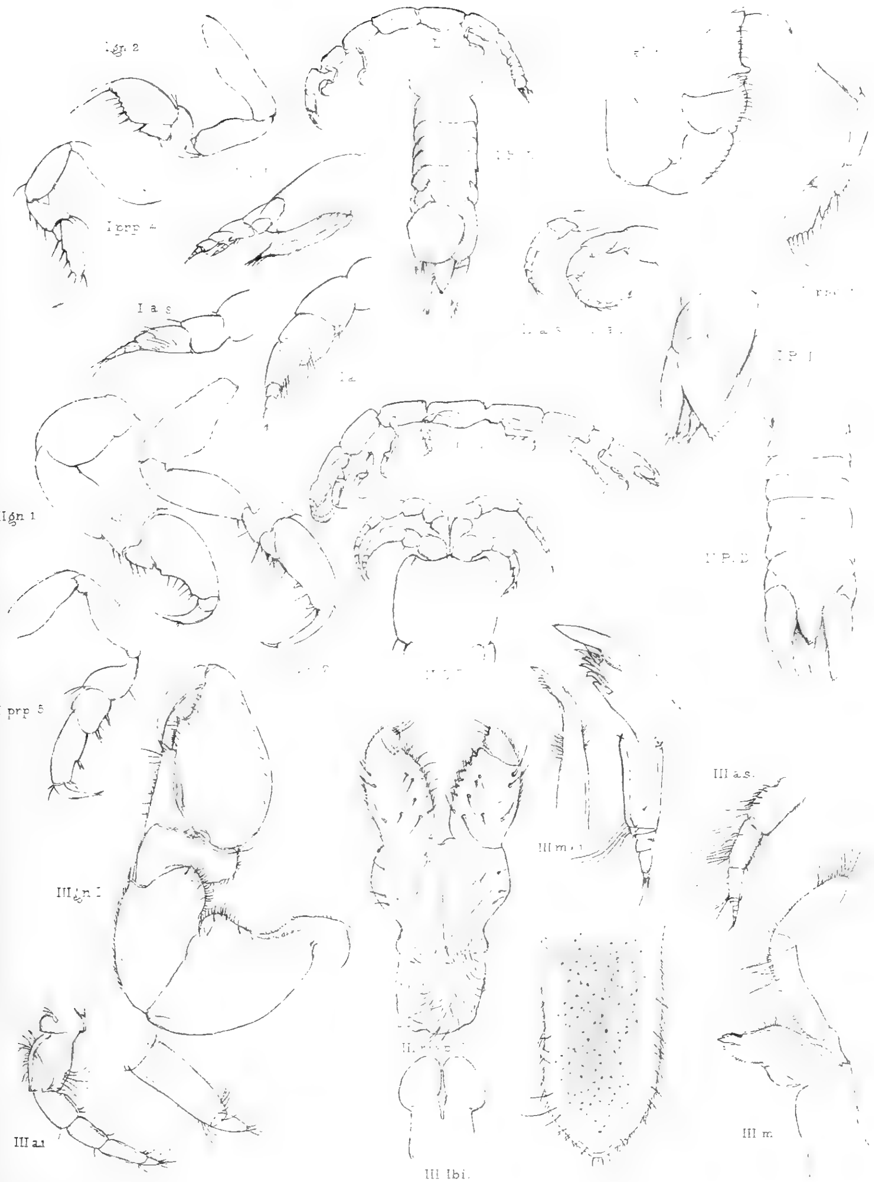

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Continued on page 3 of Wrapper.

VI. *On the Remains of a Gigantic Species of Bird* (Gastornis klaasseni, *n. sp.*) *from the Lower Eocene Beds near Croydon.* *By* E. T. Newton, *F.G.S.*[1]

Received March 17th, 1885, read May 5th, 1885.

[Plates XXVIII., XXIX.]

CONTENTS.

I.—Introduction.

THE discovery of the interesting fossil remains which form the subject of the present communication is due to the zeal of Mr. H. M. Klaassen, who obtained them from the "Woolwich and Reading Beds" of the Lower Eocene series, exposed during the excavation of the Park-Hill railway-cutting, near Croydon. These fossils are unmistakably avian, and show that, in early Eocene times, England was inhabited by a race of birds which were at least as large as, and far heavier in build than, any recent Ostrich, and must, indeed, have equalled in their proportions some of the more massive forms of the New-Zealand Moas. There is no evidence, however, of their having attained to the height of the taller species of *Dinornis.*

A full account of the geological features of the Park-Hill railway-cutting is given by Mr. Klaassen in his paper read before the Geologists' Association (Proceed. vol. viii. p. 226, 1883), and the horizon from which these fossils were obtained is pointed out below (p. 158).

It was during the early part of the year 1883, when the excavation of the northern part of the Park-Hill cutting was carried down to the "Blue" and "Mottled Clays" (see section, p. 158), that Mr. Klaassen obtained some pieces of bone from the edge of the middle basin-shaped "Lignite-bed" (*g*), and these he was good enough to bring

[1] Communicated by Prof. Flower, LL.D., V.P.R.S., P.Z.S.

to me for examination. Three of them proved to be parts of one bone, the almost perfect ulna of *Coryphodon croydonensis* (*vide* Proc. Geol. Assoc. vol. viii. p. 250, 1883). The condition of this bone and of the other fragments, the nature of which could not then be determined, showed that they had been broken by the workmen in extracting them, and suggested the probability of their having been perfect until removed from their resting-place. The interest of this discovery induced Mr. Klaassen to spare no trouble in trying to obtain more specimens, and before long he brought me a large mass of "Blue Clay" containing parts of a much broken bone still imbedded in the matrix. A pair of condyles were partly exposed, and at first it was thought to be a femur of the *Coryphodon*; but on clearing away the clay it was soon obvious that the bone was avian and not mammalian—it was, in fact, the tibio-tarsus of a gigantic bird (Pl. XXVIII. figs. 1–3), rivalling in size some of the larger species of *Dinornis*. The greatest care was taken to fit the broken pieces together; but, unfortunately, the proximal end was wanting, as well as a part of the shaft a little above the condyles, so that the proper length of the bone and the exact form of the hinder part of the distal articular surface were uncertain.

Mr. Klaassen's continued perseverance and liberality were rewarded by the acquisition of some more specimens, which proved to be the distal end and part of the shaft of another tibio-tarsus (Pl. XXIX. figs. 7–11) in a more perfect state of preservation and larger than the one previously obtained, but otherwise exactly resembling it, so that we were no longer in doubt as to the form of the distal end of the bone. Subsequently part of a large femur and a few other specimens were found. The femur (Pl. XXIX. figs. 13–15) and a portion of the proximal end of a tibio-tarsus were surrounded by a closely adhering black carbonaceous matrix, and were obtained either from the "Blue Clay" or from one of the "Lignite-beds" (*g*), most probably the latter.

Fortunately we are in no doubt as to the age of these avian remains, for Mr. Klaassen, being well acquainted with the various strata exposed in the Park-Hill section, knew the beds from which the specimens came, and most of them when brought to me were still surrounded by their matrix of blue or black clay. The bones are of a black or dark-brown colour, and their mineral condition is like that of so many Lower Eocene fossils, namely, infiltrated with iron pyrites, which renders them very hard and heavy. Although these remains were obtained at different times, extending over some months, they were all found in the north cutting at Park Hill and within a distance of about 200 yards of each other.

Portions of five tibio-tarsi and part of a femur have been found, and these indicate at least four individuals, three adults and one very young bird. The bones vary somewhat in size, but there is no good reason for supposing that they belong to more than one species. All the specimens have been presented by Mr. Klaassen to the Geological Survey Museum, Jermyn Street.

II.—Description of the Specimens.

Tibio-tarsi. The first specimen to be described is that represented by figures 7 to 11, Pl. XXIX.; it is the lower 4 or 5 inches of a left tibio-tarsus, the upper portions of which were not recovered, although the recent fracture shows that more of it was present. So much of the bone as we have is very perfectly preserved, and allows every detail of its structure to be studied, although in some parts it is covered with small rounded bosses of iron pyrites.

The most striking character of this bone, when seen from the front (Pl. XXIX. fig. 7), is the osseous supratendinal bridge (*s.t.b*), which at once proves it to be of avian origin. The groove (*t.c*) for the tendon of the common flexor muscle of the digits, which passes under the osseous bridge, is deep, and situated towards the inner side of the bone. The inner margin of this groove is well defined; but on the outer side there is no distinct boundary. The upper margin of the bridge is thin, and curves from the inner side outwards and upwards; the lower margin has a thickened upturned lip, and is directed outwards and downwards; so that the bridge itself is broadest towards the outer side *. The canal passing beneath the osseous bridge has an almost triangular lower opening, which, in consequence of the projection of the bridge at its lower margin, looks downwards and inwards. Immediately above the bridge the inner margin of the groove presents a thickened and rugose surface for the attachment of the oblique ligamentous bridge, the lower and outer end of which was fixed to the oval roughened space (*l.a*) seen on the outer part of the osseous bridge. On the outer side of the oval space (*l.a*) there is a depression or groove (*t.g*) for the tendon of the *peroneus* muscle, and the roughened surfaces on each side of this groove doubtless indicate the points of attachment of the second ligamentous arch. Below the osseous bridge, and just above the margin of the intercondylar trochlear surface, there is a deep depression (*ic.d*); above this is a roughened area, which extends upwards to the outer side of the bridge.

The articular condyles are large, the inner one (*i.c*) being larger then the outer (*o.c*), and projecting inwards beyond the general contour of the bone (Pl. XXIX. fig. 7), while the outer condyle is rather within the line of the outer side of the bone (compare fig. 2, Pl. XXVIII.). The inferior trochlear surface is somewhat rough and irregular: in a front view (Pl. XXIX. fig. 7) it is seen to be concave from side to side. Or, more correctly, the lower surface of the outer condyle forms an angle with that of the inner condyle, the point of junction (*b*) being situated at about the outer third of the bone, and consequently the lower surface of the inner condyle has about twice the width of that of the outer condyle. This angle becomes less marked towards the hinder part of the bone. When the trochlear surface is viewed from below (Pl. XXIX. fig. 11) the greater antero-posterior extent of the inner condyle (*i.c*) is most obvious. On the hinder part (*pt.s*) a definite and regular concavity connects the inner and outer parts of the

* These characters are not well represented in this figure, but are better shown in figure 2.

trochlear surface, while anteriorly the intercondylar depression (*b*, *a*) is seen to form a double angle, an inner obtuse angle at *a*, and a more acute outer one at *b*, the latter being marked by a natural fissure, also seen in the front view of the bone. The trochlear surface curves upwards at the back, and in a side view (Pl. XXIX. figs. 8, 9, *pt.s*) the inner and outer parts are seen projecting well beyond the shaft of the bone, as the prominent condyles (*i.c* and *o.c*) do in front. The inner epicondylar tuberosity (Pl. XXIX. figs. 7, 8, *i.t*) is prominent and angular, the surface of the bone in front, as well as below and behind it, being distinctly concave. The outer epicondylar tuberosity (*o.t*) is also well developed, but rounded and not quite so prominent as the inner one; it is placed towards the back of the condyle, and a flattened space intervenes between it and the rugosity a little above it (*fib.*), the latter probably indicating the position of the lower end of the fibula. Below and in front of the outer tuberosity is a deep depression (Pl. XXIX. fig. 9). The section of the shaft at about an inch and a quarter above the bridge is nearly semicircular (Pl. XXIX. fig. 7 *a*). The parietes of the bone at this part are about 6 or 7 millimetres thick, and the interior is filled with a remarkable network of cancellated bony tissue, now covered with iron pyrites.

The second specimen (Pl. XXVIII. figs. 1, 2, 3) is a right tibio-tarsus, somewhat smaller than the one just described, but having a large part of the shaft preserved. The lower and front parts of the distal articulation are quite perfect, as well as the bony bridge, and a close comparison of these important parts with the first example has not revealed any difference between them worthy of notice, except as regards size. Indeed so close is their agreement, that if they had been of the same size one could scarcely have resisted the conclusion that they were right and left bones of the same individual. It will be unnecessary therefore to say more about the form of the lower end of this bone, except that, as there is a longer piece of the inner side of the shaft preserved, it shows in a more marked manner the extent to which the inner condyle projects inwards beyond the general direction of the shaft (Pl. XXVIII. fig. 2).

About 10 inches of the upper part of the shaft of this bone is preserved, including the whole length of the fibular articulation (*fib.art*); but, unfortunately, some of the pieces connecting the shaft with the distal parts have not been recovered. In the figure, however, these parts are restored in outline from the third specimen, to be presently described (Pl. XXIX. fig. 12), and as this supplies the part of the shaft which was wanting, we can be almost certain of the exact relation of the upper to the lower part of the bone. After a careful comparison of the two specimens I do not think that the bone before it was broken could have been much longer or shorter than 51 centimetres (it is represented, half natural size, in fig. 2, Pl. XXVIII.). The outer side of the shaft, from end to end, is nearly straight, or perhaps a little convex, the fibular articulation (*fib.art*) projecting beyond the general contour. The inner surface is deeply concave from end to end, even in the present condition of the bone, and when perfect the upper end must have projected still further inwards, and so increased this curvature. The position and extent of the fibular articulation (*fib.art*) is shown in the figures 1 & 2 between the two stars (*). In this region, especially towards the upper part, the hinder surface of the bone is flattened, and a shallow groove runs along close to the fibular articulation, ending in the aperture for the tibial artery (Pl. XXVIII. fig. 1, *t.a*) near its lower end. The front and inner sides of the bone, at the upper part, are rounded, while the outer side is angular. The inner and outer sides retain these characters, more or less, throughout their length; but the anterior and posterior surfaces reverse their characters, that is to say, the front surface which is convex above becomes less so in the middle of the shaft, and towards the lower end it is flattened and then deeply grooved. The hinder surface soon loses the flattening of its upper part and at its lower end becomes regularly rounded. About 3 or 4 inches of the proximal part of this tibia are undoubtedly wanting, but the commencement of the buttresses, which spread upwards to form the cnemial crests, are still to be seen. The beginning of the outer crest is shown in fig. 2, at the upper end and a little in front of the fibular articulation, but is only traceable for a very short distance down the front of the bone. Nearly in the middle of the upper end of the shaft is the beginning of the anterior cnemial crest, and from this a ridge runs downwards and inwards so as nearly to reach the inner side of the shaft about halfway down. Continuing downwards this ridge becomes rougher and forms the inner edge of the tendinal groove (*t.c*). On the inner side of the upper end of the shaft a portion of the internal articular rugosity is preserved (*i.a.r*).

Measurements of tibio-tarsi in millimetres.

	Specimen No. 1, fig. 7.	Specimen No. 2, fig. 2.
Greatest width from inner to outer tuberosity	105	90·3
Greatest width across front of condyles	92	84·5
Greatest width across back of trochlear surface	69	
Greatest antero-posterior extent of inner condyle	105	
Greatest antero-posterior extent of outer condyle	79	
Width of lower aperture of bridge	14	12·0
Narrowest part of bridge between upper and lower apertures	20	19·0
Antero-posterior diameter of shaft one inch above bridge	33	
Lateral diameter of shaft one inch above bridge	61	
Antero-posterior diameter at middle of fibular articulation	...	36·0
Lateral diameter at middle of fibular articulation	...	50·0
Probable length of bone when complete	590	510·0

The third portion of a tibio-tarsus (Pl. XXIX. fig. 12) consists of about six inches of a left shaft immediately above the bony bridge. The depth and position of the groove, as well as the general form of the bone, agree with the specimens above described, and I have no doubt as to their belonging to the same kind of bird. On the outer side of this bone (Pl. XXIX. fig. 12, *fib.*) there is a rough and somewhat projecting portion, which begins about $2\frac{1}{2}$ inches above the bridge and extends upwards for about $1\frac{1}{2}$ inch. This rugosity seems to be the attachment for the lower end of the fibula. The form and direction of the ridge, which passes upwards from the inner side of the bridge, is clearly shown, as well as the manner in which the bone recedes from the outer side of the tendinal groove. This fragment of a tibio-tarsus is intermediate in size between the two first mentioned, and consequently represents a third individual. The specimen is chiefly interesting because it gives us the form of that part of the tibio-tarsus which is wanting in the other examples, and enables one to restore the outline of the bone, as is done in figure 2, where the restored parts are only lightly shaded.

The fourth portion of a tibio-tarsus was found with the femur described below, and is too much crushed to allow anything to be said as to its form. On one side the upper half of the fibular articulation is shown, and beyond this the bone is continued upwards for about three inches, but is still imperfect.

The fifth portion of a tibio-tarsus is represented by two pieces (Pl. XXVIII. fig. 4). These two fragments evidently belong to the same bone; but the intermediate parts are wanting. The manner in which the lower end of this bone was denuded and rounded before being fossilized, as well as the porous and laminated nature of the bone of the shaft, seemed to indicate that it was not fully ossified, and when comparing the large tibio-tarsi with those of *Dinornis* in the British Museum, the immature tibiæ of that genus attracted my attention, and gave the clue to what appears to be the correct interpretation of this specimen. The close resemblance between our specimen and the lower end of the immature *Dinornis* tibia (B. M. no. 47,444) leaves little room for questioning its being of a similar nature. There are minor points of difference, but only such as one would expect in birds which were not specifically identical. Of course in this early condition the bridge is not ossified, nor indeed are any of the prominent adult characters yet developed. Provisionally, therefore, this bone is regarded as a very young tibia of the same species as the larger bones above described.

Femur. Two pieces of a femur (Pl. XXIX. figs. 13–15), representing perhaps rather more than half the entire bone, were found either in the "Blue Clay" (*f*), or in one of the "Lignite-beds" (*g*), and the dark carbonaceous matter, infiltrated with iron pyrites, which adheres to the surface of the bones makes it most probable that they came from the latter. The interior of this femur is filled with a close network of cancellated bone, now covered with crystals of iron pyrites. One of the pieces is the proximal four inches of a left femur, including the greater part of the head with the articular surface and front part of the trochanter, the upper part having been denuded. The second piece of this femur consists of about three inches of the shaft a little above the condyles; it does not join the proximal piece, two or three inches of the shaft being absent; but there is little doubt as to their being parts of the same bone.

One of the most marked peculiarities of this bone is seen when it is viewed from the front (Pl. XXIX. fig. 13), namely, the head stands well above the trochanter, and it is evident this was more obvious when the parts were perfect. In this front view the superior articular surface (*s.art*) is seen to extend obliquely downwards and outwards from the head to the trochanter, presenting only a slight concavity, and this chiefly at its inner end, where it curves up to the rounded head (*a.h*). The outer part of this articular surface also curves slightly upwards, showing that the trochanter (*tr*), when perfect, projected a little above this surface, as well as outwards beyond the general direction of the shaft. The superior articular surface is slightly convex from before backwards, and overhangs the hinder part of the shaft as a distinctly rounded tuberosity (Pl. XXIX. fig. 15, *p.t*). Just below this, on the back of the bone, there is a depression, partly due to the crushing of the bone in this region. Anteriorly the trochanter is continued into a very prominent crest (*a.c*), which is best seen in the end view of the bone (Pl. XXIX. fig. 15). This crest is continued along the front of the shaft, so far as this is preserved, and consequently, at the point where the bone is broken, the transverse section (Pl. XXIX. fig. 13 *a*) shows the antero-posterior diameter to be greater than that from side to side. The second piece of this femur (Pl. XXIX. fig. 14) most probably held the position indicated in figures 13, 14; the cross section of its proximal end (fig. 14 *a*) is more rounded than the lower end of the proximal piece, to which it is opposed in the figure, although the crest at its outer edge is still seen. The distal end of this piece is nearly quadrate in cross section, and seems to indicate a flattening of the bone previous to its expansion into the condyles. The bony walls of the shaft in the middle region are very thick, varying in different parts of the circumference from 8 to 13 millimetres.

Measurements of femur in millimetres.

Width from head to outer tuberosity of trochanter (*a.h–tr*, Pl. XXIX. figs. 13, 15)	115
Width from front to back in same region (fig. 15, *a.c–pt*)	104
Greatest diameter of section of shaft (fig. 13 *a*)	66
Least diameter of section of shaft (fig. 13 *a*)	46
Greatest diameter of section of shaft (fig. 14 *a*)	58
Least diameter of section of shaft (fig. 14 *a*)	48

This femur is provisionally regarded as belonging to the same species as the large tibio-tarsi; but there is no direct proof that such is the case, beyond their agreement in size, and being found in the same place.

It will be seen from the above description that the six specimens of birds' bones from the Park-Hill cutting represent at least four different individuals, and as they were all from a comparatively small area, they seem to indicate that these large birds were very numerous in the locality in early Eocene times, and lead us to expect that, when these same marshy beds are exposed in other places, more specimens will be discovered.

III.—Comparison of the Croydon Bird-remains with other Eocene Birds.

About forty species of birds have been described from Eocene strata in different parts of Europe and America, but only a few are sufficiently near to our Croydon fossils to render a comparison with them desirable. The only British bird which makes any approach in size towards these from Croydon is the *Dasornis londinensis* of Prof. (now Sir Richard) Owen (Trans. Zool. Soc. vol. vii. p. 123, 1872); but as this genus is only represented by a portion of a skull from the London Clay of Sheppey, no comparison with it can be made.

M. Hébert, in the year 1855 ('Comptes Rendus,' vol. xl. p. 579), gave the name of *Gastornis parisiensis* to a large avian tibio-tarsus from the "Argile Plastique" of Meudon, to which attention had been called by M. Constant Prévost a short time before ('Comptes Rendus,' vol. xl. p. 554). Subsequently portions of a femur, another tibio-tarsus, a fibula, and some phalanges were found. In 1856 Sir R. Owen discussed the affinities of this bird before the Geological Society (Quart. Journ. Geol. Soc. vol. xii. p. 204); and M. Milne-Edwards also gave a very full description of these remains in the 'Oiseaux Fossiles' (vol. i. p. 165, 1867–68).

Dr. Victor Lemoine, in his 'Recherches sur les Oiseaux Fossiles des Environs de Reims' (part i. 1878, part ii. 1881), has described a number of birds' bones from Lower Eocene strata, some of which are believed to belong to two new species of *Gastornis*—one, equalling in size the *Gastornis parisiensis*, is called *Gastornis edwardsi*, and the other, which is much smaller, is called *Gastornis minor*. Of the larger species a good part of the skeleton has been found, including parts of the skull, vertebræ, pelvis, femur, tibio-tarsus, tarso-metatarsus, and toe-bones, also a coracoid, a fragment of a sternum, and parts of the wing. (See also Bull. Soc. Géol. Fr. sér. 3, vol. xiii. p. 412.)

M. L. Dollo has described the distal half of a large femur from the Lower Eocene (Landinien) of Mesvin, near Mons (Bull. du Mus. Roy. Belg. vol. ii. p. 297, 1883), which he refers to *Gastornis edwardsii*.

The name of *Diatryma gigantea* has been given by Prof. E. D. Cope to a large avian tarso-metatarsus from the Eocene strata of New Mexico (Proc. Ac. Nat. Sci. Philad. ser. 3, vol. vi. p. 10, 1876), which is said to resemble *Gastornis*.

The Croydon birds' remains are evidently more nearly related to *Gastornis* than to any other known form, and with this genus it is now proposed to compare them.

A plaster cast of the original tibio-tarsus of *Gastornis parisiensis* from Meudon is preserved in the British Museum of Natural History at South Kensington, and the bones from Croydon have been carefully compared with this, as well as with the published descriptions and figures. When the Croydon tibio-tarsus (Pl. XXVIII.

fig. 2) was laid by the side of this cast, the resemblance between them was more striking than one was led to expect from an examination of the figures only.

The tibio-tarsus of *G. parisiensis* is intermediate in size between the two more perfect Croydon specimens (Pl. XXVIII. fig. 2, Pl. XXIX. fig. 7); but its condyles are too much broken to allow of any close comparison of these parts, and the form of the upper end is deceptive on account of its having been crushed and spread out laterally (*vide* 'Oiseaux Fossiles,' pl. 28). In general form the French and English specimens seem to be much alike; but the shaft is proportionally more robust in *G. parisiensis*, and the back of the bone, just above the condyles, is flatter and broader in proportion to the front of the bone, while in the Croydon specimen this hinder region (Pl. XXIX. fig. 10) is more rounded, and falls away more towards the outer side. In the Croydon bone also the inner and front part stands out more boldly, where it curves down to the inner tuberosity (Pl. XXIX. figs. 7, 8, *i.t*). The Meudon bone has the lower margin of the supratendinal bridge broken, and consequently one cannot speak of it with certainty; but the lower aperture seems to be more nearly in the middle, and to look more directly forward than it does in the Croydon specimens; also the intercondylar depression is much deeper; this and some other differences, however, are probably due to the imperfection of the French specimen. The groove for the tendon of the peroneus muscle, which is distinctly seen just above the outer condyle in the Croydon bone (Pl. XXIX. fig. 7, *t.g*), is not nearly so well marked in the Meudon bird.

The tibio-tarsus of *Gastornis parisiensis* differs, therefore, from that of the Croydon bird in having the shaft proportionally stouter, the inner condyle not projecting so much inward, the back of the bone above the condyles flatter and broader, the supratendinal bridge more nearly central, possibly the intercondylar depression deeper, and little or no groove for the peroneus tendon.

The Meudon and Croydon femora are both too imperfect for satisfactory comparison; but it is clear that both have a very prominent crest extending along the front of the shaft, beginning at the trochanter, where it is most strongly developed, and reaching perhaps three fourths the length of the bone, becoming less and less as it proceeds distally.

Gastornis edwardsii seems to be less like the Croydon bird than does *G. parisiensis.* The tibio-tarsus of *G. edwardsii* figured by Dr. Lemoine (*loc. cit.* pl. 2) is proportionally a shorter and stouter bone, and the supratendinal bridge is more nearly in the middle. The Croydon remains give no evidence of the double curvature of the outer side of the bone, a character in *G. edwardsii* to which Dr. Lemoine calls special attention. The imperfection of our examples renders it somewhat uncertain, but I do not think that they could ever have had this double curvature.

The second tibio-tarsus figured by Dr. Lemoine (*l. c.* pl. 6. figs. 4, 5) has the condyles and adjacent parts preserved, and these, although in a general way corresponding with the Croydon specimens, show some important differences. The inner condyle does not project inwards to the same extent, and consequently one sees but little curvature of the inner side of the bone. The form of the trochlear surface towards the back is different (*l. c.* pl. 6. fig. 5), the outer condyle being broad and having a supplementary groove (compare this with our fig. 11, Pl. XXIX.).

The femur of *Gastornis edwardsii* (Lemoine, pl. 1) has the articular head higher than the trochanter, and the superior articular surface is in consequence placed obliquely, thus presenting one of the most peculiar characters of the Croydon femur. On the other hand, the trochanter projects more beyond the outer contour of the shaft, and the anterior crest seems to be less prominent than in the Croydon femur.

It is evident that the Croydon bird was more nearly related to the *Gastornis* than to any other known form; but it will, I think, be sufficiently obvious from the above comparisons that it cannot be referred to any one of the species yet described, the differences being too great to be lightly passed over. Among recent birds some nearly allied genera, such for example as the Duck and Goose, do not present greater differences between their femora and tibio-tarsi than those which exist between *Gastornis* and the Croydon bird, and it is possible, therefore, that the differences which have been pointed out may eventually prove to be of generic importance. However, it is not deemed expedient to introduce a new genus, but rather, until additional evidence is obtained, to refer the English specimens to the genus *Gastornis*; and in order that the name of the gentleman, who has taken so much pains to secure these fossils, may be associated with them, it is proposed to call this new Eocene bird *Gastornis klaasseni*.

IV.—Comparison of Gastornis with Dinornis and other Extinct Birds.

To what group of birds, living or extinct, is the *Gastornis* most nearly related? The interest surrounding this question has been fully appreciated by all who have written about these Eocene birds, and it has been treated with especial care by Sir R. Owen, and MM. Milne-Edwards and Lemoine, the more extended material which the last-named gentleman has had at his disposal rendering his remarks of peculiar interest. Seeing, however, that the Croydon remains have the lower end of the tibio-tarsus in a much more perfect condition than any of the continental examples, and that this part of the skeleton is very important for determination, it seems desirable to supplement what has already been done by a further comparison.

The gigantic size of these bones reminds one so forcibly of the New-Zealand *Dinornis* remains, that, although their geological horizons are so different, and their geographical positions so widely separated, one is led in the first place to take them for comparison. *Dinornis* has the supratendinal bridge and canal placed nearer the inner side of the tibia than they are in either of the forms of *Gastornis*, and these characters are very constant in all the species of *Dinornis*, although the form of the bone varies. On account of the curvature of the inner side of the tibio-tarsus and the projection of the inner condyle, the *Dinornis crassus* is the species most like the *Gastornis klaasseni*;

but these characters are more exaggerated, and the shaft of the bone is more flattened from before backwards, than in the latter species. The inner condyle of *G. klaasseni*, when viewed from the front, is seen to be almost vertical, and the inner and outer tuberosities project well beyond the condyles, while in *Dinornis crassus* the inner condyle is directed obliquely upwards and inwards, and the front of the condyles is the widest part of the distal end of the tibio-tarsus. In *D. crassus* the intercondylar margin of the trochlear surface rises higher than in the Croydon bird, and forms a distinct and gently curved line, depressed in the middle, and continued over each condyle. In consequence of this conformation the intercondylar depression is neither so deep nor of the same form as it is in *Gastornis klaasseni*, and the general contour of the condyles, in this front view, is markedly different in the two forms. In the latter the condyles are laterally compressed, while in *Dinornis* they are wide, and shaped somewhat like an hour-glass. The indenture of the inferior trochlear surface, as seen from the front, in *Gastornis klaasseni* (Pl. XXIX. fig. 7, *b*) is at about one third the width of this surface from the outer side, while in *Dinornis crassus* the deepest indenture is towards the inner side.

The femur of *Dinornis* does not present the peculiarities which characterize that of *Gastornis*. The trochanter stands above the articular head and the superior articular surface, as it leaves the head, curves upwards; while in *Gastornis*, as we have seen, the superior articular surface passes obliquely downwards. The anterior crest in *Dinornis* is not so well developed, and extends only a short distance along the shaft.

The large fossil bird from Australia, *Dromornis* (Owen, Zool. Trans. vol. viii. p. 381, and vol. x. p. 186), has the superior articular surface of the femur nearly horizontal, and therefore, in this particular, approaches somewhat to the *Gastornis*; but the other parts of the bone are unlike. At first sight the tibio-tarsus of *Dromornis* seems to resemble that of *Gastornis*; but there is no evidence of the supratendinal bridge having been ossified, and the canal is in the middle of the bone.

The great *Epiornis* of Madagascar is less like *Gastornis* than the extinct forms already noticed. Little need be said concerning the smaller birds, which have become extinct within comparatively recent times, such as the *Solitaire*, *Dodo*, *Aptornis*, *Notornis*, and *Cnemiornis*, for only the last of these (and possibly *Notornis*) makes a near approach to *Gastornis* in the form of its tibio-tarsus.

Cnemiornis is evidently nearly related to the Geese of the present day, and agrees with them in most of those characters, to be presently pointed out, which are believed to show some affinity between *Gastornis* and the Anserine birds (*Chenomorphæ*).

V.—Gastornis compared with Recent Birds.

M. Hébert was impressed with the close resemblance between the Meudon tibio-tarsus and that of the Swan and the Goose, and this resemblance is even more marked in the Croydon fossils. Taking the tibio-tarsus of the Common Goose for comparison, one notices a similar curvature of the inner side and projection of the inner condyle beyond the contour of the shaft (fig. 5); also the rounded inner side of the shaft and its sharp outer or fibular margin; the greater antero-posterior extent of the inner condyle as compared with the outer; the form of the trochlear surface; the position of the groove for the peroneus tendon; and the manner in which the ridge, rising from the inner side of the bridge, may be traced upwards to the procnemial crest. In all these points the two tibio-tarsi are remarkably alike. The fibular crest is a little more prominent in the Goose than in the Croydon specimen; but the latter has this crest more projecting than could have been inferred from the Meudon example. Notwithstanding these resemblances, there are some very decided points of difference. In the Goose the supratendinal bridge and the canal which passes under it are in the middle line of the bone, while in the Croydon species both are placed towards the inner side. The Meudon species is nearer to the Goose, inasmuch as its bridge is almost in the middle. The Goose has the lower aperture of the bridge looking directly forwards, and as nearly as possible in the middle. The lower margin of the aperture is formed by a transverse ridge of bone, and is rather more prominent than the upper margin. In the Croydon fossil the lower aperture of the bridge looks obliquely downwards and inwards, and is considerably nearer to the inner than to the outer side; and the lower margin of the aperture is not so prominent as the upper. The bridge itself, in the Goose, is in a depression, while in these fossils it stands prominently forward. The deep intercondylar depression seen in the fossil is only slightly indicated in the Goose (Pl. XXVIII. fig. 5); in the Swan this depression is perhaps a little deeper.

The New-Holland Goose (*Cereopsis novæ-hollandiæ*) makes a nearer approach to *Gastornis*, for while its tibio-tarsus agrees with the Common Goose in all those points in which the latter agrees with *Gastornis*, it has, in addition, both the tendinal canal and the aperture of the bridge placed towards the inner side. *Cereopsis* has also a more definite intercondylar depression; but still this depression is nothing like so deep as in *Gastornis*.

The Herring-Gull (*Larus argentatus*, Pl. XXVIII. fig. 6) has the lower end of its tibio-tarsus in some respects nearer to *Gastornis* than *Cereopsis*; but in other particulars it differs more widely. In this Gull the tendinal canal is well towards the inner side, and the lower aperture of the bridge is also towards the inner side, and looks downwards and inwards. At the same time the lower margin of this aperture is less prominent than in the Goose, and there is a shallow intercondylar depression, thus making an approach towards the deep depression of *Gastornis*; indeed, the same ridge and depression may be seen in both, although the ridge just below the bridge-aperture is stronger in the Gull. The roughened prominence seen in *Gastornis* at the outer side of the lower aperture of the bridge (Pl. XXIX. fig. 7, *l.a*) is present also in the Gull. The chief differences between the Gull's tibio-tarsus and that of *Gastornis*; are the more rounded and straighter shaft, the smaller proportionate size of the inner condyle, and the different contour of the latter when seen from the side.

Among the Rails, the one which seems to approach most nearly to *Gastornis* is the *Ocydromus australis*. In this form, and some others at least of the group, the lower end of the tibio-tarsus turns inwards, and the canal and bridge are towards the inner side; but the condyles are thick as in the Bustard and Turkey, and the inner one is smaller than the outer; besides this, there is no definite intercondylar depression. The Rails seem to be further removed from *Gastornis* than are either of the three recent forms noticed above.

The Bustard (*Otis tarda*) does not have the lower end of the tibio-tarsus turned inwards, the condyles are thick, and the intercondylar trochlear margin rises high. In all these characters it is unlike *Gastornis*, and approaches rather to the *Apteryx* and *Dinornis*. The tendinal canal and lower aperture of the bridge are towards the inner side. The deep intercondylar depression is the character which at first would seem to ally the Bustard to *Gastornis*; but the form of this depression appears to me quite unlike what we find in *Gastornis*, and may merely indicate a similarity of function in two different types of birds.

The Tinamou (*Rhynchotus rufescens*) has the canal and bridge-aperture very close to the inner side, and there is a moderately deep intercondylar depression; but the thick condyles and general form of the lower end of the tibio-tarsus resemble the form of that bone in *Otis* and *Apteryx*, and are unlike *Gastornis*.

One is naturally led, when comparing these large fossil birds with recent forms, to look at the Ostrich and its allies; but the recent Ratitæ seem further removed from our Eocene fossils, in so far at least as regards the tibio-tarsus, than do some of the Carinatæ, the lower end of this bone being unlike that of *Gastornis*, and, moreover, the ossified supratendinal bridge, which is such a distinctive feature of nearly all carinate birds, is wanting in the living Ratitæ, although present in the extinct *Dinornis*.

The femur of *Gastornis* is unlike that of any recent bird with which I am acquainted; but the femur of *Cereopsis* seems to show some slight indication of the peculiar obliquity of the superior articular surface, which is so striking a character of *Gastornis*.

The comparison of the Croydon *Gastornis*-remains with recent birds seems to show that most of the characters of its tibio-tarsus are to be found within the limits of the old group of the Palmipedes, the common domestic Goose and the New-Holland Goose (*Cereopsis novæ-hollandiæ*) having perhaps the greatest resemblance as to general form. The median position of the tendinal canal and lower opening of the bridge, as well as the absence of a definite intercondylar depression, are doubtless important points in which the Common Goose differs from the fossil; but we have seen that the New-Holland Goose makes a nearer approach, and the Herring-Gull has the canal and bridge near the inner side, besides presenting a remarkable similarity in the characters of the intercondylar space, although the depression of this region is not so deep as it is in *Gastornis.* The Bustard, Turkey, and other land-birds have a deep intercondylar fossa, and on this account have been thought to be related to *Gastornis*; but the character of this depression, as already noticed, is unlike that in *Gastornis*, and cannot, I think, be taken as an indication of relationship. It would seem probable, therefore, that the nearest living ally of *Gastornis*, although differing widely from it, is that aberrant form of Goose the *Cereopsis.*

The researches of Dr. Lemoine have shown that *Gastornis* had small wings, although they were proportionally somewhat larger than those of the Ostrich. The parts of the skull which have been found indicate a very large head, as much as fifteen inches in length, and consequently much larger proportionally than in either the Ostrich or *Dinornis*, but more like that of Anserine birds. The large bony tooth-like prominences on each side of the jaw are said to resemble in structure the bony teeth of the *Odontopteryx.* The parts of the sternum which are known do not include the median region, and consequently it is uncertain whether it was Ratite or Carinate. Dr. Lemoine's study of these remains led him to conclude, as others had already done, that *Gastornis* was a special type of bird unlike any living or fossil form, but showing certain points of resemblance to several widely separated groups.

The small size of the wings is sufficient evidence that *Gastornis* could not fly, and such wings are not likely to have been accompanied by a keeled sternum; hence it is highly probable that the sternum of *Gastornis* will prove to be Ratite.

One of the most interesting results of modern palæontological research has been the bridging over of the gulfs which separated certain groups of living animals by the discovery of intermediate types, and birds have been no exception. Of the three groups into which birds are divided, namely, Saururæ, Ratitæ, and Carinatæ, the Saururæ remain widely separated from all others, its sole representative, the *Archæopteryx*, still standing alone in having unankylosed metacarpals and a long tail. The Ratitæ and Carinatæ, on the other hand, do not seem so widely separated as was at one time thought. Prof. W. K. Parker (Trans. Zool. Soc. vol. v. p. 149, 1866) has called attention to the struthious affinities of the Tinamou, which thus forms a link between the Carinatæ and the Ratitæ. *Dinornis* shows us that the supratendinal bridge of the tibio-tarsus may be fully ossified in Ratite birds.

Prof. Marsh has pointed out that *Hesperornis* had a keelless sternum, as well as other characters of the Ratitæ. *Hesperornis* was a peculiarly aquatic bird, in many points resembling *Colymbus*; it forms, therefore, a second link between the Ratitæ and Carinatæ in the direction of the Colymbidæ.

It will be of the greatest interest to know whether or not *Gastornis* had a keeled sternum; for if it should prove to be Carinate, then this bird will be by far the largest of the Carinatæ yet known; but if, as seems most probable, the sternum should be found to be devoid of a keel, then we shall have an altogether new form of the Ratitæ, having affinities with another group of the Carinatæ.

VI.—Table of Characters of the Tibio-tarsus of Birds.

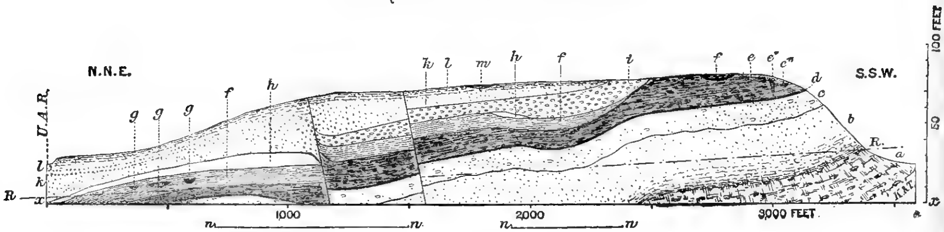
	Gastornis klaasseni.	Cherniornis.	Cereopsis.	Common Goose.	Herring-Gull.	Dinornis.	Solitaire.	Dodo.	Aptornis.	Bustard.	Turkey.	Ocydromus.	Tinamou.	Guillemot.
Inner condyle prominent	*	*	*	*	*	*	*	*	*					
Inner condyle deeper from before backwards than outer	*	*	*	*	*	*	?	*	*			*		
Inner condyle more compressed than outer		*	*	?	*				*	*	*	*	*	
Inner condyle less compressed than outer	*							*						
Tuberosities wider than condyles	*		*	?										
Tuberosities narrower than condyles		*			*	*			*	*	*	*	*	*
Condyles thick						*	*	*	*	*	*	*	*	
Condyles compressed	*	*	*	*	*									*
Lower margin of canal prominent		*	*	*	*	?			*		*	*		*
Lower margin of canal retreating	*						*	*		*			*	
Intercondylar fossa deep	*	?				*	*			*	*		?	
Intercondylar fossa shallow			*	*	*			*	*			*		*
Tendon canal near inner side	*	*	*		*	*	*	*	*	*		*	*	*
Tendon canal in middle				*										
Canal of bridge opens on inner side	*		?		*	*	*	*	*	*		*	*	*
Canal of bridge opens in middle		*		*										
Intercondylar trochlear edge high						*	?	*		*				
Intercondylar trochlear edge low	*		*	*	*						*	*		*
Lower end of tibia turned inwards	*	*	*	*	*	*			?			*		*

VII.—Description of Park-Hill Railway Section.

The Woodside and South-Croydon Branch of the South-Eastern Railway passes through Park Hill, near Croydon, and the cuttings made at that place exposed the series of Lower Eocene beds which have been so carefully described by Mr. H. M. Klaassen in his paper read before the Geologists' Association (Proceed. vol. viii. p. 226, 1883). The accompanying geological section (p. 158), kindly lent by Mr. Klaassen, will show the horizon from which the specimens were obtained. A little below the level of the railway-lines at the south end of the cuttings Chalk occurs (*a*), above which the unfossiliferous "Thanet Beds" (*b*) attain a thickness of 38 feet, and these are succeeded by the "Woolwich and Reading Beds." The last-named formation is made up of several minor subdivisions:—First the "Bottom Bed" (*c*), which is about 15 feet in thickness, and includes several beds, differing in colour, but all more or less sandy, the lowest of them being of a brown tint, and containing *Ostrea bellovacina* as well as Sharks' teeth in some abundance. The next beds, of grey, greenish-brown, and green sands, were a well-marked feature when the cutting was first made; the bright-green bed being especially striking, as it could be clearly seen along the whole length of the southern part of the cutting. The "Lavender-coloured Band" (*d*), about 18 inches thick, marks the upper limit of the "Bottom Bed," and is succeeded by about 20 feet of "Mottled Clay" (*e*), which is the highest bed seen at the southern end of the south cutting. There are in all three cuttings separated by two short tunnels*. The one above described is the south cutting. In the middle cutting the "Mottled Clay" is overlaid by about 10 feet of "Blue Clay" (*f*), this again by a "Pebble-bed" (*i*), which

Park-Hill Section on the Woodside and South-Croydon Railway.

SCALE: { Horizontal 528 feet = 1 inch. Vertical 80 feet = 1 inch.



x. 200 feet above sea-level.
a. Chalk.
b. Thanet Beds.
c. Woolwich and Reading Bottom Bed.
d. Lavender Band.
e. Mottled Clay (fluviatile).
e', *e''*. Pockets.
f. Blue Clay (estuarine).
g. Lignite-beds.
h. Shell-rock.
i. Pebble-beds.
k. Grey Sand.
l. Brown and grey laminated clayey Sand.
m. Drift.
n, *n*. Tunnels.
R. Railway Level.
U.A.R. Upper Addiscombe Road.

in one place attains a thickness of 15 feet; then there are grey sands (*k*), measuring 20 feet at their thickest part, and, lastly, about 10 feet of brown and grey laminated clayey sand (*l*). All the beds dip to the north-west, and the "Mottled Clay," which, with the exception of a small patch (*f*), is the highest bed of the south cutting, is the lowest of the north cutting, and is, indeed, below the level of the railway, but was exposed when digging for the foundation of the tunnel. Throughout the greater part of the north cutting the "Blue Clay" (*f*) is found at the level of the railway and is overlaid, not by the "Pebble-bed," but by a white "Shell-rock" (*h*), and this by the grey and brown sands seen in the middle cutting (*k*). In the "Blue Clay" of the north cutting there are three basin-shaped beds (*g*) of a dark carbonaceous clay, the so-called "Lignite-beds." Not far from these, and in some cases within them, were found the bones described in this communication. For a full account of the Park-Hill section reference should be made to Mr. H. M. Klaassen's paper mentioned above.

* The middle cutting has recently been filled in and now forms part of the tunnel.

VIII.—Synopsis of British Eocene Birds.

With some of the more nearly allied European forms.

Argilornis longipennis, Owen. *London Clay, Sheppey.* Quart. Journ. Geol. Soc. vol. xxxiv. p. 124 (1878), and vol. xxxvi. p. 23 (1880).

Dasornis londinensis, Owen. *London Clay, Sheppey.* Trans. Zool. Soc. vol. vii. p. 145, pl. 16 (1872).

Eupterornis remensis, Lemoine. *Lower Eocene, Reims.* Rech. sur les Oiseaux Foss. de Reims, part 1, 1878, p, 56.

Gastornis edwardsii, Lemoine. *Lower Eocene, Reims.* Rech. Oiseaux Foss. Reims, part i. 1878, p. 13, part ii. 1881, p. 80; also Assoc. Fran. Avanc. Sci. Montpellier, 1879 (1880).—*Lowest Eocene* (*Landinien*), *Mons, Belgium.* Bull. Mus. Roy. Belg. vol. ii. p. 297 (1883).

Gastornis minor, Lemoine. *Lower Eocene, Reims.* Rech. Oiseaux Foss. Reims, part i. 1878, p. 50.

Gastornis parisiensis, Hébert. *Argile Plastique, Meudon. near Paris.* Comptes Rendus, vol. xl. pp. 579 & 1212 (1885); Lartet, ibid. vol. xl. p. 582; Prévost, ibid. p. 554; Valenciennes, ibid. p. 583; Owen, Quart. Journ. Geol. Soc. vol. xii. p. 204 (1856); Milne-Edwards, Les Oiseaux Fossiles. vol. i. p. 165 (1867–68).

Halcyornis toliapicus, König. *London Clay, Sheppey.* Icones Fossiles Sectiles, fig. 193 (1838); Owen, Brit. Foss. Mammals and Birds, p. 554 (1846).

Lithornis emuinus, Bowerbank, *vide* Megalornis, Seeley.

Lithornis vulturinus, Owen. *London Clay, Sheppey.* Trans. Geol. Soc. ser. 2, vol. vi. p. 206, 1842 (read 1839); Brit. Foss. Mammals and Birds, p. 549 (1846).

Macrornis tanaupus, Seeley. *Eocene, Hordwell.* Annals & Mag. Nat. Hist. ser. 3, vol. xviii. p. 109 (1866); Milne-Edwards, Les Oiseaux Fossiles, vol. ii. p. 622 (1868).

Megalornis emuinus, Bowerbank. *London Clay, Sheppey* (*Lithornis*). Annals & Mag. Nat. Hist. ser. 2, vol. xiv. p. 263 (1854); Seeley, ibid. ser. 3, vol. xviii. p. 109 (1866); Milne-Edwards, Les Oiseaux Fossiles, vol. ii. p. 622 (1868–69); Seeley, Quart. Journ. Geol. Soc. vol. xxx. p. 708 (1874).

Odontopteryx toliapicus, Owen. *London Clay, Sheppey.* Quart. Journ. Geol. Soc. vol. xxix. p. 511 (1873).

Ptenornis, Seeley. *Eocene, Hempstead, Isle of Wight.* Annals & Mag. Nat. Hist. ser. 3, vol. xviii. p. 109 (1866); Milne-Edwards, Les Oiseaux Fossiles, vol. ii. p. 622 (1868–69).

Remiornis Heberti, Lemoine. *Lower Eocene, Reims.* Rech. Oiseaux Foss. Reims, part ii. p. 158 (1881).

Small wading Bird, Owen. *London Clay, Primrose Hill.* Brit. Foss. Mammals and Birds, p. 556 (1846).

DESCRIPTION OF THE PLATES.

Index to letters.

a.c. Anterior crest of femur.
a.h. Articular head of femur.
fib. Lower attachment of fibula.
fib.art. Articulation for fibula.
i.a.r. Inner articular rugosity.
i.c. Inner condyle.
ic.d. Intercondylar depression.
i.t. Inner epicondylar tuberosity.
l.a. Lower attachment of oblique ligamentous bridge.
o.c. Outer condyle.
o.t. Outer epicondylar tuberosity.
o.tt. Outer tuberosity of femur.
p.t. Posterior tuberosity of femur.
pt.s. Posterior trochlear surface.
t.a. Foramen for tibial artery.
t.c. Canal for tendon passing under bridge.
t.g. Groove for peroneus tendon.
tr. Trochanter of femur.
s.art. Superior articular surface of femur.
s.t.b. Ossified supratendinal bridge.

PLATE XXVIII.

Fig. 1. *Gastornis klaasseni*, right tibio-tarsus, outer surface partly restored.
Fig. 2. Ditto, same specimen, front view.
Fig. 3. Ditto, same specimen, inner surface.
Fig. 4. Ditto, parts of a tibia of a very young bird, front view.
Fig. 5. Common Goose, right tibio-tarsus, front view.
Fig. 6. Herring-Gull, right tibio-tarsus, front view.

Figs. 1 to 4 half natural size; figs. 5 and 6 natural size.

PLATE XXIX.

Gastornis klaasseni.

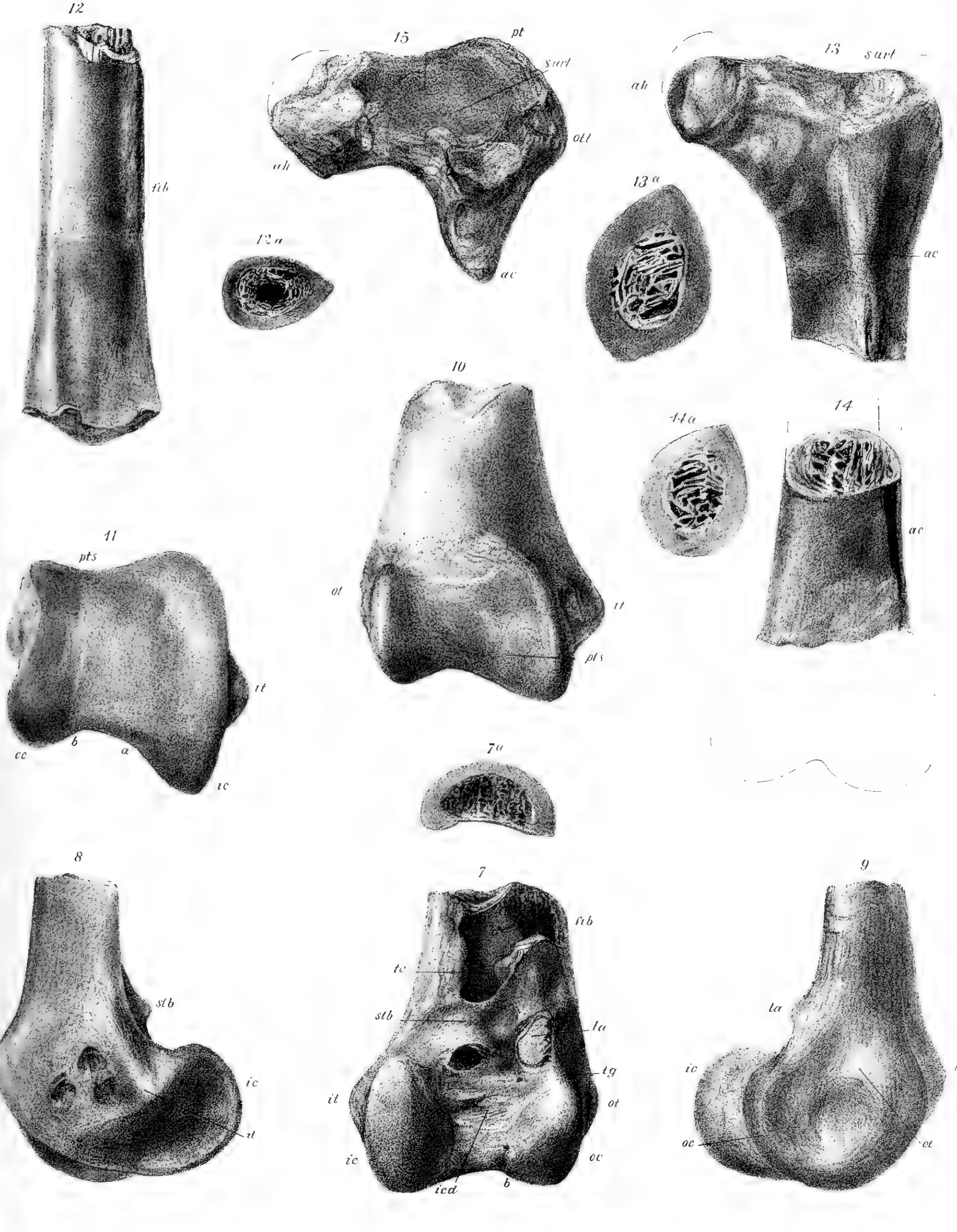
Fig. 7. Distal end of left tibio-tarsus, front view. The form of the bridge and its lower aperture are not correctly shown in this figure.
Fig. 7 *a.* Same specimen, view of upper broken surface.
Fig. 8. Same specimen, inner surface.
Fig. 9. Same specimen, outer surface.
Fig. 10. Same specimen, back view.
Fig. 11. Same specimen, seen from below.
Fig. 12. Part of shaft of a tibio-tarsus from just above the supratendinal bridge.
Fig. 12 *a.* Transverse section of upper end of same specimen.
Fig. 13. Left femur, proximal portion, front view.
Fig. 13 *a.* Transverse section of lower end of same.
Fig. 14. Another portion of same femur, from near condyles.
Fig. 14 *a.* Transverse section of upper end of same.
Fig. 15. Same specimen as figure 13, seen from above.

Figs. 7–15 half natural size.

From Nature on Stone by J. ERXLEBEN.

Hanhart imp.

1-4 GASTORNIS KLAASSENI, *Newton.* ½ nat size
5. GOOSE, *nat size.* 6 GULL, *nat size*



From Nature on Stone by J. ERXLEBEN.

Hanhart imp

GASTORNIS KLAASSENI, *Newton.* 1/2 nat size.

VII. *On* Megalapteryx hectori, *a new Gigantic Species of Apterygian Bird.*

By Julius von Haast, *C.M.G., Ph.D., F.R.S., C.M.Z.S.*

Received April 2nd, 1885, read June 2nd, 1885.

[Plate XXX.]

For many years past it has been a source of astonishment to me that we should find besides the remains of the still-living Apterygidæ (*A. australis* and *A. oweni*) no signs of any gigantic *Apteryx* that had been contemporaneous with the Dinornis. And this absence appeared the more remarkable, as we obtained the remains of the gigantic representatives of other birds now living in New Zealand, all of which, with one exception, had become extinct at the close of the Moa age.

Thus the genus *Aptornis*, of which there were probably two species, represents our present *Ocydromus*. Of the last-mentioned species, curiously enough, no remains were ever found either in the undisturbed deposits of *Dinornis*-bones in caves or peaty beds or in the kitchen-middens of the Moa-hunters. *Cnemiornis*, a gigantic flightless Goose most nearly allied to *Cereopsis* (the Cape-Barren Goose of Australia), was apparently of frequent occurrence all over the southern portion of this island; the remains of *Harpagornis*, a huge bird of prey most probably allied to our present *Circus*[1], are much scarcer, and the cranium is still a great desideratum. And, lastly, *Notornis*, belonging to the Grallæ and closely allied to *Tribonyx*, is doubtless on the point of extinction, but is still living on some of the broad mountain-ridges in the south-western portion of this island, where there are numerous tarns amongst the roches moutonnées of that highly glacialized region.

It was therefore very gratifying to me, during a visit to the Museum of Nelson last March, to observe amongst a number of Moa-bones (which by their colour and state of preservation showed that they had been obtained from limestone caves) a few bones of a dark brown colour that had doubtless been extracted from a turbary deposit. Amongst them were seven bones which apparently belonged to one individual, and at first sight appeared to me to supply the deficiency previously alluded to. And though I had neither a skeleton of *Apteryx* for comparison nor any work of reference for consultation, so convinced was I that these bones belonged to a gigantic Apteryx, that

[1] Sir R. Owen, judging from the casts of the bones I sent him, is inclined to place *Harpagornis* with the Falcons or Buzzards. ('Memoirs on the Extinct Wingless Birds of New Zealand,' p. 42.)

I at once requested the permission of the authorities of the Nelson Museum to describe them. At the same time I made a short communication of their existence to the Philosophical Society of Nelson, naming this new and interesting species *Megalapteryx hectori*, in acknowledgment of the manifold services Dr. J. Hector has rendered to science in New Zealand.

The bones consisted of right and left femora, left tibia, fibula, and tarso-metatarsus, one phalanx, and one ungual phalanx; so that there was ample material, not only to identify all the characteristic features of the principal leg-bones, but also to compare them thoroughly with the corresponding bones of *Apteryx* on the one hand, and of *Dinornis* on the other.

Though, owing to the size of the bird, the bones of *Megalapteryx* are somewhat more massive than those of *Apteryx*, nevertheless they are easily distinguished by their elegant form from those of the Dinornithidæ, which, even the most slender forms, have all a more pachydermal type than this new species. This is principally observable if we compare the bones of *Megalapteryx* with the corresponding bones of the diminutive Dinornithidæ, as, for instance, *Dinornis curtus*, in which that pachydermal character is most conspicuous. However, apart from the consideration of mere bulk, the osteological characteristic features through which *Apteryx* is differentiated from *Dinornis* are all present in *Megalapteryx*, and thus the generic relation between it and *Apteryx* can be easily and fully established.

The few differences from *Apteryx*, in which *Megalapteryx* approaches more nearly the Dinornithidæ, may, as before pointed out, be easily explained by the greater bulk of the latter when compared with *Apteryx*.

Tarso-metatarsus. (Plate XXX. figs. 1, 2.)

Table of Measurements.

	inches.
Total length	5·65
Circumference of shaft at middle	2·20
Breadth of proximal end	1·62
Breadth of middle of shaft	0·85
Breadth of distal end	2·20
Antero-posterior thickness of shaft	0·48

It will be seen from the measurements that there is not a single species of the Dinornithidæ, even those in which the tarso-metatarsus is shorter, showing such slender proportions as the species under consideration. In fact, the antero-posterior thickness of *Megalapteryx*, if reduced to that of the size of *Apteryx*, is even less than in that genus.

Beginning with the proximal end of the bone, we find that the intercondyloid tubercle, though relatively higher than in most of the Dinornithidæ, does not ascend at such a steep angle from both sides as it does in *Apteryx*; moreover, the entocondylar surface, so invariably of an oval shape antero-posteriorly in *Dinornis*, is more rounded in *Megalapteryx* and *Apteryx*, in both of which the ectocalcaneal process is also broader and more prominent than the entocalcaneal, while the reverse is the case in *Dinornis*. However, *Megalapteryx* resembles *Dinornis* in having the ectocalcaneal process much longer than the entocalcaneal, the former being the shorter in *Apteryx*. The inner border of the ectocondylar process in *Megalapteryx* is curved so that its extremity advances somewhat over the flexor tendon, the inner side of the entocondylar not possessing such a curve. The form of the calcaneal groove in *Megalapteryx* is therefore more irregular and more turned inwards than it is either in *Apteryx* or in *Dinornis*, where, however, this feature is slightly indicated. The anterior fossa is much more deeply excavated than in *Dinornis*, and thus approaches this characteristic feature in *Apteryx*. The interosseous foramina situated here are separated by a relatively larger space than is found in the Dinornithidæ, their entrance being at the same time well defined. The rough surface below the anterior fossa containing that depression downwards for the attachment of the tibialis anticus tendon is well defined, and resembles in form that of *Apteryx*.

As previously stated by Sir Richard Owen[1], when pointing out the characteristic features of the tarso-metatarsus of *Apteryx*:—

"The meso-metatarse, advancing forwards at its lower half, makes a median prominence at that part of the common shaft; the groove between it and the ectometatarse is well marked, and just before its termination it shows a small perforation from before backwards: this is the most distinctive mark between the tarso-metatarse of *Apteryx* and that of *Palapteryx*."

In examining the corresponding bone of *Megalapteryx* it will be observed that the lower portion of the mesometatarse is also rather prominent, and the groove between it and the ectometatarse better marked than in most of the Dinornithidæ; but what shows more distinctly its close relationship to *Apteryx* is the occurrence of the same perforation in that groove—thus (if this distinctive characteristic feature holds good, as I have no doubt is the case) at once establishing a marked difference between *Dinornis* and *Megalapteryx*. But while in *Dinornis* and *Apteryx* both borders of the outer edge of that groove between the condyles are straight, the anterior edge in *Megalapteryx* advances considerably, and the perforation only passes through that portion of the edge relatively a little more in front when compared with *Apteryx*.

The divisional space between the mesometatarse and the entometatarse is also less

[1] 'Memoirs on the Extinct Wingless Birds of New Zealand,' p. 201.

marked, as it is also in *Apteryx*; but here, too, at the very extremity, and passing through the anterior edge only, another small perforation exists not to be found in *Apteryx*, of which I have examined a number of skeletons. The central condyle is the most prominent, standing well in advance of the others, of which the inner condyle is the least produced, thus, in this respect, again closely agreeing with *Apteryx*. The trochlear groove on the middle condyle is, however, not so deeply excavated as in *Apteryx*.

The upper portion of the entogastrocnemial surface, scarcely indicated in *Apteryx*, is well marked in *Megalapteryx*, reaching to the inner edge of the mesometatarsal near the middle of the shaft on its posterior side. It then turns again towards the inner edge, forming a rough well-excavated tract of an oval form, and about three fourths of an inch long, for the attachment of the hallux. This tract closely resembles that of *Apteryx*. Below it the ridge becomes much narrower, running down to within a quarter of an inch to the posterior end of the articular surface on the entotrochlea.

From the well-defined, rough, flat surface of the ectometatarsal tuberosity, which at its proximal end is well defined by a deep, horizontal, and narrow incision for the insertion of the gastrocnemial muscle, a rough linear tract runs down on the outer edge, near the posterior side, to join the ectogastrocnemial surface, which is well defined and resembles more nearly that possessed by the Dinornithidæ. In *Apteryx* it exhibits only a narrow linear surface all the way. Of course, a powerful bird like *Megalapteryx* ought in this respect to show more resemblance to the Dinornithidæ than to the recent small bird.

The interspace between the ecto- and mesotrochleæ is larger than between the ento- and mesotrochleæ, in this respect also agreeing with *Apteryx*; but as the fore parts of all three trochleæ are broader than the hind part, the two interspaces are narrower near the fore part of the trochleæ than in the middle. In *Apteryx* this feature is just indicated, but in most of the Dinornithidæ it is well marked.

Another difference between *Apteryx* and *Megalapteryx* is exhibited in the length of the ento- and ectotrochleæ. In *Apteryx* the ecto- stands in advance of the ento-trochlea; moreover, owing to the osseous bridge below the small perforation, the upper edge of the interspace between the ecto- and mesotrochleæ is in advance of the same edge between the ento- and mesotrochleæ. In *Megalapteryx*, notwithstanding the existing small perforation, the opposite features are observable, thus agreeing more with the Dinornithidæ.

Tibia. (Plate XXX. figs. 3, 4.)

Though this bone in many of its characteristic features resembles that of *Apteryx*, there is ample evidence that it has others in common with the smaller Dinornithidæ, which may, however, be easily accounted for by its larger size. However, like the tarso-metatarsus, it is altogether more slender and elegant in form than any of its contemporaries.

Measurements.

	inches.
Total length	12·05
Circumference of shaft in middle	2·60
Breadth of proximal end	2·52
Breadth of shaft in middle	0·82
Breadth of distal end	1·65
Antero-posterior thickness	0·70

Comparing the articular surface of the proximal end with that of *Apteryx*, the outlines appear to be much alike. The ascending rotular or epicnemial ridge of *Megalapteryx*, standing vertically above the articular surface, rises, however, much higher than in *Apteryx* or in most of the Dinornithidæ. This is caused by the deeper excavation of the epicnemial channel than in either of the last-mentioned forms. The entocondylar surface for the articulation of the inner condyle of the femur has also a greater slope downwards and backwards, the intercondylar eminence being so much more prominent than in *Apteryx*. This greater slope of that surface also exists in a somewhat minor degree in *Apteryx*. In the Dinornithidæ the ectocnemial process, where it starts backwards from the beginning of the procnemial ridge, has the same or nearly the same breadth to its termination; but both in *Apteryx* and *Megalapteryx* it gradually enlarges, so that its broadest part is at its posterior termination, the space for the attachment of the rotular or extensor tendon being well marked. In *Megalapteryx*, as in *Apteryx*, the intercondylar eminence for the attachment of the crucial ligaments is rather flat, while the ectocondylar surface is more developed in the smaller recent bird.

Below the suprafibular facet, after a flat space of nearly one inch, the fibular ridge, 2·75 inches long, rises well above the shaft of the bone. On the inner side, just below its termination, the medull-arterial orifice is situated about two fifths of the total length of the bone from the proximal end, as in *Apteryx*; this orifice in *Dinornis* is generally situated a little lower.

The procnemial ridge, owing to the comparatively small breadth of the proximal end and the narrowness of the shaft, is much straighter than in the Dinornithidæ, so that there is scarcely any inward inclination, except where it forms the inner boundary of the extensor groove. In fact, it is almost as straight as that of *Apteryx*, where it forms rather a sharp edge, separating the flat anterior from the rounded posterior surface of the shaft. The so-called pneumatic foramina behind and below the intercondylar surface also exist in *Megalapteryx*, but they are narrower than in the species of

Dinornis of the same size, and approach more nearly those indicated in *Apteryx*. The shaft of the tibia of *Megalapteryx*, straight as in *Apteryx*, is not so flattened on its anterior side as in the recent species, in which, starting from below the well-excavated intercnemial space, the whole surface of the shaft between the procnemial and fibular ridges is nearly flat, while the posterior part is rounded off, so that it possesses an almost semicircular form, both ridges, though standing scarcely above the surface of the bone, being at the same time well defined.

On the other hand, the anterior portion of the shaft of *Megalapteryx* is well rounded on its upper portion, getting gradually flattened towards its distal end. It thus resembles *Dinornis*, with the exception that the procnemial ridge, like that of *Apteryx*, as previously pointed out, runs more along the inner side instead of crossing diagonally the frontal part of the shaft. On the posterior side the shaft of *Megalapteryx*, though near the proximal end it is a little flatter than in *Apteryx*, soon assumes a rounded form, thus closely resembling the shaft of the recent species. Altogether it is not so compressed postero-anteriorly as the shaft of *Dinornis*, a section near the centre showing a nearly oval form.

In *Megalapteryx* the extensor groove for the tibialis anticus has much the same form as in *Apteryx*. There is also a small ossified bridge over the extensor canal, which in *Apteryx* consists only of cartilage. The gastrocnemial surface forms a long rough ridge, nearly two inches in length ; it is only indicated by a slightly hollowed space in *Apteryx*.

The distal end of the tibia closely resembles that of *Apteryx*. The front part of the ectocondyle rises higher than the endocondyle in both *Megalapteryx* and *Apteryx*, while in *Dinornis* the opposite takes place.

FIBULA. (Plate XXX. fig. 7.)

The greater upper portion of the left fibula was also found amongst the bones. In form it also approaches more closely the corresponding bones of *Apteryx* in having the convex head more compressed and the shaft of the bone more bent than in *Dinornis*.

The fore and aft dimensions of the head are 1·02 inch, the transverse diameter 0·32 inch. There are two rough surfaces for the insertion of muscles on the outer edge of the shaft of the bone, of which the lower forms quite a protuberance.

Femur. (Plate XXX. figs. 5, 6.)

Measurements.

	inches.
Total length	7·80
Circumference of shaft	2·80
Breadth of proximal end.	2·05
Breadth of distal end	2·15
Diameter of shaft in middle	0·85

Sir Richard Owen, in his 'Memoirs on the Wingless Birds of New Zealand,' on p. 201, when speaking of the remains of *Apteryx* found associated with bones of *Dinornis* in the North Island, in giving some of the principal osteological features, points out that:—

"The shaft of its femur is characterized by the convexity of the fore part in the direction of its axis, which is due not only to a slight bending of the whole shaft forward, but to an enlargement in that direction of the middle of the fore part of the shaft."

As in describing the shaft of *Megalapteryx* I should have to use the same expressions, I wish the reader only to refer to the figures attached to this communication, where both bones are given of the natural size, and where this characteristic well-pronounced convexity is well seen, a feature by which both genera are so distinctly separated from the Dinornithidæ.

The femur of *Apteryx australis* is shown for comparison (Plate XXX. figs. 10 & 11).

The femur of *Megalapteryx* has, like the same bone in *Apteryx*, a well-defined neck, the constriction following round the entire circumference. The articular surface between the head and the trochanter is, however, more deeply excavated in *Megalapteryx* than in *Apteryx*, in the latter of which the trochanter has a very slight upward slope, rising scarcely above the head, whilst *Megalapteryx* in these two features has more resemblance to *Dinornis*.

On the post-trochanterian surface the two rough depressions, the upper one for the insertion of the abductor femoris and the lower one standing in advance of the former for the quadratus femoris, are well shown; but, in comparison with the size of the bones, they are not so deeply excavated as they are in *Apteryx*. Moreover, there is a marked difference between the form of these depressions in *Megalapteryx* and *Apteryx* when compared with the Dinornithidæ.

From below the quadratus-femoris depression an intermuscular ridge runs obliquely across to the middle back part of the shaft, where another meets it, which starts from below the head of the bone; below their junction the orifice of the medullary artery is situated. Similar intermuscular ridges run along the shaft of the femur of *Apteryx*, but the orifice is situated on the left femur on the right of the junction. In the Dinornithidæ these two ridges generally run at a more oblique angle, so as to approach much sooner, when for some distance they run parallel towards that orifice. There are even some of the smaller species in which the two ridges join much above that orifice, so that it is actually situated upon the ridge itself.

Below the junction the inner ridge continues, rising well above the shaft, as the so-called tuberosity, to the inner condyle, gradually, however, diminishing in height. One inch below the orifice the outer starts from the inner ridge, only slightly indicated, and reaches the outer condyle in front of the ectocondylar pit.

In *Apteryx* this tract, in which the popliteal space is enclosed, is better defined than in *Megalapteryx*, as the outer line is much more marked, thus more nearly resembling the Dinornithidæ.

A slight ridge starts in *Megalapteryx* also from the ectotrochanterian tuberosity, bifurcating 3 inches below the upper end of the femur and running towards the condyles; the inner ridge appears the most prominent. They disappear, however, entirely before the condyles are reached. The whole form of that part of the bone closely resembles that of *Apteryx*.

The rotular channel is broad and well excavated, but differs from that of *Apteryx* by continuing in equal breadth to the anterior intercondylar ridge, while in *Apteryx* the condyles on both sides approach towards their lower end, so as to restrict that channel.

The intercondylar fossæ are not, as in *Dinornis*, divided into two depressions, though the inner side is a little more excavated. In form they entirely resemble that of *Apteryx*. The edge of the postintercondylar ridge is sharper in *Megalapteryx* and *Apteryx* than in the Dinornithidæ, in which it has a more rounded form.

In the Dinornithidæ the ectocondylar surface is grooved, though the inner or post-intercondylar ridge stands much higher above the groove than the outer. Both in *Megalapteryx* and *Apteryx* this groove does not exist, the inner side alone rising above the surface for the articulation of the head of the fibula, without any ridge showing on the outside. This articulating surface, however, is longer in proportion to breadth in *Megalapteryx* than it is in the Dinornithidæ.

The popliteal space in *Megalapteryx* resembles also that of *Apteryx* in all its principal features, and is not so deeply excavated as in the Dinornithidæ. In one word, all the principal characteristic features of the femur of *Apteryx*, by which it is so distinctly differentiated from the Dinornithidæ, are repeated in *Megalapteryx*, but, owing to its size, are in most instances more pronounced in the extinct genus.

Phalanges. (Plate XXX. figs. 8 & 9.)

One of the phalanges found with the bones (fig. 8) is most probably the first phalanx of the middle toe belonging to the right leg; however, on the surface articulating with the metatarse, it does not show the central ridge so pronounced in the Dinornithidæ, but only indicated in *Apteryx*. The second (fig. 9) is an ungual phalanx resembling, like the former, that of *Apteryx*; it compares best with the outside ungual phalanx of the right foot.

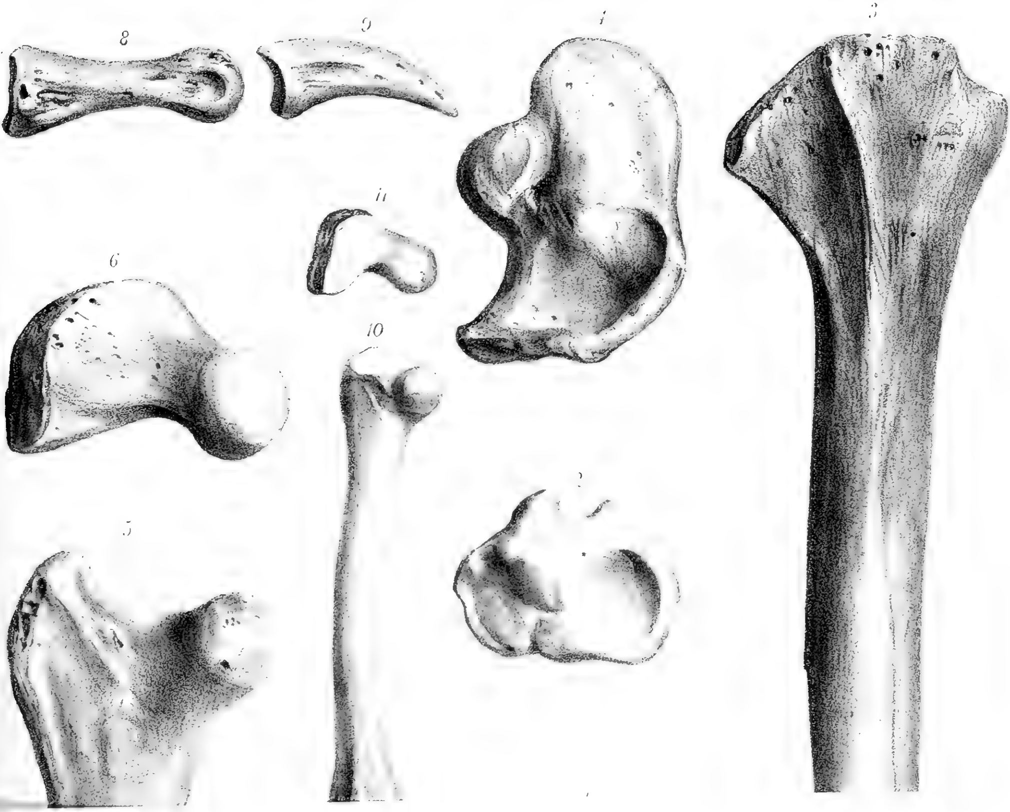
DESCRIPTION OF PLATE XXX.

Megalapteryx hectori. (Natural size.)

Fig. 1. Right tarso-metatarsus, front view.
2. Left tarso-metatarsus, upper or condylar surface.
3. Right tibia, front view.
4. Left tibia, upper articular surface.
5. Right femur, inner side view.
6. Left femur, upper articular surface.
7. Left fibula, outer view.
8. Phalanx.
9. Ungual phalanx.

Apteryx australis. (Natural size.)

Fig. 10. Left femur, inner view.
11. Left femur, upper articular surface.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Hall Hanhart lith

MEGALAPTERYX HECTORI

VIII. *On* Dinornis oweni, *a new Species of the* Dinornithidæ, *with some Remarks on* D. curtus. *By* JULIUS VON HAAST, *C.M.G., Ph.D., F.R.S., C.M.Z.S.*

Received April 2nd, 1885, read May 19th, 1885.

[PLATES XXXI., XXXII.]

SIR RICHARD OWEN in his classical memoirs on the extinct wingless birds of New Zealand describes (on pp. 133, 134) the three principal leg-bones of the smallest species then known as those of *Dinornis curtus.* These bones had been received by that distinguished comparative anatomist about 1844–45 from the Rev. W. Cotton, M.A., and were first described in part ii. of the memoirs on *Dinornis.* Though they were stated to have been collected in the Northern Island, no locality is given. In a further memoir (part xv.) Sir Richard Owen figures two metatarsi of the same species, one being much larger than the other, most probably representing male and female; but he does not state whence they were derived. Another metatarsus of *Dinornis curtus* with which I am acquainted was found in the neighbourhood of Wellington by Professor F. W. Hutton, and is now reposing in the Dunedin Museum. Therefore, when examining a large collection of Moa-bones belonging to the Auckland Museum, and entrusted to me for identification and description, I was much gratified to find amongst them, not only a considerable series of bones belonging to *Dinornis curtus,* to which I shall refer in an Appendix to this paper, but also the bones of a still smaller species, for which I wish to propose the name of *Dinornis oweni,* in honour of that illustrious biologist, to whom science in New Zealand is so deeply indebted, and whose footsteps—with much diffidence and hesitation—I wish to follow in this communication.

Before attempting a description of this peculiarly small and remarkable species, I wish to point out that before the year 1875, when Mr. Thorne, jun., first explored the sandhills and flats north of the Whangarei Harbour[1], no Dinornis-bones were known to have been found north of Auckland, except a cranium alluded to in the following pages. It was therefore an interesting fact that Moa-bones were found to exist in considerable quantities about forty miles north of that city. Mr. T. F. Cheeseman, F.L.S., the energetic curator of the Auckland Museum, continued the explorations of the grounds previously discovered by Mr. Thorne, and greatly added to our knowledge by also finding in the limestone caves near the Pataua river in the same district numerous bones and portions of some skeletons that did not owe their deposition to the hand of man. Those previously obtained were collected amongst the kitchen-middens

[1] Transactions of the New-Zealand Institute, vol. viii. pp. 83–94.

on the sandhills and flats. In a future communication I shall offer a *résumé* of the bones found in that locality, situated so far north, and at the same time make some comparison with the different species of the Dinornithidæ occurring in the various most prominent localities in the middle and southern portions of the North Island and in the whole of the South Island. However, I may here add that what strikes us most conspicuously is the abundance of the two small species, *Dinornis curtus* and *D. oweni*, in that northern locality, the first found only in the North Island, and the other hitherto obtained only near Whangarei. Mr. Cheeseman was fortunate enough to find in a cave near Pataua a nearly complete skeleton of *Dinornis oweni*, which will form the subject of these notes. I may here observe that in the collections made by those two gentlemen there are bones belonging to at least twenty skeletons of *Dinornis oweni*, being nearly all of the same size, and showing only the individual variety that has been proved to exist in all our species of the Dinornithidæ. There are always two principal sizes that can be invariably distinguished, owing doubtless to a difference of sex. Some of the separate leg-bones of *Dinornis oweni*, though evidently belonging to mature birds, are even a little smaller and more slender than the specimen under review, which, when in a resting position, would have stood about 2 feet 8 inches high, and could thus only compare as to size with *Aptornis* and *Cnemiornis*.

Cranium.

Sir Richard Owen, in his 'Memoirs on the Extinct Wingless Birds of New Zealand,' on page 119 describes a cranium (figured on pl. xxxi. figs. 4, 5, 6) as that of *Dinornis dromioides*. This cranium was received from the late W. Swainson, the distinguished naturalist, then living in New Zealand, and was obtained from the North Island, probably in the vicinity of the Bay of Islands[1].

In comparing with it the cranium belonging to the skeleton of *Dinornis oweni*, I find that in every respect as to form and size the latter closely agrees with that described as far back as 1846 by Sir Richard Owen. It is, however, a remarkable fact—showing that the smallest Dinornithidæ possess very large skulls in proportion to their size—that this cranium was then referred to a species more than twice the size of *Dinornis oweni*. The skull of *Dinornis dromioides* is doubtless much larger. So far as I am aware it has, however, never been described. This latter species seems to have been an inhabitant principally of the North Island, all the bones described by Sir Richard Owen having been collected there. The Canterbury Museum, however, possesses two metatarsi, of which one was obtained at Glenmark, the other near Temuka, Southern Canterbury, both having been found imbedded in turbary deposits, and both closely answering to the figures and descriptions of Sir R. Owen. Unfortunately the cranium under consideration is also in a mutilated state, though some parts are more perfect than those described by Sir R. Owen.

[1] Owen, *op. cit.* p. 116.

Measurements.

	inches.
Breadth at temporal fossæ	1·63
Breadth at mastoid process	2·43
Breadth at supraorbital ridge	2·64
Height of cranium between basisphenoid and transverse occipital ridge	1·25
Breadth of foramen magnum	0·54
Height of foramen magnum	0·45

The anterior border of the frontal is unfortunately broken off, so that the articulation for the nasal bones is missing. Though the cranium evidently belongs to a full-grown bird, the sutures are not entirely obliterated. The vertical ridge marking off the anterior third of the temporal fossæ, as figured by Owen, is represented on the Whangarei cranium by a linear depression which starts on the parietal with an oblique direction forwards and downwards. The supraoccipital region is very broad and low, with an upward and forward slope, and a well-defined vertical ridge in the centre. The occipital tubercle is 0·14 inch broad and 0·07 inch high, and therefore much more flattened vertically than in most of the Dinornithidæ. The paroccipitals are partly broken away, but they appear to have been broader and less pointed than in *Dinornis parvus.* The two precondyloid foramina on each side of the condyle are, as usual, very small, but the vagal foramen on each side close to them is large. The basisphenoid is also considerably destroyed, as well as the entire presphenoid, so that I am unable to allude to them more fully. The mamillar tuberosities of the basisphenoid, though partly broken away, seem also to have been well developed. A very characteristic feature of this skull is the remarkable flatness, not only of the whole parietal, but also of the posterior third of the frontal before the cranium slopes downwards. This latter feature is only partly indicated in the cranium figured by Sir Richard Owen.

The temporal fossæ are very wide and deep, and are well defined by a continuous ridge dividing them from the occipital surface, so that there is no flattened tract as in most of the Dinornithidæ. *Dinornis oweni* has this character in common with *Dinornis parvus.* The articular surface for the os tympanicum on the mastoid corresponds closely to the description given by Sir Richard Owen. The whole character of the cranium proves that this species, though so small, was nevertheless powerfully built and capable of using its beak with remarkable force. No tympanic bones were found with the cranium, but fortunately the premaxillary and greater portion of the mandible are preserved. The former has the pointed form of the same bone in that subgenus of the Dinornithidæ to which I ventured to apply the name of *Meionornis* (*casuarinus* and *didiformis*). It is somewhat narrower than the premaxillary in *Dinornis parvus.*

The right ramus of the mandible is complete, it is rather narrow and thin in comparison with the same bone in *Dinornis parvus*; the symphysis is also restricted, but the external symphysial prominence well developed. The mandible consists of the same elements as in the larger Dinornithidæ. However, while in these latter the keel of each ramus continues to the posterior wall of the articulation for the tympanic bone, in *Dinornis oweni* the keel disappears before the cup is reached, and an almost flat, or very slightly rounded, lower surface is formed below that tympanic articulation. In the ramus of *Meionornis didiformis* this flattening out on the lower side for the articulation of the tympanic bone exists also in a minor degree. Now if we compare the cranium of *Meionornis didiformis* with that of *Dinornis oweni*, the curious fact strikes us at once that, notwithstanding *Meionornis didiformis* is about twice the size of *Dinornis oweni*, its cranium is actually smaller, with all its parts more slender, showing that that species was not nearly such a powerful bird as the little troglodyte. That *Meionornis didiformis* was a weaker bird is shown in the first instance by the smallness of the temporal fossæ, the slender beak and mandible, and the whole structure of the cranium, in which the prosencephalic part stands above the general level of the calvarium.

Sir Richard Owen has described and figured the cranium of *Meionornis casuarinus* (pl. lxviii. p. 278, *op. cit.*), with which, except in size, *Meionornis didiformis* has a great resemblance in all its principal characteristic features. I may here add that that cranium of *Meionornis casuarinus* is scarcely larger than that of the small *Dinornis oweni.* It is thus evident that the peculiar mode of life which both *Dinornis parvus* and *D. oweni* had to follow had endowed them with great strength, while the larger species of *Meionornis didiformis* and *M. casuarinus*, leading a different mode of life on the open grass plains of the South Island, and doubtless feeding on different food, were endowed with less power but greater swiftness.

VERTEBRÆ.

The vertebral column belonging to the skeleton of *Dinornis oweni* was unfortunately not complete, so that it is impossible to state the exact number of vertebræ; but allowing for two dorsals missing, it appears that there were seven rib-bearing and twenty-one cervical vertebræ, together twenty-eight. Of the cervical a few are also missing.

Before offering a description of a few of these vertebræ, I might be permitted to observe that the few complete vertebral columns hitherto known, which were obtained lying close together without intermixture with any other specimen, and which I had the privilege of examining, belonged to the larger species, such as *Dinornis elephantopus*, *D. gravis*, and *D. rheides.* They all possessed seven rib-bearing vertebræ not confluent with the sacrum. Each of these vertebræ has a peculiar character of its own that cannot be mistaken, so that it is not difficult, from a number of dorsal vertebræ belonging to different species, to assign to each its proper place in the series. The same is not altogether the case with the cervical vertebræ, of which there are twenty-one. Towards the middle of the series the latter are so much alike that it is only with great difficulty one can assign to them their proper position, especially if they belong to two different sizes of the same species (male and female), or even to allied species. However, the vertebræ from the eighteenth to the twenty-first are very characteristic, and not to be mistaken. I have selected for illustration the last, or seventh, of the dorsal series.

Atlas.

This bone is 0·64 inch broad, 0·76 inch high, and 0·24 inch long. A comparison with the atlas of *Dinornis parvus*, figured by Sir Richard Owen in vol. xi. pl. li. of the 'Transactions' of this Society, will show that in *Dinornis oweni*, even allowing for difference of size, it is much smaller and more slender. This is especially shown at and near the summit of the neural arch where the small articular surfaces are situated. The neural arch is complete at its summit just as in *Dinornis parvus.* Sir Richard Owen is quite right in surmising that the non-union of the sides of the neural arch, leaving a longitudinal fissure at the upper midline in the atlas belonging to *Dinornis robustus* (as figured on pl. lxii. figs. 4, 5, *op. cit.*), may be traced to the fact that it belongs to an immature individual. The Canterbury Museum possesses the atlas of *Dinornis robustus* as well as those of *Dinornis maximus* and several other larger species of the Dinornithidæ, all evidently belonging to mature individuals, in which the neural arch is always closed.

Seventh or last Dorsal Vertebra.

This vertebra, of which the lateral and postaxial aspects are illustrated by figures 10 and 11 (Plate XXXI.) for comparison with Sir Richard Owen's figures of the same bone of *Dinornis robustus* (p. 414, *op. cit.*), shows, notwithstanding its diminutive size, that it exhibits in every particular the true dinornithic type.

The neural spine, unfortunately partly broken off, possesses on the remaining anterior and posterior surfaces the rough tract for the attachment of the elastic ligaments. Both the post- and prezygapophyses possess a nearly circular articular surface, which in *Dinornis robustus* has an oblong form. The neural canal, large for the size of the species, is not so vertically depressed as it is in *Dinornis robustus*; in fact it approaches a circular form. The postaxial surface, in comparison to size larger than in *Dinornis robustus*, is much more produced: on its upper and outer border the parapophyses with the capitular concavity are situated; moreover, its transverse convexity is much greater than its vertical concavity. The preaxial surface subquadrate, and higher than it is broad, is more flattened in both directions; a pair of small hypapophyses are produced on both sides at its lower termination. The under surface of the centrum is round, with no sign of a keel.

Pelvis.

Sir Richard Owen, in part xxiii. of his memoirs on *Dinornis*, read on January 3rd, 1882. before this Society, has described the pelvis of *Dinornis parvus*, obtained in a cave in the provincial district of Nelson. This pelvis is in a perfect state of preservation, and has therefore given ample scope to that illustrious naturalist for an excellent and exhaustive description of that important bone. Unfortunately the pelvis of *Dinornis oweni* is in a rather fragmentary condition, but is sufficiently perfect to show that, while closely agreeing with *Dinornis parvus* in possessing a true dinornithic type, some of its minor characteristic features have been modified to a small extent, owing to the form and size of the species under consideration. Thus in comparing the pelvis of *Dinornis oweni* with that of *Dinornis parvus*, we find, allowing for difference of size, that the former is more massive and broader in proportion to its length, and that the cavity of its acetabulum is much wider than in the latter. The following measurements that could be made confirm this statement:—

	inches.
Breadth (across fore end)	1·95
Depth or vertical diameter anteriorly	2·20
Vertical diameter of acetabulum	1·06
Horizontal diameter of acetabulum without trochanterian surface	1·00

The ilium, principally in front of the acetabulum, is much broader in proportion to length, and consequently the upward slope is not so steep as in *Dinornis parvus*. The ribs belonging to the first and second sacrals have not been preserved, but the articular surfaces for them still exist. The third sacral has no anchylosed ribs as in *Dinornis parvus*; a pleurapophysis on both sides is substituted for them, in that respect resembling the two following ones; while the sixth and seventh sacrals have their pleurapophyses united in one thick, short process in the same manner as in *Dinornis parvus* and the other Dinornithidæ.

In the pelvis of *Dinornis parvus*, figured by Sir Richard Owen, the parapophyses and costal elements are wanting in the eighth, ninth, and tenth sacrals, but appear again in the eleventh. In a pelvis of the same species (now in the Canterbury Museum), obtained in perfect condition in a limestone cave of Southern Nelson, and agreeing as to dimensions and form with the above-mentioned bone, the parapophysis belonging to the eleventh sacral exists only on its right side, a minute protuberance of bone indicating this process on the left side only. The parapophyses, therefore, begin on both sides only with the twelfth. In *Dinornis oweni* the parapophyses of the eleventh sacral are missing on both sides, and only the twelfth and thirteenth possess them, coalescing as usual at their distal end. Though the fourteenth sacral exists, the parapophyses have been destroyed. The breadth of the sacral vertebræ is much greater in comparison with their length than in *Dinornis parvus.* This is doubtless owing to the more pachydermal character of the species under review. Thus, while the breadth of the sacral centrum is 0·81 inch, in the fifth it has increased to 1·14 inch, and it only diminishes to 0·97 inch in the eighth, retaining the same breadth in the eleventh, and being still 0·80 inch in the fourteenth.

The ischium, broken off on both sides before its expansion in breadth, is also more massive in comparison to the size of the species than the corresponding part in *Dinornis parvus.* Only a small portion of the pubis exists, but sufficient to show that the obturator foramen was well developed.

Femur.

Measurements.	inches.
Length	5·65
Middle of shaft	0·87
Proximal end of shaft	1·95
Distal end of shaft	1·90

This bone, though so very small, in its general character closely agrees with that of the Dinornithidæ (*Dinornis maximus* included), and thus is quite different from the femur of *Megalapteryx* as previously described. The head of the bone has a well-defined neck, though not so restricted as in *Dinornis parvus.* The trochanterian articular surface is broader than in most of the Dinornithidæ, the curve of its anterior boundary being more rounded, but the slope towards the great trochanter is less, so that the latter scarcely rises above the head of the femur. The well-defined ecto-trochanterian ridge, dividing the posttrochanterian from the anterior or pretrochanterian surface, is very sharp and prominent, so that the former appears far more excavated than in any other of the Dinornithidæ, the more so as also the posterior edge of the articular trochanterian surface is a little overlapping. This feature also distinguishes it from *Dinornis curtus,* which in this respect closely agrees with the larger species of the Dinornithidæ. The rough depressions for muscular insertions on the post-trochanterian surface are well excavated, showing that this species, though of small size, must have possessed considerable power.

The linear ridges are rather inconspicuous, the principal ones being those on the inner side of the shaft, one beginning 0·60 inch below the neck. After a space of about 0·50 inch it divides, the more prominent portion continuing its oblique direction across the shaft and meeting another ridge, forming the boundary of the posttrochanterian surface.

The inner portion of the first-mentioned ridge continues in its downward course along the shaft to the well-indicated rough tuberosity. On this line the orifice for the medullary artery is situated. The outer ridge also continues in its downward direction towards the ectocondylar fossa. The interspace between the two ridges is first about 0·25 inch wide, but it gradually increases to about 0·50 inch above the popliteal space. The rough tract at the lower part of the pretrochanterian surface situated in the middle between the head and the ectotrochanterian tuberosity is also well marked. The rotular cavity is comparatively flatter than it is in the other small Dinornithidæ, and the ridge between it and the intercondylar fossæ is well defined, falling vertically towards the latter, which are far more excavated than those in the other Dinornithidæ. The postintercondylar ridge is also sharper and more prominent in this small species.

The entocondylar surface for the tibia appears a little flatter, and the ectocondylar surface narrower than in the other *Dinornis* species. At the same time, the space for the head of the fibula is not excavated but flat, thus resembling *Megalapteryx*, the ectocondylar ridge being also proportionally narrower and higher than in the other Dinornithidæ. The popliteal space closely resembles that of the larger *Dinornis* species, though, in comparison to size, it appears a little more deeply excavated. Thus, notwithstanding its remarkably small size, this bone has all the most characteristic features of the larger Dinornithidæ which have been repeatedly and fully described by Sir Richard Owen in his masterly Memoirs.

Tibia.

Measurements.

	inches.
Length	9·58
Middle of shaft	0·75
Proximal end of shaft	2·50
Distal end of shaft	1·48

The tibia also has all the characteristic peculiarities of that of the larger Dinornithidæ, with the exception that its shaft is comparatively more slender and possesses an outward curve or bend, the bird thus having been rather bow-legged. This latter character, however, it had in common with *Dinornis curtus*, to which it is doubtless generically allied. The entocondylar surface has an oval shape, the margin along the intercondylar channel being, however, less curved than the opposite outline. The ectocondylar surface is rather pointed, and the ectocnemial cavity well excavated, so that the proximal end is here rather narrow, taking its length into account. The epicnemial ridge rises conspicuously and at a steep angle above the epicnemial channel, more so than in most of the Dinornithidæ. The procnemial ridge is well defined and crosses the shaft, as in the other *Dinornis* species, so as to form at its termination the inner boundary of the extensor groove. The suprafibular facet is divided from the fibular ridge by a smooth surface of 0·85 inch in length. In some of the larger Dinornithidæ this surface is scarcely wider, and in *Dinornis maximus* it has only a length of 2 inches. The broad fibular ridge, divided into two portions, is 4·50 inches long. Near the lower end of the upper portion, and on its inner side, the medull-arterial orifice is situated. At the lower end of the fibular ridge on the surface of the shaft a narrow and shallow channel begins for the accommodation of the thin end of the fibula, which is rather conspicuous at its termination 1·60 inch above the distal end of the tibia. In the larger Dinornithidæ this lower fibular channel is represented by a slightly raised linear tract.

The posterior side of the shaft, as in all the other Dinornithidæ, is flat in the upper portion, gradually becoming convex in its lower half, the shaft itself being here much flattened antero-posteriorly. In the upper and middle portions the shaft has the usual three-sided form, caused by the presence of the procnemial ridge on the anterior side. The rough low ridge and surface noticed by Sir Richard Owen, especially in *Cnemiornis*, on the inner and anterior part of the tibia not far from its proximal end, is also well developed, terminating 2·10 inches below that end. The extensor canal and its bridge with the tuberosity at its outer pier exhibit the usual dinornithic features. There is here also a flat, rough surface on the inner side reaching to the distal end of the shaft; this distal end repeats all the dinornithic characters, the tract forming the boundary along the lower outlet of the extensor canal being, however, in comparison broader and more developed than in the larger species. Every feature in this tibia proves also that it belonged to a full-grown, mature individual, the proximal and distal epiphyses being so thoroughly anchylosed that there is not the least sign of that junction visible.

Fibula.

This well-preserved bone, 6·55 inches long, also possesses a slender form. The proximal end, bent backwards, is 1·10 inch long and 0·28 inch broad. Its articular surface on the tibial side is a little concave, on the opposite side the head is flat. Below the head of the bone the shaft exhibits the usual trihedral form. The surface for the articulation with the tibia, 2·40 inches long and in the middle 0·20 inch broad, is rough and flattened; below it the fibula contracts considerably, taking a needle-shaped form with a sharp point. On the side opposite to the tibial articulation are two rough surfaces for muscular attachment, of which the upper one is the longer. Thus this bone also shows all the principal characteristic features belonging to even the largest Dinornithidæ.

Tarso-metatarsus.

Measurements.

	inches.
Length	4·43
Middle of shaft	0·81
Proximal end of shaft	1·58
Distal end of shaft	1·98

The tarso-metatarsus of the species under consideration is a very characteristic bone. Notwithstanding its smallness, it possesses the true dinornithic type, but some of the marked peculiarities of the large species are, as it were, exaggerated in this tiny representative of a family of giants.

This is principally observable in the proximal end of the bone, which in proportion to its size is more developed than in any of the larger species. Owing to the large size of the ectocondylar cavity, the intercondylar rising (or process as it may be called here) is shifted considerably towards the entocondylar side. The entocondylar cavity has the usual oval form with the longest diameter fore-and-aft, is deeply excavated, and advances considerably beyond the entocondylar side of the shaft. In this respect *Dinornis curtus* approaches most nearly *Dinornis oweni*. The ecto- and entocalcaneal processes on both sides of the calcaneal groove are strongly developed; the latter is the longer and more prominent. The ectocalcaneal exists only in the form of a round tuberosity without any sign of the shallow longitudinal groove on it, as it occurs in the larger Dinornithidæ. The antinterosseal depression is deeply excavated, and the entrances of the ect- and ent-interosseal canals are here close together. While the former has a distinct opening on the posterior side of the shaft on the outer side of the ectocalcaneal process, the latter ends below the entocalcaneal process almost on the same line. This character, however, is not constant in the Dinornithidæ. I have examined specimens belonging to *Dinornis curtus* and *oweni* in which the posterior opening of the ectinterosseal canal lies nearly half an inch lower. In some other metatarsi of *Dinornis oweni* from the same locality there exists only the entinterosseal canal, the wide posterior orifice of which is divided by a bony bridge. This is different from the observations of Sir Richard Owen on that bone of *Dinornis gravis* ('Memoirs on the Extinct Wingless Birds of New Zealand,' page 348), in which only the ectinterosseal canal possesses a posterior orifice.

Owing to the small size of the species the entogastrocnemial surface is not so prominent as it is in the larger species of the Dinornithidæ, but it has in proportion the same length and breadth. It is broadest where the hallucial surface is situated. The same may be said of the ectogastrocnemial tract and surface. The ectometatarsal rough surface, however, is well indicated. The trochleæ are large and strong, the hind part being comparatively narrow compared with the fore part, so that the two interspaces between them are widest near the shaft. The roundish depressions for muscular insertion, especially on the ecto- and mesotrochleæ at their junction with the shaft, are well excavated, in this also resembling the larger Dinornithidæ, though we possess some bones in which the depression on the entotrochlea is the deepest and most conspicuous. The depressions on the sides of the trochleæ are deeply excavated: this is especially the case on the ecto- and meso- and the inner side of the entotrochleæ; in fact the depressions on the mesotrochlea are so deep, that they almost meet in the centre. Altogether, as before observed, the whole bone impresses the fact upon us that, notwithstanding the small size of the bird, nevertheless it possessed great power and strength. Unfortunately no phalanges of any kind seem to have been collected, as none were with the skeleton sent me, so I am unable to offer any description of them.

APPENDIX.

NOTES ON *Dinornis curtus*, Owen.

As previously observed, the only locality where the remains of this rare species have been found in any quantity is at Whangarei, in the far north of the Northern Island, where they have been collected in the kitchen-middens of the aborigines, as well as in the limestone caves, into which the birds probably retired before death overtook them.

However, the only remains transmitted to me are the three principal leg-bones. Sir Richard Owen, in his table of admeasurements of the bones of the leg of the known species of *Dinornis* (*op. cit.* p. 356), gives the length of these bones in two specimens, one a little larger than the other, which might be due to difference of sex.

Femur.

For the femur the length of 6 inches and 5 inches 6 lines is given. The length of the bone from Whangarei ranges from between 6·05 to 6·40 inches, so that we have no femur so small as the smallest in the British Museum. Unfortunately the latter has not been figured. I suspect, however, that it may possibly belong to *Dinornis oweni*. The form of the femur of *Dinornis curtus* is much stouter in all its proportions in comparison to size than that of *Dinornis oweni*: in a word it is more pachydermal.

Tibia.

Sir Richard Owen figures the tibia of *Dinornis curtus* on pl. xxxix. (*op. cit.*), its length being 11 inches 3 lines, but he also gives the length of another tibia as 11 inches. We possess several specimens having the exact length and proportions of the first-mentioned bone, but a number of them are longer, increasing to a length of 12·10 inches. However, they all agree in every respect with the illustration referred to, and with the description given on p. 133 (*op. cit.*), so that I need not enlarge upon the subject.

In comparison with the tibia of *Dinornis oweni* the same observation as to the femur holds good, that of *Dinornis curtus* being proportionately stouter.

Metatarse.

Sir Richard Owen on pl. lxxxvii. (*op. cit.*) figures two metatarsi, without, however, informing us whence they were derived. These measure 5 inches and 4 inches 6 lines in length. A comparison of the metatarse of *Dinornis oweni* figured on Pl. XXXI. fig. 15 (accompanying this memoir) with the smaller metatarse of *Dinornis curtus* figured by Sir Richard Owen on pl. lxxxvii. fig. 7 (*op. cit.*) will at once show the difference between these two species. However, I must not omit to state that there are some intermediate forms which are difficult to place, and it is therefore obvious that *Dinornis curtus* and *D. oweni* are closely allied species, in the same manner, for instance, as *Dinornis casuarinus* and *D. didiformis*, both of which I unite into the subgenus *Meionornis*.

DESCRIPTION OF THE PLATES.

PLATE XXXI.

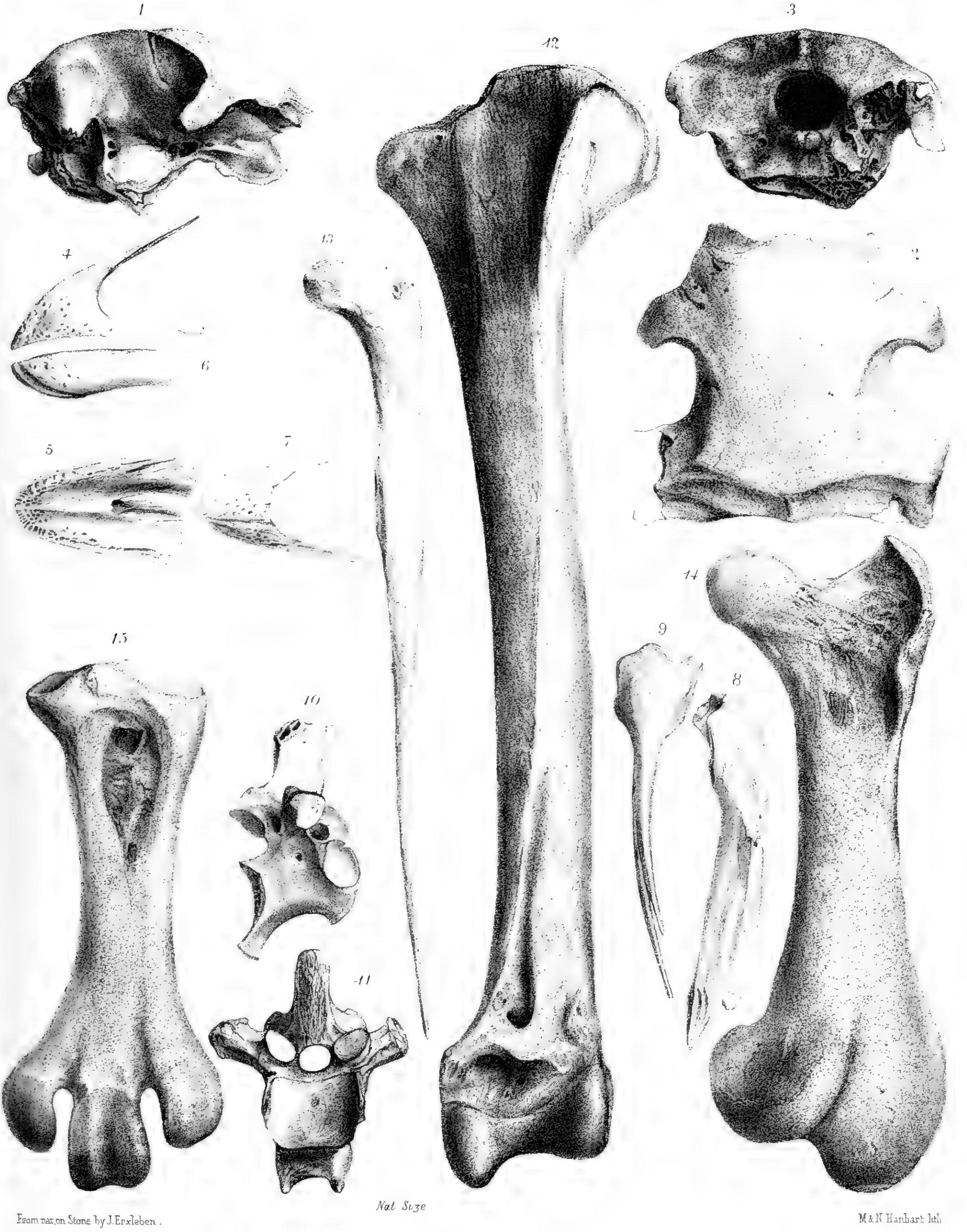
Dinornis oweni. (Natural size.)

Fig. 1. Side view of cranium.
2. Upper view of cranium.
3. Back view of cranium.
4. Premaxillary, side view.
5. Premaxillary, under view.
6. Symphysial end of mandible, side view.
7. Symphysial end of mandible, under view.
8. Back part of left ramus of lower jaw, outer side view.
9. Back part of left ramus of lower jaw, lower side view.
10. Lateral view of seventh dorsal vertebra.
11. Postaxial view of seventh dorsal vertebra.
12. Left tibia, front view.
13. Left fibula, inner view.
14. Left femur, outer view.
15. Left tarso-metatarsus, front view.

PLATE XXXII.

Dinornis oweni. (Natural size.)

Fig. 1. Pelvis, side view.
2. Pelvis, upper or outer view.
3. Pelvis, lower or inner view.
4. Pelvis, front surface.



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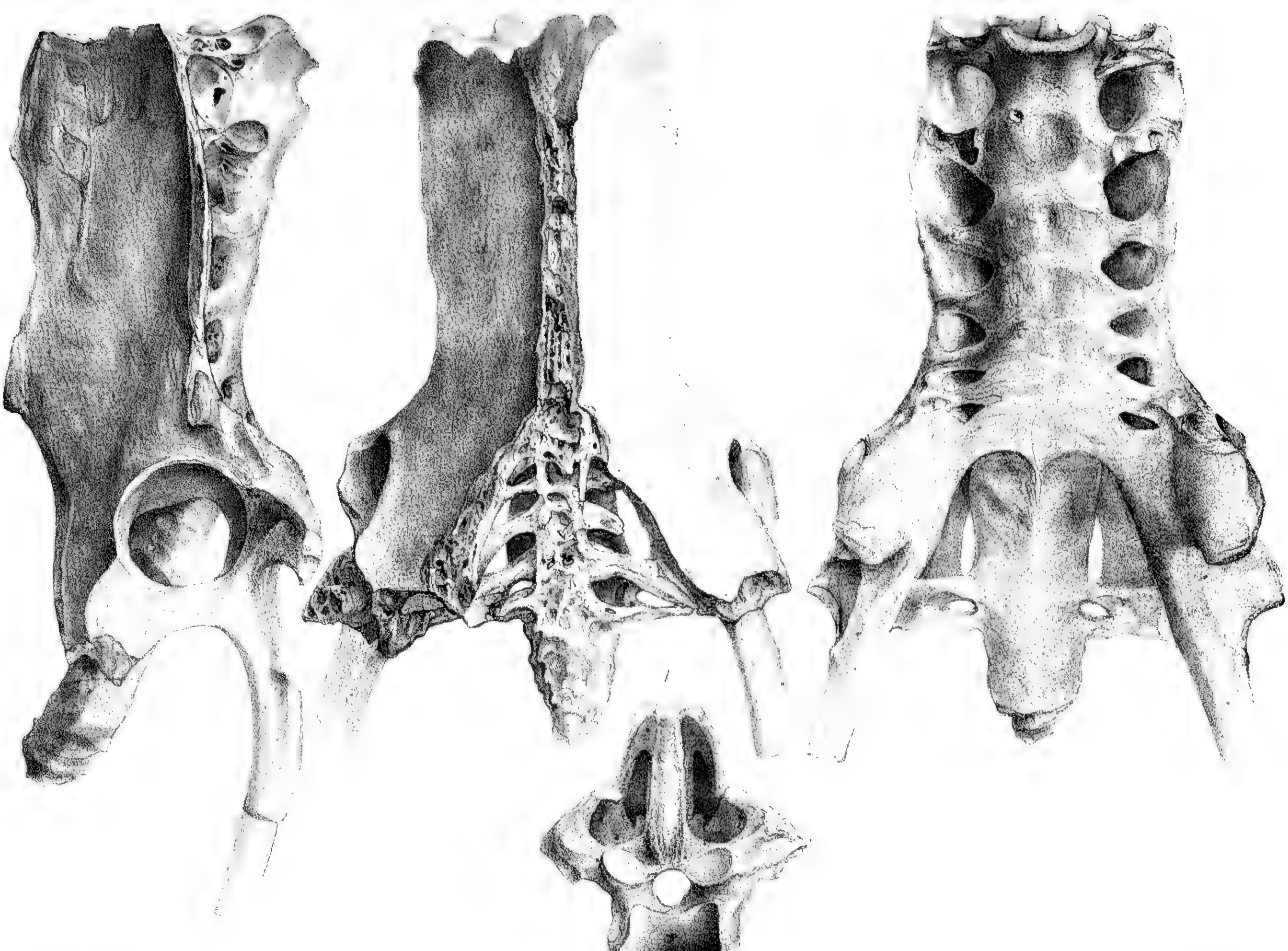

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December 1886.

P. L. SCLATER,
Secretary.

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Continued on page 3 of Wrapper.

IX. *On the Anatomy of the Sondaic Rhinoceros.*

By Frank E. Beddard, *M.A., F.R.S.E., F.Z.S., Prosector to the Society, Lecturer on Biology at Guy's Hospital, and* Frederick Treves, *F.R.C.S., F.Z.S., Hunterian Professor at the Royal College of Surgeons, Surgeon to the London Hospital.*

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[Plates XXXIII.–XXXVII.]

Contents.

Introductory.

THE Society's specimen of *Rhinoceros sondaicus*, which was acquired in 1874 and died in January of this year, has afforded us the material for the present paper. At the time of the animal's death the weather was frosty; we had therefore hoped to be able to study in detail the muscles and nerves as well as the visceral anatomy. The frost, however, broke, and, as the carcass commenced to decay, we were compelled to abandon this attempt. We have endeavoured to describe as accurately as possible the visceral anatomy, the study of which was facilitated by a successful injection of the arterial system; in this way we have been able to note the relations of the vascular system to the alimentary canal. The facts recorded in this part of our paper are new, inasmuch as no previous writer on the anatomy of the Rhinoceros has attempted to deal with the subject.

The only paper known to us which contains any description of the anatomy of *Rhinoceros sondaicus* is one by Prof. Garrod, published in the 'Proceedings' of the Society, 1877, p. 707; it will be referred to in the course of the following description.

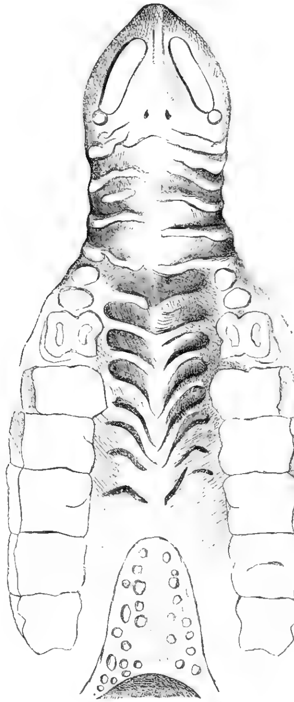
External Characters.

The *external characters* which distinguish this from the other species of Rhinoceros are so plainly shown in the drawings which accompany Mr. Sclater's paper "On the Rhinoceroses living in the Society's Menagerie"[1], that we need not do more than refer to those excellent figures.

[1] Trans. Zool. Soc. ix. p. 645.

One point, however, which appears to have escaped the attention of Prof. Garrod, is worth recording, and that is the presence of hoof-glands; close to the junction of the callous pad which covers the sole of the foot with the integument at the base the apertures of these glands were plainly visible on both fore and hind limbs. A dissection

Fig. 1.



Hard palate.

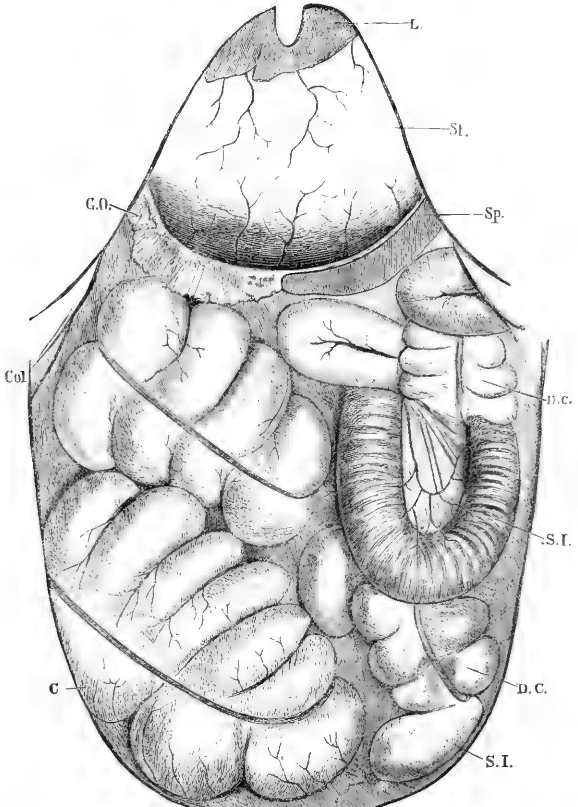
showed that these orifices were, in every case, continuous with a large oval gland situated just beneath the integument. The presence of these glands in *Rh. sondaicus* is worth calling attention to, inasmuch as they are not to be found, according to Garrod, in *Ceratorhinus sumatrensis*; they have been fully described by Sir Richard Owen [1] in

[1] Trans. Zool. Soc. vol. iv.

Rh. indicus; and their presence in *Rh. sondaicus* is another bond of union between these two species, which agree so closely in other particulars.

A pair of mammæ were found, and are inguinal in position, as appears to be the case in all Rhinoceroses.

Fig. 2.



General view of abdominal viscera after removal of ventral abdominal wall.

G.O. Great omentum. St. Stomach. Sp. Spleen. C. Cæcum. D.C. Descending colon. S.I. Small intestine. L. Liver. Col. Colon.

Mouth-cavity.

The accompanying drawing (fig. 1, p. 184) illustrates the ridges upon the hard palate, which have not been figured in any other species, and only described briefly in the Sumatran Rhinoceros by Garrod. These ridges may prove to be distinctive of the species; but in the meantime the material for comparison is so meagre that we prefer to let the figure speak for itself.

Abdomen.

The abdomen was opened within thirty-six hours after death. Previous to the dissection the arterial system had been injected from the right carotid with plaster of Paris. The injection proved to be completely successful, the abdominal arteries being occupied down to their smallest visible branches.

On opening the peritoneal cavity the stomach and intestines were found to be much distended. The stomach contained a fair amount of food, and was the seat of an acute gastritis. The small intestine was moderately and equally occupied, but the whole of the colon was greatly distended, the cæcum especially being very tightly packed with incompletely digested food. It would appear as if, during life, some obstruction in the lower bowel had been brought about by fæcal accumulation.

The following appearance was presented by the viscera when examined *in situ* (fig. 2, p. 185). The hypogastric, right iliac, and right lumbar regions were entirely occupied by the enormous cæcum (C.). It was so placed that its long axis was represented by a line drawn from right to left and from behind downwards and forwards. The apex of the cæcum was found deep in the pelvis. Above the cæcum was another greatly distended segment of the large intestine (Col.); its long axis was parallel with that of the caput coli; it filled a great part of the umbilical and right hypochondriac regions, and was in contact by its upper border with the stomach. Subsequent examination showed that it represented the root of the returning limb of the colic loop or the part where the bowel forming this loop was passing into the descending colon.

The epigastric region was occupied wholly by the stomach (St.) and spleen (Sp.); the latter viscus was lying in contact with the greater curvature of the stomach, and its lower end extended as far as the middle line. The left hypochondriac, lumbar, and iliac regions, and the left side of the umbilical district presented nothing but coils of the small intestine (S.I.) and two loops of the descending colon (D.C.). Some part of the great omentum (G.O.) was exposed to the right of the median line lying between the stomach and the colon; it was rolled up, and took no part in covering the viscera. The pelvis was occupied solely by the end of the cæcum, the rectum, and the bladder.

The Stomach. (Plate XXXIII. and Plate XXXVI. fig. 2.)

The intra-abdominal part of the œsophagus (*œ*) measured 6 inches.

The part of the stomach that most distinctly presented itself was the greater curvature, and it was this part that was most closely in contact with the anterior parietes.

In shape the viscus bore a near resemblance to the stomach of the Horse, a resemblance much more close than that presented by either *R. sumatrensis* or *R. indicus*.

The œsophageal and pyloric orifices were approximated, and a straight line drawn between these openings measured only 6 inches. This narrow interval was occupied by the gastro-hepatic omentum and the coronary artery (*G.a*).

The cardiac portion of the stomach extended 19 inches to the left of a line drawn vertically down across the viscus from the œsophageal opening to the greater curvature. This portion was much more extensive and protuberant than the like part of the stomach of *R. sumatrensis*, as depicted by Professor Garrod (P. Z. S. 1873). It showed a faint indication of a division into two cul-de-sacs (*s.c*, *i.c*), of which the upper (*s.c*) was the larger.

The superior diverticulum corresponded in position with the conical cul-de-sac noticed by Professor Garrod in the cardiac part of the stomach of *R. sumatrensis*. In the present case, however, the upper cul-de-sac was well rounded, and showed no trace of a conical outline. The separation into two sacs was more pronounced when the viscus was empty than when it was distended. At the pyloric end of the stomach was a globular cul-de-sac (*p.c*), of much smaller size than those met with at the cardiac end. As regards its pyloric segment, the stomach in the present instance bore a closer resemblance to the stomach of *R. indicus* than to that of *R. sumatrensis*. In Professor Garrod's drawing of the viscus of the latter animal the pyloric cul-de-sac is represented as exceeding in size the cardiac diverticulum. The depth of the stomach, as measured along a vertical line extending from the œsophageal orifice to the greater curve, was 24 inches, and its greatest width 37 inches. The latter measurement included both the pyloric and the superior cardiac cul-de-sacs.

Interior of Stomach.—Prof. Garrod has described the gastric mucous membrane of this Rhinoceros as well as of *Ceratorhinus sumatrensis*, and has pointed out that they agree with each other and with the Horse and Tapir in the great extension of the œsophageal lining membrane over the cardiac surface of the organ; in our specimen the white, tough, epithelial lining of the cardiac portion of the stomach was sharply marked off from the reddish, soft, mucous membrane which lined the rest of the stomach; the latter appeared to be extremely thick, and was traversed here and there by furrows, as indicated in the accompanying drawing (Pl. XXXVI. fig. 2). The drawing illustrates the marked difference in colour, as well as in texture, of the cardiac and pyloric membrane.

The Spleen. (Plate XXXIII. and Plate XXXVI. fig. 1.)

The spleen was flat and thin. It was entirely invested by peritoneum, and was connected to the greater curvature of the stomach by the gastro-splenic omentum, that measured on an average 6 inches in width. When placed upon a flat surface it presented an oblong outline, the left extremity of the body being, however, narrower and more pointed than the right. Thus at the right extremity the transverse diameter measured 11 inches, and at the left 9 inches. The entire length of the spleen was 26 inches; its long axis corresponded to that of the greater curvature of the stomach, and it was only in relation with the inferior of the two cardiac cul-de-sacs. Its upper extremity was hidden by the costal cartilages, while its lower end reached to the middle line (woodcut, p. 185). In its upper two thirds it was obliquely directed from above downwards, forwards, and to the right; in its lower third its long axis had almost a horizontal direction. It was folded upon itself in a remarkable manner. The folding took place along the centre of the viscus, and corresponded to the long axis of the gland; it was of such a character that the lateral margins of the spleen were approximated, and a transverse section made of the viscus as it lay *in situ* would have presented the appearance of a partly opened book, the long axis of the gland corresponding to the "back" of the book. The folding was towards the right—that is to say, towards the gastric aspect of the spleen. There was no distinct hilum, but the attachment of the layers of the gastro-splenic omentum was noteworthy. When the spleen was opened up or unfolded and placed upon its outer or parietal surface, it presented the appearance of a flat oblong body, as has been already observed. The two layers of the gastro-splenic omentum were not attached along the median line of the viscus, but were attached to the gastric surface of the spleen in two lines that were parallel with the lateral margins of the gland, and that were actually nearer to those margins than to the median line itself. The arrangement of these two layers is depicted in Pl. XXXVI. fig. 1. It thus happened that when the spleen was unfolded the anterior and posterior layers of the gastro-splenic omentum were separated at their splenic lines of attachment by a wide interval; but when the spleen was folded in the manner described, the two layers came in contact, and the omentum presented the appearance of a simple and comparatively thin connecting membrane. This folding of the spleen and arrangement of the omentum must have afforded facilities for a very ready and considerable enlargement of the viscus. Such enlargement would also have been favoured by the marked elasticity of the capsule and by its somewhat loose connection with the splenic pulp.

The Liver. (Plate XXXV.)

The divisions of the liver were well marked, the least pronounced fissure being that separating the right central from the right lateral lobe. The largest lobe was the left lateral (*L. L.*). It, in common with all the other lobes, was convex upon its diaphragmatic surface. It was also equally convex upon its abdominal aspect. Its measurements were 22 inches by $15\frac{1}{2}$ inches. It was thickest towards its inferior border, near which margin it measured from before backwards $3\frac{1}{4}$ inches. Within 5 inches of the superior border it measured in the same direction 2 inches. It was separated from the left central lobe by a very pronounced fissure, which extended upwards through the gland as far as the point where the upper third joined the middle third of the liver. The left central lobe (*L.C*) was very distinctly marked off, and was conical at its free extremity; it was convex in front, and of prismatic outline as regards its posterior surface; its measurements were respectively 18 inches and 5 inches, and its greatest thickness $1\frac{1}{4}$ inch. The fissure that divided it from the right central lobe (*R.C*) extended upwards in front as far as the suspensory ligament, and behind as far as the free margin of the gastro-hepatic omentum. This lobe overlapped the left lateral by its left margin, but was directly continuous with the right central across the line of the suspensory ligament. The right central (*R.C*) and right lateral (*R.L*) lobes were but faintly separated from one another, the intervening fissure separating only about the inferior fourth of this part of the gland. Together they formed a lobe that was convex upon both its surfaces, and that measured 22 inches in length, 9 inches in breadth, and $1\frac{1}{2}$ inch at its thickest part. The base of this double lobe was separated from the root of the left lateral segment by the gastro-hepatic omentum. The caudal lobe (*Ca*) was separated from the rest of the liver by a fissure that extended upwards to within 2 inches of the superior margin of the gland. The lobe was 21 inches in length, 9 in breadth, and $1\frac{3}{4}$ in thickness; its extremity was pointed; its anterior surface was convex, its posterior marked by a median ridge that followed its long axis. The lobe therefore, like the left lateral, was prismatic in section, the base of the fissure being directed forwards. On the abdominal aspect of the gland it overlapped the upper part of the right lateral lobe.

The Spigelian lobe (*sp*) was small, and represented by a narrow strip of hepatic tissue that measured 5 inches in length and $1\frac{1}{2}$ in breadth. It was shorter, wider, and less pointed than the corresponding lobe in *R. sumatrensis*, as figured by Professor Garrod [1].

The liver was entirely invested by peritoneum, except along the attachment of the suspensory and lateral ligaments and of the gastro-hepatic omentum. The extent to which these folds of the serous membrane were attached to the gland is shown in the Plates. The entire width of the lateral ligament was 16 inches.

The structures at the portal fissure had the same mutual relationship as is observed in the human subject. Thus the hepatic artery was placed upon the same plane as the bile-duct, the vascular canal being to the left and the duct to the right. The portal vein was alone and between the two.

Just before entering the gland the artery and vein broke up into two trunks of equal size, and in like manner the bile-duct was made up of two ducts of equal dimensions

[1] P. Z. S. 1873, p. 102.

that joined to form the common tube within an inch of their points of exit from the liver. A very large plexus of sympathetic nerves accompanied the portal vein to the liver.

The common bile-duct had a diameter of half an inch, the portal vein a diameter of $2\frac{1}{4}$ inches.

There were three hepatic veins, which entered the vena cava almost immediately after their exit from the liver.

There was no gall-bladder.

The Cœliac Axis.

The arrangement of the branches of the cœliac axis differed in no very essential respect from the corresponding vessels in the Horse. The trunk broke up into three divisions—gastric, hepatic, and splenic. The gastric artery (Pl. XXXIII. *G.a*) ran from right to left, to reach the gullet as it entered the stomach; at this point the vessel broke up into an inferior (anterior) (1) and a superior (posterior) branch (*s*), the former passing in front of the œsophagus and the latter behind (Pl. XXXIII.). The anterior artery followed the line of the lesser curvature, and ended by anastomosing with the pyloric branch of the hepatic; it supplied the greater part of the anterior wall of the stomach with the exception of the pyloric cul-de-sac, and its offshoots ended by anastomosing with offshoots from the posterior artery, from the splenic artery, the gastro-epiploica sinistra and the gastro-epiploica dextra. The posterior vessel (*s*) was of smaller size than the anterior; near its origin it gave off a branch that, running upwards along the posterior surface of the gullet, entered the thorax. The main vessel was distributed to the posterior wall of the stomach after the same manner that its companion vessel was distributed to the anterior surface, with the exception that it did not approach the pylorus so closely; indeed, both walls of the viscus in the vicinity of the lesser curvature were supplied exclusively by the anterior artery. The posterior artery of the stomach anastomosed with the anterior vessel and with branches from the splenic and both of the gastro-epiploic arteries.

The hepatic artery passed directly forwards to the portal fissure. Just before entering the gastro-hepatic omentum it gave off a branch that, passing downwards across the posterior wall of the pylorus divided into two vessels, the superior pancreatico-duodenal (*s.p.d*) and the gastro-epiploica dextra (*G.e.d*). The former artery ran between the layers of the meso-duodenum, and, having supplied the greater portion of the duodenum, terminated by anastomosing with the inferior pancreatico-duodenal from the great mesenteric. The right gastro-epiploic artery, soon after its origin, gave off two pyloric branches—an anterior and a posterior. These were distributed to the region of the pylorus and to the walls of the pyloric cul-de-sac. They anastomosed with branches of the gastric artery and of the right gastro-epiploic vessel; the latter vessel was of large size, and ran in the great omentum at a distance of from 3 to

6 inches from the greater curvature of the stomach. It followed this curvature, and ended about its middle by joining with the gastro-epiploic branch of the splenic. The artery on its way gave off numerous and regular branches to both surfaces of the right half of the stomach, in the vicinity of the greater curve, and supplied at the same time more than one half of the great omentum.

The splenic artery (Pl. XXXVI. fig. 1) adopted a curved course, running first from right to left and then from left to right. On reaching the smaller extremity of the spleen the artery ran in the anterior layer of the gastro-splenic omentum at a distance of about 2 inches from the viscus itself. From its concave side it gave off numerous vessels (the vasa brevia) that supplied both surfaces of the cardiac ends of the stomach, anastomosing at some little distance from the greater curvature with the anterior and posterior gastric arteries. From its convex side branches arose to supply the spleen. These reached the viscus by running in the anterior layer of the gastro-splenic omentum; some on reaching the capsule at once entered the spleen, while others were continued across its gastric surface until the attachment of the posterior layer of the gastro-splenic omentum was reached. At this point they formed arches whence small offshoots were derived for the supply of the hinder layer of the omentum. These vessels in their passage across the spleen gave off numerous branches to its substance.

The Cæcum and Colon. (Plate XXXIV.)

In all general points the disposition of the colon was identical with that described by Professor Garrod as occurring in the Sumatran Rhinoceros. The cæcum was conical in shape, and its outline very closely agreed with Professor Garrod's figure; it was median in position, its long axis was directed backwards and to the left, and its apex occupied the pelvis.

The large intestine immediately beyond the cæcum was thrown into a considerable loop, just as is the case in the Horse. This loop was first of all directed transversely to the left, but soon becoming bent upon itself turned backwards and upwards. The head of the loop was situated in the left iliac region, while the root of its returning limb was found in the right hypochondriac region. It was the returning segment of the colic loop that formed so conspicuous a feature in the abdomen when the viscera were first viewed *in situ* (woodcut, p. 185, *Col*).

From the right hypochondriac region the colon passed transversely across the abdomen from right to left, and, having reached the left side of the body, it passed almost directly backwards to form the descending colon. This transverse portion of the bowel was hidden by the root of the colic loop, while the descending colon was almost entirely hidden from view by the coils of the small intestine. The relations that the cæcum bore to the colic loop would appear to have differed somewhat from those observed in the Sumatran species.

The base of the cæcum covered entirely the inferior aspect of the root of the colic loop, so that when the parts were inspected *in situ* the precise disposition of this root was not evident (Pl. XXXIV. fig. 1). The cæcum had been displaced forwards, as it were, and to some extent bent upon itself. The bending was of such a character that the base of the cæcum concealed from view the root of the loop, while to the inferior aspect of the returning limb of the loop the dorsal wall of the caput coli was adherent. Figs. 1 and 2 show the appearance of parts before and after division of these peritoneal adhesions.

The cæcum (*c*) was about 2 feet in length, and 20 inches in breadth at its base. It presented three longitudinal muscular bands, between which were enormous sacculi. One band commenced at the ileo-cæcal junction and ran to the apex; a second band ran along the inner or left border of the caput, and was in a line with the attachment of the mesocolon at the base of the cæcum; the third band was continued from the superior of the two bands on the outgoing limb of the colic loop. These three bands all met at the apex of the cæcum, and the two first named were proper to the caput coli and were not continued beyond its limits.

Each limb of the colic loop measured 3 feet. Both limbs became greatly narrowed as the bend of the loop (*n*) was approached. The width of the outgoing limb at its root was 12 inches, and of the incoming segment at the same point 14 inches.

At the bend the width of the colon was reduced to 5 inches. Both segments of the loop were deeply sacculated as far as the narrower portion, where the gut became perfectly smooth and presented the appearance of a small intestine (Pl. XXXIV. figs. 1, 2, *n*).

There were two longitudinal muscular bands upon the colic loop, one at the superior and the other at the inferior aspect of the gut. The superior band was continued on to the loop from the cæcum, as already mentioned. The inferior band commenced at the root of the loop, about the base of the cæcum. Both the bands were continued from the incoming segment of the loop on to the transverse and descending parts of the colon (fig. 2, Pl. XXXIV.).

At the points where the wide segments of the loop passed into the narrow segment—at the point, in fact, where the sacculation ceased—the two bands became joined together at an acute angle, and the single band so formed was almost immediately lost upon the smooth bowel at the bend of the loop. Unless some error has crept into the plate that illustrates Professor Owen's account of the colon of *R. indicus*, it is evident that the colic bands have a different disposition in the two species.

The adhesion between the base of the cæcum—or, more correctly, the root of the outgoing limb of the loop—and that part of the bowel where the loop passed in to the transverse colon was exceedingly intimate. Indeed, it would be more precise to say that a muscular septum divided the lumina of these two portions of the large intestine.

At the point where the transverse colon and colic loop joined one another the bowel showed a globular distension (*d*), the transverse diameter of which measured 18 inches.

The transverse and descending parts of the colon were less sacculated than the rest of the large intestine; they presented two muscular bands, which were continued from the two met with on the top of the colon. Upon the inferior aspect of the transverse colon at its commencement was a distinct muscular band, 24 inches in length, that was placed in the long axis of the bowel; it caused no sacculation. The whole length of the colon from the ending of the loop to the anus was $6\frac{1}{2}$ feet. The width of this part of the bowel was, at its upper part, 10 inches; but as the anus was approached, the diameter diminished to 7 inches. The lesser or inferior mesenteric artery entered the bowel 3 feet from the anus.

The length of the bowel from the ileo-cæcal valve to the anus was $14\frac{1}{2}$ feet, a shorter measurement than those given for corresponding parts of the colon in the Indian and Sumatran Rhinoceroses.

The ileum (*S.i*) entered the cæcum obliquely and in a line with the long axis of the outgoing limb of the loop. The ileo-cæcal junction was entirely hidden by the adhesions (normal) that bound the base of the cæcum to the commencement of the transverse colon.

From that margin of the ileum that was most remote from the attachment of the mesentery, a large triangular fold of peritoneum (*p*) passed to the inferior surface of the cæcum (Pl. XXXIV. fig. 2). It represents the ileo-cæcal plica, and contained no visible blood-vessels.

Immediately in front of the ileo-cæcal junction the peritoneum was so arranged as to form a large rounded fossa (Pl. XXXIV. fig. 2, *f*) capable of engaging the entire fist, and surrounded by a very distinct margin. This fossa was not rendered evident until after the adhesions at the base of the cæcum already alluded to had been broken down. This pouch corresponded to the fossa ileo-cæcalis superior, met with in Man and in a large number of the Mammalia, and around its anterior margin ran a blood-vessel corresponding to the " artery of the arch of the cæcum " (4, fig. 2, Pl. XXXIV.) which Chauveau met with in the Horse.

The cæcum and the colic loop were entirely invested by peritoneum. The limbs of the loop were connected together by a simple layer of serous membrane, as in the Horse. The base of the cæcum and the roots of the colic loop were devoid of peritoneum and were closely adherent to the parietes. The transverse and descending parts of the colon were provided with an extensive meso-colon, which was attached in a vertical line along the front of the vertebral column.

The duodenum, which at its commencement was provided with a meso-duodenum, passed transversely from right to left behind the base of the cæcum. The commencement of the small intestine was consequently to the left of the caput coli. The portion of duodenum behind the cæcum was devoid of peritoneum and was in contact with that part of the colon that has been already described as adhering to the parietes. Between the segment of the duodenum and the colon the great or mesenteric artery passed.

The Mesenteric Arteries

in all essential points resembled the corresponding vessels in the Horse. The great mesenteric gave off from its left side the vasa intestina for the small intestine and the colica media.

The former branches each formed a single arch before entering the bowel. The latter artery supplied the transverse colon and upper part of the descending colon and ended by joining with the lesser mesenteric artery.

From the right side of the main trunk were derived the inferior pancreatico-duodenal artery and the two arteries of the colic loop (1 and 2, fig. 1, Pl. XXXIV.). These vessels came off separately from the great mesenteric. On their way to the loop they were buried in the adhesions that connected the base of the cæcum with the root of the incoming limb of the loop. The artery of the outgoing segment (2, fig. 1) ran upon the bowel itself; the corresponding vessel for the other segment (1, fig. 1) ran in a serous membrane that connected the two parts of the loop. The two arteries joined at the bend of the loop and gave off branches at regular intervals of two inches to supply the colon.

A remarkable azygos artery (3, fig. 1, Pl. XXXIV.) ran parallel with the artery of the outgoing limb. It was contained on the free margin of a separate fold of peritoneum, was of the same size from its commencement to its end, and served to connect not only the two colic arteries together but also the respective extremities of those vessels. It gave off no branches of any kind. It would appear that the connecting vessel placed in a special fold would serve the purpose of carrying on the circulation, in the event of the colic arteries becoming occluded by pressure or by reason of extreme bending of the colic loop.

In size this vessel was equal to the ulnar in the human subject. The artery of the arch of the cæcum (4, fig. 2, Pl. XXXIV.) has already been alluded to. The superior cæcal artery had a distribution identical with that of the vessel of the same name in the Horse, and the same observation applies to the inferior cæcal artery (5, fig. 2, Pl. XXXIV.)

With the superior cæcal artery arose the ileo-colic that was distributed to the terminal part of the ileum and ended by joining the last of the vasa intestina.

The lesser or inferior mesenteric artery approached the bowel 3 feet from the anus. Its mode of distribution differed in no respect from the corresponding vessel in the Horse.

Heart.

The heart presented nothing unusual in its structure; the apex was markedly bifid; the right auriculo-ventricular valve has the same structure as has been recorded by

Owen for the Indian Rhinoceros; as in that species, one of the three papillary muscles, corresponding to the "great" or "anterior" papillary muscle of Man, is attached to the free wall of the ventricle. This arrangement is found in many mammals either occasionally or invariably, and is apparently characteristic of the Tapir and the Ungulata generally.

The aortic arch gives off an innominate artery, from which are derived the common carotid and the right subclavian; the left subclavian arises separately from the aortic trunk; each of the two subclavians gives off an internal thoracic artery, which is large, as in *Rh. indicus*. The external and internal iliacs arise separately from the aorta.

The origin of the arteries from the abdominal aorta is precisely like that of Man; the superior and inferior mesenteric arteries are quite separate, the one arising in front of the other behind the origin of the renal arteries. In many of the lower Mammalia there is but one mesenteric artery.

For the account of the smaller branches of the arterial system reference must be made to the description of the abdominal viscera.

Urino-genital Organs.

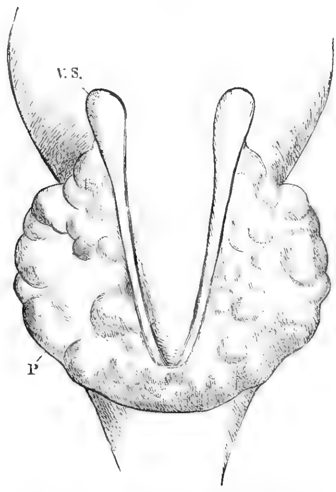
The *kidneys* showed slight indication of lobulation; they were covered below by the peritoneum, which did not extend on to the borders nor on to the dorsal surface.

The urinary bladder had a very distinct urachus; the muscular fibres of the bladder were disposed in two layers; the superficial fibres were arranged in a series of concentric circles round the urachus. The deep fibres passed round the bladder in a direction as nearly as possible at right angles with the superficial fibres. The superficial fibres were extremely conspicuous and distinct from each other by reason of their large size; the deep fibres were much smaller and whiter in colour. Our observations upon the generative organs do not entirely coincide with those of Sir Richard Owen upon the generative organs of the Indian Rhinoceros; it must be borne in mind, however, that the differences which we here record may be actual differences between the two species. The points in which we are at variance concern the structure of the vesiculæ seminales. These organs are described by Sir Richard Owen in the following words:—"The vesicular glands or 'vesiculæ seminales' present an elongate subcompressed pyriform shape, eight inches in length and three inches and a half across the broadest part of the fundus. They have a lobulated exterior and a structure very similar to that of the same bodies in man." On Plate XVI. of his memoir those structures are illustrated, and the figure of the vesicula seminalis (V. S.) is entirely in accord with the description given of them.

We are nevertheless inclined to suspect that what Prof. Owen terms the vesicula seminalis is in reality the vesicula seminalis *plus* a portion, at least, of the prostate gland.

The disposition of this part of the generative system in *Rhinoceros sondaicus* may be understood from the accompanying drawing (woodcut, fig. 3), where the vesicula seminalis is lettered V.S. and the prostate P. Each vesicula seminalis is a comparatively slender tube slightly swollen at its distal cæcal extremity, and is closely adherent to the prostate; it is a matter of no difficulty, however, to separate the two by a careful dissection, and we have assured ourselves that the drawing which illustrates this anatomical fact is an accurate representation. On comparing the vesiculæ seminales and prostates of *Rh. sondaicus* with Owen's figure of the same structures in *Rh. indicus*, it seems very easy to understand how such an error (if we are right in supposing it to be so) may have crept in. The close union between the vesicula seminalis and the prostate of its own side would easily lead to their being confounded, and there is nothing in the figure which would render our interpretation of it impossible. The late Mr. W. A. Forbes has described (Trans. Zool. Soc. vol. xi.) the male generative organs of the Sumatran Rhinoceros, and his account would certainly seem to confirm the accuracy of Sir Richard Owen's:—"The vesiculæ seminales

Fig. 3.



Base of the bladder and adjacent structures.
P. Prostate. V.S. Vesicula seminalis.

resembled in shape those described by Owen: they were $7\frac{1}{2}$ inches long, and 1 inch across at the broadest part. The right vesicula had two, the left four, narrow ducts, $1\frac{1}{2}$–2 inches long, which joined the vasa deferentia just before these entered the urethra." This is the whole description of the organs, but they are not figured, and it is impossible therefore to compare them carefully with Owen's description and with the conditions observed by us in *Rh. sondaicus*; on *à priori* grounds it would seem more likely that the Sumatran Rhinoceroses would differ from both *Rh. indicus* and *Rh. sondaicus* than that the two latter should differ in so remarkable a manner from each other.

The *penis* appears to correspond closely to that of *Rhinoceros indicus*; it is hardly worth while to describe it in detail, as Prof. Owen's description would apply almost word for word to the present species; it is important, however, to record the fact that there is this similarity, since Mr. Forbes has pointed out that the glans penis of *Rh. sumatrensis* is somewhat different in shape from that of *Rh. indicus.*

The penis is provided with two retractores penis and two levatores penis; the latter unite together and are attached to the penis about 10 inches from the end of the bulb by a thick tendon about the size of the thumb. From this point the tendon passes along the dorsal surface of the organ as far as the glans.

The retractores penis are inserted for a space of about 4 inches on to the ventral surface of the penis.

Brain.

The brain of *Rhinoceros sondaicus* is illustrated on Pl. XXXVII. by two figures; one (fig. 2) represents the superior surface of the organ, the other (fig. 1) the inferior surface. It has been already mentioned that the arterial system of the animal was successfully injected: we found on examining the brain that the arteries at its base were likewise filled with a mass of injection and rendered therefore very conspicuous; the figure shows the distribution of the arteries. Both drawings were made after the brain had been hardened in spirit.

The convolutions of the cerebral hemispheres appear to be not very different from those of *Rh. indicus*, and both rather less complicated than what is met with in *Ceratorhinus sumatrensis*, judging from the figures of these two brains which illustrate the papers of Sir Richard Owen and Prof. Garrod; in details, however, the convolutions of the brain of *Rh. sondaicus* are not precisely like *Rh. indicus*; our figure may be compared with Owen's.

EXPLANATION OF THE PLATES.

PLATE XXXIII.

Stomach and spleen, including gastrosplenic omentum; the blood-vessels injected. *œ*, œsophagus; *d*, duodenum; *sp*, spleen; *s.c*, superior cul-de-sac; *i.c*, inferior cul-de-sac; *p.c*, pyloric cul-de-sac; *G.a*, gastric artery (*s*, its superior branch; 1, its inferior branch); *s.p.d*, superior pancreatico-duodenal artery; *G.e.d*, gastro-epiploica dextra artery.

PLATE XXXIV.

Fig. 1. Colon and cæcum from the ventral aspect, the peritoneum undisturbed; the blood-vessels injected. *Co*, colon; *C*, cæcum; *n*, free loop of the colon; 1, 2, arteries of colic loop; 3, azygos artery.

Fig. 2. The same, peritoneum separated. *s.i*, small intestine; *f*, fossa; 4, artery of arch of cæcum; 5, inferior cæcal artery. Other letters as in fig. 1.

PLATE XXXV.

Fig. 1. Liver, posterior (ventral) aspect. *R.L*, right lateral; *R.C*, right central; *L.C*, left central; *L.L*, left lateral; *Ca.* caudate; *sp*, Spigelian lobes; *h.v*, hepatic vein.

Fig. 2. Liver, anterior (dorsal) aspect. Lettering as before.

PLATE XXXVI.

Fig. 1. Spleen, showing the attachment of the gastrosplenic omentum.

Fig. 2. Mucous membrane of interior of stomach.

PLATE XXXVII.

Fig. 1. Brain of *Rhinoceros sondaicus*, ventral aspect, with blood-vessels injected.

Fig. 2. Ditto, dorsal aspect.

J. Smit lith.

Hannart imp.

SONDAIC RHINOCEROS.

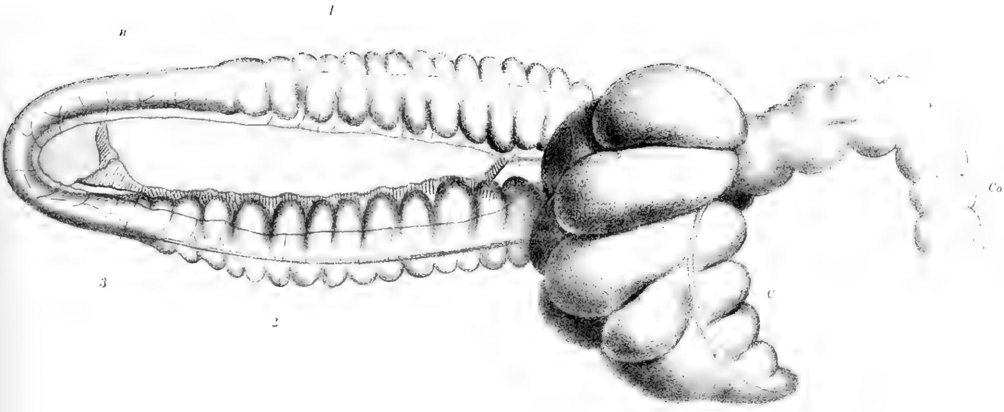


Fig 1

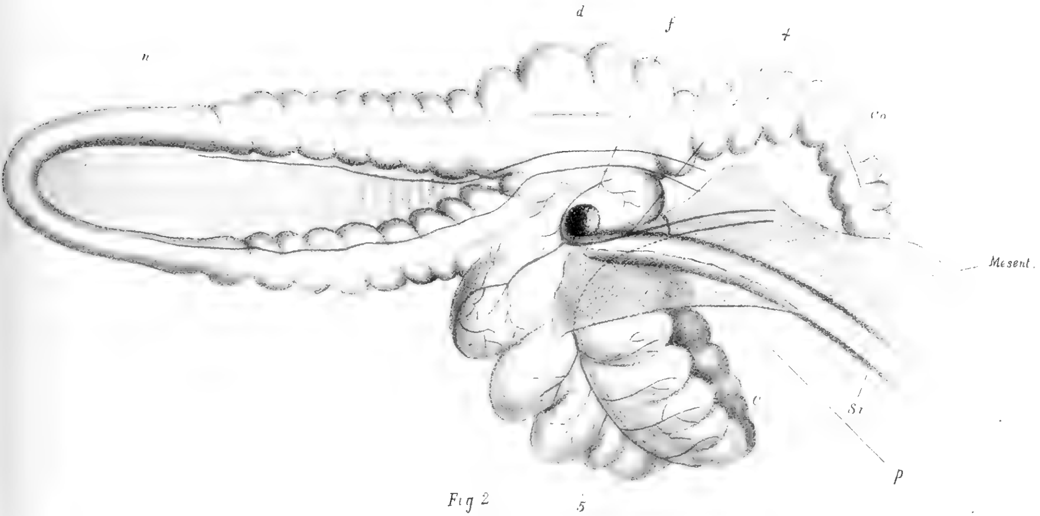
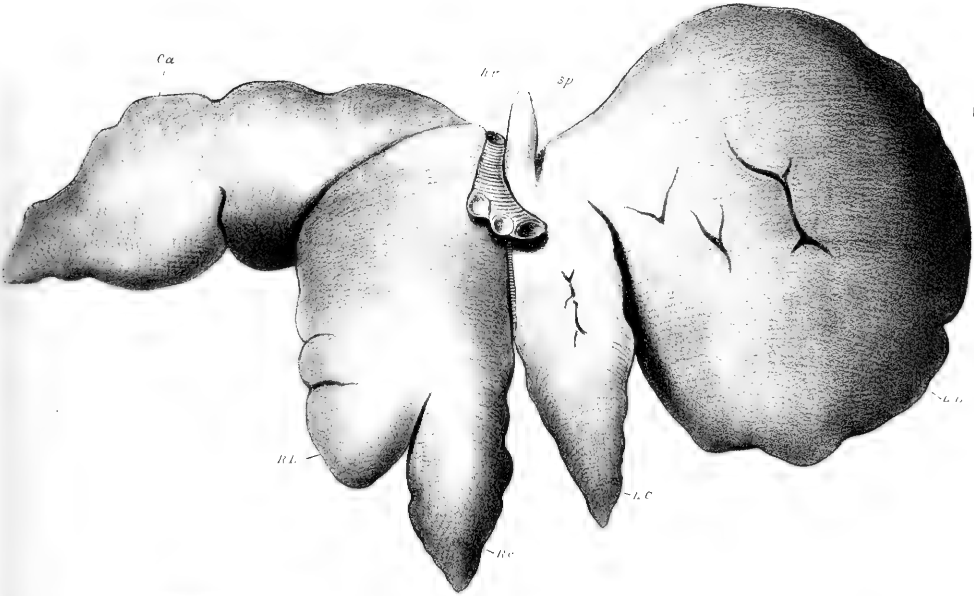


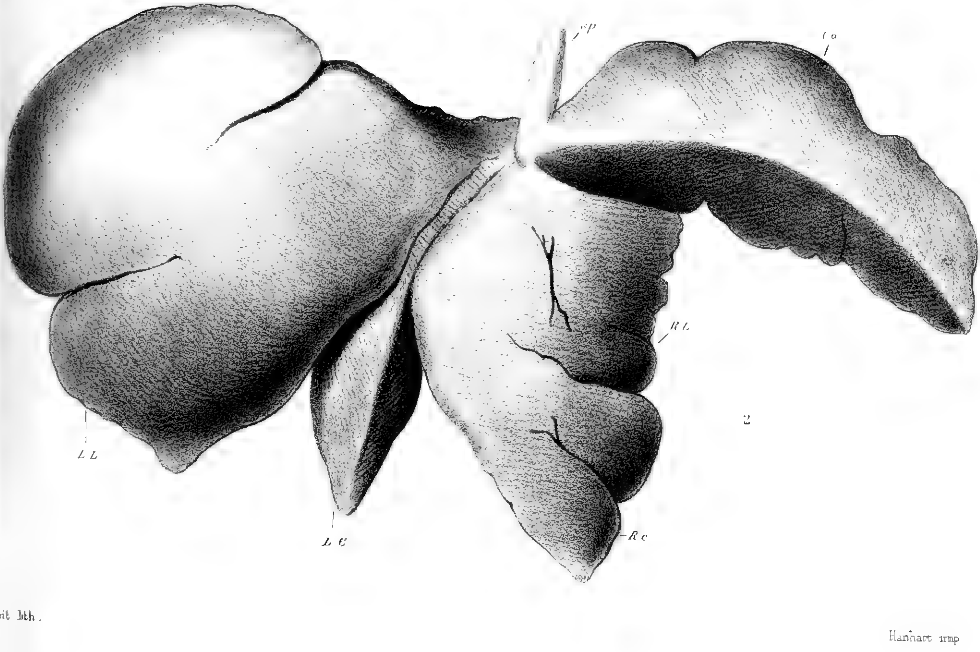
Fig 2

J Smit lith

Hanhart imp

SONDAIC RHINOCEROS.





Smit lith.

Hanhart imp

SONDAIC RHINOCEROS.

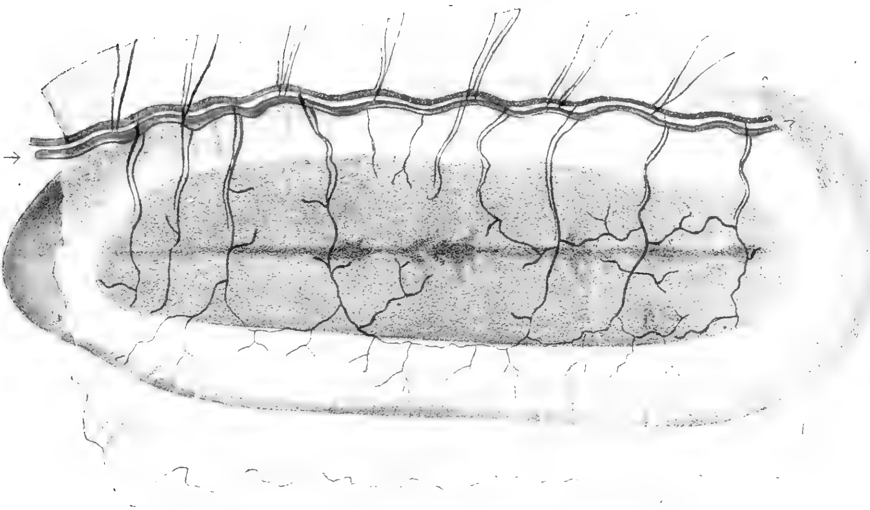
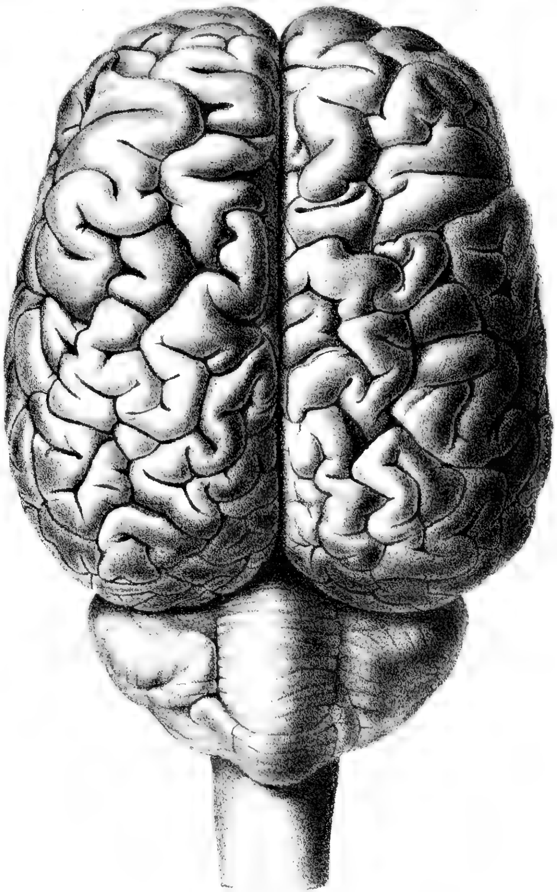


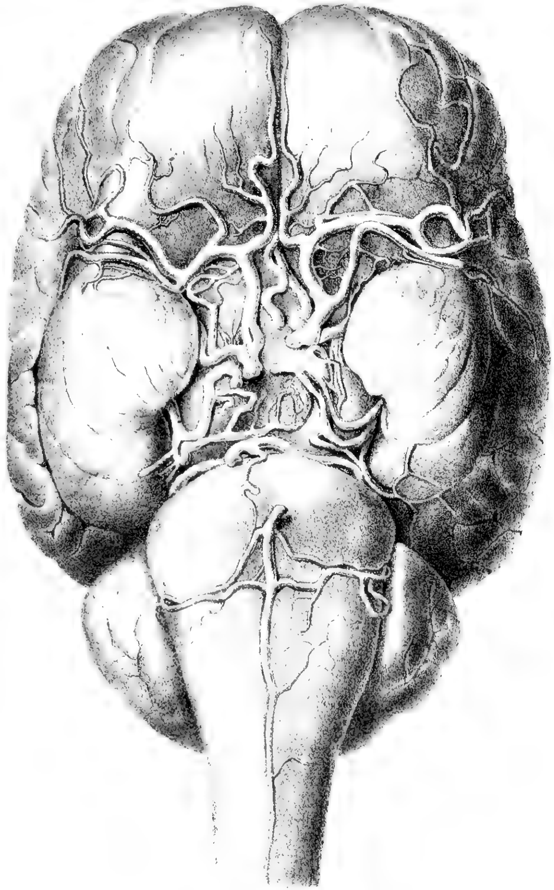
Fig 2

J. Smit lith.

Hanhart imp

SONDAIC RHINOCEROS.





J Smit lith.

SONDAIC RHINOCEROS

X. *On some new Exotic Amphipoda from Singapore and New Zealand.*

By the Rev. THOMAS R. R. STEBBING, *M.A.*

Received November 12th, 1885, read January 19th, 1886.

[PLATES XXXVIII., XXXIX.]

IN the collections made by Brigade-Surgeon S. Archer, to illustrate the 'Marine Fauna of Singapore,' numerous Decapods are included, a few Isopods, and one Amphipod specimen. This last has been passed on to me for description by my friend Mr. Alfred O. Walker. Although it does not exactly correspond with Boeck's description of *Byblis*, inasmuch as the last uropods are not very short, and the telson is deeply bifid, in other points it so well agrees with it that I should be unwilling to add to the subdivision of the Ampeliscaidæ, already perhaps carried unnecessarily far.

The two species from New Zealand were sent me by my friend Mr. G. M. Thomson, a well-known carcinologist, with brief preliminary descriptions, and the names respectively *Talorchestia tumida* and *Pherusa* (?) *cærulea.* No females of the *Talorchestia* were sent me. The *Pherusa* seems to fit in more accurately with Boeck's closely allied genus *Amphithopsis*, and may therefore be introduced to the world as *Amphithopsis cærulea*, Thomson. [See, however, the P.S. p. 208.]

1. BYBLIS KALLARTHRUS, n. sp. (Plate XXXVIII.)

The four round simple eyes have the shining yellow plate in each surrounded by a mass of dark pigment.

The upper antennæ not reaching to the end of the peduncle of the lower; the first joint short, inflated; the second between two and three times as long, slender; the third not longer than the first joint of the flagellum; flagellum with 11 joints, of which the distal are the longest, and the central the shortest; bristles longer than the joints. The lower antennæ have the first three joints curiously interlocked, directed forwards along the lower margin of the head; the fourth long, linear joint provided with a rather long hinge, which enables it to bend backwards at a sharp angle; the fifth joint still more slender, not quite so long; the flagellum of 22 joints. There are long, thin bristles on the fourth and fifth joints of the peduncle, and on most of the joints of the flagellum.

Left mandible with seven teeth on the cutting-edge, and five on the secondary plate; in the spine-row nine spines with clean points, and more or less spinulose concave edges; molar tubercle irregularly four-sided, with several nearly straight cross rows of denticles.

The lobe within the first joint of the palp is large, rounded, thin. The second joint of the palp is far the longest; this on two margins and the straight third joint on one carrying numerous long, fine bristles, not or, if at all, but feebly ciliated.

Right mandible similar to the left, but with the inner plate not divided into teeth, but laminar, running out into a fine point, and having an oblique microscopically denticulate edge.

Lower lip with main lobes broad, squared; mandibular springs presenting only a little free lobe; inner lobes stout.

First maxillæ: palp with second joint broadening distally, the end obliquely rounded, set with five short spine-teeth, bristles on the distal and inner margin; eleven more or less serrate spines in a double row on the distal edge of the outer plate, the innermost being straight, the rest curved; a single bristle at the apex of the inner plate.

Second maxillæ: outer plate much broader than the inner, both fringed distally with rather long, slightly plumose, bristles, which run a little way down the outer margin of the outer, and the inner margin of the inner plate.

Maxillipeds: inner plates narrow, reaching beyond the first joint of the palp, having on the distal end and part of inner margin straight plumose bristles; the armature of the outer plate consists of two or three small bristles, six teeth having each the shape of a hand looking-glass, succeeded by two spine-like teeth, and three long, slightly plumose, bristles. The long second joint of the palp does not project beyond the outer plate; the short third joint is dilated distally; the fourth joint ends in an almost linear nail, it has one or two short bristles on the inner curve.

First gnathopods: side-plates very shallow; first joint long, a little widened distally, numerous long bristles issuing from various parts of margins and surface; fourth joint not much shorter than the first, with numerous, long, some partially serrate, bristles on edges and inner surface; a row of short, distally biserrate bristles near the junction with the hand; hand much shorter than fourth joint, a very long oval; many long bristles as on the preceding joint; finger slender, shorter than the hand, three or four short close-lying bristles along the inner margin, and two or three at the place of insertion of the nail.

Second gnathopods: side-plates oblong, rounded behind, with long bristles, plumose throughout, on the serrate lower margin; leg similar to that of the first gnathopod, but first and fourth joints longer, fourth and fifth thinner, sixth shorter. The fifth joint, or hand, is covered on the inner surface with successive rows of short, biserrate bristles. The long irregularly oval branchia has on both surfaces a row of subsidiary sacks overlapping one another for nearly the whole length of the main sack. The narrow marsupial lamella is entirely unfringed.

First peræopods: side-plate, first and second joints, branchia, and marsupial lamella very similar to those of the second gnathopods; third joint elongate, longer than fourth and fifth combined, parallel-sided, with long bristles on the hinder, and some short ones on the front margin; fourth joint short, straight, with four bristles much longer than itself on the hinder margin, and one on the lower front angle; hand longer than wrist, curved; finger longer than wrist, shorter than hand, with an outlet near its apex for the secretion from the gland-cells conspicuous in the first and third joints.

Second peræopods: side-plates of much greater extent from before backwards than the preceding plates, excavated behind, and with the lower margin curiously sinuate, this margin carrying plumose hairs, and serrate all along, except on the hinder lobe. The joints of the leg very like those of the first peræopods, but the long bristles very plumose, the first joint, the fifth, and the sixth rather longer. The hand has three groups of bristles on the hinder concave margin, near its juncture with the wrist. The marsupial plate shows the marks of insertion of three terminal bristles, which have probably been broken off from the specimen.

Third peræopods: side-plate extended from before backwards, anterior lobe the larger; first joint with front rim serrate, closely set with bristles, very convex, a little out-drawn below; the upper half of the hinder rim convex, the lower half being the continuation of a separate fold of the outer surface, which narrows distally; third joint longer than second; fourth longer than second and third together, fifth rather longer than third; finger very small, triangular, up-turned. Besides the series of bristles on the anterior margin, the fourth and fifth joints terminate behind, as so usually in the Ampeliscaidæ, with fringes of spines varying extremely in length, especially on the wrist, and variously serrate. Along the surface of the wrist are groups of small spines, and a series of single ones on the hand; the branchiæ and marsupial plates as in the preceding pair.

Fourth peræopods: side-plates small; legs very like the third pair, but first joint pear-shaped, with both margins sinuous; fourth and fifth joints rather longer than in the preceding pair; branchiæ like the rest.

Fifth peræopods: side-plate a somewhat oval lobe; first joint widening distally, produced far below the third joint, anterior and lower margin of the produced part fringed with long plumose bristles; short bristles on the inner surface; second joint very short; third joint with seven long spine-like bristles on anterior margin, a long fine bristle and some short spines near lower hinder angle; fourth joint much longer than third, twelve spine-like bristles along serrate anterior margin; on the surface series of single spines and groups, a fringe of them at the distal end varying in size, but with none immensely elongated as in the two preceding pairs of peræopods; fifth joint about as long as third, narrow at junction with the fourth, anterior rim convex, smooth; groups of spines on surface and distally; finger linear, straight, not half the length of the hand, tipped with two fine bristles, one of them as long as the hand itself.

Pleopods with 22 joints to the rami.

First uropods: peduncle lobed above; four spines on the inner upper margin, the spine of lower distal margin not large; rami rather longer than peduncle; outer rather longer than inner; inner with a row of six spines on the upper margin.

Second uropods: rami rather shorter than peduncle, with few spines, the edges microscopically serrate, with the serrations again minutely serrate.

Third uropods: the rami longer than the peduncles; the outer edge of the outer and inner edge of the inner ramus straight, with few spines. The outer ramus has its inner edge proximally smooth, then narrowing with a curve, dentate for a short space, and for the remainder of its length to the apex microscopically serrate. The inner ramus, as in the second uropods, forms a fold beneath on its inner proximal edge; on the outer edge it overlaps the outer branch, and is uniform with the inner edge of that branch, except that the strong dentation is carried much further down. The inner branch is only a trifle shorter than the outer.

The telson is rather longer than broad, lateral edges rounded, narrowing a little distally, distal border almost straight, the slit reaching rather beyond the middle of the length. The two halves of the telson in the specimen described are not quite symmetrical, nor are the bristles equal in number or quite symmetrically placed on the two sides, one of which has five, the other six.

The head is very elongate, truncate in front, with very slight concavity, lower margin sloping obliquely backwards below the eyes; median dorsal line angled. Front and hind margins of the peræon segments strongly dovetailed below. The branchiæ have near the point of attachment a lobe which is narrower than the main vesicle.

First three segments of pleon rounded below both anteriorly and posteriorly. The line of (incomplete) coalescence between the fifth and sixth segments can be discerned across the back, not far from the telson.

The specific name is derived from κάλλος, beauty, and ἄρθρον, a limb.

2. Talorchestia tumida, n. sp. (Plate XXXIX. fig. A.)

Eyes large, round, separated from one another by less than the diameter of either, reported to be, in living specimens, of a turquoise-blue colour; ocelli extremely numerous.

Rostral angle very obtuse. Upper antennæ short, reaching a little past the end of the penultimate joint of the peduncle of the lower pair; first joint of peduncle broad, a little longer than broad, second joint shorter, much narrower, third joint rather longer than second; flagellum 7–8-jointed, not so long as the peduncle, last joint minute. Short, stiff spines at various points, of which the most considerable is an incurved one on the outer lower half of the third joint of the peduncle.

Lower antennæ as long as the head and first two segments of the peræon; the third joint of the peduncle with a short two-spined process on the inner side; fifth joint of peduncle the longest; flagellum 12–15-jointed, a little shorter than the peduncle.

Spines on all the joints of the antennæ, except the last minute one of the flagellum, which ends in a microscopic brush.

Upper lip with the hirsute lower edge (apparently) minutely emarginate.

Right mandible with six teeth on the cutting-edge, of which two are prominent; the inner plate with four teeth; spine-row consisting of five plumose bristles; molar tubercle with oval grinding-surface of more than twenty rows of denticles, with a brush of hairs at either end. Left mandible similar, but inner plate shorter, less flat; four bristles to the spine-row, which together with the biting-plates is more remote from the molar tubercle than in the right mandible.

Lower lip with broad lobes, well furred along the distal and inner margins, the mandibular springs short. On the inner side, standing clear of the lobes, is a narrow plate less than half the length of the lobes, narrowing almost to the distal end, which is minutely emarginate.

First maxillæ: outer plate oblong, crowned with ten spines, mostly pectinate in the distal half. A slight interruption in the outer margin indicates the position of a rudimentary palp. The inner plate bears distally two plumose bristles.

Second maxillæ: plates about equal in breadth, the outer projecting beyond the inner, distal edges armed with slightly curved spines, neither long nor stout; on the inner plate the series is continued some way down the inner margin, concluding with a plumose bristle longer than the preceding spines. A spine also occurs on the inner surface of this plate, nearer to the distal end than the bristle just mentioned.

Maxillipeds: inner plates long, with three teeth, some spines at the distal end of each; outer plates short, scarcely extending beyond first joint of palp, round the distal end and nearly halfway down the inner margin bushily fringed with short spines, the remainder of the margin naked; a group of five short spines on the external surface, just below the inner basal angle of the palp. The palp 3-jointed, the joints short, subequal in length, the second lobed distally on the inner side; the second and third fringed bushily on the inner side with short spines, which may or may not conceal a rudiment of a fourth joint.

First gnathopods: side-plate almost concealed by that of the next segment, the front margin a little concave towards the upper half, the lower margin projecting in front, spined. The first (free) joint with stiff spines on all three margins, and a few dispersed on the surfaces. The fourth joint is more than three quarters as long as the first; it has a small, nasiform, microscopically furred lobe near the hinder distal end, within which is a long spine constricted near the middle, and then pectinate on both edges. The hand is shorter, narrower, an oblong slightly curved, with a hinder distal, squarish, minutely furred lobe, beyond which the point of the finger projects. Both wrist and hand are armed on both edges, distal margins, and both surfaces, but especially the inner, with numerous spines of various lengths. The second and third joints are also spiny. Inside the lobe of the hand is a group of tiny pectinate spines. The finger has small spines on its inner margin and at the base of the nail.

Second gnathopods: side-plate quadrate, lower hind corner strongly rounded, spines on hind margin and inner surface. First joint scarcely longer than the hand, margins nearly parallel, anterior slightly concave, both spined; second joint, though short, longer than third or fourth, antero-distally lobed on the inner and outer sides; third joint lobed postero-distally; fourth or wrist-joint forming a very small triangular cup, much overlapped on both sides by the monstrous hand. The hand broad, long, and thick, the front margin much longer than the hinder. The palm very oblique, with two deep excavations, the process between which meets a strong projection of the finger's inner border. The palm is beset with three or more rows of spines of different sizes, which form a sort of coronet round the process. At the termination of the palm there is a pit or fold in the integument in which the end of the finger lies when closed. The finger is much arched, with the inner protuberance already mentioned, and several rows of microscopic spines on its two surfaces.

First peræopods: the side-plate quadrate, much spined on the inner surface; the first joint not much differing from the corresponding joint of the gnathopods; the third joint much longer than the fourth or fifth, which are subequal in length, and like the third carry numerous spines. The finger about as long as the hand, with small spines at the base of the distinctly socketed nail.

Second peræopods: side-plate with anterior margin nearly straight, protuberantly rounded above, rounded off below, hinder margin irregularly excavate. First joint but little projecting beyond the side-plate; third joint not much longer than the fifth; fourth shorter than fifth; finger with a strong denticular process on the inner margin, carrying a small spine at the base; the nail socketed among thin lobes and spines as in the first peræopod. Many spines on the various joints.

Third peræopods: the side-plate long, bilobed, the hinder lobe deeper than the anterior, fringed below with spines. First joint roundly quadrate, hinder rim scarcely indented; third joint a little produced below posteriorly, subequal in length to the much thinner hand; fourth joint shorter than the hand. All these joints spinose. Finger shorter than the hand, unguiculate.

Fourth peræopods: side-plate with a minute anterior lobe and a deep hinder one, strongly spined below. The first joint oval, the spines on the hinder rim minute; the third joint triangular, the sides indented, a distal lobe behind overlapping the next joint; the fourth joint expanding abruptly backwards, with four deep indents on the front margin, the hinder nearly straight, sloping down to a distal margin, which is narrow, but wider than the neck of the joint. Hand long, thin, nearly parallel-sided; finger not nearly so long as the hand; the nail little more than a third the length of the whole, instead of about half as in the first peræopod.

Fifth peræopods: side-plate small, bilobed, the hinder lobe the more important. The first joint squarely rounded, crenulate, and spined posteriorly—the measurement from the front to the hind margin much exceeding that of the corresponding joint in the third and fourth peræopods; third joint only moderately expanded distally; fourth of nearly the same length as third, nearly parallel-sided; the hand and finger as in the fourth peræopod, but both shorter.

The branchiæ are small and variously twisted; those of the third and fourth peræopods appear to be the largest.

The pleopods appear to be feeble and laminar, with long peduncles spined on the outer edge and, for a short distance near the base, also on the inner edge. The slender rami have spines on the long basal joints and plumose setæ of no great length on the terminal joints, which number about six.

The first uropods have the peduncles longer than the rami, fringed along two edges with spines, with some extra spines about the base; the rami, projecting about equally far, are armed along their margins with spines, which increase in length distally, and with some slightly incurved spines at the apex. There is a second row of smaller spines on the inner ramus.

The second uropods have the peduncle springing from what looks like a short basal joint. The ordinary peduncular joint is spinous on both margins. The rami are subequal in length to one another and to the peduncle, or, as on one side of the specimen examined, a little longer than the peduncle.

The third uropods have short stout peduncles, spined on the outer edges, projecting but little, or not at all, beyond the telson. The single ramus is armed round the outer and distal edges with twelve spines, as in one of the pair of uropods examined, or ten as in its fellow.

The telson has a straight base-line, the sides curving round to a flattened apex; its breadth at the base and length down the centre are about equal; a ring of small spines is set not quite symmetrically round the lower half.

The general form of the body, as seen from above, is much inflated, tapering strongly from the fourth peræon-segment to the telson. The first pleon-segment is spined round the lower margin to the lower hinder angle, beyond which the hinder margin bulges out, with one or two minute spines in its course. In the second and third segments the series of retroverted spines round the lower front margin does not come near the lower hinder angle, which has a spine of its own. The back margin in each of these segments is armed with spines, and is nearly perpendicular to the lower margin. There are spines on the inner surfaces. The fourth pleon-segment is dorsally saddle-shaped, although this form is not observable till the segment is withdrawn from its partial concealment under the third. The fifth is dorsally overlapped by the fourth, and the sixth, which is ventrally and distally bilobed, shows no dorsal portion, the telson apparently usurping its place.

The skin-markings correspond with those figured by Spence Bate for *Talitrus locusta*;

in general effect they are very like the conventional figure of a bird far off in the sky. There are two arms, a little notched at the end, inclined to one another at various angles, and, as it were, held together by a short central stock or handle, which projects most on the convex side of the bow.

In many specimens the large second gnathopod has a much more even palm than that above described, with only a slight emargination or concavity above one third of its length from the articulation with the finger, the finger at the same time having only a slight bulge corresponding with the sinuous part of the palm not far from its hinge. In correlation with this form of the gnathopod, the fourth peræopod has its third and fourth joints slender, not strongly dilated as above described. It is a question whether these differences should lead us to speak of two forms of the male, as Mr. G. M. Thomson suggests, or whether they are not only stages of development, the oldest males acquiring the forms first described.

It will have been noticed that in this species the development of the joints of the peræopod, which so much facilitates upright walking in *Orchestia littorea* and *Orchestia mediterranea*, does not occur, as in those species, in the last, but in the penultimate pair of peræopods.

Mr. Thomson includes in his preliminary description the following remarks:—"Colour, when alive, ivory-white. *Hab.* In sandbanks, Purakanui, near Dunedin, among roots of littoral plants, many yards from high-water mark. Each specimen inhabiting a hole of its own. When taken out they leap with great vigour."

3. Pherusa cærulea, n. sp. (Plate XXXIX. fig. B.)

Eyes minute, dark, difficult to distinguish amidst the deep blue of the head around them. Ocelli composing the eye about twelve in number.

The deep excavations of the anterior cephalic margin leave a short, but well-pronounced, depressed rostrum between the upper pair of antennæ, and on either side a blunt process between the upper and lower antennæ, a little below the position of the eye.

The upper antennæ considerably longer than the lower: first joint of peduncle longest, much the stoutest; "auditory" cilia very minute; second joint not much shorter than first; third much shorter than second; flagellum about three times as long as peduncle, with numerous (33) joints slowly increasing in length and decreasing in thickness towards the distal end.

Lower antennæ with large basal plate, small "renal" denticle, third joint short, fourth the longest, scarcely as long as the first of the upper antennæ, fifth rather shorter than the fourth; flagellum tapering, with nineteen joints, similar to the longer flagellum of the upper antennæ.

Upper lip with distal edge nearly straight, a little convex, the converging hairs on the border tolerably stout.

The right mandible with a foot-like cutting-edge, five or six of the teeth representing the toes in gradation of size; inner plate not well observed; molar tubercle very prominent; palp with first joint short, second longest and stoutest of the three, carrying spines at intervals on the indented straight margin, and a linear group of six on the convex margin near its distal end; the third joint much curved, narrowing rather abruptly for the distal half, with three spines on the concave margin and three at the extremity, besides the fine down so commonly found on this joint of the palp.

The left mandible differs a little, the stem behind the molar tubercle being apparently longer, and the cutting-edge having three of its teeth much more prominent than the other four. The secondary plate is thin, 5-toothed; the spine-row, besides a group of hairs at the base of the secondary plate, contains some six ciliated slender spines curving towards the molar tubercle. The number of teeth in the secondary plate was visible in the new growth within the old shell.

Lower lip, with the main lobes narrowing distally; inner lobes not observed; mandibular springs rather long and thin.

First maxillæ: broad distal end of the second incurved joint of the palp carrying eight little spines; outer plate crowned with ten spines distally spinulose; inner plate on its oblique indented margin carrying a row of fifteen slightly plumose bristles.

Second maxillæ: outer plate projecting beyond the inner, about equal to it in breadth; spines of various lengths, slightly ciliated, on its distal end; inner plate with convex margins, a row of distal spines, and a long row on the surface within the inner lateral margin.

Maxillipeds with long inner plates reaching as far as the distal end of the first joint of the palp, three teeth and several finer ciliated spines on the distal margin, eight bristles along the inner margin; outer plates not reaching to the end of the second joint of the palp, having spine-teeth along the inner margin, the series passing over on the distal margin into ciliated spines; second joint of the palp longest, fringed on the inside with bristles, this and the first and third joints dilated distally; finger fringed with fine hairs, ending in a nail-like spine or a spine-like nail.

First gnathopods: side-plates oblong, with some fine spines or spinules about them; first joint not so long as hand and wrist combined; second joint short; third short, rhomboidal, with a fascicle of spines on the distal margin; fourth joint longer than hand, dilated distally, spinous on both margins; hand a little dilated distally, palm oblique, with spines along it and two stouter ones at the end for the finger to impinge against, a row of four bristles on the inner surface besides those on the front and hind margins of the hand.

Second gnathopods: side-plates similar to those of the first pair, but larger; first joint shorter than hand and wrist combined, less spined than that of the first pair; second joint longer than third; third joint as in the first pair; fourth joint longer than hand, distally widened, set with various groups of spines; hand irregularly ovoid, widened distally, spines on the inner surface as well as the margins; palm oblique, with a few small serratures, and having, at the end where the finger impinges, a narrow cavity with spines, followed by an incurved process covered with curled markings. The finger is stout, with bristles on the inner margin, and spines that project on the outer margin so as to cover up the small curved nail or terminal spine and to give the appearance of the finger ending in a slightly curved wiry brush.

First peræopods: side-plate like that of second gnathopod, a little larger; the leg slender, first joint longest, third broader than fourth, subequal in length, fifth longer; finger about half the length of the fifth joint, or less.

Second peræopods: side-plate excavate above posteriorly; the leg similar to the preceding.

The three last peræopods are much alike, the first joints dilated, oval, very shallowly indented behind; the third joint is produced downwards behind; this and the fourth, which is rather longer, both terminating in a fringe of spines; the fifth joint is longer than the fourth; the finger short.

The pleopods have nine or ten joints to each ramus.

The first uropods have the peduncle longer than the rami, the outer ramus shorter than the inner. In the second uropods the longer inner ramus about equals the peduncle in length. The third uropods have the rami equal, longer than the peduncle, shorter than the rami of the other pairs; there is a group of spines near the end of the peduncle, and three groups on each ramus, the end being pointed, not, as in the other pairs, tipped with spines.

The telson a rounded lobe, shorter than the short peduncles of the third uropods.

The length is about one fifth of an inch, with a moderate inflation at the fourth peræon-segment. The colour of the body, which is reported as "a deep indigo-blue, appearing black when alive," is persistent in specimens which have been for months in methylated spirit. The flagella of the antennæ and appendages of the peræon and pleon are light in colour.

Mr. Thomson gives the following account of the *habitat*:—

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

P.S.—When this paper was read I had transferred the present species from the genus *Pherusa*, Leach, in which Mr. Thomson had doubtfully placed it, to *Amphithopsis*, Boeck; but on reconsideration I have preferred Mr. Thomson's view of its position, especially as in all the species of *Amphithopsis* the outer ramus of the third uropods is considerably shorter than the inner, while here, as in *Pherusa fucicola*, they are equal.

EXPLANATION OF THE PLATES.

PLATE XXXVIII.

Byblis kallarthrus, n. sp.

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

oc. Lateral view of the front of the head, showing two of the eyes; the first joint of the upper antennæ in position

a.i. First three joints of one of the lower antennæ.

m. The left and right mandibles respectively, at the left and right lower corners of the plate; the cutting-edges, spines, and molar tubercles more highly magnified.

l.i. Lower lip.

mx. 1. First maxilla, the apical portions more highly magnified.

mx. 2. Second maxilla.

mxp. Maxillipeds; part of the outer plate and the termination of the palp more highly magnified.

gn. 1. First gnathopod.

gn. 2. Second gnathopod.

prp. 1, 2, 3, 4, 5. The first, second, third, fourth, and fifth peræopods respectively; the apical spines of the fourth joint of the fourth peræopod more highly magnified.

ur. 1, 2, 3. The first, second, and third uropods respectively.

T. Telson.

PLATE XXXIX.

Fig. A. *Talorchestia tumida*, ♂, n. sp.

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

a.s. One of the upper antennæ.

a.i. One of the lower antennæ.

mx. 1. First maxilla; the apical portions more highly magnified.

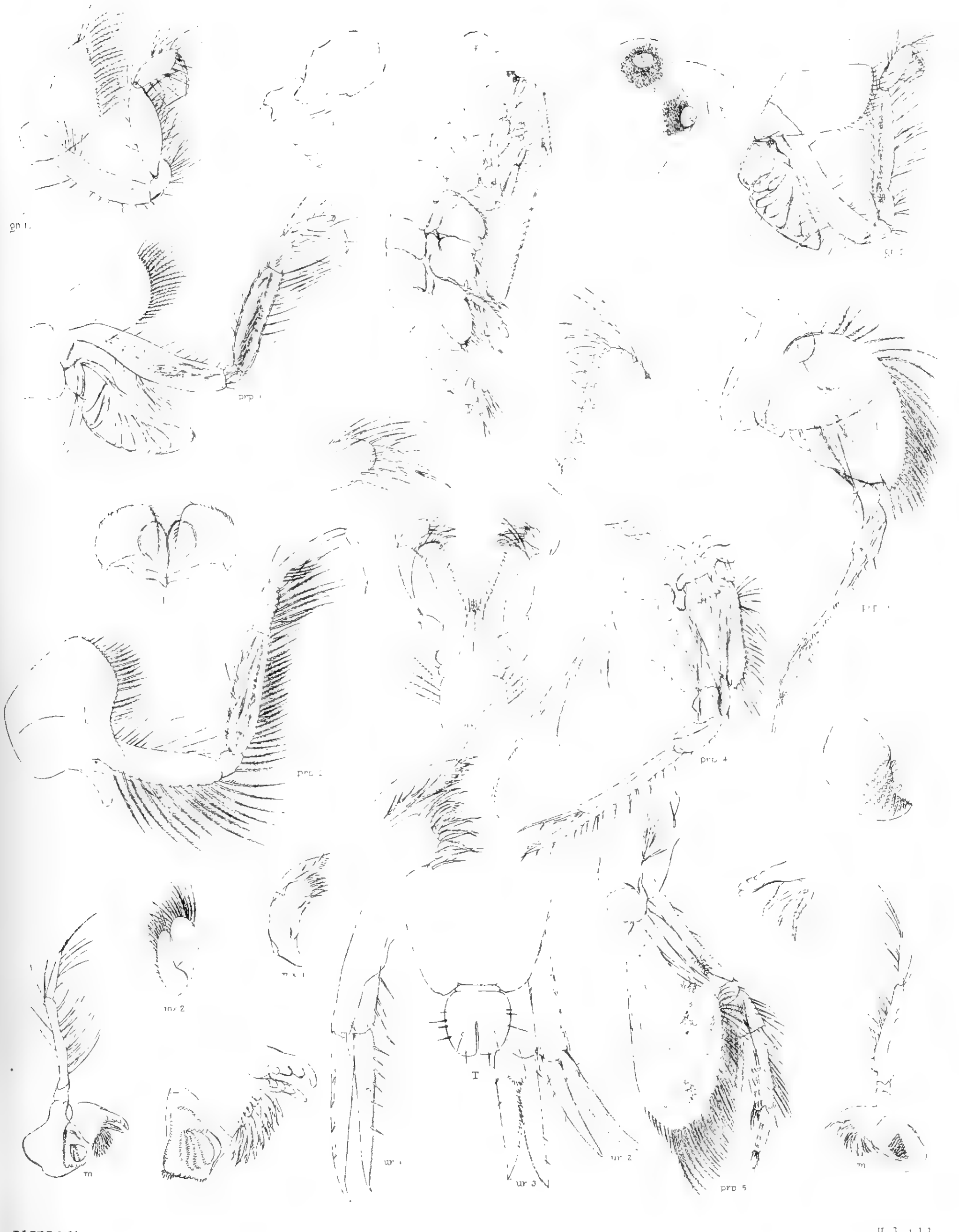
mxp. Maxillipeds.

gn. 1. First gnathopod.
gn. 2. Second gnathopod.
prp. 2. Second peræopod.
prp. 4. Fourth peræopod.
ur. 3. Third uropods.
T. Telson.

Fig. B. *Pherusa cærulea*, n. sp.

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

oc. Some of the ocelli.
a.s. One of the upper antennæ.
a.i. One of the lower antennæ.
l.s. Upper lip.
m. Left and right mandibles; the cutting-edges more highly magnified.
l.i. Lower lip.
mx. 1. First maxilla; the apical portion of the outer plate more highly magnified.
mxp. Maxillipeds.
gn. 1. First gnathopod.
gn. 2. Second gnathopod; finger and part of hand more highly magnified.
ur. 1, 2, 3. The uropods of the first, second, and third pairs respectively in connection with the fourth, fifth, and sixth pleon-segments.



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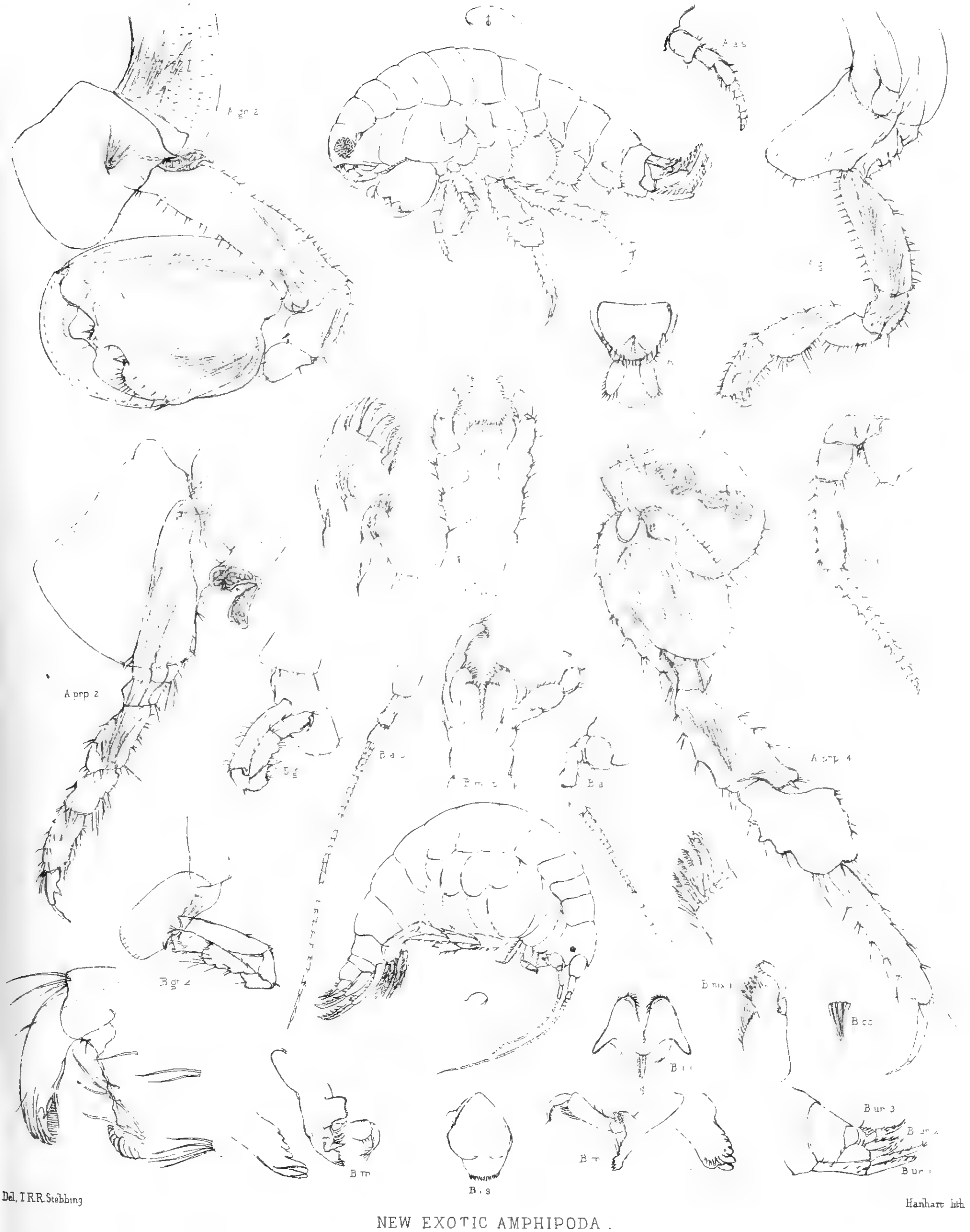
Byblis kallarthrus.



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NEW EXOTIC AMPHIPODA.

A. Talorchestia tumida.

B. Pherusa cærulea.

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April 1887.

P. L. SCLATER,
Secretary.

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OF

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Continued on page 3 of Wrapper.

XI. *On some Foraminifera from the Abrohlos Bank.*

By Henry B. Brady, *F.R.S.*, W. Kitchen Parker, *F.R.S.*, *and* T. Rupert Jones, *F.R.S.*

Received December 15th, 1886, read January 18th, 1887.

[Plates XL.–XLVII.]

Several years ago a series of soundings from the Abrohlos Bank, taken during the cruise of H.M. Surveying-ship 'Plumper' in the month of May 1857, were placed in the hands of Prof. W. K. Parker for examination. The samples were small, as was always the case before the introduction of modern sounding-appliances, but they were found to contain Microzoa of fairly representative character; and arrangements were made by Professors Parker and Rupert Jones for the publication of the results obtained from their investigation. The necessary plates were drawn and lithographed by Mr. George West, funds for the purpose having been supplied by a grant from the Royal Society; but circumstances prevented the work being further proceeded with at that time, and it has since remained in abeyance. The preliminary examination of the material supplied the basis of three columns of one of the Supplementary Tables appended to Messrs. Parker and Jones's work on North-Atlantic and Arctic Foraminifera in the 'Philosophical Transactions' for 1865; but, beyond that, little or nothing has appeared in connection with the subject. The publication, in the interval, of numerous memoirs treating of recent Foraminifera, and notably the 'Report' by one of us upon the Foraminifera obtained by the 'Challenger' Expedition, has deprived the plates of some of their novelty; but though, beyond a few previously undescribed forms, they contain little that can now be regarded as new to science, the figures, which for the most part are very accurately drawn, often illustrate structural modifications of considerable interest; whilst collectively they form a series likely to be of service to the working naturalist. From another point of view, namely the distribution of species, they have also a definite value.

We propose to limit the present communication to a catalogue of the species, accompanied in certain cases by brief notes relating to their distribution, and to any peculiarities of structure exhibited by the specimens, together with such special points of interest as may have been observed in connection with them. More than this appears needless. In point of fact, the recently published 'Challenger' Report, to which allusion has been made, deals somewhat exhaustively with a very large proportion of the species in the Abrohlos collection, and it would be a waste of labour and of space to repeat descriptions and references already easily accessible. We have therefore omitted all lists of synonyms, matters connected with nomenclature, and the like, preferring to give with each species a reference to the page at which such particulars are to be found in the 'Challenger' monograph.

Abrohlos Island, or Abrohlos Rocks, as it is sometimes set down in maps, is situated off the coast of South America, lat. 17° 53′ S., long. 38° 34′ W.; that is to say, approximately fifty miles from the mainland and about halfway down the eastern coast-line of Brazil—south of Bahia, a little south of Porto Seguro, and north of San Salvador. The "Bank" extends from Porto Seguro to Cape Frio; its length from N.E. to S.W. is 450 miles, its mid latitude 20° S., and its average reach 80 miles off shore.

The material preserved was from eight soundings, ranging in depth from 940 fathoms to 31 fathoms. Particulars from the official log are given below, together with a general indication of the nature of the sea-bottom at the different points, the latter taken mainly from Prof. Parker's notes on the material before it was prepared for microscopical examination.

"No. 1. 17th May 1857, VIII. A.M.; Lat. 19° 32′ S., Long. 37° 51½′ W.; 940 fathoms; mud."

Whitish mud; about three fifths consisting of fine yellowish-brown clay, with a small quantity of very fine siliceous sand. Containing numerous Foraminifera of the usual *Globigerina*-ooze types, together with some, like *Amphistegina*, more at home in shallow water.

"No. 2. 17th May 1857, V. 20 P.M.; Lat. 19° 47′ S., Long. 37° 58′ W.; 31 fathoms; coral."

Fragments of Nullipore, with some fine sand. The chief organisms noticed were a *Cellepora* (on the Nullipore), three species of *Lepralia*, some small Gasteropods, and a number of Foraminifera, of which the more prominent belonged to the genera *Miliolina*, *Textularia*, *Discorbina*, and *Truncatulina*.

"No. 3. 17th May 1857, VIII. P.M.; Lat. 19° 51¾′ S., Long. 37° 56′ W.; 32 fathoms; coral."

Chiefly fragments of *Eschara*; barren of Foraminifera.

"No. 4. 23rd May 1857, IX. 20 A.M.; Lat. 22° 54′ S., Long. 40° 37′ W.; 260 fathoms; mud."

Tenacious olive-brown clay, with a small percentage of fine siliceous sand, and some black grains. Contained fragments of Molluscan Shells and a few Polyzoa; together with Foraminifera of seventy species or more.

"No. 5. 23rd May 1857, VI. P.M.; Lat. 23° 0′ S., Long. 40° 48′ W.; 53 fathoms; coral."

Consisted mainly of Nullipore; no Foraminifera observed.

"No. 6. 23rd May 1857, IX. P.M.; Lat. 23° 02′ S., Long. 42° 02′ W.; 47 fathoms; sand."

Sand, with some Molluscan Shells and Foraminifera, the latter principally *Discorbinæ* and other common shallow-water forms.

"No. 7. 23rd May 1857, XI. 10 P.M.; Lat. 23° 05′ S., Long. 41° 12′ W.; 43 fathoms; sand."

Presented a Rhizopod-fauna similar to No. 6, with the admixture of a few *Globigerinæ* and *Pulvinulinæ*.

"No. 8. 24th May 1857, I. 10 A.M.; Lat. 23° 07′ S., Long. 41° 57′ W.; 40 fathoms; m. sh." (mud and shells).

About two fifths of the material consisted of a dark-grey clay with an olive tinge; the remainder of fine quartzy sand with some black grains and small stones. Amongst the organic constituents were Molluscan Shells and Polyzoa; together with Foraminifera in considerable variety, between sixty and seventy species in all.

N.B.—The numbers of the soundings correspond with those on the chart (Pl. XLVII.) of the Abrohlos Bank showing the track of H.M. Surveying-ship 'Plumper,' May 1857.

Subkingdom PROTOZOA.

Class RHIZOPODA.

Order *FORAMINIFERA* (Reticularia).

Family I. MILIOLIDÆ.

Subfamily Miliolininæ.

Biloculina, d'Orbigny.

1. Biloculina ringens, Lamarck, sp. (Plate XL. figs. 19, 20.)

Biloculina ringens, Chall. Report, p. 142, pl. 2. figs. 7, 8.

In four of the soundings; the specimens small.

2. Biloculina depressa, d'Orbigny. (Plate XL. figs. 17, 18.)

Biloculina depressa, Chall. Report, p. 145, pl. 2. figs. 12, 15–17.

At 40 fathoms; specimens small.

3. Biloculina elongata, d'Orbigny. (Plate XL. figs. 21, 22.)

Biloculina elongata, Chall. Report, p. 144, pl. 2. fig. 9.

At 260 fathoms; specimens small.

4. Biloculina irregularis, d'Orbigny. (Plate XL. figs. 24, 26.)

Biloculina irregularis, Chall. Report, p. 140, pl. 1. figs. 17, 18.

A variable form. The test is of rounded contour, stoutly built, and subject to a certain amount of flattening in a direction at right angles to the usual plane of compression. It was first figured by d'Orbigny in his memoir on South-American Foraminifera (pl. viii. figs. 22–24). Rare, at 260 fathoms.

Spiroloculina, d'Orbigny.

5. Spiroloculina planulata, Lamarck, sp. (Plate XL. figs. 14, 15.)

Spiroloculina planulata, Chall. Report, p. 148, pl. 9. fig. 11.

Occurs in one sounding only, 40 fathoms. Some of the specimens (fig. 15) show a tendency to the external thickening of the sutural lines characteristic of *S. limbata.*

6. Spiroloculina asperula, Karrer. (Plate XL. figs. 28, 29.)

Spiroloculina asperula, Chall. Report, p. 152, pl. 8. figs. 13, 14.

The figures here given of this species are somewhat defective; they fail to render the granular or arenaceous condition of the test, which is a marked feature of the specimens. In the two deeper soundings; somewhat rare.

Miliolina, Williamson.

7. Miliolina seminulum, Linné, sp. (Plate XL. figs. 23, 31.)

Miliolina seminulum, Chall. Report, p. 157, pl. 5. fig. 6.

Small specimens of this common form occur at almost all the stations.

8. Miliolina oblonga, Montagu, sp. (Plate XL. fig. 27.)

Miliolina oblonga, Chall. Report, p. 160, pl. 5. fig. 4.

Small specimens, generally associated with the last-named species.

9. Miliolina pygmæa, Reuss, sp. (?). (Plate XL. fig. 30.)

Miliolina pygmæa, Chall. Report, p. 163, pl. 113. fig. 16.

The figured specimen probably belongs to this species, but is not by any means a well-marked example. At Station IV.; 260 fathoms.

10. Miliolina bicornis, Walker and Jacob, sp. (Plate XL. fig. 25 ›

Miliolina bicornis, Chall. Report, p. 171, pl. 6. figs. 9, 11, 12.

One or two poorly-shaped, feebly-corrugated specimens, well represented by the figure, and assignable, with some reservation, to this species, occur at Station IV.; 260 fathoms.

11. MILIOLINA EXCISA, n. sp. (Plate XL. fig. 33.)

Characters. General form Quinqueloculine; segments much arched and inflated, the external margin of each presenting two salient ridges with well-marked crenulated depressions and obtuse-angled teeth. Length about $\frac{1}{50}$ inch (0·5 millim.).

Occurs at Station II.; 31 fathoms.

Costa has figured a Quinqueloculine *Miliolina* with serrate margins from the Tertiary deposit of S. Alesandro in Southern Italy, under the name *Quinqueloculina denticulata* (Paleontologia del Regno di Napoli, p. 327, pl. xxv. fig. 6); and Reuss a somewhat similar variety, perhaps the same, as *Quinqueloculina plicatula*[1] (Sitzungsb. d. k. Akad. Wiss. Wien, 1867, vol. lv. p. 74, pl. iii. fig. 2); but in both of these the test is much compressed, the periphery thin and carinate, and in addition to the denticulation of the margin the lateral faces of the shell are more or less crenulated.

12. MILIOLINA AGGLUTINANS, d'Orbigny, sp. (Plate XL. figs. 34, 35.)

Miliolina agglutinans, Chall. Report, p. 180, pl. 8. figs. 6, 7.

Medium-sized specimens in four of the soundings; 40 to 260 fathoms.

13. MILIOLINA TRICARINATA, d'Orbigny, sp. (Plate XL. fig. 32.)

Miliolina tricarinata, Chall. Report, p. 165, pl. 3. fig. 17.

A few small specimens, at 40 fathoms.

Subfamily HAUERININÆ.

ARTICULINA, d'Orbigny.

14. ARTICULINA SULCATA, Reuss. (Plate XL. fig. 11.)

Articulina sulcata, Chall. Report, p. 183, pl. 12. figs. 12, 13.

The drawing represents a nearly typical specimen of *Articulina sulcata*; but whether that be an independent species or only an arrested form of *A. sagra*, d'Orbigny, is perhaps open to question. A single example from 940 fathoms. Reuss figures a precisely similar specimen from the Lower Tertiaries of Styria.

15. ARTICULINA MULTILOCULARIS, n. sp. (Plate XL. fig. 10.)

Characters. Test (earlier portion?) free, oval, compressed or complanate; composed of numerous segments arranged as in *Spiroloculina*; lateral faces of the segments flat or slightly hollowed, peripheral edge square or obtuse-angular; apertural end broad, margin everted, orifice simple. Length about $\frac{1}{50}$ inch (0·5 millim.).

[1] Written *Quinqueloculina plicatella* on the plate.

The broad apertural end and simple orifice are sufficiently characteristic to mark this little shell as an *Articulina*; but whether a complete specimen or only the earlier portion of a dimorphous species, we are unable to say with any certainty; nor do we know of any described species with smooth exterior.

Found in the material from 31 fathoms.

16. Articulina conico-articulata, Batsch, sp. (Plate XL. figs. 7–9.)

Articulina conico-articulata, Chall. Report, p. 185, pl. 12. figs. 17, 18; pl. 13. figs. 1, 2.

A few specimens, for the most part broken, in the sounding from 940 fathoms. There are very similar forms in Prof. Parker's collection, from a Tertiary marl at Baljik on the Black Sea. (Figures 5 and 6 are fragments of some larger organism probably not Foraminiferal.)

Ophthalmidium, Kübler.

17. Ophthalmidium inconstans, Brady. (Plate XL. figs. 12, 13.)

Ophthalmidium inconstans, Chall. Report, p. 189, pl. 12. figs. 5, 6, 7.

Occurs only in the deepest sounding.

Planispirina, Seguenza.

18. Planispirina exigua, Brady. (Plate XL. fig. 4.)

Planispirina exigua, Chall. Report, p. 196, pl. 12. figs. 1–4.

Only found, associated with the species last named, at 940 fathoms.

19. Planispirina sigmoidea, Brady. (Plate XL. fig. 16.)

Planispirina sigmoidea, Chall. Report, p. 197, pl. 2. figs. 1–3.

A single specimen, at 940 fathoms.

Subfamily Peneroplidinæ.

Cornuspira, Schultze.

20. Cornuspira involvens, Reuss. (Plate XL. figs. 1–3.)

Cornuspira involvens, Chall. Report, p. 200, pl. 11. figs. 1–3.

Found at three stations.

Peneroplis, Montfort.

21. Peneroplis pertusus, Forskål, sp. (Plate XLII. figs. 18, 19.)

Peneroplis pertusus, Chall. Report, p. 204, pl. 13. fig. 17.

Some specimens present the more or less evolute nautiloid features of the typical *P. pertusus* (fig. 18); whilst others (fig. 19) are thicker and completely involute, and exhibit a tendency to produce the irregular aperture of the "Dendritine" forms.

Figure 19 *c* is a portion of the shell more highly magnified, to show the pitting of the inner surface.

Found only in the Nullipore-sand from 31 fathoms.

Family II. ASTRORHIZIDÆ.

Subfamily SACCAMMININÆ.

PSAMMOSPHÆRA, Schulze.

22. PSAMMOSPHÆRA FUSCA, Schulze.

Psammosphæra fusca, Chall. Report, p. 249, pl. 18. figs. 1–8.

We have no figure of this species. One or two smallish specimens were found in the sandy material from 47 fathoms.

Subfamily RHABDAMMININÆ.

HYPERAMMINA, Brady.

23. HYPERAMMINA RAMOSA, Brady. (Plate XLI. figs. 1–4, 13.)

Hyperammina ramosa, Chall. Report, p. 261, pl. 23. figs. 15–19.

Fragments only.

Family III. LITUOLIDÆ.

Subfamily LITUOLINÆ.

REOPHAX, Montfort.

24. REOPHAX FUSIFORMIS, Williamson, sp. (Plate XLI. fig. 18.)

Reophax fusiformis, Chall. Report, p. 290, pl. 30. figs. 1–11.

From the sandy clay at 40 fathoms.

25. REOPHAX SCORPIURUS, Montfort. (Plate XLI. fig. 10.)

Reophax scorpiurus, Chall. Report, p. 291, pl. 30. figs. 12–17.

Small examples, some of them built up of exceedingly coarse sand-grains, occur in the three deeper soundings.

Figure 16 may perhaps be assigned to the present or the last-named species; whilst the somewhat broken, rough, thick-shelled specimens, figs. 11, 12, and 15, probably belong to the spiral section of the Lituoline group, though too obscure for identification.

26. REOPHAX PILULIFERA, Brady. (Plate XLI. figs. 5–8.)

Reophax pilulifera, Chall. Report, p. 292, pl. 30. figs. 18–20.

Rare, at 40 fathoms.

HAPLOPHRAGMIUM, Reuss.

27. HAPLOPHRAGMIUM EMACIATUM, Brady.

Haplophragmium emaciatum, Chall. Report, p. 305, pl. 33. figs. 26–28.

Found sparingly in three or four of the soundings, but the specimens are small and not well characterized.

28. HAPLOPHRAGMIUM LATIDORSATUM, Bornemann, sp. (Plate XLI. figs. 14, 22.)

Haplophragmium latidorsatum, Chall. Report, p. 307, pl. 34. figs. 7–10, 14.

A few specimens of not very large size, at 260 fathoms.

29. HAPLOPHRAGMIUM CANARIENSE, d'Orbigny, sp. (Plate XLI. fig. 9.)

Haplophragmium canariense, Chall. Report, p. 310, pl. 35. figs. 1–5.

One or two small examples, at 260 fathoms.

30. HAPLOPHRAGMIUM NANUM, Brady. (Plate XLI. fig. 20.)

Haplophragmium nanum, Chall. Report, p. 311, pl. 35. figs. 6–8.

Rare, at 260 fathoms.

PLACOPSILINA, d'Orbigny.

31. PLACOPSILINA CENOMANA, d'Orbigny. (Plate XLII. fig. 13.)

Placopsilina cenomana, Chall. Report, p. 315, pl. 36. figs. 1–3.

A single specimen, at 31 fathoms.

AMMODISCUS, Reuss.

32. AMMODISCUS GORDIALIS, Jones & Parker, sp. (Plate XLII. fig. 22.)

Ammodiscus gordialis, Chall. Report, p. 333, pl. 38. figs. 7–9.

A few examples, at 260 fathoms; some of them approaching *A. charoides* in the compact disposition of the coils, as shown in the figure.

TROCHAMMINA, Parker & Jones.

33. TROCHAMMINA SQUAMATA, Jones & Parker.

Trochammina squamata, Chall. Report, p. 337, pl. 41. fig. 3.

A doubtful specimen or two at 940 fathoms.

WEBBINA, d'Orbigny.

34. WEBBINA CLAVATA, Jones & Parker. (Plates XLII. fig. 21.)

Webbina clavata, Chall. Report, p. 349, pl. 41. figs. 12–16.

No complete specimens. The figure is that of the tube only, without the primordial chamber. Found at 260 fathoms.

Family IV. TEXTULARIDÆ.

Subfamily Textularinæ.

Textularia, Defrance.

35. Textularia sagittula, Defrance. (Plate XLII. fig. 1.)

Textularia sagittula, Chall. Report, p. 361, pl. 42. figs. 17, 18.

Occurs at almost all depths.

36. Textularia abbreviata, d'Orbigny. (Plate XLII. figs. 4, 5.)

Textularia abbreviata, d'Orbigny, 1846, For. Foss. Vien. p. 249, pl. 15. figs. 9–12.

Many of the specimens in the fistulose condition, fig. 4.

37. Textularia agglutinans, d'Orbigny. (Plate XLI. figs. 17, 23; Plate XLII. figs. 2, 3.)

Textularia agglutinans, Chall. Report, p. 363, pl. 43. figs. 1–3.

In all the shallower soundings.

Verneuilina, d'Orbigny.

38. Verneuilina spinulosa, Reuss. (Plate XLII. figs. 14, 15.)

Verneuilina spinulosa, Chall. Report, p. 384, pl. 47. figs. 1–3.

Generally distributed.

Gaudryina, d'Orbigny.

39. Gaudryina pupoides, d'Orbigny. (Plate XLII. figs. 7, 8.)

Gaudryina pupoides, Chall. Report, p. 378, pl. 46. figs. 1–4.

40. Gaudryina pupoides, var. chilostoma, Reuss. (Plate XLII. fig. 9.)

Gaudryina pupoides, var. *chilostoma*, Chall. Report, p. 379, pl. 46. figs. 5, 6.

Both of these forms occur at Station IV., 260 fathoms.

41. Gaudryina siphonella, Reuss.

Gaudryina siphonella, Chall. Report, p. 382, pl. 46. figs. 17–19.

Only at the greatest depth, 940 fathoms.

42. Gaudryina filiformis, Berthelin. (Plate XLII. fig. 6.)

Gaudryina filiformis, Chall. Report, p. 380, pl. 46. fig. 12.

A single specimen at 260 fathoms.

Valvulina, d'Orbigny.

43. Valvulina conica, Parker & Jones. (Plate XLI. fig. 21; Plate XLII. figs. 16, 17.)

Valvulina conica, Chall. Report, p. 392, pl. 49. figs. 15, 16.

Found at 260 fathoms.

Clavulina, d'Orbigny.

44. Clavulina communis, d'Orbigny. (Plate XLII. fig. 11.)

Clavulina communis, Chall. Report, p. 394, pl. 48. figs. 1–13.

The figured specimen, the only one met with, is manifestly incomplete, having lost the terminal segment, or possibly more than one.

45. Clavulina parisiensis, d'Orbigny. (Plate XLII. figs. 10, 12.)

Clavulina parisiensis, Chall. Report, p. 395, pl. 48. figs. 14–18.

Not unfrequent in some of the shallower soundings.

Subfamily Buliminінæ.

Bulimina, d'Orbigny.

46. Bulimina marginata, d'Orbigny. (Plate XLIII. figs. 7, 10.)

Bulimina marginata, Chall. Report, p. 405, pl. 51. figs. 3–5.

47. Bulimina aculeata, d'Orbigny. (Plate XLIII. fig. 8.)

Bulimina aculeata, Chall. Report, p. 406, pl. 51. figs. 7–9.

48. Bulimina inflata, Seguenza. (Plate XLIII. fig. 9.)

Bulimina inflata, Chall. Report, p. 406, pl. 51. figs. 10–13.

These three closely related forms are found in company at Stations IV. and VIII., the first two also at Station VII.

49. Bulimina pupoides, d'Orbigny.

Bulimina pupoides, Chall. Report, p. 400, pl. 50. fig. 15.

A few poor specimens of this species were met with in the material from 40 fathoms.

Virgulina, d'Orbigny.

50. Virgulina schreibersiana, Czjzek.

Virgulina schreibersiana, Chall. Report, p. 414, pl. 52. figs. 1–3.

Rare, at 940 fathoms.

Bolivina, d'Orbigny.

51. Bolivina punctata, d'Orbigny.

Bolivina punctata, Chall. Report, p. 417, pl. 52. figs. 18, 19.

52. Bolivina plicata, d'Orbigny.

Bolivina plicata, d'Orbigny, 1839, Foram. Amér. Mérid. p. 63, pl. 8. figs. 10–12.

53. Bolivina textilarioides, Reuss. (Plate XLIII. fig. 1.)

Bolivina textilarioides, Chall. Report, p. 419, pl. 52. figs. 22–25.

54. Bolivina dilatata, Reuss. (Plate XLIII. figs. 3, 6.)

Bolivina dilatata, Chall. Report, p. 418, pl. 52. figs. 20, 21.

55. Bolivina ænariensis, Costa, sp. (Plate XLIII. figs. 2, 4, 5.)

Bolivina ænariensis, Chall. Report, p. 423, pl. 52. figs. 10, 11.

These *Bolivinæ* are present in considerable numbers in the two deeper soundings, and also in the sandy clay from 40 fathoms. At Station VII. the genus is only represented by *B. plicata*, and is entirely wanting at Stations II. and VI.

Subfamily Cassidulininæ.

Cassidulina, d'Orbigny.

56. Cassidulina lævigata, d'Orbigny. (Plate XLIII. fig. 11.)

Cassidulina lævigata, Chall. Report, p. 428, pl. 54. figs. 1–3.

Specimens of average size in the two deep soundings and at Station VIII.

57. Cassidulina subglobosa, Brady. (Plate XLIII. figs. 12–14.)

Cassidulina subglobosa, Chall. Report, p. 430, pl. 54. fig. 17.

At 260 fathoms, and in two of the shallower soundings.

Family V. LAGENIDÆ.

Subfamily Lageninæ.

Lagena, Walker & Boys.

58. Lagena globosa, Montagu, sp.

Lagena globosa, Chall. Report, p. 452, pl. 56. figs. 1–3.

At 260 fathoms.

59. LAGENA SULCATA, Walker & Jacob. (Plate XLIV. figs. 18, 22, 34. Var. ACUTICOSTA, Reuss, figs. 26, 31.)

Lagena sulcata, Chall. Report, p. 462, pl. 57. figs. 23, 33, &c.

Figures 18, 22, and 34 represent typical specimens, the latter two being the mucronate form of test. Figures 26 and 31 might with equal justice be assigned to *Lagena acuticosta*, Reuss (Chall. Report, p. 464, pl. 57. figs. 31, 32, &c.), a variety only separable by comparative characters of little zoological value, depending upon the number and degree of development of the costæ.

60. LAGENA STRIATA, d'Orbigny. (Plate XLIV. fig. 28.)

Lagena striata, Chall. Report, p. 460, pl. 57. figs. 22, 24, &c.

At 260 fathoms.

61. LAGENA LINEATA, Williamson, sp. (Plate XLIV. fig. 33.)

Lagena lineata, Chall. Report, p. 461, pl. 57. fig. 13.

This little shell, a solitary specimen, may perhaps most aptly be treated as a compressed modification of Williamson's species.

62. LAGENA MELO, d'Orbigny, sp. (Plate XLIV. figs. 21, 24, 25 (?).)

Oolina melo, d'Orbigny, 1839, Foram. Amér. Mérid. p. 20, pl. 5. fig. 9.
Lagena melo, Chall. Report, p. 446.

D'Orbigny's figure of this species, *loc. cit.*, is that of a pyriform entosolenian *Lagena* with an exogenous surface-reticulation, of which the longitudinal and transverse bands are of the same thickness and elevation. Such specimens are comparatively rare. On the other hand, shells with strong longitudinal ridges and slender transverse bands, as represented in fig. 21, are tolerably frequent. Figure 24 shows some approach to the form of ornament found in *L. hexagona*, Will., sp.

63. LAGENA LÆVIGATA, Reuss, sp.

Lagena lævigata, Chall. Report, p. 473, pl. 114. fig. 8.

At 260 fathoms.

64. LAGENA MARGINATA, Walker & Boys, sp. (Plate XLIV. figs. 27, 29, 30, 32.)

Lagena marginata, Chall. Report, p. 476, pl. 59. figs. 21–33.

Generally distributed.

65. LAGENA ORBIGNYANA, Seguenza, sp. (Plate XLIV. fig. 20.)

Lagena orbignyana, Chall. Report, p. 484, pl. 59. figs. 24–26, &c.

In the two deep soundings.

66. Lagena lagenoides, Williamson, sp. (Plate XLIV. fig. 23.)

Lagena lagenoides, Chall. Report, p. 479, pl. 60. figs. 12–14, &c.

The figured specimen shows the tubulation of the wing much more distinctly than given in the drawing; it has also an incipient ridge on each side of the shoulder, like that of young examples of *L. formosa*. In the deeper soundings; very rare.

Subfamily Nodosarinæ.

Nodosaria, Lamarck.

67. Nodosaria calomorpha, Reuss. (Plate XLIV. fig. 1; and fig. 4?)

Nodosaria calomorpha, Chall. Report, p. 497, pl. 61. figs. 23–27.

One or two specimens at 260 fathoms.

68. Nodosaria pyrula, d'Orbigny. (Plate XLIV. fig. 2.)

Nodosaria pyrula, Chall. Report, p. 497, pl. 62. figs. 10–12.

Fragments only.

69. Nodosaria (Dentalina) mucronata, Neugeboren, sp. (Plate XLIV. fig. 10.)

Nodosaria (Dentalina) mucronata, Chall. Report, p. 506, pl. 62. figs. 27–29.

This form is perhaps better known under d'Orbigny's name, *Nodosaria (Dentalina) obliqua* (Modèle, no. 5). Found at 40 fathoms; rare.

70. Nodosaria obliqua, Linné, sp. (Plate XLIV. fig. 7.)

Nodosaria obliqua, Chall. Report, p. 513, pl. 64. figs. 20–22.

At Station VII., 43 fathoms; rare.

71. Nodosaria scalaris, Batsch, sp. (Plate XLIV. fig. 6; and fig. 19?)

Nodosaria scalaris, Chall. Report, p. 510, pl. 63. figs. 28–31.

At 260 fathoms and less.

72. Nodosaria hispida, d'Orbigny. (Plate XLIV. figs. 3, 5.)

Nodosaria hispida, Chall. Report, p. 507, pl. 63. figs. 12–16.

At 260 fathoms; one or two fragments only, as figured.

Rhabdogonium, Reuss.

73. Rhabdogonium tricarinatum, d'Orbigny, sp. (Plate XLV. fig. 3.)

Rhabdogonium tricarinatum, Chall. Report, p. 525, pl. 67. figs. 1–3.

Tolerably frequent at Stations IV. and VIII.

CRISTELLARIA, Lamarck.

74. CRISTELLARIA CREPIDULA, Fichtel & Moll, sp. (Plate XLIV. figs. 8, 9.)

Cristellaria crepidula, Chall. Report, p. 542, pl. 67. figs. 17, 19, 20, &c.

Small and rare; Stations IV. and VIII.

75. CRISTELLARIA ROTULATA, Lamarck, sp. (Plate XLIV. fig. 15.)

Cristellaria rotulata, Chall. Report, p. 547, pl. 69. fig. 13.

At 260 fathoms and less.

A somewhat anomalous *Cristellaria* of the compressed type, of comparatively minute size, and subcarinate, is represented by fig. 17. It is difficult to say with any certainty to what species it should be assigned.

76. CRISTELLARIA CULTRATA, Montfort, sp. (Plate XLIV. fig. 13.)

Cristellaria cultrata, Chall. Report, p. 550, pl. 70. figs. 4–8.

A few specimens only, mostly broken.

77. CRISTELLARIA CALCAR, Linné, sp. (Plate XLIV. fig. 14.)

Cristellaria calcar, Chall. Report, p. 551, pl. 70. figs. 9–15.

Rare, at 40 fathoms.

78. CRISTELLARIA CASSIS, Fichtel & Moll, sp. (Plate XLIV. fig. 16.)

Cristellaria cassis, Chall. Report, p. 552, pl. 68. fig. 10.

A broken specimen at 40 fathoms.

79. CRISTELLARIA VARIABILIS, Reuss. (Plate XLIV. fig. 12.)

Cristellaria variabilis, Chall. Report, p. 541, pl. 68. figs. 11–16.

Rare, at Stations IV. and VIII.

Subfamily POLYMORPHININÆ.

POLYMORPHINA, d'Orbigny.

80. POLYMORPHINA LACTEA, Walker & Jacob, sp. (Plate XLIV. fig. 11.)

Polymorphina lactea, Chall. Report, p. 559, pl. 71. figs. 11, 14.

Very small and rare, at Station VIII.

UVIGERINA, d'Orbigny.

81. UVIGERINA PYGMÆA, d'Orbigny. (Plate XLV. figs. 1, 2.)

Uvigerina pygmæa, Chall. Report, p. 575, pl. 74. figs. 11–14.

82. Uvigerina asperula, Czjzek. (Plate XLV. figs. 4, 5.)

Uvigerina asperula, Chall. Report, p. 578, pl. 75. figs. 6–8.

These two species of *Uvigerina* are moderately common at Stations IV., VII., and VIII., and the specimens are of average size.

Sagrina, Parker & Jones (d'Orbigny ?).

83. Sagrina dimorpha, Parker & Jones. (Plate XLV. fig. 6).

Sagrina dimorpha, Chall. Report, p. 582, pl. 76. figs. 1–3.

A couple of good specimens from 260 fathoms.

Family VI. GLOBIGERINIDÆ.

Globigerina, d'Orbigny.

84. Globigerina bulloides, d'Orbigny. (Plate XLV. fig. 15.)

Globigerina bulloides, Chall. Report, p. 593, pl. 79. figs. 3–7, &c.

Generally distributed.

85. Globigerina rubra, d'Orbigny. (Plate XLV. fig. 12.)

Globigerina rubra, Chall. Report, p. 602, pl. 79. figs. 11–16.

Generally distributed.

86. Globigerina conglobata, Brady. (Plate XLV. fig. 13.)

Globigerina conglobata, Chall. Report, p. 603, pl. 80. figs. 1–5, &c.

Generally distributed.

87. Globigerina sacculifera, Brady.

Globigerina sacculifera, Chall. Report, p. 604, pl. 80. figs. 11–17, &c.

Occurs in the two deep soundings and at Station VIII.

88. Globigerina æquilateralis, Brady.

Globigerina æquilateralis, Chall. Report, p. 605, pl. 80. figs. 18–21.

Found over the same area as the last-named form, but much more sparsely scattered.

Orbulina, d'Orbigny.

89. Orbulina universa, d'Orbigny. (Plate XLV. figs. 7, 8, 14.)

Orbulina universa, Chall. Report, p. 608, pl. 78. figs. 8–26, &c.

The large orifice in fig. 7 and perhaps also that in fig. 8 are the results of accident, and probably due to the enlargement by external means of one of the normal pores of the shell. Such orifices, not at all uncommon in dead shells, though seldom quite so round and regularly shaped as those of the drawings, were regarded by d'Orbigny and many subsequent authors as the general aperture. Figure 8 is a double specimen (see Chall. Report, *loc. cit.*). Generally distributed.

PULLENIA, Parker & Jones.

90. PULLENIA SPHÆROIDES, d'Orbigny, sp. (Plate XLIII. figs. 21, 24.)

Pullenia sphæroides, Chall. Report, p. 616, pl. 84. figs. 12, 13.

At 260 fathoms and 40 fathoms.

91. PULLENIA QUINQUELOBA, Reuss. (Plate XLIII. figs. 22, 23.)

Pullenia quinqueloba, Chall. Report, p. 617, pl. 84. figs. 14, 15.

At 260 fathoms.

SPHÆROIDINA, d'Orbigny.

92. SPHÆROIDINA BULLOIDES, d'Orbigny. (Plate XLV. figs. 9, 10, 11.)

Sphæroidina bulloides, Chall. Report, p. 620, pl. 84. figs. 1–7.

In the two deeper soundings only.

Family VII. ROTALIDÆ.

Subfamily ROTALINÆ.

CYMBALOPORA, Hagenow.

93. CYMBALOPORA POEYI, d'Orbigny, sp. Var. (Plate XLVI. fig. 12.)

Cymbalopora poeyi, Chall. Report, p. 636, pl. 102. fig. 13.

The specimens, as may be seen by the figure, are by no means typical. Instead of the normal, compact, subconical shell, the test is slightly convex or depressed, and the segments are comparatively few in number, thin-walled, and much inflated. Examples with these characters are moderately common at 940 fathoms.

DISCORBINA, Parker & Jones.

94. DISCORBINA GLOBULARIS, d'Orbigny, sp. (Plate XLVI. fig. 6.)

Discorbina globularis, Chall. Report, p. 643, pl. 86. figs. 8–13.

A few poor specimens in the shallower soundings.

95. DISCORBINA ROSACEA, d'Orbigny, sp.

Discorbina rosacea, Chall. Report, p. 644, pl. 87. figs. 1-4.

96. DISCORBINA VILARDEBOANA, d'Orbigny, sp.

Discorbina vilardeboana, Chall. Report, p. 645, pl. 86. figs. 9–12, &c.

A few specimens of *Discorbina rosacea* were found in the soundings at 31 fathoms, and two or three shells of the slightly dissimilar form known as *D. vilardeboana* at 47 fathoms.

97. DISCORBINA ORBICULARIS, Terquem, sp. (Plate XLVI. fig. 1.)

Discorbina orbicularis, Chall. Report, p. 647, pl. 88. figs. 4–8.

A few good examples at Station VI.; 47 fathoms.

98. DISCORBINA BERTHELOTI, d'Orbigny, sp. (Plate XLVI. figs. 7, 8.)

Discorbina bertheloti, Chall. Report, p. 650, pl. 89. figs. 10–12.

This species in its comparative abundance appears almost to replace its isomorph *Truncatulina lobatula* in some of the shallower soundings.

99. DISCORBINA RARESCENS, Brady.

Discorbina rarescens, Chall. Report, p. 651, pl. 90. figs. 2, 3.

Rare; 260 fathoms.

PLANORBULINA, d'Orbigny.

100. PLANORBULINA MEDITERRANENSIS, d'Orbigny. (Plate XLV. fig. 18.)

Planobulina mediterranensis, Chall. Report, p. 656, pl. 92. figs. 1–3.

One or two specimens only, at 47 fathoms.

101. PLANORBULINA ACERVALIS, Brady. (Plate XLVI. fig. 11.)

Planorbulina acervalis, Chall. Report, p. 657, pl. 92. fig. 4.

Rare; 260 fathoms.

TRUNCATULINA, d'Orbigny.

102. TRUNCATULINA LOBATULA, Walker & Jacob, sp. (Plate XLII. fig. 20; Plate XLV. fig. 26.)

Truncatulina lobatula, Chall. Report, p. 660, pl. 92 figs. 10, &c.

Does not occur at the greatest depth; otherwise generally diffused, but not abundant. The broken Rotaline shell, fig. 16, of Plate XLV., appears to belong to this or some allied species of *Truncatulina.*

The adherent specimen, Plate XLII. fig. 20, shows the remains of the sandy envelope which often completely encases the shell of *Tr. lobatula* in the parasitic condition.

103. TRUNCATULINA VARIABILIS, d'Orbigny. (Plate XLV. fig. 17.)

Truncatulina variabilis, Chall. Report, p. 661, pl. 93. figs. 6, 7.

Rare; 260 fathoms.

104. Truncatulina mundula, n. sp. (Plate XLV. fig. 25.)

Characters. Test free, rotaliform; composed of about three convolutions, which are evolute on the superior and completely involute on the inferior side, the outermost whorl of the adult shell consisting of from ten to twelve segments. Superior face slightly convex or subconical, generally coarsely perforate, the sutures and periphery marked by thickening of the chamber-walls; inferior face convex, sometimes a little depressed at the umbilicus; perforation inconspicuous; sutures slightly excavated or marked by fine lines only. Diameter $\frac{1}{60}$ inch (0·42 millim.).

This is a compact, neatly made variety of *Truncatulina* that has not hitherto, so far as we are aware, received a name. Morphologically its place is near *Tr. haidingerii*, or between that species and *Tr. ungeriana*; but it is less stoutly built than the former species and has nearly double the number of chambers in each convolution. Its nearest isomorph is perhaps *Pulvinulina karsteni.*

Common at 260 fathoms.

105. Truncatulina reticulata, Czjzek, sp. (Plate XLV. figs. 23, 24.)

Truncatulina reticulata, Chall. Report, p. 669, pl. 96. figs. 5–8.

Tolerably abundant at three stations.

Anomalina, d'Orbigny.

106. Anomalina ariminensis, d'Orbigny, sp. (Plate XLV. figs. 20, 21, 22.)

Anomalina ariminensis, Chall. Report, p. 674, pl. 93. figs. 10, 11.

Generally distributed.

107. Anomalina ammonoides, Reuss, sp. (Plate XLV. fig. 19.)

Anomalina ammonoides, Chall. Report, p. 672, pl. 94. figs. 2, 3.

Associated with *A. ariminensis* in the two deeper soundings

Pulvinulina, Parker & Jones.

108. Pulvinulina elegans, d'Orbigny, sp. (Plate XLVI. fig. 2.)

Pulvinulina elegans, Chall. Report, p. 699, pl. 105. figs. 4–6.

Small specimens, both of the deep-water (*P. partschiana*) and shallow-water forms.

109. Pulvinulina schreibersii, d'Orbigny, sp. (Plate XLVI. fig. 4.)

Pulvinulina schreibersii, Chall. Report, p. 697, pl. 115. fig. 1.

Of medium size, at 43 fathoms and 47 fathoms.

110. Pulvinulina menardii, d'Orbigny, sp. (Plate XLVI. fig. 3.)

Pulvinulina menardii, Chall. Report, p. 690, pl. 103. figs. 1, 2.

111. Pulvinulina tumida, Brady.

Pulvinulina tumida, Chall. Report, p. 692, pl. 103. figs. 4–6.

112. Pulvinulina crassa, d'Orbigny, sp.

Pulvinulina crassa, Chall. Report, p. 694, pl. 103. figs. 11, 12.

113. Pulvinulina micheliniana, d'Orbigny, sp. (Plate XLVI. figs 9, 10.)

Pulvinulina micheliniana, Chall. Report, p. 694, pl. 104. figs. 1, 2.

These four species, the most important of the pelagic group of *Pulvinulinæ*, are pretty generally distributed, *P. crassa* being the least common.

114. Pulvinulina oblonga, Williamson, sp. (Plate XLVI. fig. 5.)

Pulvinulina oblonga, Chall. Report, p. 688, pl. 106. fig. 4.

In two of the shallower soundings only.

Rotalia, Lamarck.

115. Rotalia soldanii, d'Orbigny.

Rotalia soldanii, Chall. Report, p. 706, pl. 107. figs. 6, 7.

An essentially deep-water species, observed only in the material from 940 fathoms.

Subfamily Tinoporinæ.

Gypsina, Carter.

116. Gypsina globulus, Reuss, sp. (Plate XLVI. fig. 13.)

Gypsina globulus, Chall. Report, p. 717, pl. 101. fig. 8.

At 30 fathoms; rare.

117. Gypsina inhærens, Schultze, sp. (Plate XLI. fig. 19.)

Gypsina inhærens, Chall. Report, p. 718, pl. 102. figs. 1–6.

Incrusting coral and nullipore, at 31 fathoms.

Family VIII. NUMMULINIDÆ.

Subfamily Polystomellinæ.

Nonionina, d'Orbigny.

118. Nonionina depressula, Walker & Jacob, sp. (Plate XLIII. fig. 25.)

Nonionina depressula, Chall. Report, p. 725, pl. 109. figs. 6, 7.

A few specimens at Station IV.; 260 fathoms.

119. Nonionina exponens, n. sp. (Plate XLIII. fig. 16.)

Characters. Test free, equilateral, planospiral; lateral faces convex or somewhat flattened, peripheral edge rounded; composed of from two to three convolutions, all more or less visible on both sides of the shell, the final whorl consisting of about seven or eight segments; margin entire; septa marked by fine lines, without superficial depressions. Diameter $\frac{1}{100}$ inch (0·25 millim.).

A form somewhat allied to *N. depressula*, but differing from that species in its evolute mode of growth, its even sutures, and non-inflated segments. Obtained from the sounding at Station I.; 940 fathoms.

120. Nonionina umbilicatula, Montagu, sp. (Plate XLIII. fig. 19.)

Nonionina umbilicatula, Chall. Report, p. 726, pl. 109. figs. 8, 9.

Specimens of average dimensions, at four stations.

121. Nonionina scapha, Fichtel & Moll. (Plate XLIII. fig. 20.)

Nonionina scapha, Chall. Report, p. 730, pl. 109. figs. 14–16.

A very few examples at Stations IV. and VIII., of small size, and too thin to be quite typical.

Polystomella, Lamarck.

122. Polystomella striatopunctata, Fichtel & Moll, sp. (Plate XLIII. fig. 17.)

Polystomella striatopunctata, Chall. Report, p. 733, pl. 109. figs. 22, 23.

Not uncommon in the forty-fathom sounding.

123. Polystomella, sp.? (Plate XLIII. fig. 18.)

A single worn and doubtful specimen, from 47 fathoms, of which it is not easy to say whether it is a true *Polystomella* or an overgrown *Nonionina.*

Subfamily Nummulitinæ.

Amphistegina, d'Orbigny.

124. Amphistegina lessonii, d'Orbigny. (Plate XLIII. fig. 15.)

Amphistegina lessonii, Chall. Report, p. 740, pl. 111. figs. 1–7.

Small specimens, tolerably common in the deepest and the shallowest soundings, but not observed in any of the others.

Table of the Distribution of the Foraminifera in Six Soundings on the Abrohlos Bank. See Plate XLVII.

	I. 940 fths.	II. 31 fths.	IV. 260 fths.	VI. 47 fths.	VII. 43 fths.	VIII. 40 fths.
1. Biloculina ringens, *Lamk.*, sp.			*	*	*	*
2. —— depressa, *d'Orb.*						*
3. —— elongata, *d'Orb.*			*			
4. —— irregularis, *d'Orb.*			*			
5. Spiroloculina planulata, *Lamk.*, sp.						*
6. —— asperula, *Karrer*			*			
7. Miliolina seminulum, *Linné*, sp.	*	*		*	*	*
8. —— oblonga, *Montag.*, sp.	*	*	*		*	*
9. —— pygmæa, *Reuss*, sp.			*			
10. —— bicornis, *W. & J.*, sp. (?)			*			
11. —— excisa, n. sp.		*				
12. —— agglutinans, *d'Orb.*, sp.			*	*	*	*
13. —— tricarinata, *d'Orb.*, sp.						*
14. Articulina sulcata, *Reuss*	*					
15. —— multilocularis, n. sp.		*				
16. —— conico-articulata, *Batsch*, sp.	*					
17. Ophthalmidium inconstans, *Brady*	*					
18. Planispirina exigua, *Brady*	*					
19. —— sigmoidea, *Brady*	*					
20. Cornuspira involvens, *Reuss*	*	*	*			
21. Peneroplis pertusus, *Forsk.*, sp.		*				
22. Psammosphæra fusca, *Schulze*				*		
23. Hyperammina ramosa, *Brady*			*			*
24. Reophax fusiformis, *Will.*, sp.						*
25. —— scorpiurus, *Montfort*	*		*	*		
26. —— pilulifera, *Brady*						*
27. Haplophragmium emaciatum, *Brady*	?		*		*	*
28. —— latidorsatum, *Bornem.*, sp.			*		?	
29. —— canariense, *d'Orb.*, sp.			*			*
30. —— nanum, *Brady*			*			
31. Placopsilina cenomana, *d'Orb.*		*				
32. Ammodiscus gordialis, *J. & P.*, sp.			*			
33. Trochammina squamata, *J. & P.*	*?					
34. Webbina clavata, *J. & P.*			*			
35. Textularia sagittula, *Defr.*	*	*		*	*	*
36. —— abbreviata, *d'Orb.*	*	*			*	
37. —— agglutinans, *d'Orb.*		*		*	*	*
38. Verneuilina spinulosa, *Reuss*	*	*	*	*		
39. Gaudryina pupoides, *d'Orb.*			*			
40. —— ——, var. chilostoma, *Reuss*			*			
41. —— siphonella, *Reuss*	*					
42. —— filiformis, *Berthelin*			*			
43. Valvulina conica, *P. & J.*				*		
44. —— communis, *d'Orb.*			*			*
45. —— parisiensis, *d'Orb.*		*			*	*
46. Bulimina marginata, *d'Orb.*			*		*	*
47. —— aculeata, *d'Orb.*			*		*	*
48. —— inflata, *Seg.*			*			*
49. —— pupoides, *d'Orb.*						*

Table of Distribution (continued).

	I. 940 fths.	II. 31 fths.	IV. 260 fths.	VI. 47 fths.	VII. 43 fths.	VIII. 40 fths.
50. Virgulina schreibersiana, *Czj.*	*					
51. Bolivina punctata, *d'Orb.*	*		*			
52. —— plicata, *d'Orb.*	*				*	*
53. —— textilarioides, *Reuss*			*			*
54. —— dilatata, *Reuss*	*		*			*
55. —— ænariensis, *Costa*, sp.			*			*
56. Cassidulina lævigata, *d'Orb.*	*		*			*
57. —— subglobosa, *Brady*			*		*	*
58. Lagena globosa, *Montag.*, sp.			*			
59. —— sulcata, *W. & J.*			*			*
60. —— striata, *d'Orb.*, sp.			*			*
61. —— lineata, *Will.*, sp.						*
62. —— melo, *d'Orb.*, sp.	*		*			
63. —— lævigata, *Reuss*, sp.			*			
64. —— marginata, *W. & B.*, sp.	*	*	*			*
65. —— orbignyana, *Seg.*, sp.	*		*			
66. —— lagenoides, *Will.*, sp.	*		*			
67. Nodosaria calomorpha, *Reuss*			*			
68. —— pyrula, *d'Orb.*				*		
69. —— (Dentalina) mucronata, *Neugeb.*, sp.						*
70. —— obliqua, *Linné*, sp.					*	
71. —— scalaris, *Batsch*, sp.			*	*		*
72. —— hispida, *d'Orb.*			*			
73. Rhabdogonium tricarinatum, *d'Orb.*, sp.			*			*
74. Cristellaria crepidula, *F. & M.*, sp.			*			*
75. —— rotulata, *Lamk.*, sp.			*	*	*	*
76. —— cultrata, *Montf.*, sp.			*			*
77. —— calcar, *Linné*, sp.						*
78. —— cassis, *F. & M.*, sp.						*
79. —— variabilis, *Reuss*			*			*
80. Polymorphina lactea, *W. & J.*, sp.						*
81. Uvigerina pygmæa, *d'Orb.*			*		*	*
82. —— asperula, *Czj.*			*		*	*
83. Sagrina dimorpha, *P. & J.*			*			
84. Globigerina bulloides, *d'Orb.*	*		*	*	*	*
85. —— rubra, *d'Orb.*	*		*	*	*	*
86. —— conglobata, *Brady*	*		*		*	*
87. —— sacculifera, *Brady*	*		*			*
88. —— æquilateralis, *Brady*	*		*			*
89. Orbulina universa, *d'Orb.*	*		*		*	*
90. Pullenia sphæroides, *d'Orb.*, sp.			*			*
91. —— quinqueloba, *Reuss*			*			
92. Sphæroidina bulloides, *d'Orb.*	*		*			
93. Cymbalopora poeyi, *d'Orb.*, sp., var.	*					
94. Discorbina globularis, *d'Orb.*, sp.		*		*	*	*
95. —— rosacea, *d'Orb.*, sp.		*				
96. —— vilardeboana, *d'Orb.*, sp.				*		
97. —— orbicularis, *Terquem.*, sp.				*		
98. —— bertheloti, *d'Orb.*, sp.				*	*	*
99. —— rarescens, *Brady*		*				
100. Planorbulina mediterranensis, *d'Orb.*				*		
101. —— acervalis, *Brady*		*				

Table of Distribution (continued).

	I. 940 fths	II. 31 fths.	IV. 260 fths.	VI. 47 fths.	VII. 43 fths	VIII. 40 fths.
102. Truncatulina lobatula, *W. & J.*, sp.	......	*	*	*	*	*
103. —— variabilis, *d'Orb.*	......	......	*			
104. —— mundula, n. sp.	......	......	*			
105. —— reticulata, *Czj.*, sp.	......	*	*	......	......	*
106. Anomalina ariminensis, *d'Orb.*, sp.	*	......	*	*	*	*
107. —— ammonoides, *Reuss*, sp.	*	......	*			
108. Pulvinulina elegans, *d'Orb.*, sp.	*	......	......	......	......	*
109. —— schreibersii, *d'Orb.*, sp.	......	......	......	*	*	
110. —— menardii, *d'Orb.*, sp.	*	......	*	*	......	*
111. —— tumida, *Brady*	*	......	*	......	......	*
112. —— crassa, *d'Orb.*, sp.	*					
113. —— micheliniana, *d'Orb.*, sp.	......	......	*	......	*	*
114. —— oblonga, *Will.*, sp.	......	......	......	......	*	*
115. Rotalia soldanii, *d'Orb.*	*					
116. Gypsina globulus, *Reuss*, sp.	......	*				
117. —— inhærens, *Schultze*, sp.	......	*				
118. Nonionina depressula, *W. & J.*, sp.	......	......	*			
119. —— exponens, n. sp.	*					
120. —— umbilicatula, *Montag.*, sp.	......	*	*	......	*	*
121. —— scapha, *F. & M.*, sp.	......	......	*	......	......	*
122. Polystomella striatopunctata, *F. & M.*, sp.	......	......	......	......	......	*
123. —— sp.?	......	......	......	*		
124. Amphistegina lessonii, *d'Orb.*	*	*				

Note.—*Species not figured in the Plates.*

22. Psammosphæra fusca, *Schulze.*
27. Haplophragmium emaciatum, *Brady.*
33. Trochammina squamata, *J. & P.*
41. Gaudryina siphonella, *Reuss.*
49. Bulimina pupoides, *d'Orb.*
50. Virgulina schreibersiana, *Czj.*
51. Bolivina punctata, *d'Orb.*
52. —— plicata, *d'Orb.*
58. Lagena globosa, *Montagu*, sp.
63. Lagena lævigata, *Reuss*, sp.
87. Globigerina sacculifera, *Brady.*
88. —— æquilateralis, *Brady.*
95. Discorbina rosacea, *d'Orb.*
96. —— vilardeboana, *d'Orb.*
99. —— rarescens, *Brady.*
111. Pulvinulina tumida, *Brady.*
112. —— crassa, *d'Orb.*
115. Rotalia soldanii, *d'Orb.*

EXPLANATION OF THE PLATES.

PLATE XL.

Page

Figs. 1–3. *Cornuspira involvens*, Reuss. Fig. 1, × 50; figs. 2, 3, × 90 . . . 216
a a, lateral aspect; *b b*, peripheral aspect.

Fig. 4. *Planispirina exigua*, Brady. × 90 ? 216

Figs. 5, 6. Doubtful organisms. × 90 216

Figs. 7–9. *Articulina conico-articulata*, Batsch, sp. Figs. 7 and 8, × 90; fig. 9, × 70 216

Fig. 10. *Articulina multilocularis*, n. sp. × 75 215

Fig. 11. *Articulina sulcata*, Reuss. × 80 215

Figs. 12, 13. *Ophthalmidium inconstans*, Brady. × 70 216
a, lateral aspect; *b*, peripheral aspect.

Figs. 14, 15. *Spiroloculina planulata*, Lamarck, sp. × 30 214
a a, lateral aspect; *b b*, peripheral aspect.

Fig. 16. *Planispirina sigmoidea*, Brady. × 40 216
a, lateral aspect; *b*, peripheral aspect.

Figs. 17, 18. *Biloculina depressa*, d'Orbigny. × 30 213
a a, lateral aspect; *b b*, peripheral aspect.

Figs. 19, 20. *Biloculina ringens*, Lamarck, sp. Fig. 19, × 75; fig. 20, × 40 . . 213
20, lateral aspect; 19, peripheral aspect.

Figs. 21, 22. *Biloculina elongata*, d'Orbigny. × 60 214
22, lateral aspect; 21, peripheral aspect.

Figs. 23, 31. *Miliolina seminulum*, Linné, sp. Fig. 23, × 60; fig. 31, × 40 . . 214

Figs. 24, 26. *Biloculina irregularis*, d'Orbigny, sp. Fig. 24, × 30; fig. 26, × 50 214

Fig. 25. *Miliolina bicornis*, Walker & Jacob (?). × 70 214

Fig. 27. *Miliolina oblonga*, Montagu, sp. × 50 214

Figs. 28, 29. *Spiroloculina asperula*, Karrer. × 60 214

Fig. 30. *Miliolina pygmæa*, Reuss, sp. (?). × 60 214

Fig. 32. *Miliolina tricarinata*, d'Orbigny, sp. × 30 215
a, *c*, lateral aspects; *b*, apertural end.

Fig. 33. *Miliolina excisa*, n. sp. × 45 215

Figs. 34, 35. *Miliolina agglutinans*, d'Orbigny, sp. × 30 215
a, lateral aspect; *b*, apertural end.

PLATE XLI.

Figs. 1–4, 13. *Hyperammina ramosa*, Brady. (Fragments.) Figs. 1, 3, 13, × 50; fig. 2, × 25; fig. 4, × 35 217

Figs. 5–8. *Reophax pilulifera*, Brady. Fig. 5, × 75; figs. 6, 7, × 25 217

PLATE XLII.

PLATE XLIII.

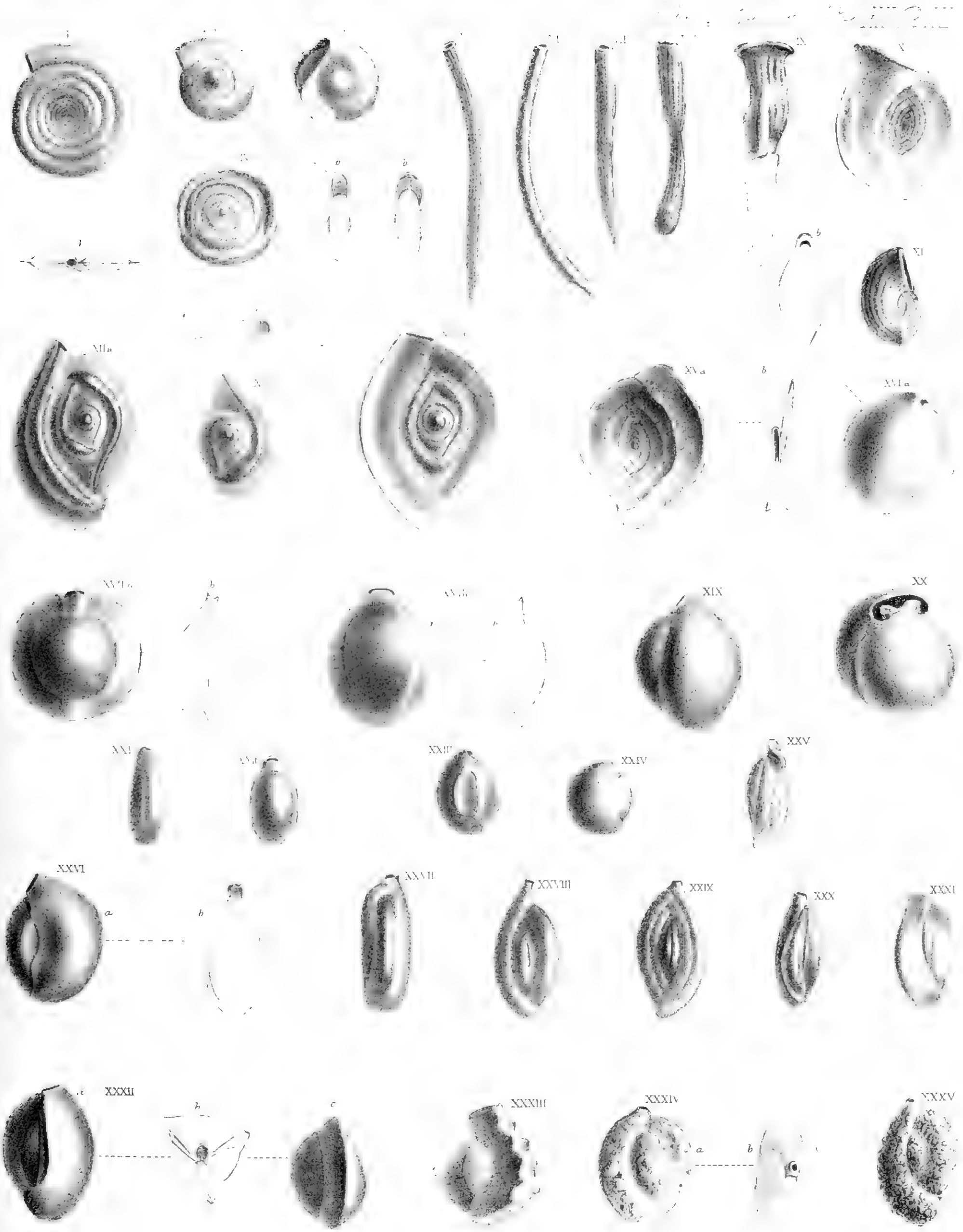
PLATE XLIV.

PLATE XLV.

PLATE XLVI.

PLATE XLVII.

CHART, showing the Track of H.M. Steam Surveying-ship 'Plumper' over the Victoria Bank (Abrohlos Bank).



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West Newman & Co imp

FORAMINIFERA : ABROHLOS BANK

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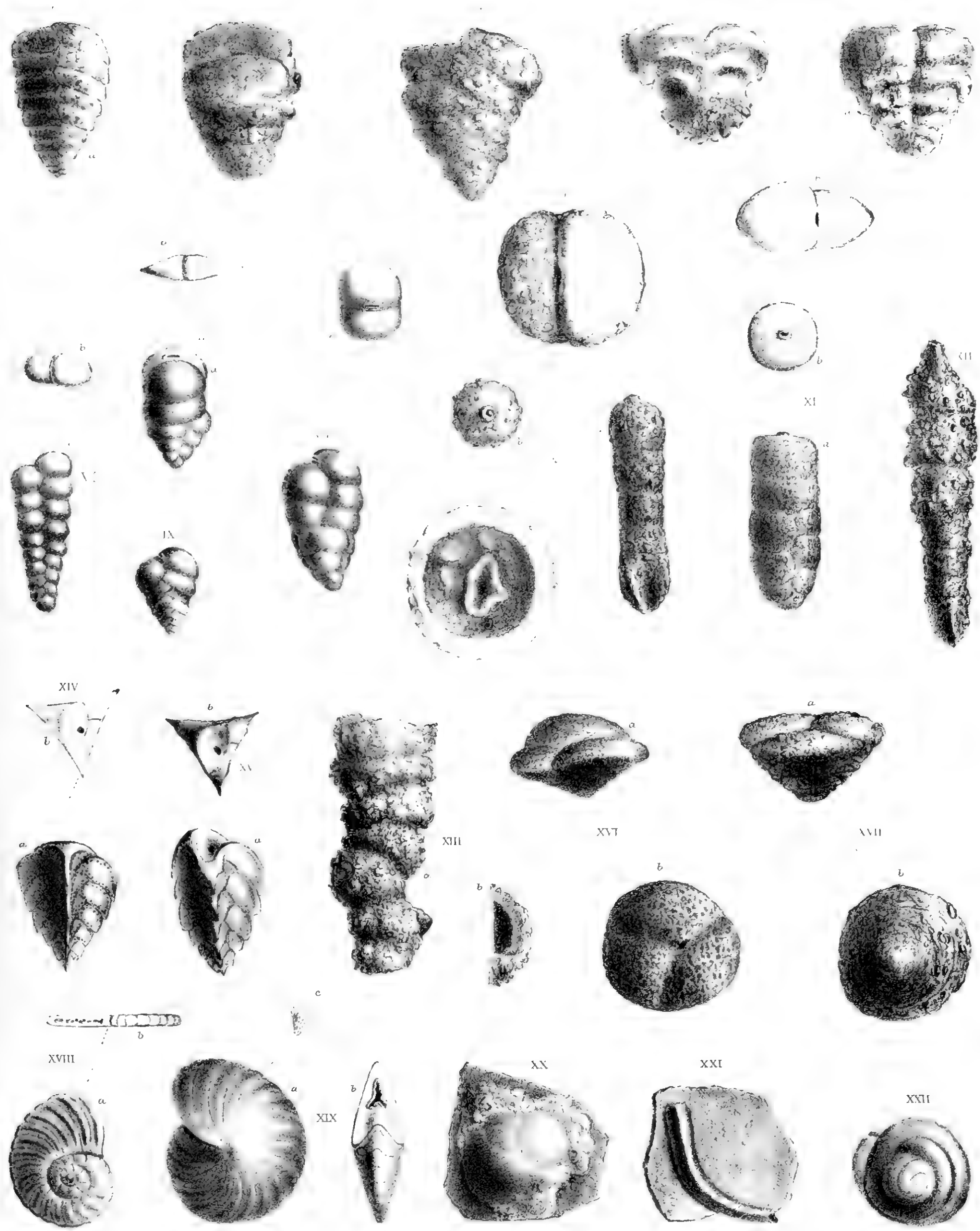
West, Newman & Co imp

FORAMINIFERA ABROHLOS BANK



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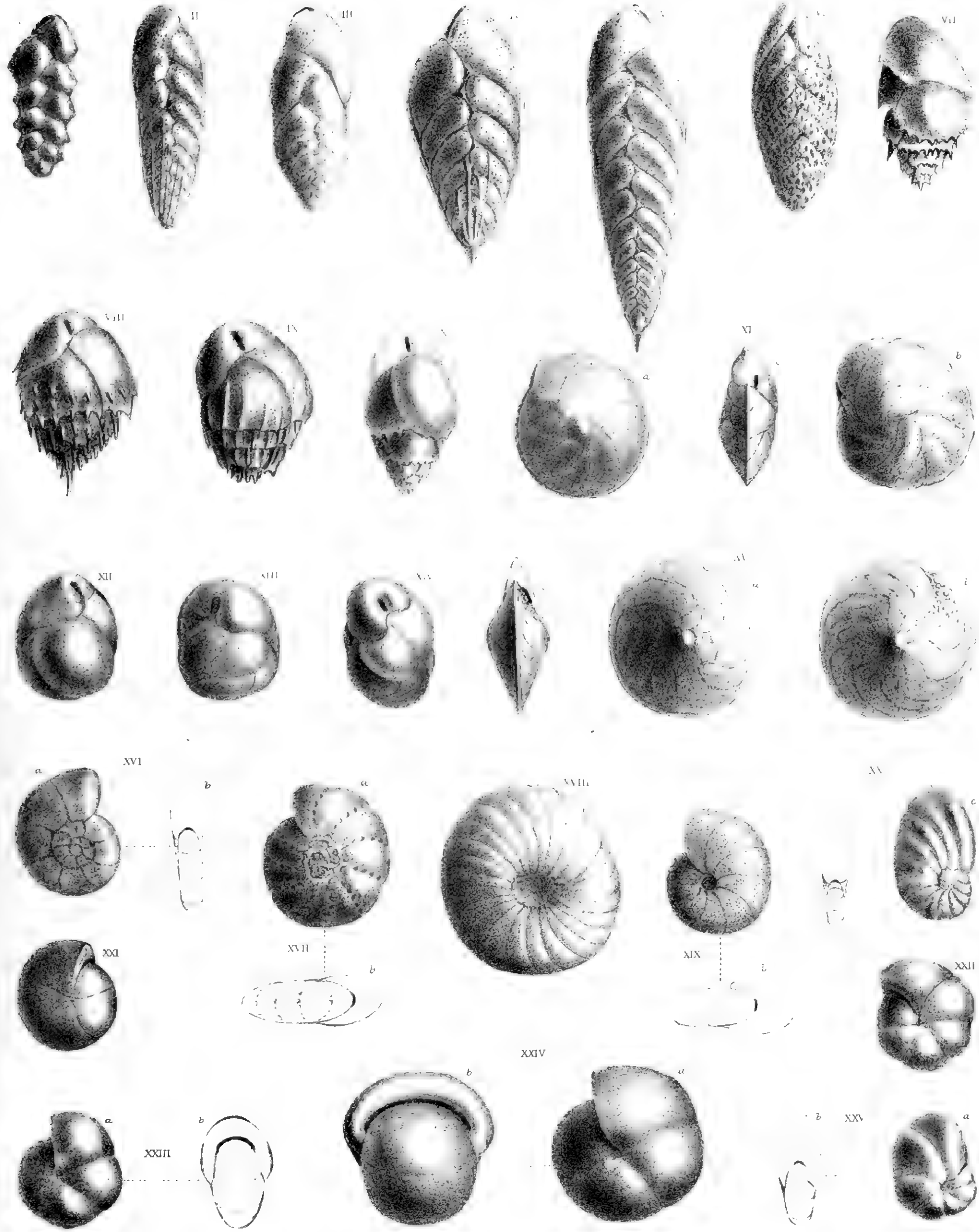

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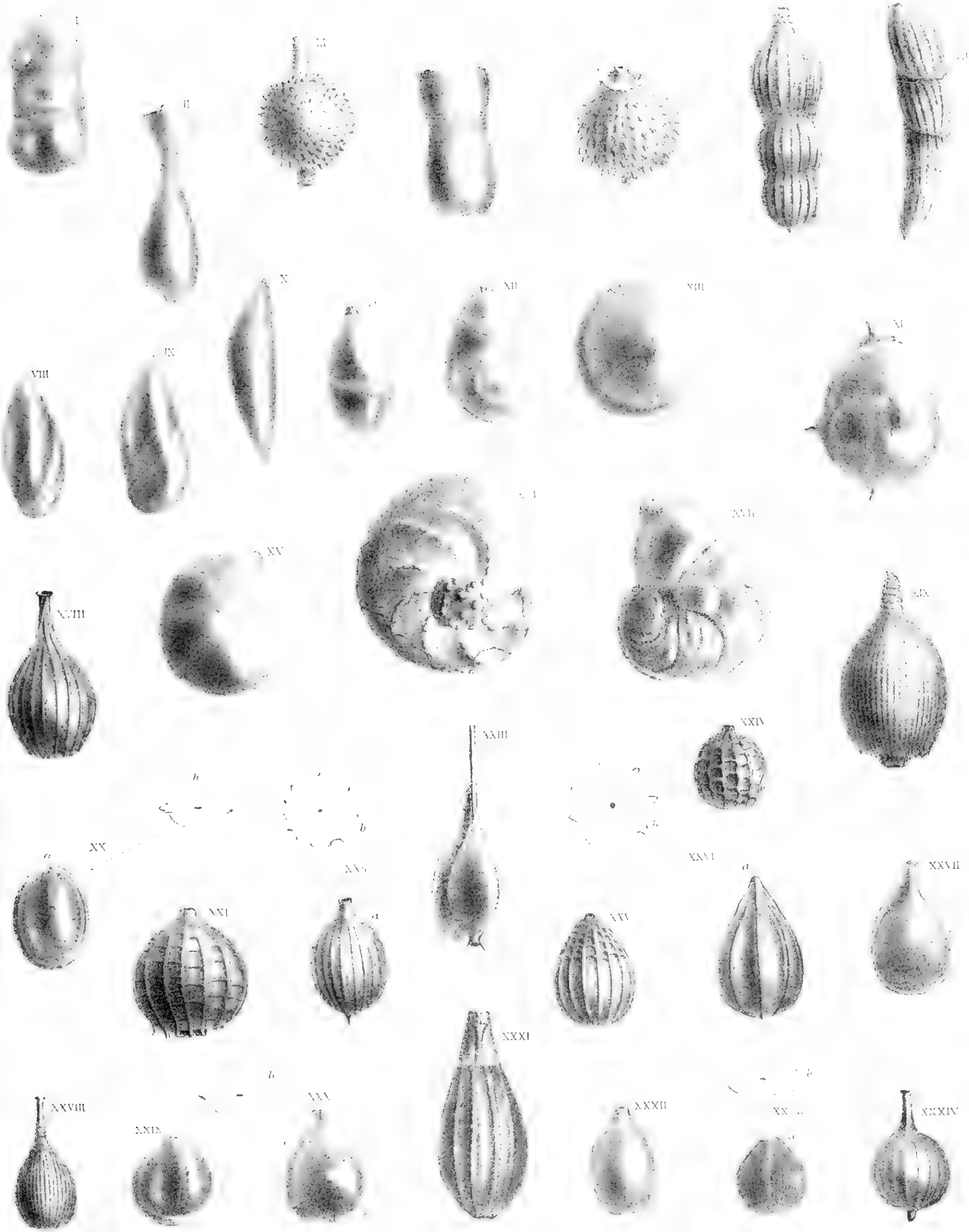

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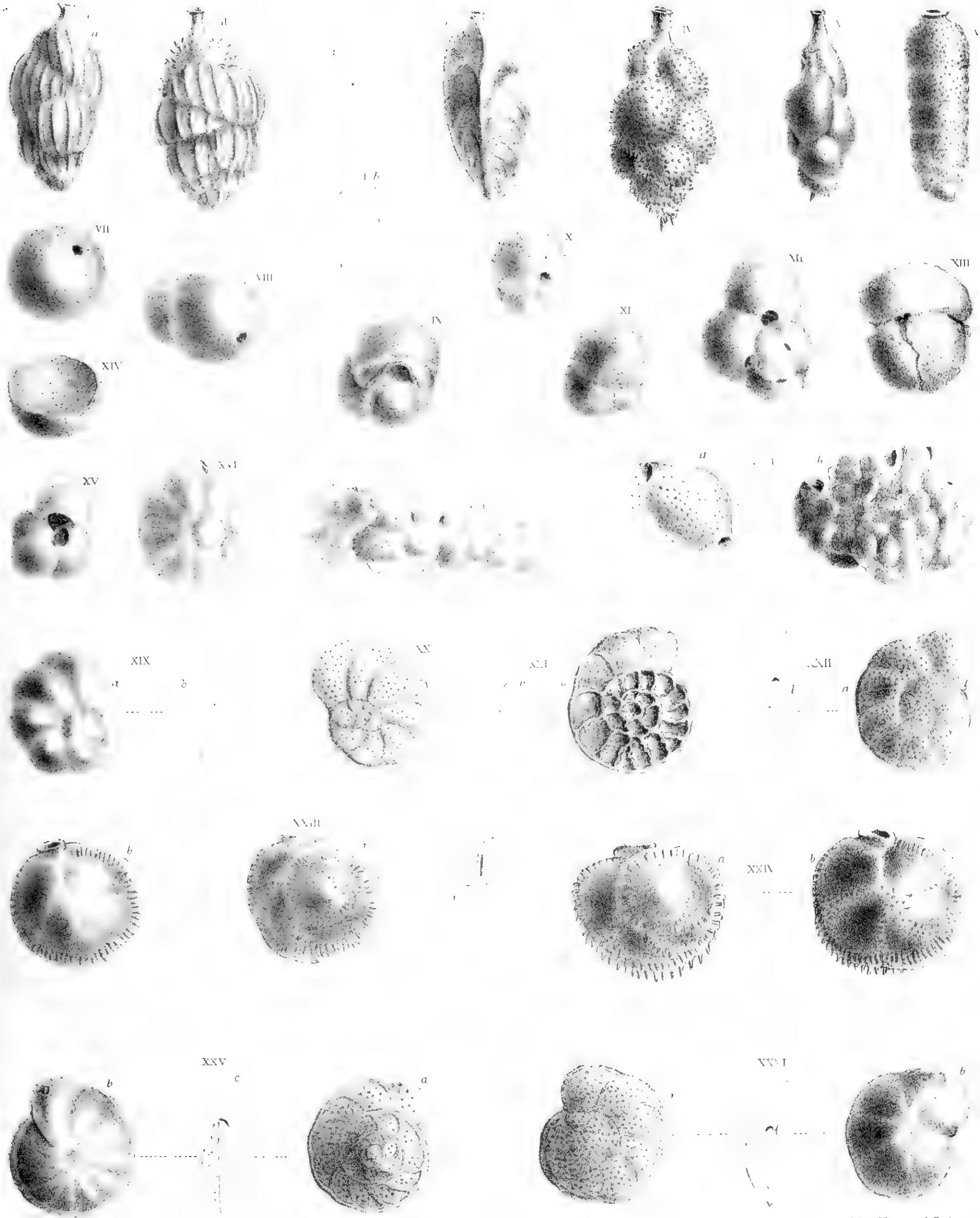

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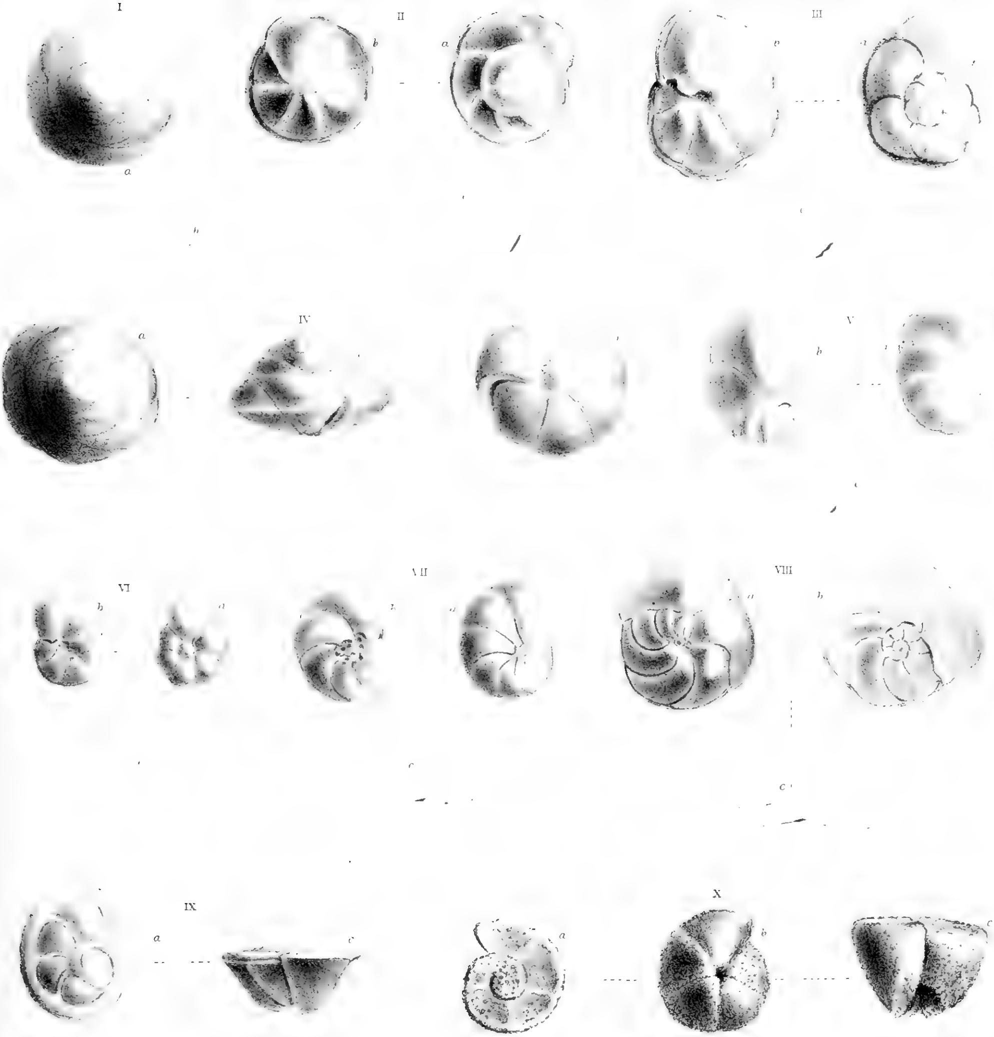

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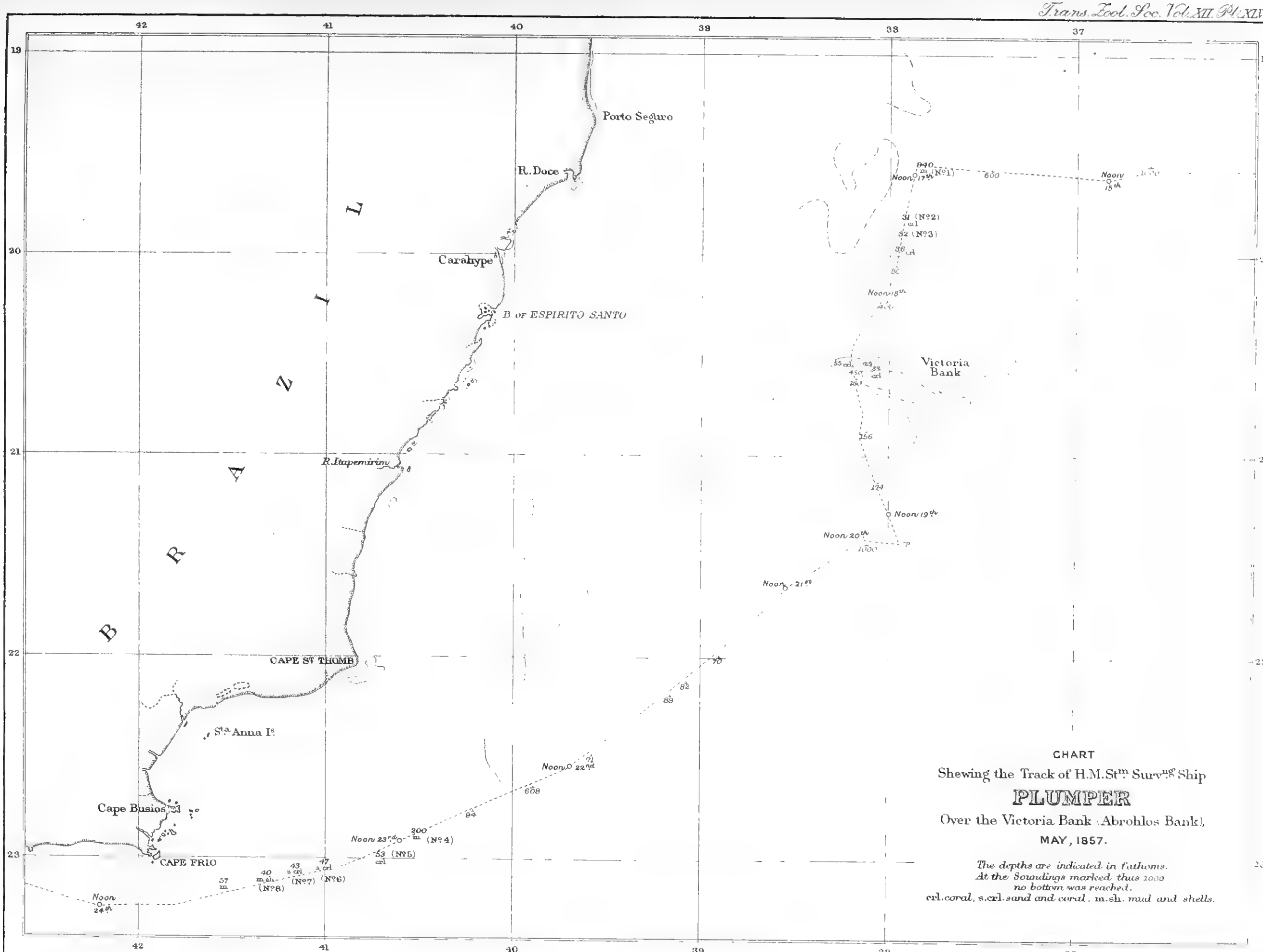
CHART
Shewing the Track of H.M.St^m. Surv^ng Ship
PLUMPER
Over the Victoria Bank (Abrohlos Bank),
MAY, 1857.
The depths are indicated in fathoms.
At the Soundings marked thus 1000 no bottom was reached.
crl. coral, s.crl. sand and coral, m.sh. mud and shells.
BRAZIL
Porto Seguro
R. Doce
Carahype
B of ESPIRITO SANTO
R. Itapemirim
CAPE St THOMÉ
Sta. Anna Is.
Cape Busios
CAPE FRIO
Victoria Bank
Noon 15th
Noon 17th
Noon 18th
Noon 19th
Noon 20th
Noon 21st
Noon 22nd
Noon 23rd
Noon 24th

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April 1888.

P. L. SCLATER,
Secretary.

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OF

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Continued on page 3 of Wrapper.

XII. *On a Specimen of* Ziphius *recently obtained near Dunedin.* *By* John H. Scott, *M.D., F.R.S.E., and* T. Jeffery Parker, *B.Sc., C.M.Z.S., Professors in the University of Otago, New Zealand.*

Received March 2nd, 1887, read April 5th, 1887.

[Plates XLVIII.–L.]

The specimen upon which the following scattered observations were made came ashore alive at Warrington, about twenty miles north of Dunedin, New Zealand, on November 6th, 1884, and was killed by a settler in the locality. We were informed of the circumstance on the following day, and on the 8th made as careful an examination as time and circumstances would permit, leaving the taxidermist of the Otago University Museum to secure the skeleton and such of the internal organs as it was thought desirable to preserve.

1. *External Characters.*

The specimen was a young female about 16 feet long, and was in excellent preservation, having hardly any wounds or other injuries, except the stab under the throat by which it was killed. When opened, the central part of the carcass was found to be still warm, although death had taken place fully forty-eight hours previously. The skin showed not a trace of the seams and scars which were so marked a feature in all the individuals described and figured by von Haast [1], the whole surface being quite smooth.

The following measurements were taken before beginning the dissection:—

	cm.	ft.	in.
Total length from anterior end of upper jaw along the back to middle of caudal fin	485	15	11
From anterior end of upper jaw to blow-hole	61	2	0
Width of blow-hole	14	0	5·5
From anterior end of lower jaw to angle of mouth	29	0	11·5
From middle ventral line to eye	44 5	1	5·5
From angle of mouth to centre of eye	34·5	1	1·5
Antero-posterior diameter of eye	3·1	0	1·25
From centre of eye to auditory aperture	14	0	5·5
From anterior end of lower jaw to axilla	27	4	2

[1] "Notes on *Ziphius (Epiodon) novæ-zealandiæ*," von Haast, Trans. N. Z. Inst. xii. (1879) p. 241; and Proc. Zool. Soc. 1880, p. 232, and 1883, p. 590.

	cm.	ft.	in.
Length of flipper along lower border	48	1	7
Greatest width of flipper	14	0	5·5
From anterior end of upper jaw to anterior end of dorsal fin	297	9	9
Length of base of dorsal fin	33	1	1
Vertical height of dorsal fin	20·5	0	8
Breadth of caudal fin	112	3	8
Girth immediately cephalad of caudal fin	56	1	10
Girth at middle of dorsal fin, excluding the latter	201	6	7
Greatest girth, 233 cm. (7 ft. 8 in.) from snout	249	8	2
Girth at axilla	233	7	8
From anterior end of lower jaw to anterior end of genito-anal fissure	325	10	7·5
Length of genito-anal fissure	48	1	7
From posterior end of genito-anal fissure to anus	6·3	0	2·5
From anterior end of genito-anal fissure to anterior end of mammary cleft	23	0	9
Length of mammary cleft	10	0	4

The head of our specimen was scarcely so convex as in that figured by von Haast[1], but considerably more so than that of the individual figured by Burmeister[2] under the name of *Ziphiorhynchus cryptodon*. (See Pl. XLVIII. fig. 1.)

Under the throat were three folds on each side, running obliquely backwards and upwards; of these the central one was much the largest and best marked. Von Haast describes only a single gular fold on each side.

As is seen in fig. 2 (Pl. XLVIII.) the middle of the caudal fin was marked by a slight projection, not shown in either von Haast's or Burmeister's figure.

The distance between the eye and ear given in the table of measurements was taken along an oblique line, the auditory aperture lying 4·6 cm. (1·8 in.) below the level of the eye. The blow-hole was, as usual, concave forwards.

In the undisturbed position of the parts the lips of the genito-anal fissure were in contact, so that neither the urino-genital nor the anal aperture could be seen. When the lips were separated as in fig. 3 (Pl. XLIX.) the vulva was seen to be surrounded by an irregular ring of caruncles, while between it and the anus was a low rounded longitudinal ridge.

Colour. The entire back and the lateral aspect above the level of the flipper, with the exception of an ill-defined dark brown longitudinal strip between the back and the side,

[1] Trans. N. Z. Inst. xii. (1879) pl. 8; Proc. Zool. Soc. 1880, pl. 23.

[2] Ann. & Mag. N. H. 3rd series, vol. xvii. (1866) pl. 3.

were deep purple-black, as were also the dorsal fin, the dorsal aspect of the caudal fin, and the flippers. The black colour of the flipper and shoulder was carried forwards on to the cheek, and ended anteriorly in a rather well-defined rounded area, in the centre of which was placed the eye. Passing forwards from the dorsal aspect of the trunk to that of the head, the black colour became distinctly browner, the dark brown being continued on to the upper lip. Between this median dark area and that surrounding the eye there was a patch of lighter brown, which shaded off below into the white of the throat. The lower jaw, like the upper, was dark brown; the throat was also brownish anteriorly. The underside of the caudal fin and the ventral aspect of the body to within a few inches of the posterior end of the genito-anal fissure were brown; the rest of the belly and the lower part of the flank white. There was also a small triangular white area running backwards from the angle of the mouth.

So far as we know, the form and colour of *Ziphius* have been noted on five different specimens, and as all these differ very materially in colour from ours, we have thought it well to be thus particular in our description.

In the four New Zealand individuals described by von Haast[1], one of which is figured, the colouring is the exact reverse of what we found, the back—or at least the anterior half of it—being described as white, and the belly black. In the Buenos Ayres specimen described by Burmeister[2] the body was "of a clear grey colour, a little yellowish, but darker on the back, and lighter on the stomach." The fins were almost black.

The skin was removed with the intention of stuffing it for the Museum, but this was found to be impracticable. The blubber seemed to pass insensibly into the cuticle, and, after removal of the former, the remainder of the skin was so delicate as to be torn by the slightest traction, thus differing very markedly from the tough and coherent skin of a Porpoise.

2. *The Skeleton.*

The skull presents no points of special interest, with the exception of a trifling difference in the shape of the nasals. Van Beneden and Gervais's figure of *Ziphius chathamiensis*[3] might have been taken from our specimen. The prenasal cartilage was entirely unossified, the mesethmoid ending, in the dry skull, in a nearly vertical border immediately cephalad of the front boundary of the anterior nasal fossa. In the hyoid the right thyro-hyal is ankylosed to the basihyal, the left being free; both have cartilaginous extremities. The stylo-hyals are tipped with cartilage at both ends, and are united to the basi-hyal by small curved cartilaginous cerato-hyals.

[1] Proc. Zool. Soc. 1876, p. 466; 1880, p. 232; 1883, p. 590.

[2] Ann. & Mag. N. H. 1866, xvii. p. 94.

[3] 'Ostéographie des Cétacés,' pl. xxi. figs. 5, 6.

The vertebral column consists of seven cervical, ten thoracic, nine lumbar, and twenty caudal vertebræ. In all but the anterior cervicals the epiphyses are separate, and, in the fresh state, the neural spines were tipped with cartilage.

The first four cervical vertebræ are united; the ankylosis of the fourth is, however, imperfect, its arch being quite separate from that of the third on the right side, and the epiphyses between the adjacent centra being clearly distinguishable.

The total number of chevron bones in the skeleton in its present condition is nine; by the facets on the vertebral centra there were almost certainly two others; the last was attached to the interval between the 11th and 12th caudal vertebræ.

The sternum has the usual character, consisting of five sternebræ united by synchondroses, diminishing progressively in size from the first to the last, and each having a deep notch both on its anterior and posterior border. The diverging posterior crura of the last sternebra are tipped with cartilage, and do not, as stated by von Haast, give attachment to the sixth sternal ribs. The first sternal rib articulates with a cartilage-covered facet on the lateral border of the first sternebra; the second to the fifth sternal ribs articulate at the intervals between the first and second, second and third, third and fourth, and fourth and fifth sternebræ respectively; the sixth is united to the posterior border of the fifth near its sternal articulation. The remaining ribs do not reach the sternum.

There is nothing remarkable about the shoulder-girdle and fore limb; as, however, all the figures of these bones we have been able to find show them in the dried condition, after removal of the cartilage, we give (Pl. XLIX.) figures of the scapula (fig. 4), of the proximal end of the ulna showing the great olecranon process (fig. 6), and of the right manus (fig. 5). Both proximal and distal epiphyses of the humerus, radius, and ulna are quite separate.

The carpus (fig. 5) consists of six elements, five of which are ossified while the sixth or pisiform remains cartilaginous. The first metacarpal articulates directly with the scaphoid, the second and third metacarpals with the trapezoid (or united trapezoid and magnum), and the fourth and fifth with the unciform.

The number of phalanges in each digit is as follows:—

I.	II.	III.	IV.	V.
1	5	5	5	2

In the second and third digits the ossification of the distal phalanx is a mere nodule of bone; in the fourth the penultimate phalanx has a similar nodular ossification, while the distal phalanx is entirely unossified. Burmeister[1] gives the number of ossified phalanges in his specimen as 1, 2, 3, 2, and 2, and the total number, *i. e.* including unossified cartilages, as 2, 7, 6, 5, and 3. In *Z. cavirostris* van Beneden and Gervais give the number as 1, 3 (?), 5, 4, and 1, and state that the carpus contains two bones

[1] Quoted by van Beneden and Gervais, 'Ost. des Cétacés,' p. 384.

in the proximal and five in the distal row. Probably these authors consider the scaphoid as a trapezium and count the pisiform cartilage in the distal row. Von Haast does not mention the number of phalanges in his specimen.

The right pelvic bone, as it appeared when freshly cleaned, is shown in Plate XLIX. fig. 7. It has the rib-like form described by Murie[1] in *Globiocephalus*, but is tipped with cartilage only at its narrow or *anterior* end.

3. *Teeth.*

As usual there are two teeth, one at the extremity of each mandibular ramus, and both completely covered, in the entire animal, by the gum. They are in the form of slightly curved hollow cones, 3·5 cm. (1·4 in.) long and 1 cm. (0·4 in.) in diameter at the base. The weight of each is 1·2 grm. (18·5 grains) in the dry state. They are thus considerably smaller than any described by von Haast, the smallest examined by whom was 1·98 inch long and weighed 62 grains.

4. *Alimentary Canal.*

The tongue is short, barely free at the tip, and has the anterior margin rounded and slightly fringed; the mucous membrane of the anterior or buccal portion is tough and leathery and devoid of papillæ.

The pharynx and pharyngeal portion of the tongue are plicated longitudinally and beset with small punctiform apertures.

The stomach (Pl. L. fig. 8) does not seem to have been adequately described: it consists of ten well-marked compartments. Shortly after removal the character of the mucous membrane was examined by partly everting the organ; it was then distended with air and dried, the compartments being finally opened.

The first compartment is 55 cm. (21·5 in.) in length, and is imperfectly divided into a larger œsophageal or proximal and a smaller distal portion by a transverse constriction situated immediately proximad of the opening into the next compartment. The mucous membrane was hard and raised into ridges, reminding one of the reticulum of the sheep's stomach, but having less prominent and less regularly arranged ridges. In the smaller or distal division the ridges were more closely arranged.

The first compartment opens by a large valvular orifice into the second. The latter is small and wedge-shaped, and lies almost concealed between the first and third compartments. In the distended condition the septa between the second and the two adjacent compartments are only separated from one another by a distance of 2 cm. The greatest length of this chamber is 9 cm., its breadth 5 cm. Its opening into the third compartment is large and oval.

The remaining (3rd to 10th) compartments are arranged in a helicine curve measuring 140 cm. (55 in.) along the convexity, and having a reflection of the peritoneum attached

[1] "On the Organization of the Caaing Whale, *Globiocephalus melas*." Trans. Zool. Soc. vol. viii. p. 235.

along its concave border. Seven of the nine (3rd to 9th) are subglobular, the 10th is more elongated. They are separated from one another by flat circular septa, each of which is perforated, usually somewhat excentrically, by a nearly circular aperture, about 2·5 cm. in diameter in the dried condition.

The duodenum springs from one side of the last compartment, nearly midway between its rounded blind end and the septum between it and the 9th chamber. Thus the relation between the duodenum and stomach of *Ziphius* recalls that obtaining in many animals between the ileum and colon. The mucous membrane of compartments 2 to 10 was soft and smooth.

The intestine was 22·5 metres (74 ft.) long, and was uniformly circular in section, showing no distinction between small and large intestine. Internally it was marked with a network of ridges. The lymphatic glands of the mesentery were large and nodular.

5. *Respiratory Organs.*

The larynx is of the ordinary Cetacean character, and measures 21 cm. (8·25 in.) from the posterior border of the cricoid to the tip of the arytenoid cartilages.

The trachea has complete cartilaginous rings, and measures 9 cm. (3·5 in.) in transverse, and 7 cm. (2·75 in.) in dorso-ventral diameter. Its length from the posterior of the cricoid to the bifurcation is 33 cm. (13 in.), to the origin of the accessory branches on the right side 15·25 cm. (6 in.). The mucous membrane lining the trachea and larynx is raised into delicate regularly arranged longitudinal folds. The lungs were undivided and covered with a thick whitish pleura.

6. *The Heart.*

When seen *in situ* and full of blood, the heart appeared regularly conical, but on removal from the body it underwent complete collapse owing to the extreme thinness of the ventricular walls, instead of retaining its form, like most vertebrate hearts, in virtue of the thickness and solidity of that region. In its collapsed condition it measured 35·5 cm. (14 in.) from the apex to the origin of the pulmonary artery. The average thickness of the left ventricle was 1·6 cm. ($\frac{5}{8}$ in.), that of the right 1 cm. ($\frac{3}{8}$ in.), and that of the septum ventriculorum 1·8 cm. (1·1 in.). The diameter of the aorta at its origin was 7 cm. (2·75 in.). The position of the ductus arteriosus was clearly marked by a conspicuous depression on the inner wall both of the aorta and of the pulmonary artery.

7. *The Urinogenital Organs.*

The kidneys are subequal, about 39 cm. (15·5 in.) long by 15·25 cm. (6 in.) wide, and are composed of lobules averaging 1·3–1·8 cm. (0·5–0·75 in.) in diameter.

The bladder (Pl. L. fig. 9) is fusiform, and, after moderate distention with alcohol, measures 19 cm. (7·5 in.) by 5·25 cm. (2·16 in.). To the apex is attached a well-developed urachus and two hypogastric arteries, which retain a small lumen. The ureters join the bladder about 6 cm. from the neck, and pass backwards and inwards for fully 4 cm. through its walls before opening into its cavity 2 cm. from the cervix. The urethra was cut off in such a way as not to injure the vulva, as it was intended to stuff the skin; the portion left attached to the bladder is no less than 23 cm. (9 in.) long.

Each horn of the uterus (Pl. L. fig. 10) is 21 cm. (9·25 in.) long and 2·25 cm. (0·8 in.) in diameter, the whole organ being moderately distended with alcohol. The corpus uteri is about 11 cm. (4·3 in.) long, and is not clearly marked off from the vagina, owing to the fact that there are three well-developed and two less perfect ora uteri or constrictions of mucous membrane between the two cavities. A similar arrangement is described by Murie in *Globiocephalus*. Each cornu uteri is marked internally by 4–6 longitudinal ridges of mucous membrane; there are 7 or 8 such ridges in the corpus uteri; in the vagina they become very numerous.

The Fallopian tube is about 6 cm. (2·4 in.) long, and opens by the usual dilated and fimbriated extremity into the bottom of a deep pouch of peritoneum, the extremities of which are gathered together and attached, on the one hand to the Fallopian tube immediately mesiad of the ovary, and on the other to the round ligament. As the organs were removed from the body before being carefully examined, we cannot say what were the precise relations of this pouch to the ovary. Murie states that in *Globiocephalus* "the broad ligament and the fimbriæ of the Fallopian tube form a delicate arched covering or pavilion which overarches the ovary."

The ovary is 6·5 cm. (2·6 in.) long by 1·4 cm. wide; its hilus, or line of attachment to the broad ligament, is fully 4·5 cm. in length. It is quite immature, presenting no prominent Graafian follicles or corpora lutea.

EXPLANATION OF THE PLATES.

PLATE XLVIII.

Fig. 1. *Ziphius*, sp. The entire animal, from the right side ($\frac{1}{18}$ natural size): *na*, position of blow-hole; *g.a.f.* position of genito-anal fissure.

Fig. 2. The tail-fin, from above ($\frac{1}{18}$ nat. size).

PLATE XLIX.

Fig. 3. View of the genito-anal and mammary clefts, the former having its lips widely separated to show *cl*, the clitoris, *v*, the vulva, and *a*, the anus; *m.cl*, the left mammary cleft ($\frac{1}{4}$ nat. size).

Fig. 4. The left scapula, outer surface, showing the cartilaginous supra-scapula and extremities of the coracoid and acromion ($\times \frac{1}{4}$).

Fig. 5. The right manus, palmar aspect ($\times \frac{1}{2}$).

Fig. 6. The proximal end of the right ulna, showing the cartilaginous olecranon process ($\times \frac{1}{2}$).

Fig. 7. The right pelvic bone, ventral surface, showing the cartilaginous anterior extremity (nat. size).

PLATE L.

Fig. 8. The stomach, drawn in the fresh condition, after distention with air ($\times \frac{1}{4}$): *œs*, œsophagus; *a–k*, the ten gastric chambers; *int*, intestine.

Fig. 9. The urinary bladder ($\times \frac{1}{2}$): *ur*, ureter; *ur′*, rod placed in aperture of ureter.

Fig. 10. The reproductive organs ($\times \frac{1}{2}$): *fall.t*, Fallopian tube; *r.lg*, round ligament; *p*, pouch of peritoneum; *ov*, ovary; *va*, vagina.

Fig. 2 (× 1/18)

Fig. 1 (× 1/18)

J.H.S. ad nat. del.
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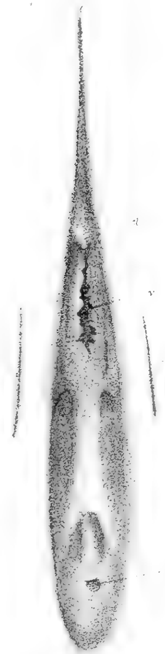
ZIPHIUS Sp.



nat. size

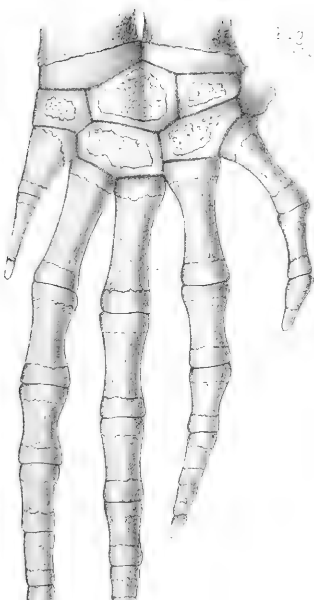


Fig. 5

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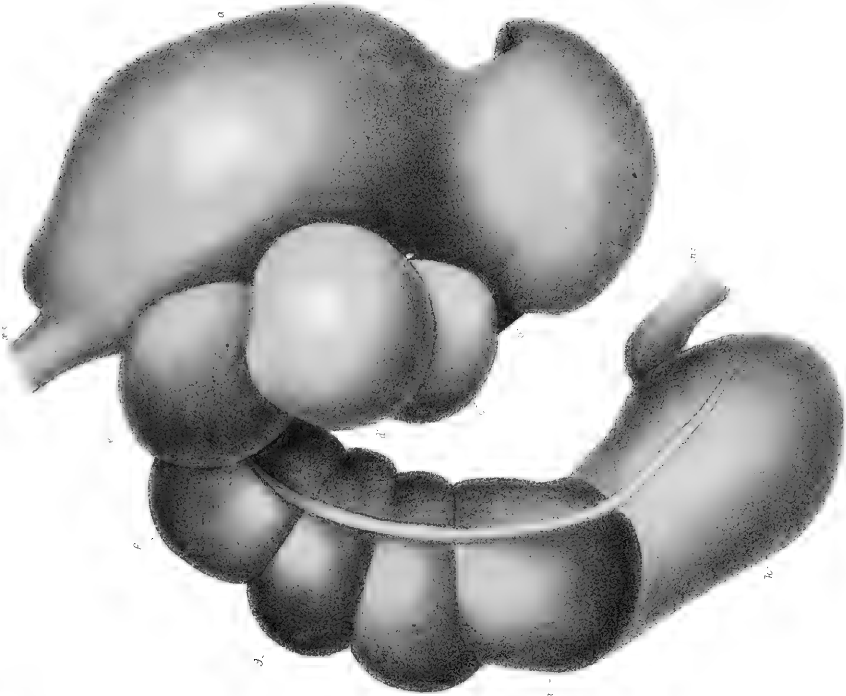

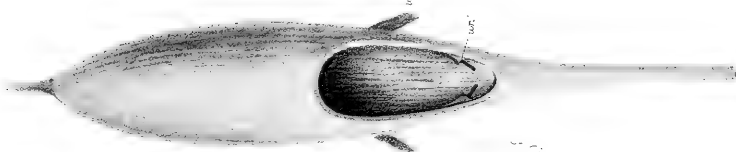

Fig. 9 (×½)

Fig. 10 (×½)

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February 1889.

P. L. SCLATER,
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Continued on page 3 of Wrapper.

XIII. *A Revision of the Subfamily Libellulinæ, with Descriptions of New Genera and Species.* *By* W. F. Kirby, *F.E.S., Assistant in the Zoological Department, British Museum.*

Received March 26th, 1887, read May 17th, 1887.

[Plates LI.–LVII.]

Contents.

PART I.

Introductory Remarks.

I HAVE lately been occupied in arranging the collection of Odonata in the British Museum, a task which has only been partially attempted before, at long intervals; and, while thus engaged, I have found it absolutely necessary to revise the large and important subfamily Libellulinæ. All the other subfamilies of Odonata have been monographed by Baron Selys-Longchamps, with the exception of the Æshninæ, on which he is now engaged. For the arrangement of the Libellulinæ our chief guides are Dr. Brauer's tables and characters of genera and lists of species published in the 'Verhandlungen der k.-k. zoologisch-botanischen Gesellschaft in Wien,' vol. xviii. (1868), pp. 364–369 and 711–737. Of course there are local faunæ and detached papers of great importance; but Brauer's is the only compendium of the subfamily which has hitherto appeared subsequently to Rambur's general work on the Neuroptera, published in 1842. The amount of material in the British Museum is very large in this subfamily, including types of nearly all the described genera; and it was at once obvious that several genera as heretofore employed included two or more natural and easily separable groups, while others, though separated by authors, had less claim to be considered distinct. In the present paper I have attempted to describe all the genera after a uniform system, freely describing both genera and species as new whenever I considered that I had sufficient material. Nothing makes the study of any group more difficult than the existence of a large number of undescribed (or, worse still, manuscript) species in collections, which will not fit into the arrangement. But although I have in some rare instances ventured to describe well-marked species and even genera from single specimens, I have always refrained from describing any form respecting which my materials appeared to be too scanty to be conveniently utilized at present. I believe that all my new species will prove to be easily recognizable by the characters which I have given, and my descriptions are in most cases taken from a long series of specimens.

In 1868 Brauer admitted forty genera of Libellulinæ, placing them in the following order:—*Zyxomma*, *Tholymis*, *Pantala*, *Tramea*, *Rhyothemis*, *Diastatops*, *Palpopleura*, *Neurothemis*, *Celithemis*, *Perithemis*, *Leucorhinia*, *Diplox* (= *Sympetrum*), *Mesothemis*, *Pachydiplax*, *Erythrodiplax*, *Erythemis*, *Lepthemis*, *Acisoma*, *Microthemis*, *Brachydiplax*, *Nannodiplax*, *Nannophya*, *Nannodythemis*, *Nannothemis*, *Tetrathenis*, *Uracis*, *Lyriothemis*, *Agrionoptera*, *Orthemis*, *Libellula*, *Libella* (= *Orthetrum*), *Onychothemis*, *Diplacina*, *Dythemis*, *Macrothemis*, *Trithemis*, *Brachythemis*, *Crocothemis*, *Macrodiplax*, and *Urothemis*.

In the present paper I have characterized 88 genera (of which 40 are new) and 42 new species.

Characters of Libellulinæ.

There is a great variety of character in Odonata; and I have selected the neuration as on the whole the most satisfactory guide. It will therefore be desirable to give a sketch of its principal features, and more briefly to notice one or two other characters of which I have made occasional use. But I must first say something of the general characters of the Libellulinæ, as distinguished from the other groups of Odonata.

Subfamily Libellulinæ.

Eyes large, little if at all expanded behind; first antenodal nervure of the fore wings not always continuous; nodal sector frequently undulated beyond the middle; hind wings rounded at the anal angle in both sexes; triangles of the fore and hind wings differing in shape.

The Libellulidæ are easily to be distinguished from all the other families of Odonata by the large contiguous eyes and by the difference in shape between the triangles of the fore and hind wings; the apex of the triangle of the fore wings is generally pointed downwards, and that of the hind wings outwards. It is sometimes harder to distinguish between the subfamilies Corduliinæ and Libellulinæ, the characters of which are not always very salient. In the Corduliinæ, however, the eyes have a slight horny tubercle behind, the triangles are generally wider, less regular, and often free, the sectors of the arculus are often completely separated, the last antenodal cross-nervure is always continuous; there is only a small number of postnodal nervures; the nodal sector is never undulated beyond the middle, and the males usually have the anal angle of the wings angulated, and the anal appendages of the abdomen more prominent. But notwithstanding all this, the Libellulinæ and Corduliinæ are more easily distinguished by their general facies than by any decisive characters which have yet been laid down; and I doubt whether the boundaries between the two subfamilies have yet been very clearly defined. I have therefore restricted myself to the discussion of genera which appear to be undoubtedly Libellulinæ, more especially as the Corduliinæ are rather poorly represented in the British Museum at present.

a. Head.

Eyes.—These are very large in the Libellulinæ, covering the sides of the head. They are very rarely separated (*Diastatops*), but in many genera they only touch each other on the crown of the head. In *Zyxomma* they are connected by a suture for nearly their whole length; and in a few other instances they are connected by a shorter, but still a considerable, portion of their length (*Pantala*, *Tramea*, &c.).

Frontal tubercle.—Between the eyes and the ocelli rises a protuberance, which may be either convex, truncated, concave, or even bifid on the summit. Its shape is frequently of generic value.

b. Thorax.

Dr. Brauer lays stress on the shape of the hinder lobes of the prothorax, a character which I have not used in the present paper. In one or two genera (*Nephepeltia* and *Raphismia*) we find simple or forked appendages springing from the metasternum.

c. Legs.

I have employed the claws of the tarsi—which are sometimes bifid (*Macrothemis*) or sometimes simple (*Onychothemis*), but more frequently toothed distinctly below the tip—as an occasional character. The spines of the hind tarsi are sometimes important; thus in *Lepthemis* and *Mesothemis* they are armed with a double row of a few very strong spines, instead of a larger number of more slender ones.

d. The Fore Wings.

These are very important organs in the classification of Odonata. The first point of interest on the costa is a notch about the middle of the wing, called the nodus, from which descends a thick nervure which divides the costal region into two halves perpendicularly. The upper part of the space between the base and the nodus is again divided longitudinally into the upper and lower antenodal costal spaces by a nervure which does not extend beyond the nodus, and has been called the internodal radius; it appears to me to correspond to the so-called "costal nervure" in *Papilio*, and would be better so designated. Between the base and the nodus are the antenodal cross nervures, varying in number from five to upwards of thirty, according to the genus and species. These generally cross both spaces, although those on opposite sides of the costal nervure do not always exactly coincide; but in many genera the last crosses the first space only, leaving the second empty below it. This character, though perfectly constant in some genera, is variable in others, and must therefore be used with caution. When the last cross nervure is not continuous it is often very oblique. I have only seen two specimens in which the first two nervures on one side were discontinuous, and I have seen no Corduliinæ in which the last antenodal cross-nervure was not continuous. When the cross nervures are very numerous and crowded they occasionally become Y-shaped, V-shaped, or anastomosed. An extra cross nervure is not unfrequently interposed between two others on either the upper or lower space, and not continued on the other. The lower antenodal subcostal space is bounded below by a nervure which runs from the base to the apex of the wing, and which is usually called the principal radius, but which would be more correctly termed the subcostal nervure. Towards the apex of the wing is an opaque spot, usually of an oblong form, bounded by two thick nervures of a darker colour than itself, and called the pterostigma. The space between the nodus and the pterostigma is the upper postnodal costal space, and is likewise traversed by cross nervures, one or more at the commencement of which are always discontinuous in the Libellulinæ. Returning to the base, we come next to the upper basal cell, a rather broad space below the subcostal nervure, which is never divided by nervures in any species of Libellulinæ. It much resembles the discoidal cell of Lepidoptera, to which (or perhaps rather to the upper part of which, as Mr. C. O. Waterhouse has suggested) it evidently corresponds. The upper basal cell is bounded on the outside by an oblique cross nervure called the arculus[1]. On the opposite side rise two nervures called the sectors of the arculus. They generally rise in a stalk from the arculus at or near its lower extremity, but sometimes diverge from a point at or close to their origin; they are rarely, if ever, so completely separated at the base as is

[1] This nervure really corresponds with the upper discocellular nervule in Lepidoptera. I have retained the name arculus, which is used by Selys-Longchamps, Hagen, Brauer, &c., because it is necessary to have a short and convenient term for it. In Charpentier's terminology, however, the term arculus seems to be applied to the short basal curve of the lower sector of the arculus, and to this the term arculus really applies much better than to the former.

the case in many species of Corduliinæ. The upper sector of the arculus curves round to the hind margin; the lower sector falls at or near the outer angle of the triangle (of which we shall speak presently), and then runs subparallel to the upper sector.

Before the upper sector of the arculus reaches the level of the nodus, it throws off two nervures, rising in a stalk from its upper surface. The upper nervure runs upwards, and passes below the nodus and pterostigma to the extremity of the wing, parallel with the subcostal nervure; it may be called the subcostal radius; and the space beyond the nodus between this and the subcostal nervure forms the lower postnodal costal space. This space is always more or less free from cross nervures at the base, and the post-nodal cross nervures are never so regular in the lower space as in the upper, and are not unfrequently bisected beyond the level of the pterostigma, rarely before.

The thick nervure (or nodal cross nervure) descending from the nodus curves a little outwards, crosses the subcostal nervure, and falls on the subnodal sector, which rises from the same stalk as the subcostal radius; it, however, throws off or, rather, is continued in a slender nervure (the nodal sector) to the hind margin; and it sometimes throws off a second short branch below, near its origin, to the subnodal sector.

The nodal sector is sometimes nearly straight at its base, but more frequently a little undulated or curved downwards; it then runs forwards nearly straight, or is arched a little at or before the middle, and at its extremity curves downwards towards the hind margin. But in several important genera (*Orthetrum*, *Leptetrum*, *Orthemis*, &c.) beyond the arch near the middle, or without forming a distinct arch, it again dips downwards in a long and sometimes rather deep curve, another alary peculiarity which I have not observed in any Corduliinæ. The subnodal sector follows the course of the nodal sector to a certain extent, but is always straighter, rarely following the course of the arch. There is generally a single row of cells between (broadest, of course, beneath the arch); but these are usually bisected towards the hind margin, occasionally increasing to three or even four rows of cells before reaching it.

Below the upper basal cell lies the lower basal cell, a long narrow space extending considerably beyond the other, and ending more or less acutely at the base of the triangle; it is generally crossed by a single nervure before the middle; in several genera, however, it is crossed by more than one, though less frequently than the lower basal cell of the hind wings.

In many genera one or, rarely, more cross nervures descend from the lower sector of the arculus to the lower basal cell, or to the base of the triangle; these are called supratriangular nervures.

We now come to one of the most important features in the wings of Odonata—the triangle. The base lies between the extremity of the lower basal cell and the lower sector of the arculus, and is usually more or less oblique.

In some genera containing small species it happens either constantly (*Nannophya* &c.), or as an individual peculiarity (*Diplacodes* and *Raphismia*), that the lower sector of the arculus falls on the base of the triangle before its extremity. It then usually happens that the base rises in a right angle, with more or less equal sides, to meet it, thus converting the triangle into a trapezium.

In less aberrant genera the triangle generally forms nearly an isosceles triangle, with its apex pointing downwards, but varies considerably in size and shape. It is either empty or crossed by a single nervure (sometimes by more), and in rare cases is reticulated.

From the apex of the triangle (or occasionally above it, as in *Nannodythemis* &c.) another nervure curves to the hind margin. This is the upper sector of the triangle. Below this is the lower sector, which is nearly always very irregular, and sometimes very short. Beyond the triangle, between the lower sector of the arculus and the upper sector of the triangle, is a series of cells, the posttriangular cells, which vary from one to twelve at the base, and often increase considerably in number towards the hind margin. Three may be considered the normal number towards the base, and the middle cells are usually more or less hexagonal. It is not uncommon for the first row of cells beyond the triangle to consist of one cell more than those which immediately follow it.

From the apex of the triangle, or from a point just below it, a line runs obliquely upwards towards the base, which is united with the nervure above by one of the straight or oblique lines descending from the lower basal cell. This may conveniently be called the subtriangular space; it is sometimes open, but is more frequently divided into a number of cells, most often three, but frequently two, four, five, and upwards. At the base of the inner margin is an opaque space called the membranule, which is usually very small on the fore wings.

I have not attempted to use the various slender and incomplete intermediate sectors in various parts of the wings for classification, and I believe that the space between the base and the subtriangular space presents no characters of any importance.

The neuration in Odonata is so complicated that the real difficulty is rather to select the characters which are of real value than to discover characters which might be employed.

e. The Hind Wings.

In the main the neuration of the hind wings is a repetition of that of the fore wings, as far as the upper basal cell. The cross nervures are generally less numerous. The last antenodal cross nervure is always continuous, except as a rare anomaly in *Leptetrum* and one or two allied genera. When we come to the triangle, however, we find that its base is usually formed by the continuation of the arculus, and that its apex is directed outwards, lying at the angle formed by the lower sector of the arculus. Occasionally (*Agrionoptera* &c.) the base lies far beyond the arculus, rendering the triangle very small. The triangle is far less frequently traversed by a nervure than that of the fore wings; and when it is traversed, a supratriangular nervure is most frequently likewise present. The lower basal cell, the extremity of which forms the base of the triangle, is much broader and shorter than on the front wings. In one or two small genera with aberrant neuration (*Nannodythemis* &c.) the triangle of the hind wings is replaced by a trapezium. The hind wings are nearly always broader than the fore wings, and the neuration of their lower portion is dissimilar. There is nothing properly corresponding to the subtriangular space [1], but the lower sector of the triangle is generally much better developed, and rises with the upper sector of the triangle from the lower angle of the triangle. It runs subparallel with the upper sector, but is rather more irregular. It varies slightly in position, and in some genera (*Mesothemis*, *Lepthemis*, &c.) the sectors of the triangle are not united at their base, and in *Nannodythemis* the nervure corresponding to the upper sector actually starts from the middle of the triangle (or rather trapezium), and the lower starts from the lower angle of the triangle [2]. In species with normal neuration two more sectors descend from the lower basal cell, the innermost a little before the middle from or near the normal cross nervure, and the outermost a cell beyond. These curve outwards below the basal portion of the lower sector of the triangle, and then suddenly curve away to the lower part of the hind margin, which they do not quite reach, uniting just above it with a short, nearly perpendicular, nervure descending from the lower sector. These may be called the subbasal sectors, and are not always distinctly present in the smaller species. Towards the base the neuration becomes irregular. The membranule is usually much larger on the hind wings than on the fore wings, and the adjacent space is frequently tinged with yellow or brown to a greater or less extent.

The lower basal cell, as I have said, is usually traversed by a cross nervure before the middle. Sometimes there are two (*Libellula* &c.) and sometimes more. It occasionally happens that a specimen of a species which has normally only one cross nervure has two on one side or, more rarely, on both.

Before dismissing the subject of neuration, I may say that, although this character is subject to considerable variation, within both genera and species, yet the probable amount of this can generally be estimated and allowed for. I have only met with a single instance in which there appears to be a constant difference between the sexes of a species in neuration, viz. *Perithemis bella*, sp. n. (*posteà*, p. 324), in which the subtriangular space has three cells in the male, and only one in the female.

f. Abdomen.

The shape of the abdomen sometimes varies so greatly in species which differ little in any other salient character that it can only be used to a very limited extent in

[1] Mr. C. O. Waterhouse suggests that the upper cells lying between the subtriangular and subbasal cells may represent it.

[2] In such cases, cells lying beyond the triangle, but below the upper sector of the triangle, must be counted as posttriangular cells.

separating genera. It is generally more or less thickened at the base, and sometimes inflated or gibbous; while towards the tip it is frequently widened and flattened. These characters, though by no means confined to one sex, are sometimes more pronounced in the male (*Scapanea*).

The abdomen normally consists of ten segments. The first is a short basal segment, and the second and third are usually thickened, and crossed by one transverse carina, rarely more (only in *Pantala*). The fourth segment is also sometimes transversely carinated, though the carina is frequently imperfect or merely indicated. Along the dorsal line from about the carina on the third segment to the extremity and along the sides run longitudinal carinæ; between them the abdomen either falls away from the dorsal ridge, like the roof of a house, or is more or less rounded off; the under surface of the body is generally quite flat in preserved specimens.

Different as are *Libellula sabina*, Dru., and *L. brunnea*, Fonsc., in the shape of the abdomen, yet I am compelled to include them both for the present in the great genus *Orthetrum*, Newm., which will take in all, or nearly all, the Old-World species usually referred to *Lepthemis*, Hag. They represent the extremes of a long series of species which lead us by insensible gradations from one to the other. The genus *Trithemis* will also include a long series of species differing very considerably in the shape of the abdomen, and most of which have been, in my opinion, less correctly referred by previous authors to *Diplax* (=*Sympetrum*) and *Erythrodiplax*.

g. Abdominal Appendages.

Although these are frequently of very striking forms, and cannot be passed over without notice, yet it appears to me that their classificatory value in Neuroptera has been to some extent overrated. In the Libellulinæ their forms are frequently very similar; and I have only employed them as occasional accessory characters. It would be quite conformable to all analogy for these characters to be of paramount importance in one family, and of little or no value in another. In Coleoptera, for instance, Dr. Leuthner states[1] that the structure of the male sexual organs is important in the Dorcidæ, but useless for classification in the Lucanidæ. Besides, wherever possible, it is desirable to avoid laying too much stress on characters which are peculiar to one sex.

Appendages of the Second Segment of the Abdomen.—The true organs of generation in the male are placed beneath the second segment; they generally present the appearance of two distinct prominences, between which is a longer and more slender projection, often double, with a hook at the extremity directed backwards. This is known as the hamulus, and differs considerably in structure in different species. The appendages of the second segment are more or less prominent; and in the genus *Misagria* they are simply enormous, nearly equalling the thickened base of the abdomen itself in bulk.

Appendages of the Eighth Segment of the Abdomen.—These are found in the female

[1] Trans. Zool. Soc. vol. xi. p. 393.

only. In many genera, especially in stout-bodied insects, the eighth segment is perfoliate, that is, the lateral carina forms a semicircular membranous expansion on each side. At the back of the eighth segment beneath we find a projection called the vulvar scale, which is very prominent in many genera, and is sometimes bifid or trifid.

Anal Appendages.—In the male there are two upper appendages, one on each side of the extremity of the abdomen, which are generally curved downwards and then backwards, and are more or less pointed. They are usually about as long as the eighth segment. There is also a lower appendage, curving upwards and usually pointed; it is sometimes nearly as long as the others, but is often shorter, and is sometimes bifid at the extremity. The anal appendages of the female are usually very much shorter than those of the males, consisting of a small pointed filament on each side of the extremity of the abdomen; in a few genera (*Tramea* &c.) they are often as long as those of the male.

PART II.

Table of Genera.

In the present stage of our knowledge I think it would be premature to attempt to subdivide the genera of Libellulinæ into natural groups. I have, however, endeavoured to tabulate the genera in such a manner as to allow of their easy identification, and to arrange the genera themselves in something like a natural sequence. Even this, however, is not easy, from their great number and variety; and in using the table it must always be remembered that specimens will often occur which vary somewhat from the usual characters of the genus, and hence may not always fall into the artificial divisions of the table. Most of those anomalies, however, which have fallen under my notice have been allowed for by duplicate entries in the table; and every genus the name of which occurs more than once is marked with an asterisk. As a rule, accidental aberrations in neuration are confined to one side of a specimen, the other being normal; and therefore when the two sides do not agree, both must, if necessary, be compared with the table.

For convenience, the term "cosmopolitan" has here been used to denote genera occurring in Asia, Africa, and America at least, but does not necessarily imply that a genus is also represented in Europe.

Table of Genera of Libellulinæ.

1. A distinct concavity on the costa of the fore wings before the nodus. (2.)		
No concavity on the costa of the fore wings before the nodus. (4.)		
2. Eyes not contiguous	12. *Diastatops.*	S. America.
Eyes contiguous. (3.)		
3. Tips of all the wings transparent	14. *Palpopleura.*	Africa, China.
Tips of the hind wings opaque	13. *Potamothemis.*	S. America.

4. Apex of the triangle of the fore wings placed distinctly beyond the level of the outer angle of that of the hind wings. (5.)		
Apex of the triangle of the fore wings placed on a level with the outer angle of that of the hind wings, or only slightly beyond it. (14.)		
5. Abdomen with more than one distinct transverse carina on each of segments 2–4	2. *Pantala.*	Cosmopolitan.
Abdomen with not more than one distinct carina on each of segments 2–4. (6.)		
6. Last antenodal cross nervure on the fore wings continuous.	*38. *Orthemis.*	America.
Last antenodal cross nervure on the fore wings not continuous. (7.)		
7. Triangle of the fore wings open. (8.)		
Triangle of the fore wings traversed. (9.)		
8. Subtriangular space consisting of one cell	8. *Miathyria.*	America.
Subtriangular space consisting of three cells	49. *Chalcostephia.*	Angola.
9. Sectors of the arculus of fore wings separated at or close to the base	9. *Rhyothemis.*	Old World.
Sectors of the arculus of fore wings stalked, or gradually diverging. (10.)		
10. Fore wings with more than one cross nervure in the lower basal cell	5. *Antidythemis.*	Para.
Fore wings with only one cross nervure in the lower basal cell. (11.)		
11. Abdomen with segments 2–4 carinated. (12.)		
Abdomen with segments 2 and 3 carinated. (13.)		
12. Fore wings with four rows of post-triangular cells, increasing	6. *Tramea.*	Cosmopolitan.
Fore wings with one row of four post-triangular cells, followed by three increasing	3. *Hydrobasileus.*	Celebes.
13. Nodal sector undulated beyond the middle	10. *Pseudothemis.*	China.
Nodal sector not distinctly undulated beyond the middle.	7. *Tauriphila.*	Trop. America; ? Australia; ? Philippines.
14. Claws of the tarsi not toothed	34. *Onychothemis.*	Philippines; [? Madagascar.
Claws of the tarsi more or less distinctly toothed. (15.)		
15. Eyes connected by a long suture. (16.)		
Eyes connected by a short suture, or merely touching. (17.)		
16. Abdomen slender, inflated at the base................	64. *Zyxomma.*	E. Indies.
Abdomen moderately stout, not inflated at the base	1. *Tholymis.*	Cosmopolitan.
17. Triangles of the fore wings with the base more or less angulated, converting them into trapeziums. (18.)		
All the triangles complete. (29.)		
18. Triangles of the hind wings converted into trapeziums. (19.)		
Triangles of the hind wings regular. (20).		
19. Hind wings with two cross nervures in the lower basal cell.	82. *Nannodythemis.*	Australia.
Hind wings with one cross nervure in the lower basal cell.	83. *Nannophlebia.*	Moluccas.

20. Abdomen with segments 2–4 carinated. (21.)		
Abdomen with segments 2 and 3 carinated. (23.)		
21. Last antenodal nervure on the fore wings continuous. (22.)		
Last antenodal nervure on the fore wings not continuous. .	85. *Fylgia.*	Para.
22. Fore wings with one row of post-triangular cells	86. *Nannothemis.*	America.
Fore wings with two rows of post-triangular cells	*88. *Fylla.*	E. Indies.
23. All the wings, or at least the hind wings, with more than one cross nervure in the lower basal cell. (24.)		
Hind wings with only one cross nervure in the lower basal cell. (25.)		
24. Fore wings with more than one cross nervure in the lower basal cell, or with only one near the base	79. *Tetrathemis.*	E. Indies.
Fore wings with only one cross nervure in the lower basal cell near the tip	78. *Neophlebia.*	Madagascar.
25. Trapezium of fore wings very narrow	84. *Nannodiplax.*	Australia.
Trapezium of fore wings broad or moderate... (26.)		
26. Triangle of hind wings very small, its base placed half-way between its apex and the arculus	80. *Brachygonia.*	Borneo.
Triangle of hind wings with its base nearly coinciding with the arculus. (27.)		
27. Abdomen long, the terminal segments broad and depressed	81. *Nephepeltia.*	S. America.
Abdomen short, the terminal segments not broad and depressed. (28.)		
28. Hind wings with one row of post-triangular cells increasing.	87. *Nannophya.*	Amboina.
Hinds wings with two rows of post-triangular cells increasing..................................	*88. *Fylla.*	E. Indies.
29. More than one cross nervure in the lower basal cell of the fore or hind wings. (30.)		
Only one cross nervure in the lower basal cell of the fore or hind wings. (52.)		
30. No supratriangular nervures. (31.)		
One or more supratriangular nervures. (36.)		
31. Abdomen stout, or moderately stout. (32.)		
Abdomen rather slender. (34.)		
32. Abdomen with segments 2–4 carinated	*15. *Perithemis.*	America.
Abdomen with segments 2 and 3 carinated. (33.)		
33. Sectors of the arculus separated, or rising from a point or very short stalk	*39. *Leptetrum.*	Europe, Asia, America.
Sectors of the arculus stalked	*71. *Cannaphila.*	Haiti, Jamaica.
34. Abdomen hardly thickened at base; last antenodal cross nervure on fore wings not continuous	*53. *Hemistigma.*	Africa.
Abdomen thickened or inflated at base; last antenodal cross nervure on fore wings continuous. (35.)		
35. Triangle of hind wings with base placed far beyond the level of the arculus	*48. *Agrionoptera.*	East Indies.
Triangle of hind wings with base nearly coinciding with the arculus	56. *Misagria.*	Para.

36. Sectors of the arculus separated, or rising from a point or very short stalk. (37.)		
Sectors of the arculus distinctly stalked. (41.)		
37. Abdomen short, broad, much depressed	35. *Libellula.*	Europe.
Abdomen not remarkably depressed. (38.)		
38. Abdomen short and broad, with parallel sides; at least two cross nervures in the lower basal cell of the fore or hind wings. (39.)		
Abdomen more or less tapering, one cross nervure (or two on one side, rarely on both) in the lower basal cell of hind wings. (40.)		
39. Triangle of fore wings not reticulated	41. *Belonia.*	America.
Triangle of fore wings reticulated	4. *Camacinia.*	Moluccas.
40. Abdomen stout, wings short, or moderately long	*39. *Leptetrum.*	Europe, Asia, America.
Abdomen longer and more slender; wings rather long ..	40. *Plathemis.*	America.
41. Pterostigma with the basal half pale	*53. *Hemistigma.*	Africa.
Pterostigma with the basal half not pale. (42.)		
42. Abdomen rather slender, distinctly dilated at base. (43.)		
Abdomen variable, slightly, or not at all, dilated at base. (44.)		
43. Frontal tubercle bifid	*48. *Agrionoptera.*	E. Indies.
Frontal tubercle convex	47. *Nesoxenia.*	Solomon Islands.
44. Triangle of fore wings free	74. *Orchithemis.*	E. Indies.
Triangle of fore wings traversed. (45.)		
45. Abdomen slender, an opaque line running from the base on the lower costal space of all the wings, and ceasing before the nodus	54. *Thermochoria.*	W. Africa.
Wings with no such opaque line, or with a suffused line in a similar position extending to the nodus. (46.)		
46. Wings more or less opaque, or if not, strongly suffused with yellow on the hind wings, at least at the base; abdomen rather slender, or moderately stout........	11. *Neurothemis.*	E. Indies.
Wings hyaline, or opaque at the tip and in the centre; if any yellow or brown tinge is present at the base of the hind wings, the abdomen is decidedly stout. (47.)		
47. Abdomen rather slender, as long as the hind wings; wings often opaque at the tip or in the middle	55. *Uracis.*	S. America.
Abdomen stout, generally shorter than the hind wings. (48.)		
48. Fore wings with three or four supratriangular nervures .	36. *Untamo.*	Sula.
Fore wings with at most two supratriangular nervures. (49.)		
49. Nodal and subnodal sectors very strongly curved at the extremity	37. *Lyriothemis.*	E. Indies.
Nodal and subnodal sectors very gradually curved at the extremity. (50.)		

50. Abdomen with segments 2–4 distinctly carinated	*71. *Cannaphila.*	Haiti, Jamaica.
Abdomen with segments 2 and 3 carinated. (51.)		
51. Size rather small; several cross nervures in lower basal cell of hind wings	73. *Calothemis.*	E. Indies.
Size large; more than one cross nervure in the lower basal cell of fore wings only	*43. *Thermorthemis.*	Africa.
52. One or more supratriangular nervures. (53.)		
No supratriangular nervures. (63.)		
53. Sectors of the arculus separated, or rising from a point or very short stalk. (54.)		
Sectors of the arculus distinctly stalked. (57.)		
54. Abdomen slender, nodal sector nearly straight, or not much waved beyond the middle	*17. *Celithemis.*	America.
Abdomen stout or moderately thick; nodal sector always much waved beyond the middle. (55.)		
55. Wings and pterostigma long; abdomen moderately stout, long and tapering.............................	*42. *Holotania.*	America.
Wings short or moderately long; abdomen stout, not very long. (56.)		
56. Pterostigma short or moderately long; abdomen short, stout, and tapering	*39. *Leptetrum.*	Europe, Asia, America.
Pterostigma long; abdomen shorter than the hind wings, only slightly tapering	*40. *Plathemis.*	America.
57. Base of the pterostigma pale	*53. *Hemistigma.*	Africa.
Pterostigma unicolorous. (58.)		
58. Triangle of fore wings free	76. *Diplacina.*	Philippines.
Triangle of fore wings traversed. (59.)		
59. Base of triangle of hind wings lying considerably beyond the arculus	*48. *Agrionoptera.*	E. Indies.
Base of triangle of hind wings nearly on a level with the arculus. (60.)		
60. Abdomen not distinctly thickened at base. (61.)		
Abdomen always distinctly thickened, and sometimes inflated at base	*65. *Orthetrum.*	Old World.
61. Abdomen slender	*16. *Pseudoleon.*	Mexico.
Abdomen stout. (62.)		
62. Fore wings with three rows of post-triangular cells	44. *Protorthemis.*	E. Indies.
Fore wings with four or five rows of post-triangular cells.	*43. *Thermorthemis.*	Africa.
63. A wide space between the last postnodal cross nervure and the pterostigma..........................	30. *Macrodiplax.*	Ceram, Philippines.
Space between the last postnodal cross nervure and the pterostigma hardly wider than that between the cross nervures themselves. (64.)		
64. Sectors of the arculus separated, or rising from a point or very short stalk. (65.)		
Sectors of the arculus distinctly stalked. (75.)		

65. Nodal sector nearly straight or gradually curved, hardly waved beyond the middle. (66.)		
Nodal sector always waved beyond the middle, in most cases considerably	*39. *Leptetrum.*	Europe, Asia, America.
66. Abdomen stout or moderately stout; segments 2–4 distinctly carinated. (67.)		
Abdomen stout or slender; segments 2 and 3 carinated (sometimes 4 imperfectly in *Celithemis*, which has a slender abdomen). (69.)		
67. Size small; fore wings with 4–6 postnodal nervures	*15. *Perithemis.*	America.
Size moderate; fore wings with 8–11 postnodal nervures. (68.)		
68. Last antenodal nervure of fore wings continuous	29. *Deielia.*	Sandwich Islands.
Last antenodal nervure of fore wings not continuous	28. *Brachymesia.*	Australia.
69. Pterostigma short, very broad. (70.)		
Pterostigma moderately long, not unusually broad. (71.)		
70. Abdomen moderately long, slightly thickened at the base and beyond the middle	18. *Leucorhinia.*	Europe, N. America.
Abdomen rather short, thickened at the base, and greatly expanded beyond the middle	19. *Cœnotiata.*	Europe.
71. Subtriangular space on fore wings consisting of three or more cells. (72.)		
Subtriangular space on fore wings consisting of 1 cell only. (74.)		
72. Abdomen slender, triangles of fore wings traversed or reticulated	*17. *Celithemis.*	N. America.
Abdomen stout. (73.)		
73. Abdomen not inflated at base; triangles of fore wings nearly always free	31. *Urothemis.*	Old World.
Abdomen inflated at base; triangles of fore wings traversed	62. *Cannacria.*	Amazons.
74. Abdomen rather slender, long; last antenodal cross nervure of fore wings not continuous	33. *Ephidatia.*	America.
Abdomen short and broad; last antenodal cross nervure of fore wings continuous	32. *Æthriamanta.*	India.
75. Claws of the tarsi bifid, or toothed close to the tip. (76.)		
Claws of the tarsi toothed before the tip. (77.)		
76. Last antenodal cross nervure of fore wings continuous	52. *Tyriobapta.*	Borneo.
Last antenodal cross nervure of fore wings not continuous.	57. *Macrothemis.*	America.
77. Nodal sector distinctly waved beyond the middle. (78.)		
Nodal sector gradually curved, or straight, not distinctly waved beyond the middle. (85.)		
78. Abdomen hardly thickened at base. (79.)		
Abdomen more or less thickened at base. (81.)		
79. Wings variegated	*16. *Pseudoleon.*	Mexico.
Wings mostly hyaline. (80.)		
80. Wings long; abdomen long, rather slender	61. *Pseudomacromia.*	Africa.
Wings moderately long; abdomen stout or very stout	*44. *Protorthemis.*	E. Indies.

81. Base of triangle of hind wings considerably beyond the level of the arculus. (82.)		
Base of triangle of hind wings nearly coinciding with the arculus. (83.)		
82. Abdomen slender	*48. *Agrionoptera.*	E. Indies.
Abdomen stout	45. *Nesocria.*	Solomon Islands.
83. Frontal tubercle bifid; eyes merely touching in front	*65. *Orthetrum.*	Old World.
Frontal tubercle truncated; eyes distinctly contiguous in front. (84.)		
84. Abdomen slender	63. *Neocysta.*	S. America.
Abdomen stout	*38. *Orthemis.*	America.
85. Basal segments of abdomen broad, terminal segments suddenly tapering	77. *Acisoma.*	Africa, E. Indies.
Abdomen more uniformly broad, often inflated at base, or gradually tapering. (86.)		
86. Triangle of fore wings free. (87.)		
Triangle of fore wings traversed. (96.)		
87. Fore wings with last antenodal cross nervure continuous. (88.)		
Fore wings with last antenodal cross nervure not continuous. (89.)		
88. Wings and pterostigma rather short	26. *Microthemis.*	Papua, Borneo.
Wings and pterostigma rather long	27. *Brachydiplax.*	E. Indies.
89. Fore wings with three or four rows of post-triangular cells. (90.)		
Fore wings with two rows of post-triangular cells. (94.)		
90. Abdomen long and slender; wings long	*53. *Hemistigma.*	Africa.
Abdomen and wings rather short or moderately long; abdomen not remarkably slender. (91.)		
91. Abdomen with segments 2 and 3 carinated. (92.)		
Abdomen with segments 2–4 carinated. (93.)		
92. Abdomen stout, hardly thickened at base	*25. *Crocothemis.*	Old World.
Abdomen slender or moderately stout, generally distinctly thickened at base	*20. *Sympetrum.*	Cosmopolitan.
93. Subtriangular space consisting of three cells	*24. *Brachythemis.*	E. Indies.
Subtriangular space consisting of one cell	72. *Cacergates.*	Africa, W. Asia.
94. Triangle of fore wings long and narrow	*75. *Diplacodes.*	Africa, Asia.
Triangle of fore wings broad. (95.)		
95. Triangle of hind wings with its base nearly coinciding with the arculus	51. *Anatya.*	Brazil.
Triangle of hind wings with its base placed considerably beyond the arculus	50. *Raphismia.*	Ceram.
96. Basal half of pterostigma pale	*53. *Hemistigma.*	Africa.
Basal half of pterostigma not paler than the rest. (97.)		
97. Fore wings with six continuous antenodal cross nervures.	70. *Pachydiplax.*	N. America.
Front wings with the last antenodal cross nervure very rarely continuous, in cases when the total number exceeds six. (98.)		

98. Abdomen with segments 2–4 distinctly carinated	*24. *Brachythemis.*	E. Indies.
Abdomen with segments 2 and 3 distinctly carinated; sometimes 4 imperfectly. (99.)		
99. Frontal tubercle distinctly bifid	69. *Erythemis.*	S. America.
Frontal tubercle convex or concave, but not distinctly bifid. (100.)		
100. Abdomen not dilated at base; wings and abdomen long and slender	46. *Lathrecista.*	E. Indies.
Abdomen stout; or if slender, more or less dilated at base. (101.)		
101. Triangle of fore wings followed by two rows of cells increasing, or by one row of three cells, followed by a series of two cells increasing. (102.)		
Triangle of fore wings followed by three rows of cells increasing. (105.)		
102. Abdomen short and broad; wings short	*23. *Erythrodiplax.*	S. America.
Abdomen more or less slender; wings not remarkably short. (103.)		
103. Abdomen distinctly dilated at base and tip	68. *Micrathyria.*	America.
Abdomen slightly and gradually dilated at base and tip, if at all. (104.)		
104. Abdomen slender; first row of cells beyond the triangle of fore wings consisting of two cells; subtriangular space consisting of two cells, rarely three	*75. *Diplacodes.*	Asia, Africa.
Abdomen slender or moderate; first row of cells beyond the triangle of fore wings generally consisting of three cells; subtriangular space always consisting of three or four cells	*22. *Trithemis.*	Cosmopolitan.
105. Base and apex of abdomen greatly dilated	59. *Scapanea.*	Antilles.
Base of abdomen generally more or less dilated; the apex slightly and gradually, or not at all. (106.)		
106. Wings long, abdomen long and slender. (107.)		
Wings moderately long, abdomen variable. (108.)		
107. Abdomen gibbous and inflated at base; hind tibiæ with two rows of five or six very strong spines	66. *Lepthemis.*	America.
Abdomen gradually thickened; hind tibiæ with shorter, slenderer, and more numerous spines	58. *Dythemis.*	America.
108. Hind tibiæ with two rows of 5–7 very strong spines	67. *Mesothemis.*	America.
Hind tibiæ with shorter, slenderer, and more numerous spines. (109.)		
109. Male with the upper anal appendages curved upwards at the tips; female with the vulvar scale forked or bifid..	21. *Thecadiplax.*	China, Japan.
These organs otherwise formed. (110.)		
110. Abdomen rather stout, hardly thickened at base. (111.)		
Abdomen slender or moderately stout, generally distinctly thickened at the base. (112.)		

111. Wings and abdomen short, the latter with parallel sides .	*23. *Erythrodiplax.*	S. America.
Wings and abdomen not remarkably short, the latter tapering	*25. *Crocothemis.*	Old World.
112. Fore wings with 18–20 antenodal cross nervures	60. *Rhodopygia.*	S. America.
Fore wings with 7–14 antenodal cross nervures. (113.)		
113. Fore wings with triangle rather broad; 7 or 8 antenodal cross nervures placed rather widely apart; very rarely 9 or 10......................................	*20. *Sympetrum.*	Cosmopolitan.
Fore wings with triangle not remarkably broad; 8–14 antenodal cross nervures (generally 9–11) placed rather closely together.........................	*22. *Trithemis.*	Cosmopolitan.

PART III.

Characters of Genera.

Genus 1. Tholymis.

Hagen, Stett. ent. Zeit. xxviii. p. 221 (1867); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 365, 712 (1868).

Frontal tubercle truncated above; eyes connected by a long suture; face very hairy; abdomen moderately slender, as long as the hind wings, segments 2 and 3 a little thicker than the remainder, and 2–4 carinated, dorsal and lateral carinæ very slightly marked, segment 8 not perfoliate in female: wings rather short and broad, tips rounded off, pterostigma moderately long; fore wings with 10–12 antenodal and 7–11 postnodal nervures, the last antenodal and first two or three postnodal nervures not continuous, cells of the lower postnodal space generally simple (bisected at the extreme tip only in *T. pallida*, Brauer), triangle on nearly the same plane as that of the hind wings, moderately long and narrow, oblique, traversed by one nervure, and followed by three rows of cells, no supratriangular nervures, nor more than one nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, nodal sector waved, lower sector of the arculus broken towards the extremity, lower sector of the triangle in this and the seven following genera often very irregular; hind wings broader than the fore wings, with 7–8 antenodal and 8–11 postnodal nervures, last antenodal always continuous, the first two or three postnodals not so; triangle free, followed by two rows of cells, the sectors sometimes separated at the base (*T. citrina*, Hag.): anal appendages rather long.

Type *Libellula tillarga*, Fabr.

Genus 2. Pantala.

Hagen, Neur. N. Amer. p. 141 (1860); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 364, 713 (1868).

Frontal tubercle broad, with a slight depression in the middle; eyes connected by half their length in front; abdomen moderately broad, gradually tapering to the extremity, and shorter than the hind wings, the basal segments very slightly thickened, segment 2 with two transverse carinæ, segments 3 and 4 with three, and 5 with one, dorsal carina well marked, segment 8 not perfoliate in female: wings rather long and pointed, pterostigma rather short; fore wings with 12–14 antenodal and 7–8 postnodal nervures, the last antenodal and the first two or three postnodal nervures not continuous, cells of the lower postnodal space simple, triangle nearly straight, rather narrow, placed far beyond the plane of that of the hind wings, traversed by one nervure and followed by three rows of cells (or four on one side, as an occasional anomaly), one supratriangular nervure very rarely present, one nervure in the lower basal cell, subtriangular space consisting of three or four cells, nodal sector much waved, sectors of the arculus stalked, the lower sector broken towards the extremity; hind wings broader than the fore wings, with 7–8 antenodal and 8–9 postnodal nervures, the last antenodal continuous, the first two or three postnodals not so, triangle free, followed by three rows of cells, sectors of the triangle united at base, two cross nervures in the lower basal cell: anal appendages rather long.

Type *Libellula flavescens*, Fabr.

Genus 3. Hydrobasileus, g. n.

(Plate LI. fig. 10.)

Male.—Allied to *Tramea*; abdomen with segments 2–4 transversely carinated: wings long and rather pointed, pterostigma moderate; fore wings with 16 antenodal and 8 postnodal nervures, the last antenodal and first postnodal not continuous, triangle rather long and narrow, oblique, with two cross nervures, and followed by four rows of cells, subtriangular space consisting of five cells, nodal and subnodal sectors much waved, lower sector of the arculus almost continuous; hind wings twice as broad as the fore wings at the base, and very gradually narrowed towards the tip, with 10–11 antenodal and 9–10 postnodal nervures, the first two postnodals not continuous, triangle free, followed by three and then four rows of cells, sectors of the triangle united at base. anal appendages moderate.

Type *Tramea quadrivittata*, Hag., MS. (*Hydrobasileus vittatus*, sp. n., *posteà*, p. 314.)

Genus 4. Camacinia, g. n.

Head very large; frontal tubercle bifid; eyes contiguous in the middle; abdomen stout, not thickened at the base, the sides nearly parallel, segments 2 and 3 carinated: wings rather long, pointed at the tips, pterostigma moderately long; front wings with 25–27 antenodal and 17–20 postnodal nervures, frequently anastomosing or bifurcating, the three or four first postnodals not continuous, cells of the postnodal area simple, triangle very long and narrow, oblique, on a level with that of the hind wings, reticulated, of from 7–12 cells, followed by 6–8 rows of cells, 5–6 supratriangular nervures, 3–6 cross nervures in the lower basal cell, subtriangular space ill defined, consisting of about forty cells, sectors of the arculus separated or rising from a very short stalk, and strongly arched at the extremity, nodal and subnodal sectors greatly waved beyond the middle, and strongly arched towards the extremity, where the subnodal sector is somewhat broken, the intermediate cells bisected just before the hind margin, sectors of the triangle subparallel, separated by a double row of cells; hind wings more than twice as broad as the front wings, with 15–17 antenodal and 20–21 postnodal nervures, the first four postnodals not continuous, triangle narrow, crossed by four or five nervures, its base nearly coinciding with the arculus; followed by 6–7 rows of cells increasing, 1 supratriangular nervure, 1–2 cross nervures in the lower basal cell, sectors of the triangle rising close together, spines of the hind tibiæ rather short and strong: anal appendages of male a little longer than the ninth segment; the lower appendages as long as the others, broad, pointed, triangular; appendages of the second segment small.

Type *Neurothemis gigantea*, Brauer.

The characters of this genus are taken partly from Brauer's description (Verh. zool.-bot. Ges. Wien, xvii. p. 8, 1867) and partly from a male in the British Museum. I have not ventured to figure it, because it is from Morty Island (the locality given by Brauer being Amboina), and because the neuration does not quite agree with Brauer's description. Until more specimens are obtained it would be rash to hazard an opinion as to whether this specimen is distinct from Brauer's species or not; but it is certainly congeneric with it, and cannot be conveniently retained in *Neurothemis*, although that genus is used at present in a rather elastic sense.

Genus 5. Antidythemis, g. n.

(Plate LI. fig. 4.)

Frontal tubercle wide, not distinctly depressed in the middle; eyes contiguous in the middle; abdomen moderately slender, with parallel sides, the basal segments hardly thickened, segments 2–4 transversely carinated, dorsal and lateral carinæ fairly well marked, segment 8 not perfoliate in female: wings long and rather pointed at the tips, pterostigma very long; fore wings with 24–25 antenodal and 13–17 postnodal nervures, the last antenodal and the first three or four postnodals not continuous, cells of the lower postnodal space simple, triangle long and narrow, placed a little beyond the level of that of the hind wings, traversed by 3–4 cross nervures, and followed by five rows of cells, a supratriangular nervure occasionally present, lower basal cell long and narrow, crossed by one nervure at one fourth of its length, and by two or three others close together near its extremity, subtriangular space consisting of 9–11 cells, sectors of the arculus rising close together from a point, subparallel, arched at the extremity, nodal sector and the cells between the nodal and subnodal sectors more or less irregular from the point where an incomplete interstitial sector enters; hind wings opaque at base, nearly twice as broad as the fore wings at the base, but rapidly narrowed towards the tips, with 16–18 antenodal and 18 postnodal nervures, the first three or four postnodals not continuous, triangle rather long, divided by three cross nervures (one of them cutting off the lower basal angle) into four cells, and followed by four or five cells, a supratriangular nervure sometimes present, sectors of the triangle rising from a point, lower basal cell with two cross nervures: anal appendages in male rather long.

Type *Dythemis* (?) *trameiformis*, Selys, MS.

Genus 6. Tramea.

(Plate LI. fig. 1.)

Hagen, Neur. N. Amer. p. 143 (1860); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 364, 713 (1868).

Eyes connected by a short space in front, frontal tubercle broad, very slightly grooved in the middle; abdomen moderately slender, distinctly shorter than the hind wings, segments 2 and 3 slightly thickened, and 4 and 5 slightly contracted, basal and lateral carinæ distinct, though not strongly marked, segments 2, 3, and 4 transversely carinated, segment 8 not perfoliate in female: wings long, rather pointed, pterostigma moderate; fore wings with 11–13 antenodal and 9–11 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, cells of the lower postnodal space simple, triangle generally rather long and narrow, placed considerably beyond the plane of that of the hind wings, traversed by one or two cross nervures, and followed by four rows of cells, no supratriangular nervure, and only one cross nervure in the lower basal cell, subtriangular space consisting of five or six cells, sectors of the arculus stalked, curved, and the lower one often a little irregular at the extremity, nodal sector not waved or broken, subnodal sector broken towards the extremity; hind wings much broader than the fore wings at the base, with 6 or 7 antenodal and 12–13 postnodal nervures, the last antenodal continuous, and the first two postnodals not so, triangle free, followed by three or four rows of cells, an opaque reticulated space at the base of the hind wings, one cross nervure in the lower basal cell, sectors of the triangle united at base: anal appendages rather long.

Type *Libellula carolina*, Linn.

Genus 7. Tauriphila, g. n.

Allied to *Tramea*; abdomen rather broader, and with only segments 2 and 3 transversely carinated: wings long, pterostigma moderate; fore wings with 11–14 antenodal and 8–9 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, triangle traversed by one nervure, and followed by three rows of cells, subtriangular space consisting of three or four cells, subnodal sector and lower sector of the arculus nearly continuous; hind wings not much broader than the fore wings, with 7–9 antenodal and 9–11 postnodal nervures, the first two or three postnodals not continuous, triangle free, followed by two (rarely three) rows of cells: anal appendages rather short.

Type *Tramea iphigenia*, Hag.

Genus 8. Miathyria, g. n.

(Plate LII. fig. 3.)

Frontal tubercle truncated; eyes large, contiguous in front for rather a long space; abdomen slender, rather shorter than the hind wings, compressed, somewhat gibbous at the base, segments 2 and 3 carinated, 4 imperfectly so, segment 8 not perfoliate in female: wings rather broad, pterostigma short; fore wings with 7–9 antenodal nervures, the last not continuous, and 5–8 postnodal nervures, the first two not continuous, cells of the postnodal area simple, triangle rather narrow, placed considerably beyond that of the hind wings, free, followed by two rows of cells, only increasing on the hind margin, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of one very large pentagonal cell, sectors of the arculus stalked, nodal sector considerably waved at the base, subnodal sector and lower sector of the arculus broken beyond the middle, intermediate cells between the nodal and subnodal sectors only bisected on the hind margin; hind wings much broader than the fore wings, with 4–5 antenodal and 6–9 postnodal nervures, the first two or three postnodals not continuous, triangle free, its base on a level with the arculus, followed by two rows of cells increasing, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle rising together, membranule very large: anal appendages of the male slender, arched, as long as the ninth segment, those of the second segment moderately developed.

Type *Libellula simplex*, Ramb.

Genus 9. Rhyothemis.

(Plate LI. figs. 5, 6.)

Hagen, Stett. ent. Zeit. xxviii. p. 232 (1867); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 364, 714 (1868).

Frontal tubercle moderately broad, more or less depressed in the middle when viewed from the front; abdomen moderately slender, cylindrical, with parallel sides, the basal segments hardly thickened, segments 2–4 transversely carinated, dorsal and lateral carinæ very slightly marked, segment 8 not perfoliate in female: wings long, rather pointed at the tips, pterostigma short or moderate; fore wings with 8–12 antenodal and 7–14 postnodal nervures, the last antenodal and the first two or three postnodal nervures not continuous, and the following postnodals of the first and second spaces rarely coinciding, cells of the lower postnodal space simple, triangle generally rather broad and not very acute, placed considerably beyond that of the hind wings, traversed by from 1–4 cross nervures, and followed by from 3–5 rows of cells, one or two supratriangular nervures generally present, not more than one nervure in the lower basal cell, subtriangular space consisting of from four to ten cells, sectors of the arculus separated, rising at or just above its lower extremity, the lower sector of the arculus and the nodal and subnodal sectors nearly continuous, the cells between the nodal and subnodal sectors frequently bisected towards the extremity, lower sector of the triangle arched, generally more regular than in any of the preceding genera; hind wings slightly or considerably broader than the fore wings, with from 5–7 antenodal and 7–13 postnodal nervures, the first two postnodals not continuous, triangle free, followed by two or three rows of cells, its sectors united at the base: anal appendages moderate.

Type *Libellula phyllis*, Drury.

Genus 10. Pseudothemis, g. n.

(Plate LII. fig. 1.)

Frontal tubercle truncated above, slightly concave in front; eyes contiguous in front; abdomen moderately stout, subcylindrical, not thickened at base, and slightly tapering to the extremity, not more than two thirds as long as the hind wings, segments 2 and 3 carinated: wings long, pterostigma moderate; fore wings with 14–15 antenodal nervures, the last not continuous, and 9–10 postnodals, the first three or four not continuous, cells of the postnodal area simple, triangle rather broad, traversed, situated just beyond that of the hind wings, the base and inner side forming a right angle, followed by three rows of cells increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, the lower sector nearly continuous, nodal sector slightly undulated at the base and in the middle, subnodal sector much less so, the intermediate cells only bisected (if at all) close to the hind margin, lower sector of the triangle arched, comparatively regular; hind wings broader than the fore wings, with 9–10 antenodal and 8–11 postnodal cells, the first three or four postnodals not continuous, triangle free, followed by two rows of cells increasing; no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle united at the base, anal appendages of the male stout, as long as the last two segments, and very hairy, those of the second segment not conspicuous: anal appendages of the female conspicuous, fully as long as the eighth segment; legs clothed with long and slender, but stiff hairs and spines.

Type *Libellula zonata*, Burm.

Genus 11. NEUROTHEMIS.

(Plate LIV. fig. 2; neuration, Plate LV. fig. 2.)

Brauer, Verh. zool.-bot. Ges. Wien, xvii. p. 8 (1867), xviii. pp. 366, 717 (1868).

Frontal tubercle bifid or truncated; eyes connected by a short space in front; abdomen moderately slender, generally shorter than the hind wings, the basal segments not thickened, the longitudinal carinæ slightly marked, the second and third segments transversely carinated (fourth imperfectly); eighth segment not perfoliate in female: wings long, rather pointed at the tips, pterostigma moderately long; fore wings with from 12–30 antenodal and 7–20 postnodal nervures, the last antenodal sometimes continuous, and the first two to four postnodals not continuous; cells of the lower postcostal space simple at the extremity, though the costal spaces are occasionally more or less divided between the base and the pterostigma; triangle placed just beyond that of the hind wings, variable in form, divided by one or more nervures, and often (where the neuration is close) reticulated, followed by from 3–12 rows of cells; 2–8 supratriangular nervures, three nervures at least in the lower basal cell, and often eight or nine; subtriangular space consisting of five cells and upwards, often ill defined, and containing very numerous cells; nodal and subnodal sectors and lower sector of the arculus continuous, but more or less waved, the cells between the two former often bisected, sectors of the arculus stalked; hind wings slightly or considerably broader than the fore wings, with from 10–20 antenodal and 6–20 postnodal nervures, the first two to four postnodals not continuous; triangle traversed by one or more nervures, and often reticulated, the sectors united at base; 1–3 supratriangular nervures, lower basal cell with from 1–3 nervures (generally 2): anal appendages rather short.

Type *Libellula fulvia*, Dru.

Genus 12. DIASTATOPS.

Rambur, Ins. Névr. p. 135 (1842); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 364, 715 (1868).

Frontal tubercle raised, slightly divided in the middle; eyes distinctly separated, contiguous at no point; abdomen moderately slender, shorter than the hind wings, a little thickened beyond the middle, but the basal segments not thickened, segments 2–4 transversely carinated, dorsal carina well marked, segment 8 not perfoliate in female: wings rather short, rounded at the tips, pterostigma very long, neuration extremely close; fore wings with the costa deeply concave between the base and the nodus, with 14–22 antenodal and about 10 postnodal nervures, the last antenodal and the first two or three postnodal nervures not continuous; the postnodal nervures of both spaces frequently anastomosing between the nodus and the pterostigma, or the cells more regularly bisected; triangle generally long and narrow, placed considerably beyond that of the hind wings, crossed by four or more nervures, and often reticulated, followed by 6–9 rows of cells; 4–6 supratriangular nervures, subtriangular space not clearly defined, consisting of very numerous cells; sectors of the arculus separated, nodal sector slightly waved, subnodal sector and lower sector of the arculus continuous, space between the nodal and subnodal sectors bisected or reticulated; hind wings distinctly longer than the fore wings, and rather broader, with 12–19 antenodal and about the same number of postnodal cells, some of the latter occasionally bisected, the first two to four postnodals and sometimes the last antenodal not continuous; triangle unusually long, crossed by three or more nervures, and often reticulated, followed by numerous cells, its boundaries sometimes indistinct, one or two supratriangular nervures; the lower basal cell crossed by two nervures, and sometimes with the extremity reticulated, sectors of the triangle united at base: anal appendages rather short.

Type *Libellula pullata*, Burm.

Genus 13. Potamothemis, g. n.

Frontal tubercle rounded, hardly depressed in the middle; eyes contiguous; abdomen rather slender, shorter than the hind wings, the basal segments not thickened, 2–4 transversely carinated, segment 8 not perfoliate in the female, pterostigma long: fore wings with a concavity on the costa between the base and the nodus, with about 13 antenodal and 8 postnodal nervures, the last antenodal and the first three or four postnodals not continuous, cells of the costal areas simple, the triangle rather large, placed on a level with that of the hind wings, crossed by one or two nervures, no supratriangular nervures, subtriangular space consisting of 3–8 cells, sectors of the arculus separated (also in the hind wings), lower basal cell free, nodal and subnodal sectors and lower sector of the arculus continuous, the cells on the outer half of the space between the nodal and subnodal sectors bisected; hind wings a little longer than the fore wings, but very slightly broader, with 7–8 antenodal and as many postnodal nervures, the first three or four of the latter not continuous, the triangle rather long, traversed by 1–3 nervures, and followed by 4–5 rows of cells, no supratriangular nervures, two cross nervures in the lower basal cell, sectors of the triangle separated at base: anal appendages moderate.

Type *Libellula fasciata*, Linn.

Genus 14. Palpopleura.

(Neuration, Plate LVI. fig. 6.)

Rambur, Ins. Névr. p. 129 (1842); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 365, 717 (1868).

Frontal tubercle truncated; eyes contiguous; abdomen rather broad, sometimes slightly depressed, shorter than the hind wings, and broadest in the middle, basal segments not thickened, segments 2–4 transversely carinated, dorsal carina strongly marked, segment 8 not perfoliate in the female; pterostigma long, often bicoloured:

neuration not unusually close; fore wings with the costa a little swollen at one fourth of its length, which is followed by a more or less distinctly marked concavity about halfway between the base and the nodus; 11–15 antenodal and 5–9 postnodal nervures, the last antenodal generally not continuous, and the first two or three postnodals not continuous, cells of the costal areas simple; triangle large, placed hardly beyond that of the hind wings, crossed by 1–3 nervures, and followed by 3–6 rows of cells, supratriangular nervures (1–3) present or absent; subtriangular space consisting of 3–7 cells, sectors of the arculus stalked (or rarely separated on the fore wings), lower basal cell empty or traversed, nodal sector continuous, but slightly waved, subnodal sector and lower sector of the arculus continuous, space between the nodal and subnodal sectors more or less bisected at the extremity; hind wings about as long as the fore wings, and not much broader, with 7–8 antenodal and 5–7 postnodal cells, the first two or three of the latter not continuous; the triangle traversed by one nervure (sometimes two), one or two cross nervures in the lower basal cell (occasionally four); a supratriangular nervure occasionally present, triangle followed by two to three rows of cells, its sectors rising from a point: anal appendages moderate.

Type *Palpopleura vestita*, Ramb.

The variations in neuration between specimens of the same species are very great in this genus, and but little importance can be attached to them. That of a specimen of *P. jucunda*, Ramb., is figured. The sinuation of the costa in the Chinese *P. sexmaculata*, Fabr., is so slight as to be sometimes hardly perceptible.

Genus 15. Perithemis.

(Plate LI. figs. 7, 8, 9.)

Hagen, Neur. N. Amer. p. 185 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 365, 718 (1868).

Frontal tubercle rounded; eyes contiguous in front; abdomen moderately stout, with the sides nearly parallel, or rather broad in the middle, tapering at each extremity, and somewhat depressed, shorter than the hind wings; segments 2–4 transversely carinated, segment 8 not perfoliate in the female; pterostigma moderately long, and generally rather thick; fore wings with 7–8 antenodal and 4–6 postnodal nervures, the last antenodal and the first one to three postnodals not continuous, cells of the costal area simple, triangle broad, the upper and basal sides nearly equal, free, or traversed by one or two nervures, followed by two (rarely three or four) cells; no supratriangular nervures, subtriangular space consisting of 1–3 cells, sectors of the arculus separated, or rising from a short stalk, the lower sector continuous, and only gradually curved, lower basal cell with one cross nervure, nodal and subnodal sectors continuous, the former arched, the two last intermediate cells only divided; hind wings slightly broader than the fore wings, with 5–6 antenodal and 4–5 postnodal nervures, the first one or two of the latter not continuous, triangle traversed or free, followed by two or three rows of cells, one or two cross nervures in the lower basal cell, sectors of the triangle rising from a point: anal appendages of the male short and slender.

Type *Libellula tenera*, Say.

Genus 16. Pseudoleon, g. n.

(Plate LIII. fig. 7.)

Frontal tubercle bifid; eyes contiguous; abdomen moderately slender, shorter than the hind wings, not thickened at base, segments 2 and 3 carinated, 4 imperfectly: wings rather short and broad, of an extremely iridescent hyaline, mottled with brown or purplish brown as in many *Myrmeleonidæ*, pointed at the tips, pterostigma long; fore wings with 9–10 antenodal nervures, the last not continuous, and 5–6 postnodals, the first two not continuous, the postnodals are very irregular in both costal spaces, and most of them are oblique, cells of the postnodal area simple, triangle long and narrow, just beyond that of the hind wings, traversed by a nervure across its upper portion, base oblique, followed by four rows of cells increasing, or by a row of four cells, followed by a series of three increasing, subtriangular space composed of three cells; no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the arculus stalked and considerably curved at the extremity, the nodal sector much waved beyond the middle, and as well as the subnodal sector considerably curved at the extremity, most of the intermediate cells bisected beyond the middle; hind wings rather broader than the fore wings, with 7–8 antenodal and 5–6 postnodal nervures, the first two postnodals (between which and the third there is rather a wide gap, which is likewise the case on the fore wings) are not continuous, triangle traversed, its base corresponding to the arculus, followed by three rows of cells increasing, a supratriangular nervure exceptionally present, one cross nervure on the lower basal cell, sectors of the triangle united at the base: anal appendages of the male rather stout, as long as the last two segments; lower appendage hardly shorter than the others.

Type *Celithemis superba*, Hag.

Genus 17. Celithemis.

(Plate LII. fig. 2.)

Hagen, Neur. N. Amer. p. 147 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xvii. pp. 367, 718 (1868).

Frontal tubercle truncated above; eyes contiguous; abdomen rather slender, shorter than the hind wings, the basal segment not thickened, 2 and 3 transversely carinated, segment 8 not expanded in the female, pterostigma long; fore wings with 9–10 antenodal and 7–10 postnodal nervures, the last antenodal sometimes continuous, and the first three or four postnodals not continuous, cells of the costal area simple, triangle moderate, placed about level with that of the hind wings, consisting of 3–6 cells, or simply traversed and followed by 3–6 rows of cells, a supratriangular nervure rarely present, subtriangular space consisting of 3–5 cells, sectors of the arculus distinctly separated on the fore wings and stalked in the hind wings, gradually curved, lower basal cell with one cross nervure, nodal and subnodal sectors continuous and nearly straight, many of the cells bisected beyond the middle of the intermediate space; hind wings rather broader than the fore wings, with 5–6 antenodal and 8–10 postnodal nervures, the first three or four of the latter not continuous, the triangle open or traversed, sometimes by a forked nervure, and followed by 3–5 rows of cells, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle united at the base: anal appendages rather short.

Type *Libellula eponina*, Dru.

I have a little extended the characters of this genus in order to include in it *Diplax elisa* of Hagen (placed in *Leucorhinia* by Brauer, but more correctly referred to *Celithemis* by Walsh) and a new species. *Diplax amanda*, Hag., and *Libellula ornata*, Ramb., may also be included provisionally in *Celithemis*, though they are smaller and the nervures less numerous than in the more typical species.

Genus 18. Leucorhinia.

Brittinger, Sitzungsb. Akad. Wiss. Wien, math.-nat. Classe, i. p. 333 (1850); Brauer, Verh. zool.-bot. Ges. Wien, xviii. p. 719 (1868).
Leucorhina, Brauer, l. c. p. 368 (1868).

Frontal tubercle rounded above; eyes contiguous; abdomen moderately slender, not longer than the hind wings, the basal and sometimes also the terminal segments a little thickened, segment 3 (sometimes also 2) transversely carinated, segment 8 not perfoliate in the female, pterostigma short and broad, not more than twice as long as broad; fore wings with 7–8 antenodal and 6–10 postnodal nervures, the last antenodal nearly always continuous, the first three to five postnodals not so, cells of the costal area simple, triangle rather wide, on a level with that of the hind wings, nearly always traversed, no supratriangular nervures, subtriangular space consisting of from 1–3 cells, triangle followed by 2–4 cells, sectors of the arculus separated, or rising from a very short stalk (distinctly stalked on the hind wings), gradually curved, lower basal cell with one cross nervure, nodal and subnodal nervures continuous, the intermediate cells bisected towards the hind margin; hind wings broader than the fore wings, with 5–6 antenodal and 8–10 postnodal nervures, the first three or four postnodals not continuous, triangle free, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of triangle united at base: anal appendages of the male rather short.

Type *Libellula albifrons*, Burm. (This species is not before me, and I have had to take the characters of the genus from *L. pectoralis*, Charp., *dubia*, Lind., *rubicunda*, Linn., *hudsonica*, Selys, and *intacta*, Hag.; the last species is somewhat aberrant, but I have only been able to examine two bad specimens.)

Genus 19. Cœnotiata.

Buchecker, Syst. Ent., Odonata, p. 10 (1876).

Frontal tubercle rounded above; eyes contiguous; abdomen much shorter than the hind wings, segments 2 and 3 a little thickened, segment 3 transversely carinated, 3–5 of equal length, 4 constricted, 5 expanding, 6 a little shorter, and the remainder rapidly diminishing in length, but much thickened, and somewhat depressed, segment 6 being the broadest; segment 8 not perfoliate in the female, pterostigma short and broad, about twice as long as broad: fore wings with 8–10 antenodal and 6–8 postnodal nervures, the last antenodal not always continuous, and the first three postnodals not continuous, cells of the costal areas simple, triangle wide, on a level with that of the hind wings, traversed, no supratriangular nervures, subtriangular space consisting of three (rarely two) cells, sectors of the arculus rising from a short stalk, gradually curved, lower basal cell with one cross nervure, nodal and subnodal sectors continuous, the intermediate cells bisected towards the hind margin, nodal sector sometimes slightly waved, especially towards the base; hind wings broader than the fore wings, with 6–7 antenodal and 7–8 postnodal nervures, the first three postnodals not continuous; triangle open, followed by two or three rows of cells, no supratriangular nervure; two (rarely one) cross nervures in the lower basal cell, sectors of the triangle hardly united at base: anal appendages of the male rather short.

Type *Libellula caudalis*, Charp.

Buchecker's genus *Cœnotiata* is equivalent to *Leucorhinia*; and as he mentions no type, I have retained the name for one of the species which he includes in it, which appears to me sufficiently distinct to rank as a separate genus.

Genus 20. Sympetrum.

(Neuration, Plate LV. fig. 4.)

Newman, Ent. Mag. i. p. 511 (1855).

Diplax, Charp. Lib. Eur. p. 12 (1840); Hag. Neur. N. Amer. p. 173 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 369, 719 (1868).

Frontal tubercle slightly truncated; eyes contiguous; abdomen slender, as long as the hind wings, segments 2 and 3 slightly thickened and transversely carinated, segment 8 not perfoliate in the female, pterostigma generally short or moderate: fore wings with 7–8 antenodal (very rarely 9 or 10) and 6–7 postnodal nervures, the last antenodal very rarely, and the first two or three postnodals never continuous, cells of the costal area simple, triangle rather broad, on a level with that of the hind wings, traversed (very rarely free), followed by three (rarely four) rows of cells, no supratriangular nervures, subtriangular space consisting of three cells, sectors of the arculus stalked, gradually curved, lower basal cell with one cross nervure, nodal and subnodal sectors a little irregular, the former generally waved towards the base, the intermediate cells often bisected towards the hind margin, upper sector of the triangle continuous; hind wings broader than the fore wings, with 5 antenodal and 6–8 postnodal nervures, the first three postnodals not continuous, triangle free, followed by two rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at base or rising from a point: anal appendages of male rather short; legs with numerous slender bristles.

Type *Libellula vulgata*, Linn.

Buchecker (Syst. Ent., Odonata, p. 9, 1878) includes *Libellula flaveola*, Linn., *depressiuscula* and *fonscolombii*, Selys, and three new species in *Sympetrum*, retaining *Diplax* for the remaining European species. However, even if the genus should be subdivided, his employment of the name *Sympetrum* could not be accepted in this sense, as Newman expressly specifies *L. vulgata*, Linn. (which Buchecker refers to *Diplax*), as his type.

Genus 21. Thecadiplax.

Selys, Ann. Soc. Ent. Belg. xxvii. p. 140 (1883), xxviii. p. 38 (1884).

"♂. Appendices anals supérieurs à pointe plus ou moins redressée, le dessous formant une sorte de dent avant la partie terminale, qui est coupée en biseau. Organes génitaux du 2ᵉ segment presque toujours saillants. ♀. Ecaille vulvaire assez longue, fourchue ou prolongée en lames contigués (rappelant les *Uracis*). Les 9ᵉ et 10ᵉ segments de consistance molle comme chez les femelles des *Cordulegaster*."

Type *Diplax erotica*, Selys.

Hardly distinct from *Sympetrum*: the pterostigma is moderately long, and the antenodal nervures vary from 7 to 11 on the fore wings.

Genus 22. Trithemis.

(Plate LIII. fig. 2.)

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 176, 366, 738 (1868).

Frontal tubercle convex, or slightly depressed in the middle; abdomen moderately slender, sometimes a little thickened at the base, segments 2 and 3 carinated: fore wings with 8–14 antenodal nervures, the last not continuous, and 7–11 postnodal nervures, the first two or three not continuous, cells of the postnodal area simple, pterostigma short or moderate, triangle moderate, on a level with that of the hind wings, traversed, followed by three rows of nervures increasing, or by one or two rows of three, then by several of two increasing, the base hardly oblique, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three (rarely four) cells, sectors of the arculus stalked, the lower sector a little irregular behind the middle, nodal sector waved at the base, and sometimes slightly in the middle, but usually continuous and nearly straight, subnodal sector continuous, the intermediate cells bisected towards the hind margin; hind wings much broader than the fore wings, with 5–10 antenodal nervures and 6–12 postnodal nervures, the first two or three subnodals not continuous, triangle free, its base nearly coinciding with the arculus, followed by two or three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at the base (separated in *T. trivialis* and some other species): anal appendages of the male as long as the last two segments, depressed, the lower appendages nearly as long as the others, appendages of the second segment not very conspicuous; appendages of the female rather long; vulvar scale of the female very variable, in typical *Trithemis* hardly perceptible, but in some of the American species which approach *Erythrodiplax* (a genus which I regard as at present only provisionally distinct) it is nearly as prominent as in *Crocothemis.*

Type *Libellula aurora*, Burm.

I find it necessary, after separating several discordant species from *Trithemis* under other names, to include in this genus, at least provisionally, (1) the tropical Old-World group usually placed in *Diplax*, of which *Libellula trivialis*, Ramb., is the type; (2) a number of American species included by Hagen in *Diplax* (*Sympetrum*), but distinguished by their more numerous and more crowded costal nervures, and generally by the variable number of posttriangular cells; and (3) most of the species placed in *Erythrodiplax* by Brauer.

Genus 23. Erythrodiplax.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 368, 722 (1868).

Characters of *Trithemis.* Wings short; abdomen very short and thick, slightly thickened at the base, otherwise almost equally broad throughout; anal appendages of the male unusually small (as long as the ninth segment) and depressed; the middle appendage a little shorter than the others; appendages of the second segment very conspicuous. From *Erythemis*, which it much resembles, it may be distinguished by the convex frontal tubercle, the very short broad body, hardly tapering even at the extremity, and the slender spines on the legs. The vulvar scale of the female is very prominent.

Type *Libellula plebeia*, Ramb. (= *corallina*, Brauer).

Genus 24. Brachythemis.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 367, 736 (1868).

Frontal tubercle large, distinctly convex above; eyes contiguous in front; abdomen rather stout, cylindrical, thickened at the base, and gradually tapering, shorter than the hind wings, segments 2–4 carinated, segment 8 not perfoliate in female: wings short, pterostigma rather long; fore wing with 7–8 antenodal nervures and 5–7 postnodals, the last antenodal and the first three postnodals not continuous, cells of the postnodal area simple, triangle moderate, traversed (exceptionally free), the base slightly oblique, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus rising from a short stalk, the nodal sector slightly waved towards the base, the subnodal nearly straight, the intermediate cells only bisected on the hind margin; hind wings broader than the fore wings, with 5 antenodal and 6–7 postnodal nervures, the first two or three subnodals not continuous, triangle free, its base corresponding to the arculus, followed by two rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of triangle united at base: anal appendages of the male slender, as long as the last two segments, the lower appendage somewhat shorter than the others; appendages of the second segment not very conspicuous.

Type *Libellula contaminata*, Fabr.

Genus 25. Crocothemis.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 367, 736 (1868).

Frontal tubercle slightly indented above; eyes contiguous in the middle; abdomen stout, thickest at the base, and gradually tapering, about as long as the hind wings, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather short, pterostigma moderate; fore wings with 9–13 antenodal nervures, the last only exceptionally continuous, and 7–11 postnodals, the first two or three not continuous, cells of the postnodal area simple, triangle moderately long, traversed by one nervure (very rarely free, or traversed by two nervures), the base oblique, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, nodal sector waved at the base, and hardly at all in the middle, nodal and subnodal nervures only slightly curved, the intermediate cells bisected towards the hind margin; hind wings broader than the fore wings, with 8–9 antenodal and 8–11 postnodal nervures, the first two or three postnodals not continuous, triangle free (very rarely traversed) and followed by two or three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle more or less separated at base: anal appendages of the male hardly longer than the eighth segment, the lower appendage distinctly shorter than the others; appendages of the second segment conspicuous.

Type *Libellula erythræa*, Brullé.

Genus 26. Microthemis.

(Neuration, Plate LVI. fig. 1.)

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 367, 724 (1868).

Frontal tubercle rounded; eyes contiguous in the middle; abdomen as long as the wings (which are rather short), broad, depressed, tapering a little towards the tip, segments 2 and 3 carinated, pterostigma short: fore wings with 7 antenodal and 6–7 postnodal nervures, the first two postnodals not continuous, cells of the postnodal area simple, triangle moderate, free, on a level with that of the hind wings, followed by two rows of cells, no supratriangular nervures, subtriangular space consisting of 1–3 cells, sectors of the arculus stalked, the lower sector a little irregular towards the extremity, lower basal cell with one cross nervure, nodal sector undulating at base, the subnodal sector a little irregular towards the extremity, cells between the nodal and subnodal sectors only bisected on the hind margin, lower sector of the triangle regularly zigzag, subparallel to the upper; hind wings a little broader than the fore wings, with 6 antenodal and 6–7 postnodal nervures, the first two postnodals not continuous, triangle free, followed by two rows of cells, or by two, one, two and three, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at the base: anal appendages of male short, slender, a little depressed.

Type *Perithemis duivenbodi*, Brauer.

Genus 27. Brachydiplax.

(Plate LIV. fig. 9.)

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 172, 368, 725 (1868).

Frontal tubercle rounded; eyes contiguous in the middle; abdomen as long or longer than the hind wings, a little thickened at the base, and tapering gradually towards the tip, segments 2 and 3 carinated, pterostigma moderate: fore wings with 6–7 antenodal and 5–6 postnodal nervures, the first two postnodals not continuous, cells of the postcostal area simple, triangle rather broad, free, followed by two rows of cells, no supratriangular nervure, subtriangular space consisting of 1–3 cells, if of two the lower triangular portion is cut off by a curved nervure, sectors of the arculus stalked, lower basal cell with one cross nervure, nodal sector undulating at base, the subnodal sector and lower sector of the arculus a little irregular beyond the middle, cells between the nodal and subnodal sectors only bisected on the hind margin; hind wings a little broader than the fore wings, with 5–6 antenodal and 5–6 postnodal nervures, the first two postnodals not continuous, triangle free, the base only just beyond the arculus, followed by a single row of cells (the first obliquely divided) and then by two or more, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle united at the base; legs armed with numerous slender spines: anal appendages of the male rather short, depressed.

Type *Diplax denticauda*, Brauer.

As Brauer's type is not before me, I have characterized this genus from *B. maria*, Selys, and a new species described below.

Genus 28. Brachymesia, g. n.

Male.—Frontal tubercle large, indented, but hardly bifid at the extremity; eyes contiguous; abdomen rather stout, much thickened at the base, and gradually tapering, segments 2 and 3 carinated: wings and pterostigma moderate; fore wings with 9 antenodal and 8–9 postnodal nervures, the last antenodal and the first three postnodals not continuous, cells of the postnodal area simple, triangle long and narrow, traversed, very oblique (the base straight), placed a little beyond the level of that of the hind wings, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus rising from a point, the lower nodal sector a little waved at the base only, nearly straight beyond the middle and then gradually curved, subnodal sector and upper sector of the triangle nearly continuous, intermediate cells between the nodal and subnodal sectors only bisected close to the hind margin; hind wings broader than the fore wings, with 6 antenodal and 8 postnodal nervures, the first two or three postnodals not continuous, arculus very oblique, its sectors shortly stalked, triangle with its base corresponding with the arculus, and followed by two rows of cells, increasing, no supratriangular nervure, one cross nervure in the lower basal cell, membranule large, sectors of the triangle united at the base: anal appendages as long as the last two segments, depressed and denticulated beneath to the middle, then thickened and gradually curving upwards to the tips; lower appendage very broad and short, not half the length of the upper ones, and broadly bifid at the extremity; appendages of the second segment moderate, the three portions of equal length, the tip of the hamulus slender and recurved.

Type *Brachymesia australis*, sp. n.

Genus 29. Deielia, g. n.

(Plate LIII. fig. 6.)

Female.—Frontal tubercle truncated; eyes contiguous for rather a long space; abdomen rather stout, hardly thickened at the base, but gradually tapering, a little shorter than the hind wings, segments 2–4 carinated, segment 8 not perfoliate: wings moderately long, rounded at the tips, pterostigma rather long; fore wings with 7–8 antenodal and 8–11 postnodal nervures, the first four or five postnodals not continuous, cells of the postnodal area simple, triangle rather broad, on a level with that of the hind wings, traversed, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus diverging from a very short stalk, the lower sector nearly continuous from the base to beyond the middle, nodal and subnodal sectors only slightly curved, the second half of the intermediate cells bisected; hind wings broader than the front wings, with 5 antenodal and 8–9 postnodal nervures, the first four postnodals not continuous, base of triangle nearly coinciding with the arculus, followed by two rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of triangle rising from a point; legs long and slender.

Type *Deielia fasciata*, sp. n.

Genus 30. Macrodiplax.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 366, 737 (1868).

Frontal tubercle with a very slight depression in the middle; eyes contiguous; abdomen moderately stout, cylindrical, hardly thickened at the base, shorter than the hind wings, segments 2–4 carinated: wings rather long, and pointed at the tip, pterostigma short; fore wings with 6 antenodal and 6–7 postnodal nervures, a wide space between the last postnodal and the pterostigma, only three nervures in the lower postcostal area before the pterostigma [this character is probably not constant], triangle rather broad, free, followed by two rows of cells, sectors of the arculus with short stalks, nodal sector hardly waved; hind wings very broad.

Type *Diplax cora*, Brauer.

Not in the British Museum; the characters are compiled from Brauer's description.

Genus 31. Urothemis.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 175, 366, 437 (1868).

Frontal tubercles truncated; eyes large, contiguous in front for two thirds of their length; abdomen moderately stout, slightly thickened at the base, and very gradually tapering, generally shorter than the hind wings, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings moderately long and broad, pterostigma rather short; fore wings with 6–7 antenodal and 5–8 postnodal nervures, the first two postnodals not continuous, cells of the postnodal area simple, triangle rather broad, slightly beyond that of the hind wings, nearly always free, the base nearly straight; followed by two rows of cells, increasing, or the first row of three followed by two, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus rising from a point or from a very short stalk, the lower sector gradually curved, a little irregular beyond the middle, nodal and subnodal sectors nearly straight, the former slightly waved at the base only, the intermediate cells only bisected close to the hind margin; hind wings rather broader than the fore wings, with 5–6 antenodal and 7–8 postnodal nervures, the first two postnodals not continuous, triangle rather large, free, its base corresponding with the arculus, and its outer angle meeting the lower sector of the arculus, followed by two rows of cells (the first row sometimes divided into three), increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at the base: anal appendages of the male shorter than the last two segments, the lower appendage nearly as long as the others; appendages of the second segment not conspicuous.

Type *U. bisignata*, Brauer.

The type is not in the British Museum, and the present description has been drawn up from a comparison of *Libellula sanguinea*, Burm., *signata*, Ramb., *designata*, Selys, &c.

Genus 32. Æthriamanta, g. n.

(Plate LIII. fig. 3.)

Frontal tubercle convex; eyes contiguous; abdomen broad, depressed, shorter than the hind wings, not thickened at the base, but broadest in the middle, segments 2 and 3 carinated: wings short, pterostigma moderate; fore wings with 6 antenodal and 5 postnodal nervures, the first two postnodals not continuous, cells of the postnodal area simple, triangle very broad, on a level with that of the hind wings, free, the base straight, forming a right angle with the inner side, followed by two rows of cells, then three, and four on the hind margin, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of one cell, sectors of the arculus rising from a point, the lower sector rather irregular beyond the middle, nodal sector waved at the base only, subnodal sector nearly straight, the intermediate cells only bisected close to the hind margin; hind wings slightly broader than the fore wings, with 5 antenodal and 5 postnodal nervures, the first two postnodals not continuous, triangle large, free, its base coinciding with the arculus, but (as is likewise the case in the fore wings) the lower sector of the arculus falls a little beyond its outer angle, it is followed by two or three cells, first decreasing and then increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle hardly separated: anal appendages of the male hardly longer than the ninth segment, the lower appendage nearly as long as the others; appendages of the second segment conspicuous.

Type *Libellula brevipennis*, Ramb.

Genus 33. Ephidatia, g. n.

Allied to *Macrothemis*, but with some resemblance to the Corduliinæ. Thorax and abdomen rather slender; abdomen with lateral carinæ on segments 2 and 3, the dorsal carina but slightly marked: fore wings with 7–9 antenodal and 5–6 postnodal nervures, the first antenodal and the first 2 or 3 postnodals not continuous, no supratriangular nervures, discoidal cell wide, empty, followed by two rows of cells, one very large pentagonal subtriangular cell, nodal sector slightly waved, sectors of the arculus rising from a point on the fore wings and stalked on the hind wings, the lower sector of the arculus broken and undulating beyond the middle; hind wings with 5–6 antenodal and postnodal cells, the first two postnodals not continuous, the triangle free, followed by two cells increasing, sectors of the triangle of the hind wings united at base: legs, especially the tibiæ, long and slender, spines moderate.

Type *Erythemis longipes*, Hag. *Ephidatia* will also include *Macromia cubensis*, Scudd., and possibly some other named American species. The type of *Erythemis* is fixed by the "narrow triangle" which Hagen mentions, as *E. bicolor*, Erichs.

Note.—This genus should be placed after *Macrothemis* on p. 297.

Genus 34. Onychothemis.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 170, 365, 732 (1868).

Frontal tubercle bifid; eyes contiguous; abdomen moderately and uniformly broad, the base a little inflated and compressed when viewed laterally, segments 2–4 carinated, segment 8 perfoliate in female: wings large; the hind wings broad, pterostigma moderate; fore wings with 15 antenodal and 10 postnodal nervures, triangle long and narrow, traversed by one or two nervures, on a level with that of the hind wings, followed by three rows of cells, sectors of the arculus stalked, one cross nervure in the lower basal cell, nodal sector much waved, the upper sector of the triangle curved: legs strongly spined, the claws not toothed, only those of the hind tarsi with a little notch beyond the middle.

Type *Onychothemis abnormis*, Brauer.

The above description is compiled from Brauer. The genus is distinguished from all others by the untoothed claws of the tarsi. I am doubtful whether it is correctly placed here.

Genus 35. Libellula.

(Neuration, Plate LV. fig. 1.)

Linn. Syst. Nat. ed. x. i. p. 543 (1758); Latr. Hist. Nat. Crust. Ins. iii. p. 286 (1802).
Platetrum, Newm. Ent. Mag. i. p. 511, note (1833).
Pigiphila, Buch. Syst. Ent., Odonata, p. 11 (1878).

Frontal tubercle broad, a little depressed in the middle; abdomen much shorter than the hind wings, very broad and depressed, with the usual dorsal and lateral carinæ, and transverse carinæ on the second and third segments, segment 8 not perfoliate in female: wings moderately long and broad, narrowed at the tips, pterostigma moderately long; fore wings with about 15 antenodal and 12 postnodal nervures, last antenodal nervure almost always continuous, at least on one side, first four postnodals not continuous, cells of the lower postnodal space not bisected, triangle moderate, traversed by two or three nervures, and followed by 3–5 rows of cells, one supratriangular nervure, subtriangular space consisting of 4–6 cells, sectors of the arculus separated, regularly curved, nodal sector waved, cells between the nodal and subnodal sectors bisected towards the hind margin, lower sector of the triangle arched, comparatively regular; hind wings broader than fore wings, lower basal cell with two cross nervures, the triangle traversed and sometimes reticulated, generally consisting of three cells, and more rarely of two or four, one or two subtriangular nervures, sectors of triangle united at base: anal appendages short.

Type *Libellula depressa*, Linn.

Genus 36. Untamo, g. n.

(Plate LIII. fig. 4.)

Female.—Frontal tubercle truncated; eyes contiguous; abdomen moderately broad, a little compressed and slightly tapering, much shorter than the hind wings, the base not thickened, segments 2 and 3 carinated, segment 8 not perfoliate: fore wings rather narrow; hind wings broad, moderately long and slightly pointed at tips, pterostigma moderate; fore wings with 17–18 antenodal nervures, the last not continuous, and 10–12 postnodals, the first two or three not continuous, cells of the postcostal area simple, triangle moderate, a little beyond that of the hind wings, traversed, the outer side oblique, and followed by four rows of cells, then three, and afterwards more, subtriangular space consisting of five cells, sectors of the arculus stalked, the lower sector very slightly undulating, three supratriangular nervures before the triangle and sometimes one above, lower basal cell with 2–3 cross nervures, nodal sector only slightly undulating, the nodal and subnodal sectors continuous and only moderately curved, cells between the nodal and subnodal sectors bisected towards the hind margin; hind wings with 12–13 antenodals, the last or one of the intermediate ones not continuous, and 11–12 antenodals, the first three not continuous, triangle traversed, followed by three rows of cells, its base corresponding with the arculus, one supratriangular nervure, and one cross nervure in the lower basal cell, sectors of the triangle united at the base: anal appendages moderately prominent.

Type *Untamo apicalis*, sp. n.

Genus 37. Lyriothemis.

(Plate LIII. fig. 5.)

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 180, 365, 728 (1868).

Frontal tubercle bifid; eyes contiguous for a moderately long space; abdomen rather broad, triquetral, of nearly uniform width, much shorter than the hind wings, the base not thickened, segments 2 and 3 carinated, segment 8 slightly perfoliate in female: wings broad, especially the hind wings, moderately long and obtusely rounded at tips, pterostigma moderate; fore wings with 16–20 antenodal and 9–12 postnodal nervures, the first two postnodals not continuous, cells of the lower postcostal area usually more or less bisected towards the apex, beyond the pterostigma, triangle rather short, traversed, on a level with that of the hind wings, the outer side generally very oblique, followed first by three rows of cells, then by several rows of two, then by three and more, subtriangular space consisting of three cells, sectors of the arculus stalked, one supratriangular nervure before the triangle, lower basal cell with two or three cross nervures, nodal sector only slightly waved towards the base, cells between the nodal and subnodal sectors simple, or only the last bisected, these sectors, as well as those of the arculus, nearly continuous, but towards the extremity very strongly curved downwards to the hind margin, almost at a right angle, lower sector of the triangle nearly as long as the upper, slightly and regularly undulating; hind wings considerably broader than the fore wings, with 12–13 antenodal and 10 postnodal nervures, the first two or three postnodals not continuous, triangle traversed, followed by two rows of cells, its base corresponding with the arculus, one supratriangular nervure occasionally present, three or four nervures in the lower basal cell: anal appendages of the male nearly as long as the eighth segment, lower appendage broad, triangular, not shorter than the others, sectors of the triangle united at base; appendages of the second segment prominent.

Type *Lyriothemis cleis*, Brauer.

The type is not in the British Museum, which, however, possesses three other closely allied species, from which the preceding description is chiefly drawn up.

Genus 38. Orthemis.

(Plate LIV. fig. 1; neuration and details, Plate LVII. figs. 3, 3 *a–e*, 5, 5 *a*.)

Hagen, Neur. N. Amer. p. 160 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 367, 729 (1868).

Frontal tubercle broad, concave in the middle, forming two obtuse projections; abdomen moderately stout, of nearly uniform breadth throughout, a little shorter than the hind wings, segments 2 and 3 carinated, segment 8 perfoliate in female: wings long and rather pointed, pterostigma very long, placed near the tips; fore wings with 16–18 antenodal and 11–14 postnodal nervures, the first three postnodules not continuous, cells of the postnodal area simple, triangle moderate, rather beyond the level of that of the hind wings, traversed, followed by three rows of cells, subtriangular space consisting of four cells, sectors of the arculus stalked, curved towards the extremities, one cross nervure in the lower basal cell, no supratriangular nervures, all the principal sectors nearly continuous, nodal sector nearly straight at the base, undulating in the middle, space between the nodal and subnodal sectors only bisected towards the hind margin, base of the triangle in a straight line with the upper sector, which is only curved towards the extremity; hind wings with 12–15 antenodal and postnodal nervures, the first three postnodals not continuous, triangle free, followed by three rows of cells (often varied with two rows immediately after the first), no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at base: anal appendages moderate, a little shorter than the eighth segment, the lower appendage nearly as long as the others; appendages of the second segment not prominent.

Type *Libellula ferruginea*, Fabr.

Genus 39. Leptetrum.

Newm. Ent. Mag. i. p. 511, note (1833).

Libellula, Hagen, Neur. N. Amer. p. 151 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 366, 730 (1868).

Frontal tubercle broad, truncated, or notched in the middle; eyes contiguous; abdomen rather stout at the base, but not inflated, and gradually tapering, rarely as long as the hind wings, and often much shorter, segments 2 and 3 carinated, 8th segment slightly perfoliate in the female: wings moderately long and broad, pterostigma moderate; fore wings with 11–15 antenodal nervures, the last sometimes not continuous, and 9–13 postnodal nervures, the first two to five not continuous, cells of the postnodal area simple, triangle moderately broad or long, on a level with that of the hind wings, traversed by one to three nervures, the base slightly oblique, followed by three to five rows of cells, generally decreasing, and then increasing, generally one supratriangular nervure, one cross nervure in the lower basal cell, subtriangular space consisting of 2–8 cells, sectors of the arculus rising from a point, and moderately curved at the extremities, the nodal sector waved (often considerably) in the middle, the subnodal much less so, two rows of intermediate cells, frequently increasing to three or even four, before the hind margin; hind wings rather broader than the fore wings, with 9–13 antenodal and 10–16 postnodal nervures, the first four to six postnodals not continuous, triangle generally traversed, followed by two to four rows of cells, a supratriangular nervure sometimes present, one cross nervure in the lower basal cell (rarely two), sectors of triangle united at base: anal appendages of the male rather stout, often nearly as long as the last two segments, the lower appendage distinctly shorter; appendages of the second segment moderately conspicuous.

Type *Libellula 4-maculata*, Linn.

Genus 40. Plathemis.

Hagen, Neur. N. Am. p. 149 (1861).

Frontal tubercle broad, notched in the middle; eyes contiguous; abdomen rather stout, thickest at the base, especially in the male, and gradually tapering to the extremity, about as long as the hind wings (shorter, and hardly narrowed in the female), segments 2 and 3 carinated, segment 8 strongly perfoliate in female: wings rather short, pterostigma rather long; fore wings with 12–25 antenodal nervures, the last not always continuous, and 8–15 postnodals, the first three to five not continuous, cells of the postnodal area simple, triangle long and rather narrow, about on a level with that of the hind wings, traversed by 1–4 nervures, the base oblique, followed by 4–7 rows of cells, generally decreasing to three or four, and then increasing, one or two supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of 3–11 cells, sectors of the arculus rising from a point, and gradually curved at the extremities, the nodal sector nearly straight at the base, but much waved in the middle, subnodal sector only slightly waved, two rows of intermediate cells (rarely three) before the hind margin; hind wings broader than the fore wings, with 10–19 antenodal nervures, the last not always continuous, and 9–14 postnodal nervures, the first four not continuous, triangle traversed by one or two nervures (sometimes reticulated, forming four cells), followed by three or four rows of cells (or four and then three) increasing, a supratriangular nervure generally present, one (rarely two) cross nervure in the lower basal cell, sectors of the triangle united at base: anal appendages of the male as long as the eighth segment, moderately stout, the lower appendage distinctly shorter; appendages of the second segment moderately conspicuous.

Type *Libellula lydia*, Drury.

I provisionally include *L. pulchella*, Dru., in this genus, though this species has some resemblance to *Holotania*.

Genus 41. Belonia, g. n.

(Plate LIV. fig. 4.)

Frontal tubercle incised above; eyes contiguous; abdomen very stout, somewhat depressed, of equal thickness from the base to the eighth segment in both sexes, considerably shorter than the hind wings; the lateral carinæ very strongly marked, segments 2 and 3 transversely carinated, segment 8 strongly perfoliate in the female: wings generally rather short, pterostigma moderate or long; fore wings with 16–21 antenodal and 12–15 postnodal nervures, the first four postnodals not continuous, cells of the postnodal area simple, triangle moderately long, just beyond that of the hind wings, crossed by two or three nervures, the base hardly oblique, followed by 4–6 rows of cells, decreasing to three or four, and then increasing, 1–3 supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of 5–8 cells, sectors of the arculus rising from a point or from a very short, thick stalk, moderately curved at the extremities, nodal sector hardly waved at the base, but considerably in the middle, subnodal sector hardly waved, two, and sometimes three, rows of intermediate cells towards the hind margin; hind wings slightly broader than the fore wings, with 12–16 antenodal and 14–16 postnodal nervures, the first four not continuous, triangle traversed by one (exceptionally two) nervures, and followed by three or four rows of cells, often decreasing to two or three, and then increasing; a supratriangular nervure frequently present, two cross nervures in the lower basal cell, sectors of triangle united at base: anal appendages of the male rather shorter than the last two segments, and considerably thickened before the extremity; lower appendage broad and slightly indented at the extremity; appendages of the second segment not very conspicuous.

Type *Belonia foliata*, sp. n.

One or two described North-American species, such as *Libellula saturata*, Uhl., and *luctuosa*, Burm., appear to be congeneric, though the abdomen is more slender and somewhat tapering. In these species, too, the first antenodal is generally not continuous.

Genus 42. Holotania, g. n.

(Neuration, Plate LVII. fig. 2.)

Frontal tubercle elevated, sloping forward, attenuated and concave at the apex; eyes contiguous in front; abdomen long and slender, about as long as the hind wings, hardly thickened at the base, not narrowed, even in the male, till segment eight, segments 2 and 3 carinated, segment 8 perfoliate in the female: wings and pterostigma very long, the latter rather narrow, and slightly pointed at the tip; fore wings with 16–19 antenodal nervures, the last exceptionally discontinuous from irregularity of those in the lower costal area, and 10–16 postnodal nervures, the last three or four not continuous, cells of the postnodal area simple, triangle moderately long, situated just beyond that of the hind wings, traversed by 1–3 (generally two) cross nervures, and followed by four rows of cells, and afterwards by three, increasing (by five or four, or four increasing in some species), generally one or two supratriangular nervures (sometimes wanting), one cross nervure in the lower basal cell, subtriangular space consisting of 3–7 cells, sectors of the arculus rising from a point and moderately curved at the extremities, nodal sector much waved in the middle, subnodal very slightly, the intermediate cells beyond the wave being divided into rows of two, three, and sometimes at the extremity even four cells, lower sector of the triangle rather long, regularly undulating; hind wings a little broader than the fore wings, with 11–14 antenodal nervures, the last sometimes not continuous, and 12–19 postnodal nervures, the first four not continuous, triangle traversed, followed by three or four rows of cells, then two, increasing (exceptionally three), a supratriangular nervure rarely present, one cross nervure in the lower basal cell, sectors of triangle united at base: anal appendages of the male rather shorter than the last two segments, the lower one-third shorter than the others; appendages of the second segment inconspicuous; spines of the legs not numerous, straight, rather slender.

Type *Libellula axilena*, Westw. (=*lydia*, p., Dru.).

Genus 43. Thermorthemis, g. n.

Frontal tubercle bifid; abdomen as long as the wings, broad, but not depressed, with the usual dorsal and lateral carinæ, and transverse carinæ on the second and third segments, and eighth segment of the female perfoliate: wings moderately long and broad, tips rather pointed, pterostigma very long; fore wings with 19–22 antenodal and 12–14 postnodal nervures, last antenodal nervure continuous, first three or four postnodals not continuous, cells of the lower postnodal space not bisected, triangle long, traversed by two or three nervures (very rarely one), and followed by four or five rows of cells, two or three supratriangular nervures, subtriangular space consisting of six or seven cells, sectors of the arculus stalked, considerably arched at the extremities, nodal sector waved, cells between the nodal and subnodal sectors bisected towards the hind margin; hind wings distinctly broader than the fore wings, the triangle always traversed, and always with one supratriangular nervure, sectors of the triangle united at base.

To include *Libellula caffra*, Burm., *angustiventris* and *madagascariensis*, Ramb.; the last may be regarded as the type.

Genus 44. Protorthemis, g. n.

(Plate LIV. fig. 7; details, Plate LVII. figs. 6, 6 *a*.)

Frontal tubercle bifid; abdomen shorter than the wings, very broad or moderately broad, a little depressed, with the usual dorsal and lateral carinæ, and transverse carinæ on the second and third segments, eighth segment of the female perfoliate: wings long, narrow, pointed, pterostigma very long; fore wings with 17–21 antenodal and 9–21 postnodal nervures, last antenodal nervure continuous, the first three or four postnodals not continuous, cells of the second postnodal space bisected between the pterostigma and the apex, triangle moderate, traversed, followed by three rows of cells, frequently a supratriangular nervure, subtriangular space consisting of three or four cells, sectors of the arculus stalked, more or less curved, and the intermediate cells bisected before the extremities as well as those between the nodal and subnodal sectors, nodal sector waved, lower sector of the triangle rather long; hind wings not much broader than the fore wings, the triangle traversed, and sometimes with a supratriangular nervure, sectors of triangle united at base.

Type *Protorthemis celebensis*, sp. n. This genus will also include *Orthemis coronata* and *metallica*, Brauer. *O. metallica* may ultimately form another genus, characterized by the metallic coloration, longer and more slender body, larger membranule on the hind wings, and total absence of supratriangular nervures.

Genus 45. Nesocria, g. n.

Frontal tubercle bifid; clypeus very broad, with a small tubercle on each side; eyes contiguous; abdomen moderately stout, a little thickened at the base, and gradually tapering to the extremity, shorter than the hind wings, segments 2 and 3 carinated: wings very long, narrow, and pointed, pterostigma rather long; fore wings with 18 antenodal and 17 postnodal nervures, the first three postnodals not continuous, cells of the lower postnodal space simple, triangle moderate, traversed by two nervures, on a level with that of the hind wings, and followed by three rows of cells, increasing, subtriangular space consisting of five or six cells, sectors of the arculus stalked, considerably arched at the extremities, lower basal cell with one cross nervure, nodal sector waved beyond the middle and then gradually curved, cells between the nodal and subnodal sectors bisected towards the hind margin and raised to three cells before reaching it; hind wings not much broader than the fore wings, with 16 antenodal and 15–16 postnodal nervures, the first two or three postnodals not continuous, triangle free, its base placed at about one fifth of the distance between the arculus and the extremity of its lower sector, followed by two rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, membranule very small, sectors of triangle united at base: anal appendages nearly straight, as long as the eighth segment, the lower appendage rather broad, as long as the others; appendages of the second segment not conspicuous.

Type *Nesocria woodfordi.*

Intermediate between *Agrionoptera* and *Protorthemis*, but not agreeing very well with either.

Genus 46. Lathrecista, g. n.

Frontal tubercle concave, but hardly bifid; eyes contiguous; abdomen rather slender, of nearly uniform thickness, about as long as the hind wings, the base not dilated, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather long and narrow, the hind wings not much broader than the fore wings, pterostigma long and rather broad; fore wings with 14–20 antenodal nervures (10–11 in *L.*(?) *difficilis*, Selys), the last not continuous, and 11–13 potsnodals, the first three not continuous, cells of the postnodal and costal areas simple or bisected at the tip, beyond the pterostigma triangle moderate, on a level with that of the hind wings, traversed, followed by three rows of cells, increasing (free, followed by two rows in *L.*(?) *difficilis*), subtriangular space consisting of 3–4 cells, sectors of the arculus stalked, strongly curved at the extremities, no supratriangular nervures, one cross nervure in the lower basal cell, nodal and subnodal sectors undulating in the middle, and curved at the extremity, the intermediate cells bisected towards the hind margin; hind wings with 11–13 antenodal and postnodal nervures, the first three postnodals not continuous, triangle free, followed by two rows of cells, its base corresponding with the arculus or placed just within it; no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at base: anal appendages as long as the eighth segment, the lower one hardly shorter than the others, those of the second segment not conspicuous.

Type *Libellula pectoralis*, Brauer.

Genus 47. Nesoxenia, g. n.

(Plate LIII. fig. 8.)

Frontal tubercle rounded; eyes large, contiguous in front; abdomen slender, as long as the hind wings, slightly but abruptly dilated at the base, as in *Micrathyria*, and thickened at the sutures, segments 2 and 3 carinated, 4 imperfectly: wings long and narrow, pterostigma broad, not very long; fore wings with 14–15 antenodal and 11–15 postnodal nervures, the last two or three postnodals not continuous, cells of the lower postnodal area simple, triangle small, free or traversed, at or beyond the level of that of the hind wings, and followed by two rows of cells, only increasing at about three fourths of the distance to the hind margin, subtriangular space consisting of two cells, being divided by a curved nervure, sectors of the arculus with a very long stalk and only slightly curved at the extremities, lower basal cell with two to four cross nervures, no supratriangular nervures, nodal and subnodal sectors nearly straight, gradually curved towards the hind margin, where there are two or three rows of intermediate cells, lower sector of the triangle regularly undulated beyond the middle and nearly as long as the upper; hind wings rather broader than the fore wings, with 10–13 antenodal and 13–15 postnodal nervures, the first two postnodals not continuous, triangle free, its base placed at one fourth of the distance between the arculus and the lower sector, followed by two rows of cells increasing; no supratriangular nervures, three (rarely four) cross nervures in the lower basal cell, membranule very small, sectors of triangle united at base: upper anal appendages of the male slender, the lower one rather stout, fully as long as the others; appendages of the second segment not prominent, hamulus small, slender, recurved; anal appendages of the female very short.

Type *Nesoxenia cingulata*, sp. n.

Genus 48. Agrionoptera.

(Neuration, Plate LVI. fig. 3.)

Brauer, Verh. zool.-bot. Ges. Wien, xiv. p. 163 (1864), xviii. pp. 365, 367, 728 (1868); Reise d. Novara, Neur. p. 100 (1866); Selys, Ann. Mus. Genov. xiv. p. 298 (1879).

Frontal tubercle bifid; eyes large, contiguous; abdomen slender, longer than the hind wings, the first three segments much inflated, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather long and narrow, the hind wings not much broader than the fore wings, pterostigma rather long and broad; fore wings with 14–18 antenodal and 12–15 postnodal nervures, the first two or three postnodals not continuous, cells of the postcostal area simple, triangle small, on a level with that of the hind wings, free or traversed (rarely by two nervures), followed by two rows of cells, increasing, or by three, and then a series of two increasing, subtriangular space consisting of 2–5 cells, sectors of the arculus stalked, more or less curved at the extremities, a supratriangular nervure only exceptionally present, one cross nervure in the lower basal cell, nodal and subnodal nervures undulating in the middle, not much curved at the extremity, the intermediate cells bisected towards the margins; hind wings with 14–16 antenodal and 11–15 postnodal nervures, the first two postnodals not continuous, triangle free, followed by two rows of cells, its base placed considerably beyond the arculus, no supratriangular nervures, one to three cross nervures in the lower basal cell, sectors of the triangle united at base: anal appendages of the male rather slender, as long as the eighth segment, the lower one not much shorter than the others; appendages of the second segment not conspicuous.

Type *Agrionoptera sexlineata*, Selys.

The neuration of *A. 4-notata*, Brauer, is figured.

Genus 49. Chalcostephia, g. n.

Male.—Frontal tubercle convex; eyes contiguous for rather a long space; abdomen moderately broad, a little narrowed in the middle, hardly thickened at the base, as long as the hind wings, segments 2 and 3 carinated: wings moderately long and broad, rounded at the tips, pterostigma rather long; fore wings with 11 antenodal nervures, the last not continuous, and 8–9 postnodal nervures, the first two not continuous, cells of the postnodal subcostal area simple, triangle rather short and broad, free, placed distinctly beyond that of the hind wings, the lower sector of the arculus striking the base a little before the outer angle, but hardly breaking it, followed by two rows of rather large cells, increasing, subtriangular space consisting of three cells, sectors of the arculus stalked, moderately curved at the extremities, the lower one a little irregular, no supratriangular nervures, one cross nervure in the lower basal cell, nodal sector only slightly waved towards the base, moderately curved at the extremity, subnodal sector straighter, intermediate cells only bisected close to the hind margin; hind wings slightly broader than the fore wings, with 9 antenodal and 8 postnodal nervures, the first two postnodals not continuous, triangle free, placed considerably beyond the level of the arculus, followed by two cells, then by one increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at the base: upper anal appendages as long as the last two segments of the abdomen, depressed, the extremities much thickened and pointed, lower appendage a little shorter; appendages of the second segment very small.

Type *Chalcostephia flavifrons*, sp. n.

Genus 50. Raphismia, g. n.

(Neuration, Plate LVI. fig. 4.)

Allied to *Brachydiplax*. Fore wings with 9–10 antenodal and 6–8 postnodal cross nervures, the last antenodal and the first two postnodals not continuous, triangle equilateral, followed by two rows of nervures, subtriangular space consisting either of a single very large cell, or divided by a perpendicular line; hind wings with 7 antenodal and 6–7 postnodal nervures, the first two of the latter not continuous, triangle rather narrow, commencing considerably beyond the arculus (with which its base always coincides in *Diplacodes*): male with two small spines projecting from the middle of the metasternum, and the appendages beneath the second segment of the abdomen also prominent, and exhibiting two small hooks, directed backwards, as in some species of *Tramea*.

Type *Diplax bispina*, Hag.

Genus 51. Anatya, g. n.

(Plate LIII. fig. 9; appendages, Plate LVII. fig. 7.)

Frontal tubercle convex; eyes contiguous in front; abdomen rather slender, as long as the hind wings, a little compressed, the base slightly thickened, the extremity still more slightly, segments 2 and 3 strongly carinated, segment 8 not perfoliate in female: wings rather long and narrow, pterostigma rather short and broad; fore wings with 10–11 antenodal nervures and 8–10 postnodal cross nervures, the last antenodal and the first two postnodals not continuous, cells of the postnodal area simple, triangle rather small, on a level with that of the hind wings, free, the base slightly oblique, followed by two rows of cells, increasing at or beyond the middle to three (and on the hind margin more), no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of one or two cells (generally bisected by a vertical line, as in *Macrothemis*), sectors of the arculus stalked, slightly and gradually curved, nodal sector only waved at the base, subnodal sector sometimes a little irregular, cells between the nodal and subnodal sectors only bisected at the hind margin; hind wings rather broader than the fore wings, with 7–10 antenodal and 10 postnodal nervures, the first two postnodals not continuous, triangle free, its base on a level with the arculus, followed by two (or three and two) rows of cells increasing, no supratriangular nervures, one cross nervure in the lower basal cell, upper sector of the triangle rising considerably above the lower angle, where the lower sector rises: legs clothed with long slender spines, claws of the tarsi throwing off a branch before the tip: upper anal appendages of the male extremely anomalous, as long as the last two segments, curving abruptly downwards just before the extremity of the very short, pointed, lower appendage, and then throwing upwards and backwards a pointed projection three times as long as the shaft and almost at right angles to it; appendages of the second segment not conspicuous.

Type *Anatya anomala*, sp. n.

Genus 52. Tyriobapta, g. n.

(Plate LIV. figs. 5, 6.)

Frontal tubercle broad, very slightly convex; eyes contiguous in front; abdomen moderately slender, not thickened at the base or tip, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather long, pterostigma moderately long, rather longer on the hind than on the fore wings; fore wings with 11–13 antenodal and 11–12 postnodal nervures, the first two postnodals not continuous, cells of the postnodal area simple, triangle moderate, on a level with that of the hind wings, free, followed by two rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of one cell, sectors of the arculus stalked, gradually curved, nodal and subnodal sectors nearly straight, gradually curved towards the hind margin, intermediate cells bisected towards the hind margin, sectors of the triangle rather short, of nearly equal length, the lower one comparatively regular; hind wings rather broader than the fore wings, with 9–10 antenodal and 10–11 postnodal nervures, the first two or three postnodals not continuous, triangle free, its base on a level with the arculus, followed by two or three rows of cells, increasing, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle rising from a point: spines of the legs slender, rather long: anal appendages of the male as long as the ninth segment, the lower appendage hardly shorter; appendages of the second segment conspicuous, the hamulus terminating in a slender double hook.

Type *Tyriobapta torrida*, sp. n.

Genus 53. Hemistigma, g. n.

Frontal tubercle convex; eyes contiguous in front; abdomen slender, as long as the hind wings in the male and a little shorter in the female, hardly thickened at the base, segments 2 and 3 strongly carinated, segment 8 not perfoliate in female: wings long, narrow, and rather pointed, pterostigma long, the basal third always pale; fore wings with 10–14 antenodal nervures and 8–10 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, cells of the postnodal area simple, triangle moderate, on a level with that of the hind wings, free, or traversed by one nervure (exceptionally two), followed by three rows of cells, increasing, or two increasing, or three followed by a series of two increasing, the base hardly oblique, generally one supratriangular nervure, one cross nervure in the lower basal cell, sectors of the arculus stalked, more or less curved at the extremities, nodal sector only waved at the base, the subnodal hardly at all, the intermediate cells bisected towards the hind margin; hind wings broader than the fore wings, with 7–8 antenodal and 8–10 postnodal nervures, the first two or three subnodals not continuous, triangle free, its base on a level with the arculus, and followed by two rows of cells, increasing, or two and then one, increasing, a supratriangular nervure only exceptionally present, one (rarely two) cross nervures in the lower basal cell, sectors of the triangle united at base: anal appendages of the male slender, as long as the ninth segment, the lower one nearly as long as the others; appendages of the second segment moderately conspicuous.

Type *Libellula albipuncta*, Ramb.

Genus 54. Thermochoria, g. n.

(Plate LII. fig. 8.)

Characters of *Hemistigma*. Abdomen more distinctly thickened at base, pterostigma shorter, unicolorous; fore wings with 16–17 antenodal nervures and 10 postnodal nervures, the last antenodal and the first two postnodals not continuous, triangle traversed, followed by three rows of cells, and a series of two increasing, two supratriangular nervures, three cross nervures in the lower basal cell, sectors of the arculus hardly more curved at the extremity than the nodal and subnodal sectors; hind wings with 12 antenodal and 11 postnodal nervures, the first two postnodals not continuous, triangle traversed, followed by two rows of cells, increasing, one supratriangular nervure, three cross nervures in the lower basal cell.

Type *Thermochoria equivocata*, sp. n.

Genus 55. Uracis.

Ramb. Ins. Névr. p. 31 (1842); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 365, 727 (1868).

Frontal tubercle slightly concave; eyes contiguous in front; abdomen slender, of uniform thickness, and rather shorter then the hind wings, not thickened at the base, segments 2 and 3 carinated, segment 8 not perfoliate in female, pterostigma long; fore wings with 12–13 antenodal nervures and 10–13 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, cells of the postnodal spaces generally more or less bisected or reticulated beyond the pterostigma, triangle moderate, traversed, followed by three rows of cells (sometimes two), subtriangular space consisting of three or four cells, sectors of the arculus stalked, moderately curved at the extremities, one to three supratriangular nervures sometimes present, lower basal cell with one to six cross nervures, nodal sector undulating at the base, subnodal sector nearly continuous, but with the curve more flattened than usual in the middle, cells between the nodal and subnodal sectors bisected towards the hind margin; hind wings with 10–12 antenodal and postnodal nervures, the first two postnodals not continuous, the triangle traversed, followed by two and more rows of cells, its base is sometimes on a level with the arculus, and sometimes one fourth of the distance from the arculus to the tip of the triangle, one supratriangular nervure generally present, lower basal cell with three to five cross nervures, sectors of the triangle united at base or occasionally rising from a very short stalk: anal appendages of the male slender, as long as the eighth segment; appendages of the second segment moderately prominent.

Type *Libellula imbuta*, Burm.

I have not been able to examine a sufficient series of the few described species of the genus to venture to subdivide it; but I doubt if *L. infumata*, Ramb., which Brauer places here, is really congeneric. The triangle of the hind wings falls considerably beyond the arculus, and is followed by two cells (or, rather, a large one bisected), and then a row of single cells, afterwards increasing.

Genus 56. Misagria, g. n.

(Plate LII. fig. 9; details, Plate LVII. figs. 8, 8 *a*.)

Male.—Frontal tubercle convex; eyes contiguous; abdomen rather slender, nearly as long as the hind wings, considerably and suddenly thickened at the base, and each segment thickened at the extremity to the seventh, eighth and ninth as broad as the extremity of the seventh, segments 2–4 carinated: wings and pterostigma rather long; fore wings with 16–17 antenodal and 12 postnodal nervures, the first three postnodals not continuous, cells of the postnodal area simple, triangle small, on a level with that of the hind wings, traversed, the base hardly oblique, followed by two rows of cells, increasing to three in the middle, and to four or five on the hind margin, no supra-triangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, somewhat arched at the extremities, nodal and subnodal nervures only slightly waved towards the base, the latter more arched on the hind margin, intermediate cells only divided on the hind margin, sectors of the triangle rather long; hind wings rather broader than the fore wings, with 13–14 antenodal and 12–13 postnodal nervures, the first three postnodals not continuous, triangle traversed and followed by two rows of cells, increasing, no supra-triangular nervures, three cross nervures in the lower basal cell, sectors of the triangle united at base: anal appendages as long as the eighth segment, thickened before the extremity and pointed, lower appendage shorter than the others, broad, bifid at the extremity; appendages of the second segment very large, especially the hinder lobe, which is inflated like a bladder, the lateral processes preceding it are like very thick pincers, the apices directed inwards.

Type *Misagria parana*, sp. n.

Genus 57. Macrothemis.

(Plate LIV. fig. 3; claws, Plate LVII. fig. 11.)

Hagen, Stett. ent. Zeit. xxix. p. 281 (1868); Brauer, Verh. zool.-bot. Ges. Wien, xviii. p. 734 (1868).

Frontal tubercle broad, truncated above; eyes contiguous in front for rather a long space; abdomen slender, as long as or longer than the hind wings, the basal and terminal segments distinctly but not excessively thickened in both sexes, segments 2 and 3 (and sometimes 4 partially) carinated, segment 8 not perfoliate in female: wings long and narrow, pterostigma short; fore wings with 12–15 antenodal and 6–9 postnodal nervures, the last antenodal and the first two postnodals not continuous, cells of the post-nodal area simple, triangle small, rather beyond the level of that of the hind wings, free, followed by two rows of cells, only increasing towards the hind margin, no supra-triangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of one or two cells, most frequently bisected by a nearly perpendicular nervure, sectors of the arculus stalked, rather suddenly curved at the extremities, the nodal sector only slightly waved at the base, the subnodal nearly continuous, the intermediate cells bisected towards the hind margin; hind wings with 9–10 antenodal and 7–10 postnodal nervures, the two or three first postnodals not continuous, triangle free, its base nearly corresponding with the arculus, followed by two rows of cells increasing (sometimes the series is interrupted by a single cell), no supratriangular nervures, one cross nervure in the lower basal cell, sectors of triangle rising from a point: upper anal appendages of the male as long as the eighth segment, pointed, and triangularly thickened below before the apex; lower appendages two thirds as long, pointed; appendages of the second segment small, but the hamulus distinct, rising straight, and the apex recurved; legs long, clothed with numerous long and slender spines or bristles; claws of the tarsi bifid.

Type *Libellula celæno*, Selys.

Our figures represent *M. hemichlora*, Burm.

Genus 58. Dythemis.

Hagen, Neur. N. Amer. p. 162 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 368, 733 (1868).

Frontal tubercle convex; eyes contiguous in front; abdomen slender, as long as the hind wings, the base gradually thicker, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather long and narrow, pterostigma long; fore wings with 15–16 antenodal and 9–10 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, cells of the postnodal area simple, triangle long, rather narrow, nearly straight, a little beyond that of the hind wings, traversed, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three or four cells, sectors of the arculus stalked, gradually curved at the extremities, nodal sector distinctly waved in the middle, subnodal nearly continuous, the intermediate cells bisected towards the hind margin; hind wings broader than the fore wings, with 10–12 antenodal and postnodal nervures, the first three postnodals not continuous, triangle free, its base on a level with the arculus, followed by two rows of cells increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle generally rising from a point, but sometimes showing a tendency to separation; spines of the legs rather short and slender: anal appendages of the male as long as the eighth segment, the lower appendage only slightly shorter than the others; appendages of the second segment not conspicuous.

Type *Libellula rufinervis*, Burm.

Genus 59. Scapanea, g. n.

Frontal tubercle concave; eyes contiguous in front; abdomen moderately stout, shorter than the hind wings, a little compressed, the base somewhat gibbous and gradually thickened, greatly thickened at the extremity beyond segment 6, especially in the male, where the expanded apex is broadly spatulate and depressed, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather long; fore wings with 14–16 antenodal and 9–10 postnodal nervures, the last antenodal and the first three postnodals not continuous, cells of the postnodal area simple, triangle long, rather narrow, oblique, a little beyond that of the hind wings, traversed, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, suddenly curved at the extremities, nodal sector distinctly waved in the middle, subnodal much less so, the intermediate cells bisected towards the hind margin; hind wings broader than the fore wings, with 10–13 antenodal nervures (the last exceptionally discontinuous) and 9–11 postnodal nervures, the first three not continuous, triangle free, its base on a level with the arculus, followed by two or three rows of cells increasing, no supratriangular nervures, one cross nervure in the lower basal cell: spines of the legs short and slender, sectors of the triangle united at base: anal appendages of the male rather stout, as long as the eighth segment, the lower appendage only slightly shorter than the others; appendages of the second segment not conspicuous.

Type *Libellula frontalis*, Burm.

Genus 60. Rhodopygia, g. n.

(Plate LII. fig. 10.)

Characters of *Dythemis* and *Scapanea*, but more robust and with more numerous cross nervures. Fore wings with 18–20 antenodal and 12–14 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, nodal sector hardly undulated beyond the middle; hind wings with 12–15 antenodals and 14–15 postnodals, the first three postnodals not continuous; abdomen as long as the hind wings, triquetral, rather stout, slightly gibbous at the base, dilated laterally, but compressed, so that the dilatation is not visible from above, the segments very gradually widening as far as the seventh, and slightly depressed at the widest part.

Type *Libellula cardinalis*, Erichs.

Genus 61. Pseudomacromia, g. n.

(Plate LII. fig. 7.)

Allied to *Lepthemis*, but with the abdomen stouter and very slightly expanded at the base, and the wings broader, giving the insect at first sight a strong resemblance to *Macromia* or *Anax*. Eyes large, connected by a moderate space; segments 2 and 3 of the abdomen carinated, segment 4 slightly; legs stout, of moderate length, and with slender and moderately long bristles, femora distinctly serrated beneath: fore wings with 11–12 antenodal and 6–8 postnodal nervures, the last antenodal and the first 1–3 postnodals not continuous, nodal sector much waved in the middle, sectors of the arculus rising at two thirds of its length in a long stalk which arches upwards, and rather suddenly curved at the extremities, triangle moderate, traversed, followed by three rows of cells, its upper sector nearly straight, subtriangular space consisting of three or four cells, no supratriangular cells, and only the usual single cross nervure in the long and narrow basal cell, pterostigma moderate, triangle of the hind wings generally open, its sectors united at their origin.

Type *Pseudomacromia torrida*, sp. n.

Has much external resemblance to *Macromia*, but for the open cells and the discontinuity of the last antenodal subcostal nervure on the fore wings. The latter character is of the greatest importance; for (with a single doubtful exception) every species of Corduliinæ known to me has the last antenodal nervure continued on the lower costal space, an arrangement which is only occasional in the Libellulinæ.

Genus 62. CANNACRIA, g. n.

(Plate LIII. fig. 1; appendages, Plate LVII. fig. 9.)

Frontal tubercle slightly concave; eyes contiguous in front; abdomen as long as the hind wings, of moderate and nearly uniform thickness beyond the base, which is gibbous, and considerably thickened when viewed laterally, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather long and pointed, pterostigma moderate; fore wings with 10–11 antenodal and 9–10 postnodal nervures, the last antenodal and the first three postnodals not continuous, cells of the postnodal area simple, triangle moderate, rather oblique, just beyond the level of that of the hind wings, traversed, and followed by three rows of cells increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus separated or rising from a very short stalk, rather abruptly curved at the extremities, and the lower one slightly waved beyond the middle, nodal and subnodal sectors gradually curved, and the intermediate cells bisected towards the hind margin, nodal sector waved towards the base, very slightly in the middle, upper sector of the triangle rather long; hind wings broader than the fore wings, with 6 antenodal and 9–10 postnodal nervures, the first three postnodals not continuous, triangle free, its base nearly on a level with the arculus, followed by two rows of cells increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle hardly separated at base: anal appendages of both sexes at least as long as the ninth segment, lower appendage in the male very broad, short, and bifid at the extremity; appendages of the second segment not conspicuous.

Type *Cannacria batesii*, sp. n.

Genus 63. NEOCYSTA, g. n.

Male.—Frontal tubercle truncated, hardly concave above; eyes contiguous near the front for one third of their length; abdomen rather slender, about as long as the hind wings, the basal segments inflated, but not gibbous, segments 2 and 3 carinated, segment 4 not carinated nor contracted at the base: wings and pterostigma rather long; fore wings with 16–18 antenodal nervures, the last continuous, and 12–15 postnodals, the first three not continuous, cells of the postnodal area simple, triangle moderately long and narrow, traversed, on a level with that of the hind wings, and followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of four cells, sectors of the arculus stalked, arched at the extremities, nodal and subnodal sectors undulating in the middle, the intermediate cells bisected towards the hind margin; hind wings broader than the fore wings, with 12–15 antenodal and 15–17 postnodal nervures, the first three postnodals not continuous, triangle free, followed first by three rows of cells and then by a series of two, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle united at the base: anal appendages of the male as long as the ninth segment, rather slender towards the base, then thicker and a little depressed, the lower appendage nearly as long as the others; those of the second segment not conspicuous; spines of the hind tibiæ more numerous than in *Lepthemis* and slender.

Type *Libellula attenuata*, Eversm.

Genus 64. Zyxomma, Ramb.

(Head, Plate LVII. fig. 10.)

Ramb. Ins. Neur. p. 30 (1842); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 364, 712 (1868).

Eyes connected by a long suture as in *Æshna*; face very hairy; frontal tubercle rounded above, entire; abdomen very slender, longer than the hind wings, segments 2 and 3 inflated, and 2–4 carinated, dorsal and lateral carinæ very slightly marked, segment 8 not perfoliate in female: wings long and narrow, pterostigma moderately long; fore wings with 11–12 antenodal and 5–7 postnodal nervures, last antenodal and first two or three postnodals not continuous, cells of the lower postnodal space simple, triangle on the same plane as on the hind wings, slightly oblique, rather broad and short, traversed by one nervure, and followed by three rows of cells, no supratriangular nervures, nor more than one nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, arched at the extremities, the lower one often a little irregular beyond the middle, nodal sector very slightly waved; hind wings not much broader than the fore wings, with 8 or 9 antenodal and 5–9 postnodal nervures, the last antenodal nearly always continuous, but the first two or three postnodals not continuous, triangle free, followed by two rows of cells, sectors of the triangle often slightly separated at base: anal appendages rather short.

Type *Zyxomma petiolatum*, Ramb.

Genus 65. Orthetrum.

(Neuration, Plate LV. figs. 5, 6.)

Newm. Ent. Mag. i. p. 511, note (1833).
Libella, Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 368, 731 (1868).
Hydronympha, Buch. Syst. Ent., Odonata, p. 8 (1878).

Frontal tubercle bifid; eyes contiguous in front; abdomen slender or moderately broad, shorter or longer than the hind wings, the base always more or less thickened, and sometimes inflated, segments 2 and 3 carinated, segment 4 sometimes a little constricted at the base, segments 4–7 generally of nearly equal size, whatever the shape of the abdomen, segment 8 slightly perfoliate in female: wings moderately long and broad, the hind wings a little broader than the fore wings, pterostigma moderate; fore wings with 12–16 antenodal and 7–11 postnodal nervures, first one to three postnodals not continuous, cells of the postcostal area sometimes bisected at the extreme tip, triangle moderate, traversed, on a level with that of the hind wings, followed by three rows of cells, increasing, subtriangular space consisting of two to five cells (generally three), sectors of the arculus shortly stalked, and strongly curved at the extremities, one (rarely two) subtriangular nervure generally present before the base of the triangle, one cross nervure in the lower basal cell, nodal sector undulating considerably in the middle and moderately curved at the extremity, the subnodal much less waved, the intermediate cells bisected towards the hind margin; hind wings with 10 antenodal and 10–11 postnodal nervures, the first three postnodals not continuous, triangle free or traversed, followed by three rows of cells, its base corresponding with the arculus, a supratriangular nervure very rarely present, one cross nervure in the lower basal cell, sectors of the triangle united or separated at base: anal appendages about as long as the ninth segment, the lower appendage a little shorter than the other, those of the second segment more or less conspicuous; tibial spines usually strong.

Type *Libellula cœrulescens*, Fabr.

I have been compelled to give this genus a very wide extension, and even to include in it the bulk of the Old-World species placed in *Lepthemis* by authors. The conspicuous differences in the shape of the abdomen visible in the groups typified by *Libellula sabina*, Dru., *brachialis*, Beauv., *cœrulescens*, Fabr., and *brunnea*, Fonsc., are unaccompanied by any permanent characters of neuration, and are linked together to a great extent by intermediate forms. The most distinct-looking section is that of *L. sabina*, Dru., and its immediate allies, in which the abdomen is more suddenly and considerably inflated, and the sectors of the triangle on the hind wings are more widely separated than in the other sections of *Orthetrum*; but these characters are only comparative, and are hardly sufficiently well marked or isolated to entitle this group to generic separation.

Genus 66. Lepthemis.

(Neuration, Plate LVII. fig. 1.)

Hagen, Neur. N. Amer. p. 160 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 368, 723 (1868).

Frontal tubercle concave above; eyes contiguous in the middle; abdomen long and slender, generally longer than the hind wings, the basal segments gibbous above, and distinctly inflated when viewed from above as well as from the side, segments 2 and 3 carinated, segment 4 usually a little contracted at the base, segment 8 not perfoliate in female: wings and pterostigma rather long; fore wings with 14–15 antenodal and 12–13 postnodal nervures, the last antenodal and the first two postnodals not continuous, cells of the postnodal area simple, triangle rather long and narrow, traversed, on a level with that of the hind wings, and followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, curved at the extremities, nodal sector with the basal half more or less undulating, subnodal sector a little broken for the last fourth of its length, where it closely approaches the nodal, several of the intermediate cells generally bisected towards the hind margin; hind wings broader than the fore wings, with 10–11 antenodal and 12–15 postnodal nervures, the first two postnodals not continuous, triangle free, followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle separated at their origin: anal appendages of the male straight, parallel, not much longer than those of the female; legs long, rather stout, hind tibiæ with two rows of about five or six spines.

Type *Libellula vesiculosa*, Fabr.

Genus 67. Mesothemis.

(Neuration &c., Plate LVII. figs. 4, 4 *a*.)

Hagen, Neur. N. Amer. p. 170 (1861); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 369, 721 (1868).

Frontal tubercle slightly concave before; eyes contiguous; abdomen moderately stout, hardly as long as the hind wings, segments 2 and 3 laterally thickened, carinated, and segment 4 with a false carina, segment 5 the slenderest, the abdomen being gradually thickened beyond, segment 8 not perfoliate in female, pterostigma long: fore wings with 10–15 antenodal and 9–11 postnodal nervures, the last antenodal and the first two postnodals not continuous, cells of the lower postnodal area simple, triangle rather narrow, traversed, on a level with that of the hind wings, and followed by three rows of cells, no supratriangular nervures, subtriangular space consisting of three cells, sectors of the arculus stalked, curved at the extremities, lower basal cell with one cross nervure, nodal sector undulating at the base, but hardly beyond the middle, which is arched, the cells between the nodal and subnodal sectors generally bisected towards the hind margin; hind wings distinctly broader than the fore wings, with 6–9 antenodal and 9–11 postnodal nervures, the first two postnodals not continuous, triangle open, followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle distinctly and often widely separated at base: anal appendages of male rather short; spines of legs very strong, especially those on the hind tibiæ (two rows of five to seven) and at the extremity of the hind femora.

Type *Libellula simplicicollis*, Say.

Genus 68. Micrathyria, g. n.

Frontal tubercle concave or slightly bifid; eyes contiguous; abdomen slender, thickened at the base and tip in both sexes, shorter than, or as long as the hind wings, segment 8 not perfoliate in female: wings and pterostigma rather long; fore wings with 10–11 antenodal and 8–9 postnodal nervures, the last antenodal and the first three postnodals not continuous, cells of the postnodal area simple, triangle moderate, on a level with that of the hind wings, traversed or open, followed by two rows of cells, afterwards increasing to three, nearly to the hind margin (the first row beyond the triangle often consisting of three cells), no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells (rarely two), sectors of the arculus stalked, slightly curved at the extremities, nodal sector hardly waved in the middle and not much curved, subnodal sector very slightly irregular beyond the middle, cells between the nodal and subnodal sectors only bisected near the hind margin; hind wings rather broader than the fore wings, with 6–8 antenodal and 7–9 postnodal nervures, the first two postnodals not continuous, triangle free, its base on a level with the arculus, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle widely separated at their origin: spines of the legs slender, moderately long, stiff; claws of the tarsi notched before the tip: anal appendages of the male as long as the eighth segment, or shorter, the lower one a little shorter than the others; appendages of the second segment conspicuous, the hamulus short, recurved.

Type *Libellula didyma*, Selys.

Genus 69. Erythemis.

(Neuration, Plate LV. fig. 3.)

Hagen, Neur. N. Amer. p. 168 (1860); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 368, 723 (1868).

Frontal tubercle distinctly bifid; eyes contiguous in the middle; abdomen rather short and broad, triquetral, about as long as the hind wings, the basal segments considerably expanded when viewed laterally, but not visibly from above, segments 2 and 3 carinated, segment 8 not perfoliate in female: wings rather short, pterostigma moderate; fore wings with 12 antenodal and 9–11 postnodal nervures, the last antenodal and the first two postnodals not continuous, cells of the postnodal area simple, triangle rather narrow, traversed, on a level with that of the hind wings, and followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, regularly curved, nodal sector as in *Mesothemis*, the subnodal sector and upper sector of the triangle a little broken for the last fourth of their length, the cells between the nodal and subnodal sectors only bisected close to the hind margin; hind wings slightly broader than the fore wings, with 8–9 antenodal and 9–12 postnodal nervures, the first two postnodals not continuous, triangle free, followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle widely separated at their origin: anal appendages of male rather short; legs stout, moderately long, femora serrated, with one to three long spines at the extremity, hind tibiæ with about seven pairs of long, straight spines.

Type *Libellula peruviana*, Ramb.

Genus 70. PACHYDIPLAX.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 368, 722 (1868).

Frontal tubercle raised, truncated; eyes contiguous; abdomen moderately stout, as long as the hind wings, of nearly equal breadth throughout, segments 2 and 3 carinated, 4 indistinctly, segment 8 not perfoliate in female: pterostigma rather long; fore wings with 6 antenodal and 5–6 postnodal nervures, the last antenodal always continuous, the first two postnodals not so, cells of the costal area simple, triangle rather broad, traversed, on a level with that of the hind wings, followed by three rows of cells, no supratriangular nervures, subtriangular space consisting of three cells, sectors of the arculus stalked, gradually curved, lower basal cell with one cross nervure, nodal and subnodal nervures continuous, the nodal sector undulating, especially at the base, the intermediate cells only bisected towards the hind margin; hind wings broader than the fore wings, with 5 antenodal and 6–7 postnodal nervures, the first two or three postnodals not continuous, triangle rather long, free, followed by two rows of cells, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle more or less separated: anal appendages of the male moderate, pointed.

Type *Libellula longipennis*, Burm.

Genus 71. CANNAPHILA, g. n.

Frontal tubercle bifid; eyes contiguous; abdomen moderately stout, triquetral, thickest at the base, but not remarkably, and gradually tapering, about as long as the hind wings, segments 2 and 3 carinated, 4 imperfectly, segment 8 perfoliate in female: wings rather narrow, moderately long, pterostigma long; fore wings with 13–15 antenodal and 9–10 postnodal nervures, the first three postnodals not continuous, cells of the postnodal area sometimes bisected on the hind margin, triangle rather small, placed just beyond that of the hind wings, traversed, followed by two rows of cells increasing, or the first row of three, and then a series of two, one supratriangular nervure sometimes present, one or two cross nervures in the lower basal cell, subtriangular space consisting of three cells, sectors of the arculus stalked, gradually curved, nodal sector slightly waved beyond the middle, subnodal sector nearly continuous, the intermediate cells bisected towards the hind margin; hind wings rather broader than the fore wings, with 10–13 antenodal and 9–10 postnodal nervures, the first two or three postnodals not continuous, triangle free, followed by three rows of cells (sometimes four in the first row) increasing, no supratriangular nervures, two cross nervures in the lower basal cell, membranule very small, sectors of the triangle widely separated: anal appendages of the male not much curved, a little longer than the eighth segment, the lower appendage hardly shorter than the others; appendages of the second segment not conspicuous.

Type *Cannaphila insularis*, sp. n.

The above characters are partly based upon a male from Jamaica, and a female from Guatemala, undoubtedly congeneric with *C. insularis*, but not in sufficiently good condition to describe.

Genus 72. Cacergates, g. n.

Frontal tubercle rather broad, a little depressed in the middle; eyes contiguous in front; abdomen moderately stout, considerably thickened at the base, shorter than the hind wings, segments 2–4 carinated, segment 8 not perfoliate in female: wings rather short, pterostigma moderately long, pale or particoloured; fore wings with 8–9 antenodal nervures, the last not continuous, and 6–8 postnodals, the first three or four not continuous, cells of the postnodal area simple, triangle moderate, free, on a level with that of the hind wings, the base straight, followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, subtriangular space consisting of one cell, sectors of the arculus stalked, gradually curved, nodal sector only slightly waved at the base, the subnodal nearly straight, the intermediate cells only bisected close to the hind margin; hind wings broader than the fore wings, with 6–7 antenodal and 7–8 postnodal nervures, the first two or three postnodals not continuous, triangle free, its base nearly coinciding with the arculus, and followed by three rows of cells, increasing, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle widely separated at their origin: anal appendages of the male as long as the last two segments, considerably depressed, the lower one shorter than the others; appendages of the second segment not conspicuous.

Type *Libellula leucosticta*, Burm.

Genus 73. Calothemis.

Selys, Mitth. Mus. Dresd. iii. p. 305 (1878).

Differs from *Orchithemis* as follows:—Abdomen considerably shorter than the hind wings, broader than in *Orchithemis*, and very slightly tapering, especially in the male, eighth segment perfoliate in female: fore wings with the nodal sector more waved and the cells between the nodal and subnodal sectors bisected towards the hind margin, triangle traversed, preceded by one or two supratriangular nervures, two to five cross nervures in the lower basal cell, subtriangular space consisting of three cells; hind wings distinctly broader than the fore wings, triangle traversed, followed by three rows of cells, one or two supratriangular nervures, two or three nervures in the lower basal cell: anal appendages of male as long as the eighth segment, or a little shorter, those of the second segment much less conspicuous than in *Orchithemis*.

Type *Calothemis meyeri*, Selys.

Genus 74. Orchithemis.

(Neuration, Plate LVI. fig. 2.)

Brauer, Sitz. Akad. Wiss. Wien, xlvii. p. 196 (1878).

Frontal tubercle bifid; eyes contiguous for a moderately long space; abdomen moderately broad, nearly as long as the hind wings, gradually tapering towards the extremity, the base not remarkably thickened, segments 2 and 3 carinated: wings rather long and narrow, pterostigma moderate; fore wings with 13–14 antenodal and 8–9 postnodal nervures, the first two postnodals not continuous, cells of the postcostal area simple, triangle rather small, free, followed by two rows of cells, only increasing near the hind margin, subtriangular space consisting of from one to three cells, sectors of the arculus stalked, one supratriangular nervure before the triangle, lower basal cell with one cross nervure, nodal sector continuous, hardly curved at base, this and all the other sectors running nearly straight almost to the hind margin, where they curve downwards gradually, the subnodal sector slightly irregular, cells between the nodal and subnodal sectors simple; hind wings hardly broader than the fore wings, with 11–12 antenodal and 8–10 postnodal nervures, the first two subnodals not continuous, triangle traversed, followed by three and then two and more rows of cells, no supratriangular nervure, two nervures in the lower basal cell, sectors of the triangle rather widely separated at their origin: anal appendages of male slender, curved downwards, as long as the ninth segment, the lower appendage nearly as long as the others; appendages of the second segment very conspicuous.

Type *Orchithemis pulcherrima*, Brauer.

Genus 75. Diplacodes, g. n.

Diplacina, p., Brauer, Verh. zool.-bot. Ges. Wien, xviii. p. 733 (1868).

Frontal tubercle truncated; eyes contiguous; abdomen slender, linear, hardly dilated at the base, about as long as the hind wings, segments 2 and 3 carinated, segment 8 not perfoliate in female; pterostigma rather long: fore wings with 7–9 antenodal and 5–7 postnodal nervures, the last antenodal and the first two or three postnodals not continuous, cells of the subcostal area simple, triangle moderate, nearly always open (when traversed, only by a continuation of the nervure dividing the first two cells), on a level with that of the hind wings, and followed by two rows of cells, no supratriangular nervure, subtriangular space consisting of from one to three cells, when divided it is primarily by a curved nervure cutting off the lower angle, sectors of the arculus stalked, more or less gradually curved, lower basal cell with one cross nervure, nodal sector undulating at the base, subnodal sector very slightly irregular towards the extremity, the intermediate cells only bisected towards the hind margin; hind wings slightly broader than the fore wings, with 5–7 antenodal and 5–7 postnodal nervures, the first two postnodals not continuous, triangle free, followed by three rows of cells, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle widely separated at their origin: anal appendages of the male short and straight.

Type *Libellula tetra*, Ramb.

This genus will include all the species placed in *Diplacina* by Brauer, except his type, *D. nana*, from the Philippines, which is clearly not congeneric with the others. Several species previously referred to *Diplax* will come better here, such as *Libellula nebulosa*, Fabr. (E. Indies), *Diplax exul*, Selys (S. Africa), and *Lib. minuscula*, Ramb. (S. America). In the smaller species (*Diplacodes minuscula* and *nebulosa*) the triangle of the fore wings occasionally shows a tendency to assume a trapezoidal form, as in *Nannophya*, &c., owing to the lower sector of the arculus sometimes, but only occasionally, falling on the base of the triangle before its extremity.

Genus 76. Diplacina.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 173, 368, 733 (1868).

Brauer's typical species is not before me; but it differs sufficiently from *Diplacodes* by the following characters:—Fore wings with the pterostigma short and broad, 12 antenodal and 8–9 postnodal nervures, triangle free, followed by first two, then one, and then two or three rows of cells, subtriangular space divided by a curved nervure, one supratriangular nervure.

Type *Diplacina nana*, Brauer.

Genus 77. Acisoma.

(Neuration, Plate LVI. fig. 5.)

Rambur, Ins. Névr. p. 28 (1842); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 367, 724 (1868).

Frontal tubercle convex above; eyes contiguous in the middle; abdomen as long as the hind wings, segments 2–4 carinated, segments 1–5 broad, but cylindrical, and not inflated, the remaining segments suddenly tapering, and comparatively slender, segment 8 not perfoliate in female: wings and pterostigma moderately long; fore wings with 6–8 antenodals, the last continuous in the type but not in other species, and 6–8 postnodals, the first two not continuous, cells of the postnodal area simple, triangle moderate, free, on a level with that of the hind wings, and followed by two rows of cells, no supratriangular nervure, one cross nervure in the lower basal cell, subtriangular space consisting of one or three cells, sectors of the arculus stalked, more or less gradually curved, nodal sector undulating at the base, subnodal continuous, the intermediate cells only bisected (if at all) on the extreme margin; hind wings only slightly broader than the fore wings, with 5–7 antenodals and 6–8 postnodals, the first two postnodals not continuous, triangle open, followed by three rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell, sectors of the triangle widely separated at their origin: anal appendages of the male hardly longer than those of the female; four hind tibiæ armed with a double row of about seven strong spines.

Type *Acisoma ascalaphoides*, Ramb.

Although there is an Indian species which agrees with Rambur's description of *A. panorpoides*, yet I have not ventured to select it as the type of the genus, as I would have preferred to do, because Rambur figures as well as describes it, and he distinctly represents his insect with four cross nervures in the lower basal cell of the fore wings; if this is correct, it cannot be congeneric with the other species.

There are several doubtful forms from Africa and Madagascar, in all of which (with the exception of a specimen which I regard as the true *A. ascalaphoides* of Rambur) the last antenodal is not continuous. Only one of these is sufficiently well marked for me to venture to describe without more extensive materials then I at present possess.

Genus 78. Neophlebia.

Selys, in Pollen & Van Dam, Faune Madag., Ins. p. 18 (1869); Mitth. Mus. Dresd. iii. p. 315 (1878).

Resembles *Tetrathemis*, but the fore wings have ten antenodal nervures, the last not continuous, and one supratriangular nervure, the lower median cell has one cross nervure on the fore wings and two on the hind wings; the hind wings have no supratriangular nervure, and the wings are partly opaque, at least in the adult male.

Type *Neophlebia polleni*, Selys.

Genus 79. Tetrathemis.

(Plate LII. fig. 4; neuration, Plate LVI. fig. 8.)

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 182, 369, 727 (1868).

Frontal tubercle rounded; eyes large, contiguous in front; abdomen longer than the hind wings and rather slender, second segment considerably dilated at the base, segments 2 and 3 indistinctly carinated, segment 8 not perfoliate in female: wings long and narrow, pterostigma thick, more than twice as long as broad; fore wings with 7–9 antenodal and 5–7 postnodal nervures, the first (or first and second) postnodal not continuous, cells of the postnodal area simple, triangle converted into a trapezium by the lower sector of the arculus striking an angle in the middle of its upper side, small, traversed, followed by one row of cells, subtriangular space consisting of a single, large, cone-shaped cell, with the apex directed outwards, its base nearly coinciding with a line descending from the lower sector of the arculus just beyond its origin, and corresponding to a supratriangular nervure, sectors of the arculus with a very long stalk, and almost straight, lower basal cell with from one to four cross nervures, nodal sector only waved at base, intermediate cells between the nodal and subnodal sectors only bisected on the hind margin, no closed cells below the lower sector of the triangle; hind wings slightly broader than the fore wings, with 6–8 antenodal and 5–6 postnodal nervures, the first postnodal not continuous, triangle free, followed by two (or three) rows of cells, increasing, a supratriangular nervure nearly always present, two to four cross nervures in the lower basal cell, sectors of the triangle distinctly separated at their origin: anal appendages of the male short, rather slender, and curved downwards.

Type *Tetrathemis irregularis*, Brauer.

In the case of aberrant genera like this, it is often necessary to place several rather dissimilar forms together until they are better known, and the limits of their variation can be more positively ascertained.

Genus 80. BRACHYGONIA, g. n.

Frontal tubercle rounded; eyes large, contiguous in front; abdomen nearly as long as the hind wings, moderately slender and slightly tapering, segments 2 and 3 carinated: wings rather long and narrow, pterostigma moderate; fore wings with 6–7 antenodal and 5 postnodal nervures, the first two (rarely three) postnodals not continuous, cells of the postnodal area simple, triangle converted into a trapezium, the outer angle being truncated, but very slightly, free, followed by two rows of cells, separated by a line zigzag to the middle of the wing, and then nearly continuous, no supratriangular nervures, subtriangular space consisting of one cell (rarely divided by a curved line), sectors of the arculus stalked, very slightly curved, lower basal cell with one cross nervure, the nodal sector hardly waved, even at the base, the subnodal sector more or less irregular beyond the middle, cells between the nodal and subnodal cells simple, no closed cells below the lower sector of the triangle; hind wings not much broader than the fore wings, with 5 antenodal and postnodal nervures, the first two postnodals not continuous, triangle free, very short, its base halfway between its apex and the arculus, followed by two rows of cells, no supratriangular nervures, one cross nervure in the lower basal cell: anal appendages of male slender, as long as the eighth segment, the lower segment nearly as long as the upper ones, sectors of the triangle separated by at least half the length of its outer side, or more; appendages of the second segment distinct, not very prominent.

Type *Tetrathemis oculata*, Brauer.

In all the specimens of the male the abdominal segments 2 (behind the carina), 3, and 4 to the middle are dusted with pale blue. This is absent in the only female specimen.

Genus 81. NEPHEPELTIA, g. n.

Allied to *Nannothemis*, but the middle segments of the abdomen very long and slender, the basal and terminal segments (especially the seventh and eighth) much dilated; the hinder part of the pectus with a very strong spine, pointing backwards; upper anal appendages in the male longer than the eighth segment, depressed and recurved, the lower appendage only half as long as the others; appendages of the second segment very prominent: fore wings with 6 antenodal and 5 postnodal nervures; hind wings with 5 of each, all the first postnodals not continuous; trapezium of fore wings followed by two and then more cells; upper sector rising a little above the lower angle; on the hind wings the upper sector of the triangle rises about the middle of its outer side.

Type *Libellula phryne*, Perty.

Genus 82. Nannodythemis.

(Plate LII. fig. 5.)

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 369, 726 (1868).

Frontal tubercle rounded; eyes contiguous in front; abdomen a little thickened at the base, the middle segments slender, and the hinder ones considerably thickened and somewhat flattened, longer than the hind wings, segments 2–4 carinated: pterostigma moderate, a little longer on the hind wings (as is the case to a less extent in the allied genera); fore wings with 5 antenodal and 3–5 postnodal nervures, the first postnodal not continuous, cells of the postcostal area simple, triangle converted into a trapezium, free, followed by two rows of cells, the upper row divided towards the hind margin, no supratriangular nervures, subtriangular space consisting of one cell, sectors of the arculus stalked, the upper sector angulated before the nodus, lower basal cell with one cross nervure, the nodal sector much waved at the base, the other sectors very slightly, the intermediate cells simple, the upper sector of the trapezium rising about the middle of its outer side; hind wings rather broader than the fore wings, with 4 antenodal and 4 postnodal nervures, the first postnodal not continuous, triangle converted into a trapezium, as on the fore wings, followed by two and then more rows of cells, the base of the nodal sector slightly waved, but much less so than on the fore wings, no supratriangular nervures, two cross nervures in the lower basal cell, upper sector of the trapezium rising at about the middle of its longest side: anal appendages of the male very short, a little curved downwards, those of the second segment moderately well developed.

Type *Nannodythemis australis*, Brauer.

Genus 83. Nannophlebia.

Selys, Mitth. Mus. Dresd. iii. p. 315 (1878).

Differs from *Nannodythemis* in its larger size, the absence of any supratriangular nervures, and of more than one cross nervure in the lower basal cell, and in the base of the trapezium of the hind wings being formed by the prolongation of the arculus: fore wings with 7 antenodal nervures; hind wings with 6; 5–6 postnodal nervures on all the wings.

Type *Neophlebia lorquini*, Selys.

Genus 84. Nannodiplax.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 369, 556, 725 (1868).

Frontal tubercle convex; eyes contiguous; abdomen shorter than the hind wings, hardly thickened at the base, segments 2 and 3 carinated: pterostigma short; fore wings with 7 antenodal and 6 postnodal nervures (those not continuous not stated), triangle replaced by a narrow trapezium (broad in all the allied genera), followed by first two and then three rows of cells, subtriangular space consisting of one very narrow cell, sectors of the arculus stalked, nodal sector scarcely waved; hind wings rather broader than the fore wings, the triangle normal.

Type *Nannodiplax rubra*, Brauer.

The characters are compiled from Brauer's description.

Genus 85. Fylgia, g. n.

(Plate LI. figs. 2, 3.)

Frontal tubercle rounded; eyes large, contiguous in front; abdomen moderately broad, a little constricted at the base, about as long as the hind wings, segments 2–4 carinated, segment 8 not perfoliate in female: pterostigma moderate; fore wings with 8–10 antenodal nervures, the last not continuous, and 5–6 postnodals, the first not continuous; hind wings with 6–7 antenodals and 5 postnodals, the first postnodal not continuous; fore wings with cells of the postcostal area simple, triangle converted into a trapezium, free, followed by one row of cells almost to the margin, subtriangular space consisting of one cell; sectors of the arculus with a long stalk, the upper sector slightly angulated before the middle, no supratriangular nervures, lower basal cell with one cross nervure, nodal sector only slightly curved at base, cells between the nodal and subnodal sectors simple nearly to the hind margin, upper sector of the triangle rising at its apex in male, just above in female; hind wings with the triangle regular, its base formed by the prolongation of the arculus, followed by three rows of cells, then two, and more, upper sector of the triangle rising at about one third of the distance from the apex: upper anal appendages of the male shorter than the eighth segment, pointed, the lower appendage not much shorter, appendages of the second segment only moderately prominent.

Type *Fylgia amazonica*, sp. n.

Genus 86. Nannothemis.

Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 369, 726 (1868).
Nannophya, Hag. Neur. N. Amer. p. 186 (1861).

Frontal tubercle rounded; eyes large, contiguous in front; abdomen moderately slender, cylindrical, shorter than the hind wings, segments 2–4 carinated, segment 8 not perfoliate in female: pterostigma rather small; fore wings with 6–7 antenodal and 5–6 postnodal nervures, the first postnodal not continuous, cells of the postnodal area simple, triangle converted into a trapezium, open, followed by one row of cells, then two, subtriangular space consisting of one cell, sectors of the arculus with a long stalk, gradually curved, lower basal cell with one cross nervure, nodal sector curved at base, the subnodal slightly irregular, intermediate cells only divided on the hind margin, sectors of the triangle rising together at its apex; hind wings slightly broader than the fore wings, with 5 antenodal and postnodal nervures, the first postnodal not continuous, triangle regular, its base corresponding with the continuation of the arculus, open, followed by two rows of cells, the upper sector rising above the middle of its outer side.

Type *Nannophya bella*, Uhl.

The description of the genus is partly compiled from those of Hagen and Brauer, and partly from *N. sylvia*, sp. n. Hagen's *N. maculosa*, which is described as having 8 antenodals, and first two cells, and then one beyond the triangle, may not be congeneric; the species which seems to represent Hagen's *Nannophya semiaurea* (MS.) certainly is not.

Genus 87. Nannophya.

(Neuration, Plate LVI. fig. 7.)

Rambur, Ins. Névr. p. 27 (1842); Brauer, Verh. zool.-bot. Ges. Wien, xviii. pp. 369, 726 (1868).

Frontal tubercle rounded; eyes contiguous in front; abdomen moderately slender, hardly thickened at the base, shorter than the hind wings, segments 2 and 3 carinated: pterostigma moderate, about two and a half times as long as broad; fore wings with 6–7 antenodal nervures, the last rarely continuous, and 4–5 postnodals, the first, and sometimes the second also, not continuous, cells of the postcostal area simple, triangle converted into a trapezium, free, followed by one or two rows of cells, no supratriangular nervures, subtriangular space consisting of one cell, sectors of the arculus stalked, the upper sector angulated before the middle, lower basal cell with one cross nervure, nodal and subnodal sectors and lower sector of the arculus regularly curved, cells between the nodal and subnodal sectors simple; hind wings broader than the fore wings, with 4–5 antenodal and 4–6 postnodal nervures, the first postnodal not continuous, triangle large, free, followed by one row of cells (the first cell sometimes divided), and then more, no supratriangular nervure, one cross nervure in the lower basal cell, sectors of the triangle united at their origin: appendages of the second abdominal segment in the male prominent.

Type *Nannophya pygmæa*, Ramb.

Genus 88. Fylla, g. n.

(Plate LII. fig. 6.)

Frontal tubercle rounded; eyes contiguous in front; abdomen moderately slender, cylindrical, hardly thickened at the base in the male, and not at all in the female, in which the abdomen is rather stouter, not thickened before the extremity in either sex, and distinctly shorter than the hind wings, segments 2 and 3 carinated, also 4 in female: wings short, rounded, pterostigma small, twice as long as broad; fore wings with 5 antenodal nervures and 4 postnodal nervures, the first postnodal not continuous, cells of the postnodal area simple, triangle converted into a trapezium, free, followed by two rows of cells, no supratriangular nervures, subtriangular space consisting of one rather large cell, sectors of the arculus stalked, upper sector angulated before the middle, lower basal cell with one cross nervure, the nodal sector a little waved at the base, the subnodal nearly continuous, and the intermediate cells simple, upper sector of the triangle rising on all the wings about the middle of its outer side; hind wings broader than the fore wings, with 4 antenodal and 4 postnodal nervures, the first postnodal not continuous, triangle free, followed by two rows of cells; no supratriangular nervures, one cross nervure in the lower basal cell: anal appendages of the male slender, as long as the eighth segment, lower appendage nearly straight, as long as the others; appendages of the second segment not very prominent.

Type *Fylla exigua*, sp. n.

PART IV.

Descriptions of New Species.

Hydrobasileus vittatus. (Plate LI. fig. 10.)

Tramea quadrivittata, Hag. MS.

Long. corp. 47 millim.; exp. al. 76 millim.; long. pter. 3 millim.

Male.—Head dull red, the upper part of the front deeply excavated below the frontal ocellus, and blackish; rhinarium also black. Thorax reddish above; pleura yellowish green, with black sutural lines. Abdomen with transverse carinæ on the first three segments, which are red, with black dorsal and lateral carinæ and sutures, beyond this point black extends more and more over the abdomen, till on the sixth segment there are only two red dots in the middle and a small red streak on each side, the remaining segments (above) and appendages are quite black; on the under surface the abdomen is black, with a long pale yellow stripe on each side of all the segments. Anal appendages about as long as the last two segments, upper appendages arched and bristly, lower appendage nearly as long as the others, stout, conical, and slightly curved up at the tip. Wings rather long and narrow; fore wings with 16 antenodal (one supernumerary) and 8 postnodal nervures; pterostigma rather short and broad, reddish, covering one and a half cells, triangle long and moderately broad, with two transverse nervures, followed by four cells in the first row, and then by three; wings reddish hyaline, with reddish-brown nervures, and a rusty brown band running across the wings just within the nodus, not quite reaching the hind margins nor (in the hind wings) the costa; membranule blackish, slightly bordered with white; base of the inner margin of the hind wings with a rusty brown blotch.

Hab. Menado, Celebes (*Wallace*).

ANTIDYTHEMIS TRAMEIFORMIS. (Plate LI. fig. 4.)

Dythemis (?) *trameiformis*, Selys, MS.

Long. corp. 48 millim.; exp. al. 100–110 millim.; long. pter. 7 millim.

Rufous, mentum yellow, back of last three abdominal segments above, anal appendages, and tarsi black. Wings yellowish hyaline, iridescent, more strongly tinged with smoky yellow towards the tips, nervures brown or reddish; pterostigma yellow between blackish nervures; hind wings purplish brown at the base to beyond the triangles, this colour projecting at two thirds of the breadth of the wing from the costa, and again upon the hind margin; below the lower basal cell is a vitreous space in the female; in the male two vitreous spaces are visible on the right side only, one below the lower basal cell, and another below the triangle. Anal appendages of male longer than the eighth segment, slightly thickened in the middle, and pointed, the middle one nearly as long as the lateral ones, those of the second segment not conspicuous, the last division globular; anal appendages of female small.

Hab. Para.

TRAMEA DARWINI. (Plate LI. fig. 1.)

Long. corp. 45 millim.; exp. al. 84 millim.; long. pter. $3\frac{1}{2}$ millim.

Female.—Greenish yellow, suture on which the frontal ocellus stands blackish; lower parts of the mouth more inclining to orange; labrum edged below with a black line; pleura with two rather indistinct yellowish stripes. Legs dark brown, pale beneath and at the base of the femora. Abdomen reddish brown, dorsal carina unicolorous, lateral carina black, last three segments black, reddish on the sides at the base; anal appendages reddish brown, nearly as long as the last two segments, nearly straight, slightly approximating, slender, and hairy. Wings very clear hyaline, veins brown, paler towards the costa; pterostigma yellow, enclosed by dark brown nervures, rather longer on the fore wings than on the hind wings; fore wings with 11–12 antenodal and 11–12 postnodal nervures, triangle rather narrow, followed by four rows of cells; hind wings with the membranule white, bordered by a narrow black line, the usual opaque spot beyond unusually small, though varying a little in shape and size.

Hab. Galapagos Islands.

The reddish body, clear hyaline wings, and very small opaque spot on the hind wings render this species very distinct from any described American *Tramea*. There are five specimens in the British-Museum collection, but only one in fairly good condition.

TRAMEA TRANSLUCIDA.

Long. corp. (absque app.) 48 millim.; exp. al. 88 millim.; long. pter. 3 millim.

Female.—Head pale testaceous yellow in front; frontal tubercle and occipital triangle more waxen, the front of the former above the frontal ocellus reddish brown, shading below into black, in front of the ocellus is a violet-black stripe; rhinarium blackish; mandibles red, black at the base. Thorax extremely villous, testaceous yellow, with black lines on the sutures of the pleura. Legs black; coxæ, trochanters, and base and under surface of the femora reddish; tibiæ with rather long spines. Abdomen yellowish brown, the sutures rather broadly brown, and the upper surface of the last three segments black, the sides yellowish brown; anal appendages destroyed; the two basal segments of the abdomen are clothed beneath (like much of the thorax and especially the pectus) with long grey hairs. Wings clear hyaline, with brown nervures; fore wings with 11–12 antenodal and 10 postnodal nervures; pterostigma rather short, yellow, between slender black nervures; triangle rather large, crossed by one nervure, and followed by four rows of cells; hind wings with a dark brown basal patch, extending as far as the first antenodal nervure and the base of the triangle, occupying the first two subnodal cells, and extending below the lower subnodal sector for three more cells, and then rounded off, terminating at about three fourths of the length of the inner margin. Membranule white, just beyond the membranule is a large hyaline space, running half across the brown patch, the four cells below the lower basal cell are marked with large oval subhyaline spots, and there are pale spots in some of the other dark cells.

Hab. North India.

Possibly the female of *T. stylata*, Ramb., to which it is closely allied.

TRAMEA BURMEISTERI.

Libellula chinensis, Burm. (nec De Geer), Handb. Ent. ii. p. 852, no. 27 (1839).

Long. corp. 49 millim.; exp. al. 80 millim.; long. pter. 3 millim.

Testaceous yellow. Head yellow; labrum darker, with the extremity blackish. Thorax testaceous; the pleura spotted with black on the sutures. Front legs reddish, striped with black; the four hinder legs blackish, except at the base of the femora. Abdomen testaceous above and more or less blackish below, the sutures broadly black on the sides above, more narrowly on the median line, the last three segments entirely black in the middle above, testaceous at the base on the sides: upper anal appendages reddish, a little shorter than the last three segments, depressed at the base, and then straight; lower appendage short, not much more than one third of the length of the upper ones; appendages of the second segment rather prominent; hamulus long, slender, with a small tooth near the extremity. Wings hyaline, the nervures reddish, or yellowish in male, brown in female; fore wings with 11–14 antenodal and 8–10 postnodal nervures; triangle rather narrow, oblique, crossed by one nervure, and followed by four rows of cells; hind wings with the membranule white, the rest of the base of the hind wing yellow to the second antenodal nervure, as far as the triangle, and along the course of its lower sector and the subbasal sectors, thence curving round to about three fourths of the length of the inner margin of the wing, and thus not extending to the anal angle; more or less of the lower basal cell and part of the wing below adjacent as far as the base of the triangle is filled up by a brown band, which is sometimes continued within the first subbasal sector for a short distance, and then curves round more broadly towards the inner margin, which it does not reach; but it is more frequently detached from the broad brown band which runs from the base of the sector of the triangle nearly to the inner margin. Meshes of the hind wings rather large.

The sexes differ little. The anal appendages in the female are shorter than in the male.

Hab. N. India (common), Ceylon.

Nearly allied to the African *T. basilaris*, Beauv., in which, however (judging from the single broken specimen before me), the yellow area on the hind wings is much less extended, and the opaque spaces (of which the upper one is much more extended) are nearly black. It has very little resemblance to *T. chinensis*, De Geer, with which Burmeister confounded it.

TRAMEA MADAGASCARIENSIS.

Long. corp. 50 millim.; exp. al. 96 millim.; long. pter. $3\frac{1}{2}$ millim.

Male.—Reddish brown, villous, vertex below the ocellus violet, this colour extending, though paler, to the front of the frontal tubercle, tips of mandibles blackish. Thorax with somewhat indistinct blackish markings on the pleura. Abdomen sometimes with obsolete black lines on the sides of the second and third segments, and obsolete black dots on each side towards the extremities of the following segments above; the last three segments black in the middle above, but more narrowly than usual. Legs black, front femora reddish beneath to the middle; appendages of the second segment very conspicuous, the lateral appendages slender and slightly hooked backwards; anal appendages fully as long as the last three segments, slender, black, with a red basal spot, curved downwards and approximating at the base, then parallel, and again separating a little, and acuminate at the extremity. Wings hyaline, most of the nervures on the costa to beyond the nodus, and at the base up to or beyond the triangles, reddish, the rest black, 12–13 antenodal and 9–10 postnodal nervures; triangles rather long, followed by four rows of cells (five cells first on the left wing), and with two cross nervures (sometimes one); pterostigma yellow, between two black nervures; hind wings with the membranule white, the opaque space (except a slight clouding on the nervures above) commencing with the lower basal cell, only touching the first subbasal sector at its base, and then dropping downwards almost perpendicularly, though slightly indented on each cell, and then curving off gradually towards the anal angle, which it does not quite reach; this opaque space is of the usual reddish-brown colour, with reddish nervures, and is almost entirely uniform, only the edges being rather paler here and there; there is no vitreous space on the inner margin, and there are no pale centres to any of the cells.

Hab. Betsileo, Madagascar.

Allied to *T. limbata*, Desj., and *erythræa*, Brauer. The only specimen of *Tramea* which we possess from Mauritius has yellowish-hyaline wings with black nervures, a wider band on the hind wings, more dentated on the outside than in *madagascariensis*, and a large vitreous space on the inner margin. It agrees with Rambur's *T. mauriciana*, except that Rambur does not mention the vitreous spot; nor does Desjardin, whose description is very vague, though his species may be regarded as identical with Rambur's insect. From Rodriguez we have two specimens of *Tramea*; one agrees with the Mauritian specimen of *T. linbata*, just mentioned, and the other is a new species (allied to *T. erythræa*, Brauer, which the British Museum does not possess), but which cannot be confounded with any other species on account of the shortness of the anal appendages. It is, however, too much damaged for description.

TRAMEA MADAGASCARIENSIS ♀ (?).

Differs from the male in the shape of the opaque patch of the hind wings, which is very similar to that of the Australian *T. rosenbergii*, Brauer. It extends along the lower basal cell to the point of departure of the first subbasal sector, and then drops downwards, and curves inwards towards the inner margin at hardly two thirds of the length of the wing, but leaving the whole inner margin and even a large space between the band and the lower end of the white membranule free, and several of the cells on the edges of this small dark stripe, which it partially invades, are otherwise yellowish, instead of clear hyaline; the triangle of the fore wings is crossed by two nervures, and is followed by four rows of cells. The anal appendages are nearly as long as in the male, black, with the base reddish, straight, and slightly convergent.

It is possible that this insect is the female of an allied species; but it so closely resembles the male of *T. madagascariensis* that I should hesitate to describe it as new, unless the arrival of more specimens should show that the difference in the shape of the dark band of the hind wing is constant in both sexes of each.

MIATHYRIA PUSILLA. (Plate LII. fig. 3.)

Long. corp. 28–30 millim.; exp. al. 55–60 millim.; long. pter. 2 millim.

Reddish testaceous, sides of the thorax probably varied with yellowish and black markings in fresh specimens. Abdomen with a black spot at the end of the third and following segments of the abdomen above, sometimes coalescing into a continuous black dorsal stripe. Legs reddish brown, more or less of the femora, especially beneath, dull yellow. Wings clear hyaline with brown or reddish nervures; pterostigma dirty white; fore wings with 7 antenodal and 5 postnodal nervures; hind wings with 4 antenodal and 6–7 postnodal nervures; hind wings with a brown blotch (in which the nervures are white) at the base, beyond the pure white membranule, but not extending to the anal angle; between the membranule and the bltoch are one or two nearly colourless cells.

Hab. Santarem, Tapajos.

RHYOTHEMIS APICALIS. (Plate LI. fig. 5.)

Long. corp. 28 millim.; exp. al. 60 millim.; long. pter. $2\frac{1}{2}$ millim.

Female.—Head metallic green above, coarsely punctured, black behind and beneath, the ocelli, the under surface of the front, and the rhinarium testaceous. Thorax with brassy-green reflexions. Abdomen black, with brassy-green reflexions on the sides, but much less distinct than on the thorax. Legs dull black. Wings clouded hyaline, yellowish on the basal third and on the costa; pterostigma black, the apex of all the wings beyond smoky brown; fore wings with 11 antenodal and 10–11 postnodal nervures; sectors of the arculus not stalked; triangle rather wide, crossed by one nervure, and followed by four rows of cells; subtriangular space consisting of 4–5 cells, a series of small, almost connected, reddish-brown spots extends along the antenodal cross nervures, filling up the first space from just beyond the sixth to the eighth, where it expands into a large blotch, irregular on both sides, extending from the costa to the upper sector of the arculus beyond the nodus; there is a smaller irregular blotch occupying the upper cell of the triangle, extending above it towards the base for a short distance below the lower sector of the arculus; it also projects a little below the transverse nervure of the triangle. On the hind wings the base, to two fifths of the width of the wing, is covered with a large irregular blotch, which extends to beyond the nodus, though relieved by a yellowish interrupted line on the costa to the fifth antenodal cross nervure, yellowish spaces in the upper basal cell and beyond, and a series of three or four paler spots at about two thirds of the length of the basal blotch. From the inner margin runs another broad reddish-brown blotch to nearly one third of the length of the wing; the space between this and the upper blotch, and the narrower space between the lower blotch and the hind margin, are decidedly yellowish.

Hab. New Hebrides.

Perhaps nearest to *R. dispar*, Brauer, but very distinct from any described species.

RHYOTHEMIS TRIANGULARIS.

Long. corp. 27 millim.; exp. al. 52 millim.; long. pter. $1\frac{1}{2}$ millim.

Male.—Greenish black, vertex and back of thorax steel-blue, clypeus and labrum reddish. Legs blackish, set with long slender bristles. Wings dark brown towards the base, with violet reflexions, the centre of most of the cells towards the costa rather lighter; fore wings with one or two cross nervures in the triangle, followed by three rows of cells (sometimes four in the first row), 8 antenodal and 8 or 9 postnodal nervures, the last antenodal and the first three postnodals not continuous; subtriangular space consisting of 3–4 cells. On the fore wings the opaque portion extends to between the fourth and fifth antenodal cross nervure, and its outline coincides very nearly with the outer side of the triangle; above the triangle there are two slight projections, and below the triangle the opaque portion runs straight down very nearly to the inner margin, but turns a little towards the base just before reaching it. On the hind wings the opaque portion extends to the nodus, the centre of the last antenodal cells, however, being clear; its outline runs down to the hind margin nearly below the last antenodal cross nervure, but with two irregular dentated projections in the middle. Pterostigma short, black, about twice as long as broad. The transparent portion of the wings is iridescent hyaline, especially beyond the middle of the wings. Anal appendages of ordinary form, about as long as the last two segments of the abdomen.

Hab. Borneo.

Allied to *R. semihyalina*, Desj., from Mauritius, and *R. resplendens*, Selys, from Australia and New Guinea; but (apart from other differences) the transparent portion of the wings is clear hyaline in these species.

One male has the opaque part of the wings black, shading into greenish and deep violet, and less extended, ceasing beyond the third antenodal cross nervure on the fore wings, and only extending to the triangle (which it does not invade) at the inner and upper angle; on the hind wings it ceases at the last nervure before the nodus. It is probably a variety, but may be distinct, as the anal appendages seem rather shorter than in typical specimens.

RHYOTHEMIS CUPRINA. (Plate LI. fig. 6.)

Long. corp. 25 millim.; exp. al. 52 millim.; long. pter. 2 millim.

Female.—Head violet above, reddish below, clothed with long hair in front, rhinarium black. Thorax clothed with long grey hair, coppery green above and reddish below. Legs long and slender, reddish brown, darkest on the tibiæ. Abdomen violet-black above, with slight coppery-green reflexions on the sides, and reddish beneath. Wings brown, with a strong coppery iridescence, the principal nervures brown, most of the cross nervures coppery green; pterostigma concolorous, but the apex of the fore wings beyond, as far as the subnodal sector, an irregular space occupying the first two subnodal cells, and descending as far as the upper sector of the arculus, a small spot just beyond the apex of the triangle, several cells below, on the inner margin, and a spot on the hind margin at the extremity of the sectors of the arculus, clear hyaline; several of the cells near the costa and base are likewise slightly marked with paler in the middle. On the hind wings the transparent space beyond the nodus does not extend to the costa, and that at the apex is smaller, semicircularly scooped out on the costa from just beyond the pterostigma to the apex; from the inner margin beyond the grey membranule run two rows of subhyaline spots, slightly converging, and ceasing a little before and nearly below the triangle; beyond the lower row are two more spots placed obliquely downwards in the direction of the hind margin; besides these there are three or four more distinctly hyaline and larger spots above the upper sector of the triangle, beyond the first row of discoidal cells; all the cells on the hind margin, between the anal angle and the extremities of the sectors of the arculus, are likewise subhyaline. Neuration somewhat irregular, but very similar to that of *R. notata*, Fabr., to which this species is closely allied; fore wings with 8 antenodal and 7 subnodal nervures, triangle rather broad, crossed by two nervures on one side and by three on the other (in the latter, the second cell from the tip is longitudinally bisected), and followed by five rows of discoidal cells (first row on one side of four only). Subtriangular space consisting of eight cells. Anal appendages short but distinct, slightly curving upwards, and acuminate.

Hab. Sierra Leone.

RHYOTHEMIS OBSOLESCENS.

Long. corp. 24 millim.; exp. al. 46 millim.; long. pter. 2 millim.

Male.—Allied to *R. fulgens*, but with the wings, especially the hind wings, rather longer and narrower. Upper part of the head and labium bronzed, face otherwise testaceous. Thorax and abdomen blue-black. Legs wanting. Appendages of the second segment of the abdomen not prominent. Upper anal appendages rather shorter than the last two segments, slender at the base, curving downwards, thickened at the extremity, and not sharply pointed. Lower appendage three fourths as long as the other, very slender, curving upwards, and with a very conspicuous excrescence on the upper surface, just before the middle. Wings brown, slightly iridescent; fore wings with 8 antenodal and 5 postnodal nervures (the last antenodal nervure is not continuous, but there are, nevertheless, 8 in the lower space, where an additional nervure is intercalated between the fourth and fifth). The antenodal nervures of both the subcostal spaces of the fore wings form the diagonals of nearly square dark spots, set obliquely to the costa. Beyond the nodus, the spaces before the third postnodal nervure, and the spaces below, to beyond the subnodal sector, form a large pale triangle; and all the cells around the pterostigma, and between the postnodal nervures of the upper space, and the last two nervures of the lower space are likewise paler. On the hind wings the costal markings are nearly similar, but the hind margin is pale from the anal angle to just beyond the subnodal sector, and there are two pale bars running from the middle of the inner margin to about one seventh of the length of the wing, the uppermost nearly straight, the lower one narrower, curved upwards, and with a third short pale streak below its inner extremity; a little beyond the triangle is likewise an ill-defined pale space. Triangle of the fore wings divided by two nervures, and followed by five rows of cells (four in the first row on one side, owing to the disappearance of a nervure). Subtriangular space consisting of six cells.

Hab. Borneo.

This species is interesting as forming a connecting link between the sections represented by *R. phyllis*, Selys, and *R. pygmæa*, Brauer. The pale markings in *R. obsolescens* correspond to the yellow markings of the hind wings in the former group.

RHYOTHEMIS FULGENS.

Rhyothemis fulgens, Selys, Mitth. Mus. Dresd. iii. p. 300 (1878), not described.

Long. corp. 26 millim.; exp. al. 42 millim.; long. pter. 2 millim.

Male.—Allied to *R. pygmæa*, Brauer, from New Guinea, and almost exactly agreeing with it in dimensions. Head steel-blue, thorax and abdomen coppery green, both the head and thorax villous. Wings brownish hyaline, iridescent, with coppery-green and fiery-red reflections, the submarginal cells just beyond the nodus rather paler than the rest of the wing; fore wings with 8 antenodal and 6 postnodal nervures, the last antenodal and the first two or three postnodals not continuous; triangle of the fore wings with two transverse nervures, and followed by four rows of discoidal cells. Subtriangular space consisting of 5–6 cells. Legs reddish, spiny. Appendages of the second segment rather prominent, hairy; hamulus very slender, recurved; upper anal appendages as long as the last segment, hairy, curved dowwards in the middle, and then straight; lower appendage about two thirds as long as the upper. Another specimen, a male, possibly belonging to the same species, is darker and less shining; the head and thorax are steel-blue, and the abdomen is nearly black.

Hab. Sarawak.

Evidently closely allied to *R. pygmæa*, Brauer, from Papua, but that species is described as having nine antenodal and eight postnodal cross nervures on the fore wings, and as having the triangle of the fore wings divided by one nervure only.

NEUROTHEMIS DISPARILIS[1]. (Plate LIV. fig. 8.)

Long. corp. 30 millim.; exp. al. 42–56 millim.; long. pter. 3 millim.

Male.—Reddish brown. Abdomen with longitudinal black spots on the sides of segments 3–7 and on the back of the two following segments. Wings hyaline, suffused with yellow or chestnut-brown from the base to beyond the triangle, and occasionally as far as the nodus, the first costal space and upper basal cell clearer; pterostigma yellow between black nervures; fore wings with 14 antenodal (12–14 in female) and 9–11 postnodal nervures, the last antenodal and first three postnodals not continuous; triangle composed of three to seven cells (in female sometimes only one cross nervure), and followed by four or five rows of cells: subtriangular space composed of six to ten cells; nodal and subnodal sectors continuous, the former arched, the last three or four cells between the nodal and subnodal sectors, and between the sectors of the arculus generally, bisected, and sometimes one or two other cells irregularly in addition; hind wings with 8–11 antenodal and 9–11 postnodal nervures, the first three

[1] Among the Odonata obtained by Mr. C. M. Woodford in the Solomon Islands is a long series of a species which appears to be identical with *Neurothemis innominata*, Brauer, which Brauer subsequently regarded as a form of *N. oculata*, Fabr. It varies very little in either sex.

I have taken the present opportunity to describe three new species of Libellulinæ taken by Mr. Woodford in the Solomon Islands. A fuller account of the Odonata of these islands may possibly appear when larger materials are received.

postnodals and occasionally the last antenodal not continuous, triangle followed by three cells, traversed by one or two nervures, a supratriangular nervure generally present, two or three cross nervures in the lower basal cell: anal appendages as long as the ninth segment, a little curved upwards at the tips, and pointed, the lower one nearly as long as the lateral ones; those of the second segment not conspicuous.

Female.—More yellow, with the black spots on the abdomen more distinct. Wings hyaline, slightly tinged with yellow along the costa as far as the nodus, and more distinctly towards the anal angle; neuration nearly as in the male.

Hab. Borneo.

Allied to *Libellula fluctuans*, Fabr., also a very common insect in Borneo; but in all the specimens of *L. stigmatizans* and *L. fluctuans* before me there is a double row of cells between the nodal and subnodal sectors for almost their entire length, or even three or four in some of the closely allied forms which authors class under these species. As the neuration appears to be fairly constant in a good series of both sexes of *N. disparilis*, I regard it as a perfectly good species, notwithstanding the peculiar difficulties of variation and dimorphism alleged to exist in the genus *Neurothemis*. It is also allied to *N. degener*, Selys, from India, which differs in having only three cells in the subtriangular space.

NEUROTHEMIS AFFINIS. (Plate LIV. fig. 2.)

Long. corp. 41 millim.; exp. al. 60 millim.; long. pter. $5\frac{1}{2}$ millim.

Male.—Inky black, only the frontal ocellus, the mandibles, and the anal appendages yellowish. Abdomen much longer and more slender in proportion than in *N. tullia*, Drury. Wings dark violet-brown from the base to two fifths of the distance between the nodus and the pterostigma, the remainder clear hyaline; fore wings with the costa very narrowly edged below with hyaline from the base nearly to the nodus, and the subcostal nervure similarly edged below from the base to half the distance to the level of the nodus; most of the cells with paler centres; the upper basal cell also subhyaline; pterostigma very long and rather broad, 12–13 antenodal and 10 postnodal nervures, the last antenodal and first two or three postnodals not continuous; triangle moderate, traversed by a nervure, and followed by three cells. Subtriangular space consisting of four cells. The hind wings appear darker than the fore wings, owing to their cells not being centred with paler.

Hab. Barang.

Very close to *N. tullia*, but can hardly be a variety. The latter species is very constant, only varying a little in size and depth of colour. The description of *N. decora*, Brauer, from Amboina, somewhat resembles this, but has a milk-white band between the dark space and the pterostigma, and 18–20 antenodal and 11–13 postnodal nervures, besides other differences. Brauer now refers his *N. decora* to *palliata*, Ramb., itself hardly distinct from *N. fluctuans*, Fabr.

Perithemis bella. (Plate LI. figs. 8 ♂, 9 ♀.)

Perithemis bella, Hag. MS. (?).

Long. corp. 23 millim.; exp. al. 34 millim.; long. pter. $2\frac{1}{2}$ millim.

Male.—Body brown, the face, the pleura, and the sides of the base of the abdomen yellowish; thorax with a central reddish stripe, and broader oblique ones on each side just before the base of the fore wings; the first three segments are paler above (though less conspicuously than below) and segments 2–4 carinated, a double row of small dark spots (sometimes expanding into blotches at the base) runs down the back of the abdomen, the carinated segments being marked with two on each side, and the others with one only; the dorsal and lateral carinæ are black. Fore wings hyaline, more or less deeply yellow at the base to beyond the triangles, on both the upper and lower antenodal to the nodus, and from the nodus to the pterostigma on the first postnodal space only; pterostigma red, bounded below only by a black line, the neuration of the rest of the wings is mostly brown. Hind wings wholly yellow, pterostigma as above; membranule white, narrowly edged with black. Fore wings with 7 antenodal and 4 or 5 postnodal nervures; triangle rather wide, open or traversed, followed by two or three rows of cells, subtriangular space consisting of three cells; hind wings with the triangle open. The abdomen is shorter and flatter than in *P. domitia,* Drury, and considerably widened in the middle. Anal appendages about as long as the ninth segment.

Female.—Brown, face, pleura, and base of abdomen beneath dull white rather than yellowish, the thorax with the reddish markings much extended, leaving only a broad yellowish stripe on each side above, the abdomen greatly constricted at the base, and much flattened and widened in the middle, narrowing again towards the tip, brown, blackish in the middle, with a row of long, slightly constricted spots or short yellowish stripes on most of the segments on each side of the black dorsal carina; wings with the nervures brown, the costa blackish, pterostigma brownish yellow, enclosed by blackish nervures; all the triangles open, that of the fore wings followed by two rows of cells; subtriangular space consisting of one cell only. Wings hyaline, lower antenodal space yellow, spotted with brown on several of the cross nervures; a brown spot, partly bordered with yellow, covers the nodus; hind wings hyaline at base and tip, more or less of the middle of the wing yellow from the costa to the hind margin; a brown spot on the nodus, extending towards the pterostigma, and sometimes a brown shade in the middle of the yellow portion of the wing.

Hab. Santarem.

Perithemis thais.

Perithemis thais, Hag. MS.

Long. corp. 15 millim.; exp. al. 34–38 millim.; long. pter. 2–$2\frac{1}{2}$ millim.

Head yellow, shading into greenish on the vertex. Thorax greenish yellow, with a rather broad rusty band on the middle above, and a stripe of the same colour on the pleura, above the middle pair of legs. Abdomen with the sides nearly parallel in both sexes, with dorsal and clateral arinæ, and transverse carinæ on segments 2–4, brown, the dorsal and sometimes the lateral carinæ black, the first and ninth segments black above, and the others with a broad black stripe on each side above, only divided by the sutures and the transverse carinæ; appendages short, reddish in the male, black in the female. Wings yellow, with brown and light yellow nervures, pterostigma reddish brown; fore wings with more or fewer of the cells between the base and the level of the nodus, except along the costa and about the triangle, subhyaline; above the triangle, and sometimes touching its upper and outer angle, is a brown blotch, varying in size, but not extending to the costa, and one cell beyond the nodus is a transverse brown band, with a projection inwards below the costal areas, and extending across the wing to the inner margin; hind wings yellow, the cells at the base, and sometimes some of those below the subcostal nervure, hyaline; lower antenodal costal space between the first and last nervure more or less brown, and an irregular brown band descends from this across the triangle, then growing narrower, and almost interrupted in the middle of the wing, and then widening, and turning inwards towards the anal angle, which it does not reach; just beyond the nodus is a transverse band nearly as on the fore wings, but rather broader, and a little expanded basally where it strikes the hind margin; the apical third of the wing is hyaline, but with a narrow brown border, extending from the yellow part of the wing round the tip nearly to the pterostigma. Membranule very small, white at the base and black on the outside. Fore wings with 8–9 antenodal and 6 postnodal nervures, triangle oblique, not traversed, followed by two rows of cells, subtriangular space consisting of two cells; sectors of the arculus hardly stalked; hind wings with the triangle generally traversed.

Hab. Para.

In one female, perhaps more adult than the others, the wings are only slightly vitreous in the basal cells, and the brown border of the hind wings is absent, though the whole apex is rather darker than the rest of the wing. Unfortunately this specimen is without locality.

This species, notwithstanding its resemblance to *Libellula lais*, Perty, is very distinct in neuration, and agrees in all essential characters with the true *Perithemis domitia*, Drury (probably=*metella*, Selys, but apparently quite distinct from the various North-American species which have been regarded as synonymous with *domitia* by Selys and Hagen). Drury's figure was taken from a Jamaican specimen, and although it is rough, and probably represents too many costal nervures, the subtriangular space of the fore wings is distinctly represented as consisting of two cells. I regard a male in the British Museum, from St. Domingo, as probably Drury's species (7 antenodal and 5 postnodal nervures). Another specimen, without head, and with no locality label, may be the female; the abdomen is cylindrical and subparallel, and the wings are yellow from the base to beyond the nodus, and on the upper costal spaces to the pterostigma, and there is a brown spot over the lower extremity of the nodal vein; the apical third of the wing is clear hyaline, and the tip of the hind wing is slightly brownish. This is the only other specimen in the British Museum which agrees with the supposed *P. domitia*, from St. Domingo, in neuration, but there are others, from Jamaica, in the Dublin Museum.

Perithemis intensa. (Plate LI. fig. 7.)

Long. corp. 25 millim.; exp. al. 40 millim.; long. pter. 3 millim.

Male.—Brown (colours of body altered); pleura greenish, two black dots at the extremity of most of the segments of the abdomen above; anal appendages black, moderately long, the upper appendages depressed, not much longer than the lower. Wings deep brownish-yellow, the basal cells and several of the cells in the first antenodal costal space of the fore wings clearer, nervures reddish; pterostigma red, rather long (slightly longer on the hind wings than on the fore wings); fore wings with 8 antenodal and 6–7 postnodal nervures; triangle very large for the size of the insect, and very oblique, the upper and basal sides being of equal length, and the outer side longer, divided by two transverse nervures, and the upper cell bisected; triangle followed by three and four or four and three rows of discoidal cells; subtriangular space consisting of three cells; hind wings with the triangle traversed by one nervure; membranule small, white.

Hab. Mexico.

Celithemis fasciata. (Plate LII. fig. 2.)

Long. corp. 34 millim.; exp. al. 60 millim.; long. pter. 3½ millim.

Male (mature).—Black, vertex violet, occipital triangle reddish, face reddish, sides and rhinarium dull yellow, labium clear yellow, except the sutures; pleura, base of abdomen at sides, and legs dark reddish brown; pleural sutures indistinctly black. Wings with 7–8 antenodal and 7–8 postnodal nervures; triangle rather broad, crossed by one or two nervures, and followed first by four and then by three rows of cells; pterostigma reddish brown, enclosed by black nervures; fore wings with the apex brown from the middle of the pterostigma, and with a brown band extending on the costa from the second or third postnodal nervure nearly to the pterostigma, and transversely across the wing nearly to the hind margin, on the outer side it is excavated between the subcostal nervure and nodal sector; the first antenodal space is yellowish, and the second is filled up by a brown basal streak, invading the first space towards its extremity, this is connected with a transverse band running rather irregularly towards the inner margin, extending from the vein of the nodus (between which and the lower sector of the arculus it is excavated on the outside, on the disk it is excavated on the inside) to the base of the nodal sector, and throwing off a branch towards the base between the sectors of the arculus nearly to their origin, which is again connected with another blotch covering the upper part of the triangle and part of the upper cells of the inner triangle, and throwing off another branch towards the base nearly to the cross nervule of the lower basal cell; on the hind wings the apical patch and the middle band differ only in being more extended; the basal markings extend to the level of the nodus, and consist of a bar filling the lower antenodal costal space and the lower part of the first, a broader one extending from the membranule (which is white, with a black line in the centre) which narrows outwards, but covers the lower basal cell and the triangle, and then fills up the space between the sectors of the arculus, and fills up the space to the vein of the nodus; and from the outer side of these confluent basal stripes a band descends nearly to the hind margin, and then turns inwards, again expanding towards the inner margin, but touching neither margin; the enclosed space is of a slightly yellowish hyaline. Appendages nearly as in *C. elisa*, Hag., to which this species is allied, but the anal appendages are longer and black, and the upper ones form a more distinct angle beneath before the extremity.

Immature male.—Head yellow, violet above, the mandibles and the suture of the labium reddish. Thorax reddish brown above, with a yellow stripe on each side; the sides yellow, with two oblique brown stripes connected above. Abdomen black, shading into reddish brown at the base, with longitudinal yellow dorsal spots on segments 3–7, and with three yellow spots on the side of the first segment, followed by a series of four on the sides of segments 2–4, ending in two small dots at the base of the fifth. Wings paler, the dark markings less extended, and more interrupted by transparent spaces; the band on the hind wings is broadly interrupted opposite to the hind margin, so that the large spot near the inner margin is entirely disconnected; all the secondary nervures on and between the dark basal markings of the hind wing are distinctly yellow, which is much less conspicuous in the mature specimen.

Hab. Georgia.

SYMPETRUM PALLIDINERVIS. (Neuration, Plate LV. fig. 4.)

Long. corp. 35–37 millim.; exp. al. 63–67 millim.; long. pter. $2\frac{1}{2}$–3 millim.

Head yellow, vertex violet in the male; mandibles and suture of the labium black; occipital triangle brown in the female, the vertex is concolorous, except that the frontal suture is black or bronze; male with the prothorax yellow above, with a central dark stripe bisected with yellow; a slender reddish-brown stripe on the pleura before the wings, and three large black sutural stripes on the pleura. Metathorax tessellated with yellow and reddish brown. Abdomen black, the first three segments yellow on the sides, the second with an oval yellow spot on each side above, behind the carina, and the remainder with a long yellow spot on each segment, visible from above, as far as the eighth, tenth segment sometimes partly yellow; anal appendages a little shorter than the ninth and tenth segments together, pale yellow, tipped with black. Fore wings with 9 antenodal and 8 postnodal nervures, the last antenodal and the first three postnodals not continuous; pterostigma smoky brown, sometimes a little paler at the ends, between black nervures; triangle ordinary, followed by three rows of cells; hind wings hyaline, slightly tinged with yellow at the base, and occasionally on the disk, and with reddish nervures, towards the margins the nervures shade into brown, the subcostal nervure being conspicuously dark on all the wings throughout its whole length in the female, and beyond the nodus in the male. Hind wings with 6 antenodal and 9 postnodal nervures, the first three postnodals not continuous; triangle followed by two rows of cells.

Hab. India.

Appears to be a common species. Somewhat resembles the European *S. striolatum*, &c.

Trithemis rubra.

Long. corp. 32 millim.; exp. al. 50–56 millim.; long. pter. 2–3 millim.

Bright red, the prothorax marked with a conspicuous black spot on each side above the base, opposite the head, and the upper part of the suture below the front wings also marked with black. Abdomen slightly thickened at the base, moderately broad, the dorsal carina very strongly marked, especially towards the tip; anal appendages of the male rather longer than the ninth segment, the lower one not much shorter than the others, those of the second segment not very conspicuous. Wings hyaline, a little tinged with yellow in some of the cells at the base; nervures red, 9 antenodals, the last not continuous, on the fore wings, and 6 on the hind wings, 5 or 6 postnodals, the first two or three not continuous; pterostigma variable in length, yellow between black nervures.

Hab. Australia and New Hebrides.

Trithemis (?) attenuata. (Plate LIII. fig. 2.)

Long. corp. 30–35 millim.; exp. al. 44–53 millim.; long. pter. 2–2½ millim.

Face reddish tawny or yellowish, the frontal tubercle and summit of clypeus coppery green. Head black behind, with small yellow spots behind the eyes and behind the occipital triangle. Thorax black, sides often more or less reticulated with yellow, and pruinose above in male, or yellow with slender reddish lines in female. Legs black, base of the femora tawny. Abdomen black, slender, gradually thickened at base and tip, basal segment more or less transversely banded with yellow, segments 4–7 with longitudinal stripes on the sides, longest and united at the base on segments 4 and 5, and broadest and united broadly behind on the back, but not reaching the hinder suture, on segments 6 and 7; anal appendages yellow, slightly tipped with black. Fore wings with 10–11 antenodal nervures and 9–11 postnodal nervures, the last antenodal and the first two postnodals not continuous; triangle traversed, followed by one or two rows of three cells, and then a series of two increasing, rarely three throughout; hind wings with 8–9 antenodal and 9–10 postnodal nervures, the first two postnodals not continuous; triangle followed by three cells, increasing, the upper sector rising a little before the apex, and distinctly separated from the lower, which is not the case in typical *Trithemis.* Wings hyaline, more or less yellow at the base in the female and immature male; in the mature male there is a large roundish brown smoky spot near the centre of each wing, varying in size, and another at the base of the hind wings, which, in the darkest specimens, is suffused with the outer one.

Hab. Santarem.

TRITHEMIS (?) LACUSTRIS.

Long. corp. 28 millim.; exp. al. 48 millim.; long. pter. 2 millim.

Male.—Red, the upper part of the head rather darker, and coarsely punctured; ocelli conspicuously black; frontal tubercle, cheeks, and lower mouth-parts varied with yellow, pectus rather irregularly spotted with black, and femora black above nearly to the knees. Wings hyaline, with reddish nervures, smoky yellow at the base for more than a third, the colour extending on the hind wings nearly to the nodus; fore wings with 9 antenodal and 7 postnodal cross nervures, the last antenodal and the first three postnodals not continuous; pterostigma rather long, very pale yellow, between thick black nervures, and slightly clouded at the extremity; fore wings with the triangle traversed, followed by three rows of cells, increasing, subtriangular space consisting of two cells; hind wings with 6 antenodal and 6 or 7 postnodal nervures, the first three postnodals not continuous; the triangle followed by two rows of cells, increasing, its sectors rising together.

Hab. Wadelai, Central Africa; collected by Emin Pasha[1] on Jan. 27, 1887.

This species has a superficial resemblance to *Trithemis sanguinolenta*, Burm.; but in many characters it resembles the genus *Cacergates.*

BRACHYDIPLAX INDICA. (Plate LIV. fig. 9.)

Long. corp. 29–32 millim.; exp. al. 50–54 millim.; long. pter. 3 millim.

Front and frontal tubercle entirely blue or greenish blue, strongly punctured; face yellow, the extremity of the labrum, the mandibles, except a spot at the base on each side, and the sutures of the labium broadly black; back of the head entirely black, except two small contiguous yellow spots behind the occipital triangle, and a yellow crescent just above the neck. Thorax black above, pruinose in the adult male; the pleura coppery green, marked in the adult male with a yellow spot about the middle, a yellow streak beyond, and the extremity yellow; in the immature male there is a yellow stripe on the side just in front of the wings, extending almost to the back, two stripes, the second interrupted, below the first pair of wings, and the hinder

[1] The only other Odonata sent home by Emin Pasha in his last collection belong to *Palpopleura portia*, Dru., *Cacergates leucosticta*, Burm., and *Ischnura senegalensis*, Ramb., three very common and widely distributed African species.

part is yellow, marked with a small coppery-green spot; in the female the yellow colour of the thorax predominates, the middle being broadly black (spotted with yellow between the wings), and the sides marked with four coppery stripes, confluent below; the front of the prothorax and legs black, except the under surface of the front femora in the female. Abdomen with a row of reddish or yellow spots on the sides of segments 2–7 above (divided by the carinæ on segments two and three), and in the female there is a row of smaller spots (mostly obliterated in the male) below the lateral carinæ as far as segment seven. Wings hyaline, very slightly smoky at the base of the hind wings; pterostigma yellow, between black nervures; membranule white, blackish within.

Hab. India.

Appears to be a common species.

Brachymesia australis.

Long. corp. 40 millim.; exp. al. 66 millim.; long. pter. $3\frac{1}{2}$ millim.

Head and thorax very hairy, dull greenish, shading into reddish in the middle of the clypeus, near the mouth, and near the coxæ. Legs blackish above and testaceous beneath. Abdomen testaceous brown, segments 7 and 8 marked with a black spot above. Wings hyaline, with brown nervures, the costa a little yellowish; pterostigma yellow, between black nervures; hind wings with the base narrowly tinged with yellow beyond the black membranule.

Hab. Sydney.

There is nothing in the shape, size, or colour of this species to distinguish it from any ordinary *Crocothemis* or *Urothemis* at first glance, notwithstanding its very peculiar structure.

Deielia fasciata. (Plate LIII. fig. 6.)

Long. corp. 39 millim.; exp. al. 70 millim.; long. pter. $3\frac{1}{2}$ millim.

Female.—Upper part of the head black, except the frontal tubercle, which is yellow, large, and oval; the frontal ocellus very large and conspicuous, entirely surrounded with black, and the suture deeply hollowed to receive it; back of the head black, spotted with yellow; face almost entirely yellow, punctured; mandibles black; nasus with a deep black puncture on each side; labrum with three black punctures on the basal suture, and the sutures of the labium black. Prothorax broadly brown in the middle, with a yellow stripe on each side. Mesothorax brown above, with rather indistinct transverse bands before and behind the insertion of each wing; pleura yellow, with four broad black bands on the sutures, connected beneath, and with short narrow black lines in the yellow spaces before and behind the last. Abdomen with all the sutures and carinæ black, and a wide black band (only interrupted at the base of the second segment) on each side, broadening from the base of each segment, thus giving the abdomen a tessellated appearance; segment 7 is black above, with a narrow yellow line on each side, 8 and 9 are black, with a transverse yellow line on each side at the extremity; and the anal appendages are dull reddish, the lateral parts being black. Beneath, the abdomen is black, with an irregular and deeply excavated yellow blotch at the base of each segment, and a yellow dot on each side at the extremity. Legs black, the four front coxæ and the front femora beneath yellow. Wings hyaline, with reddish nervures, both the antenodal costal spaces on all the wings, and the base as far as the triangle inclusive on the fore wings, and considerably further on the hind wings deeply tinged with yellow, a smoky cloud runs across each wing just before the pterostigma, which is yellow, banded by black nervures. Accessory membrane white, bordered with black nervures.

Hab. Sandwich Islands.

EPHIDATIA AMAZONICA.

Long. corp. 36 millim.; exp. al. 60 millim.; long. pter. $2\frac{1}{2}$ millim.

Male.—Head violet, purple above, rufous beneath, the nasus and rhinarium black. Prothorax violet-blue above; mesothorax blue-black; pleura rufous, with three more or less extended greenish-blue stripes. Legs blackish. Abdomen blue-black, the under surface and sides of the first two segments rufous, this colour extending in one specimen to the lateral carinæ of the two following segments. Wings hyaline, with brown nervures; fore wings with 7 antenodal and 5 postnodal nervures; hind wings marked with smoky yellow at the base, but scarcely further than just beyond the cross nervure in the lower basal cell; pterostigma rather short, hardly more than covering one cell, reddish, between black nervures. Anal appendages injured; upper anal appendages as long as the last two segments, bending downwards, and then recurved at tip.

Hab. Santarem; another specimen, rather smaller, from Para.

Allied to *E. longipes*, Hag., which is in the British Museum, from Colombia; still nearer, according to Scudder's description, to *E. cubensis*, in which, however, a lateral fuscous band extends the whole length of the abdomen, and the costal nervures are more numerous.

UNTAMO APICALIS. (Plate LIII. fig. 4.)

Long. corp. 33 millim.; exp. al. 60 millim.; long. pter. 3 millim.

Female.—Yellowish testaceous; the central and humeral sutures of the thorax and the sutures and carinæ of the abdomen black, the dorsal carina broadly black, and a broadening black lateral stripe coalescing with the dorsal and lateral carinæ on the apical segments, which are almost entirely black; anal appendages yellow. Legs reddish, the femora more or less blackish above. Wings yellowish hyaline; the pterostigma reddish, all the tips with a deep smoky-brown patch extending nearly to the middle of the pterostigma.

Hab. Sula.

Lyriothemis frontalis.

Long. corp. 36 millim.; exp. al. 78 millim.; long. pter. 3 millim.

Female.—Head: frontal tubercle blue, front metallic green, bordered below and at the sides with yellow, nasus reddish brown, rhinarium ochraceous, the lower mouth-parts and back of the head black, a large yellow spot at the base of the mandibles, and a broad yellow stripe marked with a short black streak from behind just above the middle, behind each eye. Thorax black above, with a short testaceous stripe on each side, and several small testaceous spaces before and between the wings; pleura and pectus testaceous, the sutures narrowly black, and a short black streak on each side of the metasternum. Abdomen red, with all the sutures black, an obsolete interrupted dusky line on each side, two dusky triangular spots on the back of segments 6 and 7, and a continuous blackish band covering the middle of the terminal segments. Wings smoky hyaline; pterostigma dark reddish brown; fore wings with 15 antenodal and 10 postnodal nervures, 1 supratriangular nervure, and 2–3 cross nervures in the lower basal cell; hind wings with 12 antenodal and 10 postnodal nervures, no supratriangular nervures, 3 nervures in the lower basal cell.

Hab. Sula.

Lyriothemis braueri. (Plate LIII. fig. 5.)

Long. corp. 38 lines; exp. al. 74 millim.; long. pter. 3½ millim.

Female.—Head: frontal tubercle and front metallic green, the back of the frontal tubercle and the lower part of the front shading into violet-blue, sides yellow, the lower parts of the face dark brown, the rhinarium paler reddish brown, back of the head black. Thorax dull yellowish, a broad black band on each shoulder, shading into reddish before the suture, and confluent below with the narrower blackish band on the next suture. Legs black. Abdomen red, only the sutures narrowly black. Wings smoky hyaline, especially at the tips, but with several unsymmetrical clearer spaces; pterostigma blackish brown; fore wings with 18 antenodal and 9–11 postnodal nervures, 1 supratriangular nervure, 3 cross nervures in the lower basal cell; hind wings with 13 antenodal and 10–12 postnodal nervures, 1 supratriangular nervure, and 3 nervures in the lower basal cell.

Hab. Sula.

Orthemis flavopicta. (Plate LIV. fig. 1; appendages, Plate LVII. fig. 5.)

Long. corp. 50 millim.; exp. al. 76–82 millim.; long. pter. 5 millim.

Head: frontal tubercle and clypeus above blue; face reddish in the middle, shading into yellowish above and black below, the sides broadly yellow; labium black, the sides broadly yellow, back of the head reddish, shading into black above; the middle of the eyes bordered behind with yellow. Thorax and abdomen reddish above, thorax with slender yellow lines, one on each side of the dorsal line, and one on each shoulder;

between the wings is a broader yellow interrupted dorsal stripe, narrowly continued on the dorsal carina of the abdomen for nearly its whole length; pleura coppery green, a broad oblique yellow stripe beneath the front wings, a short yellow stripe below the base of the hind wings, and a broad yellow horizontal stripe on the metapleura, narrowly continued on as reddish lines on each side of the lateral carinæ of the abdomen nearly to the extremity; there is likewise a pale line on each side of the median line of the abdomen beneath. Legs blackish, femora pale beneath. Wings hyaline, browned at the tips, and with brown pterostigmata; male with the anal appendages as long as the eighth segment, the lower appendage nearly as long as the others, broad and bifid, or rather crescent-shaped at the extremity.

Hab. Para.

A longer and more slender insect than *O. ferruginea*, Fabr. The triangle of the fore wings is sometimes on a level with that of the hind wings, and sometimes considerably beyond it, even on opposite sides of the same specimen.

Belonia foliata. (Plate LIV. fig. 4.)

Long. corp. 45–47 millim.; exp. al. 85 millim.; long. pter. $5\frac{1}{2}$ millim.

Female.—Head and thorax greenish, rhinarium reddish, tips of mandibles black, frontal tubercle raised, broad, bifid. Abdomen reddish, with all the carinæ, and the edges of the foliation on the eighth segment, black. Legs reddish; knees, spines, and tarsi black. Wings yellowish hyaline, more clouded towards the tips, base tinged with yellow, chiefly along the lower costal space and in the lower basal cell; all the nervures blackish, except the outside of the costal nervure at the base, pterostigma reddish brown between black nervures, sectors of the arculus very shortly stalked, triangle long and rather narrow, traversed by two or three nervures, and followed by four rows of cells, one supratriangular nervure; hind wings with the triangle traversed by one or two nervures, membranule very small, black.

Hab. Mexico.

A male from Guatemala, which appears to belong to this species, is much darker (long. corp. 55 millim.; exp. al. 88 millim.; long. pter. 7 millim.); it has 17–18 antenodal and 14–15 postnodal nervures; there is no yellow at the base, and there is a supratriangular nervure on the hind wings; the appendages are short, about as long as the seventh segment, thickened before the extremity, which is slightly raised and pointed; the lower appendages and those of the second segment are not visible.

This specimen being in bad condition, I have preferred to take a female as typical of the species.

Belonia uniformis.

Long. corp. 49 millim.; exp. al. 90 millim.; long. pter. 8 millim.

Female.—Closely allied to *B. foliata*, but almost the entire insect reddish brown, with only the tips of the mandibles, the spines on the legs, the under surface of the tarsi, and the claws black. Wings of a slightly yellowish hyaline, with brown nervures; all the principal basal nervures red or reddish brown on the costa as far as the pterostigma, and on the hind wings including all the nervures of the triangle; fore wings with 19–20 antenodal and 12 postnodal nervures; pterostigma yellow, long and narrow, enclosed by brown nervures; sectors of the arculus with a very short stalk; triangle moderate, crossed by two nervures, and followed by four or five rows of cells; one supratriangular nervure; hind wings with the triangle traversed, membranule small, white.

Hab. Mexico.

Besides the colour, the very long pterostigma will at once separate this species from *B. foliata.* The frontal tubercle is truncated, with a slight prominence on each side, but not distinctly bifid.

Belonia longipennis.

Long. corp. 53 millim.; exp. al. 108 millim.; long. pter. 8 millim.

Female.—Uniform dark brownish red, the abdominal carinæ and the sides of the foliation on the eighth segment of the abdomen black; frontal tubercle distinctly bifid. Wings yellowish hyaline, rather more clouded towards the tips, all the veins blackish; fore wings with 20–21 antenodal and 14–15 postnodal nervures; sectors of the arculus very shortly stalked; triangle moderate, crossed by two nervures, and followed by four rows of cells; three supratriangular nervures; pterostigma brownish yellow between black nervures; hind wings with the triangle traversed, and with one supratriangular nervure, membranule grey, very small.

Hab. Cuença.

The largest species, varying a little in its characters from the type of the genus.

Protorthemis celebensis. (Plate LIV. fig. 7; head, &c., Plate LVII. figs. 6, 6 *a.*)

Long. corp. 55 millim.; exp. al. 102 millim.; long. pter. 5 millim.

Male.—Head: frontal tubercle violet, strongly bifid, vertex inky black, very coarsely pectinated above, smooth and yellow on the lower part of the sides next the eyes, and with a smooth black longitudinal groove, widest in front, back of the head shining black, with a yellow spot behind the occipital triangle, and on each side behind the middle of the eye; lower part of head yellow in front; mandibles black, and the middle third of the labium black. Thorax black above, with a double stripe on the suture of a testaceous yellow, narrower behind, space between the wings dusted with blue; pleura with alternate stripes of testaceous yellow and dark brassy green. Legs black, femora testaceous yellow beneath. Abdomen red (paler beneath, and second segment black, with a pale spot on each side), the last two segments and the anal appendages black, second and third segments carinated, rather broad, with dorsal and lateral carina, the latter distinctly denticulated; upper appendages as long as the ninth and tenth segments, thickened below, and slightly turned up and pointed at the tip; lower appendage not visible. Wings hyaline, with black nervures; fore wings with 21 antenodal and 21 postnodal nervures, the last antenodal nervure continuous; postnodal nervures of the lower space irregular, and a double row beyond the pterostigma; sectors of the arculus stalked, nodal and subnodal sectors undulated, upper sector of triangle regular; triangle moderate, followed by three rows of cells, traversed, and with a supratriangular nervure; subtriangular space consisting of four cells; pterostigma long, very dark brown, between black nervures; hind wings with the triangle traversed, and one supratriangular nervure; membranule very small, white.

Hab. Makian.

Allied to *Orthemis coronata*, Brauer.

NESOCRIA WOODFORDI.

Long. corp. 50 millim.; exp. al. 85 millim.; long. pter. 5 millim.

Face yellow, frontal tubercle and upper part of clypeus violet, mandibles and labium black, the sides of the latter broadly yellow, back of head black, with a yellow spot on each side behind the eyes. Thorax black above, the dorsal line nearly concolorous, a short double pale line near the front, a yellow spot within the inner angle of the hinder prothoracic lobes, and the interalary space with the scutellum &c. spotted with yellow; sides of the thorax almost entirely yellow behind the first suture, before it there is a yellow spot on the collar adjoining a larger one on the prothorax, and there are two small ones on an extension of the black colour below the fore wings; portions of the hinder sutures, and the middle of the prosternum, especially before the front legs, are also largely black. Legs black, the basal half of the front femora yellow beneath. Abdomen red, the extreme base, and all beyond the eighth segment, black. Wings hyaline, with fuscous nervures, the lower antenodal subcostal space and the lower basal cell filled up with smoky brown to beyond the arculus.

Hab. Alu Island, Solomon Islands.

Possibly allied to *Agrionoptera longitudinalis*, Selys.

LATHRECISTA TERMINALIS.

Long. corp. 40–43 millim.; exp. al. 72 millim.; long. pter. 4 millim.

Face yellow, frontal tubercle and front (except at the sides) steel-blue; mandibles, suture of the labium, and back of the head, black. Thorax rufous above, with a double yellowish dorsal line, the sides yellow, with three oblique steel-blue stripes, the first very thick and broadly Y-shaped, the second simple, and the third Y-shaped above and curved below, where it runs horizontally to the base of the abdomen, the space between the wings above, and also the base of the abdomen, as far as the suture on the third segment in fully coloured specimens, densely pruinose in the male. Abdomen rufous, the ninth and tenth segments (as well as part of the eighth in the female) and anal appendages black; anal appendages of male as long as the ninth segment, those of the second segment not prominent. Wings yellowish hyaline, darkening with age, the tips tinged with rust-colour as far as the base of the pterostigma, which is dark reddish brown between black nervures; fore wings with 17–18 antenodal and 12–13 postnodal nervures; hind wings with 11–13 antenodals and 12–13 postnodals.

Hab. Borneo.

Allied to *Agrinoptera simulans*, Selys.

Nesoxenia cingulata. (Plate LIII. fig. 8.)

Long. corp. 33 millim.; exp. al. 60 millim.; long. pter. 3 millim.

Head yellow, clypeus, except on the sides, and frontal tubercle greenish blue, the greater part of the mandibles and the suture of the labium blackish; back of the head black, with a double yellow spot behind the occipital triangle, and two yellow spots on each side behind the eyes. Thorax bronzy green above, with a large spot on each shoulder, an oval spot on the median line, a spot on the base of the tegulæ, three spots below the base of the fore wings, and the usual interalary spaces yellow, the base of the scutellum being marked with a black crescent; sides of thorax yellow, with two oblique bronzy-green stripes, trifid above and subbifid below, the spaces enclosed by the first forming the spots already noticed at the base of the fore wings; between these is a detached stripe on the lower part of the mesopleura. Legs black, front femora yellow beneath. Abdomen black, the first segment yellow beneath, the second yellow to beyond the transverse carina, which is black; the basal half of segments 2–6 more or less yellow on the sides, and the dorsal carina is interruptedly marked with yellow; segment 7 with a complete ring on the basal half. Wings hyaline, with black nervures; pterostigma dark brown, nearly black, the lower antenodal subcostal space, and the lower basal cell, a little clouded as far as the first cross nervures.

Hab. Alu.

Agrionoptera insularis.

♂. Long. corp. 37 millim.; exp. al. 62 millim.; long. pter. 3 millim.

♀. Long. corp. 41 millim.; exp. al. 70 millim.; long. pter. 4 millim.

Male.—Face yellow, upper angle of the clypeus strongly projecting, frontal tubercle and upper surface of clypeus coppery green; labium black, the sides rather broadly yellow; mandible black, back of head black, with a double yellow spot behind the occipital triangle, and a yellow spot behind the middle of each eye. Thorax bronzy black above, a shoulder-spot, two small spots on each side before the base of the wings, an incomplete double stripe on each side of the median line, a spot on the base of the two hinder lobes, and the scutellum and interalary spaces, yellow; sides of thorax yellow, beneath the wings coppery green, the ventral surface darker bronzy green, this colour extending up and down along the sutures, but only continuous behind the first suture; on the ventral surface are one or two more yellow spots. Legs black, the front coxæ and base of the femora yellow beneath. Abdomen red, the base black as far as the carina on the second segment, with a transverse yellow stripe on the first segment, the sutures very narrowly black, the terminal segments, except sometimes a narrow stripe on the base of the eighth, entirely black; segments 3–7 with a rather indistinct blackish dot on each side of the dorsal line just before the suture. Wings more or less clouded hyaline, with dark brown nervures and pterostigma, a little clouded along the lower antenodal subcostal space and the lower basal cell at the base. Wings with 15–16 antenodal and 12–14 postnodal nervures, the first two or three postnodals not continuous; triangle small, more or less oblique, and placed on a level with that of the hind wings or a little beyond, followed by two rows of cells increasing (on one side of one specimen by three cells increasing), no supratriangular nervure and only one cross nervure in the lower basal cell in both fore and hind wings, subtriangular space consisting of two or three cells; hind wings with 13–15 antenodal and 11 postnodal nervures, the first two postnodals not continuous; triangle placed at about one fifth of the distance between the arculus and the end of its lower sector, followed by two rows of cells increasing; membranule very small, whitish.

Female.—Similar, but with the pale markings of the pleura dull flesh-colour rather than yellow; the abdomen is of a dull reddish brown, the black markings not being very sharply defined, and more extended on the sutures and along the lateral carinæ; there are sometimes two cross nervures in the lower basal cell of the fore wings, and the traversed triangle is followed indifferently by two or three rows of cells increasing, or by a row of three cells followed by a series of two increasing. In one female the lower sector of the arculus falls on the base of the triangle a little before its extremity.

Hab. Solomon Islands, Santa Anna (1 male), and Alu (1 male, 2 females).

Allied to *A. quatuornotata*, Brauer.

CHALCOSTEPHIA FLAVIFRONS.

Long. corp. 35 millim.; exp. al. 62 millim.; long. pter. 4 millim.

Male.—Face yellow, upper part of clypeus coppery green, shading into blue on the summit and on the frontal tubercle; tips of mandibles, suture of labium, and back of head black, the latter with about three small yellow spots on each side behind the eyes. Thorax, abdomen, and legs dull black, the thorax with a slight bluish-grey pulverulence, base of the femora with a reddish-brown spot on the inside. Wings of a slightly brownish but very iridescent hyaline, the extreme tips brownish, pterostigma brown, palest in the centre between brown nervures, the upper nervure very thick; membranule very small, blackish, with a white dot in the middle.

Hab. Angola.

Anatya anomala. (Plate LIII. fig. 9; appendages, Plate LVII. fig. 7.)

Long. corp. 32–34 millim.; exp. al. 47–50 millim.; long. pter. 3 millim.

Male.—Head yellow, frontal tubercle and middle of the clypeus blue, tips of the mandibles and back of the head above black, and below reddish towards the base; thorax pale greenish blue with irregular blackish or reddish markings above, and to a less extent on the sides; under surface yellow; coxæ with a black spot at the tips above; femora yellow, black above from a little beyond the base; tibiæ and tarsi black; abdomen black, the base banded and spotted with dull pale blue (buff in less mature examples), which is continued on the sides of the third segment beyond the carina as a broad dark stripe reaching nearly to the extremity; this is followed by buff stripes at the sides of the bases of segments 4 and 5, a much shorter and broader one on the sides of segment 6 in the middle, and, lastly, a round spot on each side of segment 7, nearly meeting above. Anal appendages yellow, the upper ones tipped with black. Wings very clear hyaline; pterostigma dark reddish brown between black nervures.

Female.—Yellow, the thorax a little varied with reddish; abdomen yellow at the base, and reddish brown beyond the carina of the third segment, spotted with yellow as in the male; femora, tibiæ, and tarsi as in the male; pterostigma yellowish brown.

Hab. Brazil.

In one specimen the neuration is very irregular, the last antenodal nervure on the left front wing, on the upper costal space, is nearly continuous with the last nervure in the lower costal space; but on the right wing the last two antenodals are entirely discontinuous, an anomaly of which I have seen but one other instance.

Tyriobapta torrida. (Plate LIV. figs. 5, 6.)

Long. corp. 30–35 millim.; exp. al. 52–64 millim.; long. pter. 3–4 millim.

Male (mature).—Head black, clypeus above and frontal tubercle violet-blue, sides and base of labium yellow; thorax and base of abdomen dull reddish brown, the former with a transverse black band before the wings and black stripes on the sutures of the pleura; abdomen otherwise black, with a row of dull blue spots on the sides of segments 3–8 above. Legs testaceous brown nearly to the end of the femora and black beyond. Wings hyaline, pterostigma dark brown; hind wings with a large purplish-brown blotch at the base, with green and purple reflexions, broadest at the anal angle, where it covers rather more than one fourth of the wing.

Male (immature).—Thorax and abdomen testaceous brown, the black markings are much more distinct, the transverse band in front of the thorax is connected with and preceded by a black stripe on the median line; the three stripes on the pleura are unconnected with this, but are nearly connected with each other below; the abdomen is black, with the base, and a row of spots on the sides of segments 3–8, testaceous brown; the blotch on the hind wings is light brown, and is confined to the neighbourhood of the anal angle.

Female.—Head as in the male; thorax and abdomen testaceous brown, the black markings on the pleura less extended; abdomen with the dorsal carina and sutures black, expanding into dorsal spots and laterally expanded bands on the sutures; wings hyaline, more or less clouded, especially towards the tips, but with no basal blotch on the hind wings.

Hab. Borneo.

A very common species.

Thermochoria equivocata. (Plate LII. fig. 8.)

Long. corp. 30 millim.; exp. al. 48 millim.; long. pter. 3 millim.

Male.—Head, frontal tubercle and clypeus blackish, the latter strongly punctured above, channelled in the middle, and marked with a large horseshoe-shaped spot on each side; back of the head black, the whole face below the clypeus yellow, and the eyes from a little below the occipital triangle broadly bordered behind with yellow, and unspotted; thorax and abdomen black, the pleura, the space between the wings above, and the base of the abdomen pulverulent blue; anal appendages slender, yellow, as long as the ninth segment, the lower appendage nearly as long as the others; appendages of the second segment rather small. Wings rather long and narrow, rounded at the tips, the hind wings not much broader than the fore wings, clear hyaline, with black nervures; pterostigma very dark reddish brown, a stripe of the same colour on the nodus (on the fore wings only), and another stripe, almost black at the base, filling up the lower basal cell from the base to the twelfth antenodal cross nervure on the fore wings, and to the fourth antenodal cross nervure on the hind wings; tips of the wings from one cell beyond the pterostigma edged with rufous; membranule of hind wings very small, white, marked with a blackish dot.

Hab. West Africa.

Misagria parana. (Plate LII. fig. 9; abdomen &c., Plate LVII. figs. 8, 8 *a*.)

Long. corp. 37 millim.; exp. al. 62 millim.; long. pter. $3\frac{1}{2}$ millim.

Male.—Head: face yellow, mandibles and suture of the labium blackish, frontal tubercle reddish, summit of the clypeus bright blue, back of the head reddish, the eyes bordered behind with yellow; thorax rufous brown above, with a longitudinal greenish line on the middle, followed by green spots between the wings; sides green, with reddish-brown bands on the sutures. Abdomen reddish brown, with an interrupted greenish line on the dorsal suture, extending to the middle of the seventh segment; sides of the basal segments spotted with yellow, the tips of all the segments beyond the third, and the greater part of the sixth and following segments above, black. Legs reddish brown, with a yellowish line on the femora beneath. Wings hyaline, the extreme base a little marked with yellowish, and the extreme tips a little clouded; pterostigma dark brown.

Hab. Para.

Pseudomacromia torrida. (Plate LII. fig. 7.)

Long. corp. 58 millim.; exp. al. 100 millim.; long. pter. 5 millim.

Male.—Head violet above and testaceous beneath; nasus, rhinarium, and labium (except at the basal suture, which is testaceous, and the sides at the base, which are rather broadly yellow) black; occipital triangle testaceous yellow. Thorax brownish testaceous, prothorax with a broad brassy-green band on each side above, the pleura more inclining to yellow, with three rather broad and somewhat irregular brassy-green stripes on each side. Legs black; coxæ, trochanters, and base of femora testaceous above. Abdomen black, with a large testaceous spot on the sides of all the segments, except the tenth; the base of the third and fourth, and the lateral carinæ on the third, are also narrowly of the same colour; the dorsal carina is marked with a testaceous spot in the middle of segments 3–8, and the carina itself shows an interrupted line of the same colour from segments 4–9; on segment 7 the central spot is united with those on the sides by a transverse band. Wings hyaline, slightly inclining to yellowish; neuration black, pterostigma dark brown between black nervures; membranule of all the wings white; fore wings with 11–12 antenodal and 8 postnodal nervures, subtriangular space consisting of four cells. Anal appendages thick, short, black, about as long as the ninth segment, acuminate, the lower one as long as the others, those of the second segment not conspicuous.

Female with the brassy-green markings of the thorax replaced with a violet iridescence over brown. Wings yellowish hyaline, three subtriangular cells. Abdomen with the dorsal carina from the third to the ninth segment much more continuous, the sutures narrowly yellow as far as that between the fifth and sixth segments, and the lateral spots more extended, connected by a line across the back on the middle of segments 5–7. Appendages straight, pointed, nearly as long as in the male, but more slender.

Hab. Sierra Leone.

Another specimen, from Abyssinia, is rather smaller and darker; there are but seven postnodal nervures on the fore wings, and the markings on the sides of the second and third segments of the abdomen are greenish, and the subtriangular space consists of three cells only. Another dark specimen, from West Africa, has only three subtriangular cells and seven postnodal nervures on the fore wings, in which, too, the upper triangle is open on one side. There is also another from Natal, nearly agreeing with the type, but with three subtriangular cells. Another male, apparently of the same species, from Teneriffe, shows extreme anomalies of neuration. The wings are strongly clouded, and the last antenodal and first postnodal nervures are not continuous; in all the other specimens the first two postnodal nervures are not continuous. On the fore wings there are three cells in the subtriangular space on the left side and four on the right, and on the right side is one supratriangnlar nervure. On the hind wings the triangles are traversed, and on the left side there are two cross nervures in the lower basal cell, instead of one.

Notwithstanding these differences, I am not at present inclined to treat any of these specimens (all of which are males, the only female being described above) as specifically distinct.

CANNACRIA BATESII. (Plate LIII. fig. 1; appendages, Plate LVII. fig. 9.)

Long. corp. 48 millim.; exp. al. 80 millim.; long. pter. 4 millim.

Head and thorax yellowish (probably green when alive); tips of mandibles, suture of labium, and legs black. Abdomen rufo-testaceous, with a black dorsal band, commencing at the end of the third segment, and covering the middle of segments 4–9, and widened at the end of each segment to cover the whole width. Wings brownish hyaline, more or less tinged with smoky yellow, especially towards the costa; pterostigma yellow, below slender black nervures.

Hab. Amazons.

CANNAPHILA INSULARIS.

Long. corp. 37 millim.; exp. al. 67 millim.; long. pter. 4 millim.

Female.—Face yellow, frontal tubercle and middle of clypeus violet; jaws, a large square spot at the base of the labium, and the back of the head black, the latter with a double yellow spot behind the occipital triangle, three spots on each side behind the eyes, and a yellow crescent at the base. Thorax chocolate-red, shading into coppery green at the sides, with slender yellow lines on the median suture, on each shoulder (interrupted), and slightly on the hinder sutures; pleura yellow, with wide coppery-green bands, interrupted by yellow lines on the lower part of the sutures; the space between the wings spotted with yellow, space behind the legs marked with large yellow spots, divided and separated by chocolate-red. Legs black, front femora yellow beneath, and middle femora slightly lined with yellow. Abdomen brownish red, a little yellowish at base; the sutures, lateral carinæ, and ninth segment, except a spot on each side, black. Wings hyaline, slightly tinged with yellowish at the base, and brownish at the tips; pterostigma reddish brown, between black nervures.

The male differs little, except in being pulverulent blue.

Hab. Haiti (types in British Museum); Jamaica (Dublin Museum).

ACISOMA (?) TRIFIDA.

Long. corp. 26 millim.; exp. al. 47 millim.; long. pter. 3 millim.

Male.—Head black; the upper part of the front, the nasus, a large spot on each side of the mentum, the base of the mandibles, and two spots on each side behind the eyes whitish or yellowish. Thorax black; the pleura with numerous small irregular yellow spots and stripes. Abdomen with lateral carinæ on segments 2–4, broad, but not inflated, as far as segment 6, and then suddenly contracted, segment 1 black, with a small yellow spot on the middle of the sides, second segment black, with a large yellow spot on the lower part of the sides, above the appendages, which are not conspicuous, segment 3 with a pale band, broader on the back, in front of the carina, and a large oval spot on the back behind, segment 4 with a similar band before the carina, the upper part behind it entirely pale, except a black spot on each side behind the carina, segments 5 and 6 are pale above, but there is a black longitudinal spot on the suture of the 4th and 5th segments, towards the end of segment 5 a black stripe commences, and gradually broadens till it covers the whole extremity of segment 6; the remaining segments are entirely black, as well as the under surface below the lateral carinæ, except for the spots on the two first segments, the basal bands on the 3rd and 4th, and a large spot on each side of the 5th and 6th: anal appendages slender, pointed, as long as the ninth segment, black, yellow above, except at the tips; lower appendage rather shorter than the others, black, raised at the tip. Legs black, slender; tibiæ with double rows of slender spines. Wings clear hyaline, the extreme base of the hind wings smoky brown; pterostigma yellow, between black nervures; fore wings with 9 antenodal and 8 postnodal nervures, the last antenodal and the first two postnodals not continuous; triangle moderate, open, followed by two rows of cells; lower subtriangular space consisting of three cells (one in all the other species, except the typical *A. ascalaphoides*, in which it is divided by a curved line as in *Diplacina*).

Hab. Congo.

TETRATHEMIS HYALINA. (Neuration, Plate LVI. fig. 8.)

Long. corp. 26 millim.; exp. al. 45 millim.; long. pter. 2 millim.

Male.—Black; head with the front and vertex coppery green; face yellow, the rhinarium reddish; back of the head shining black, with a transverse yellow spot above the neck. Thorax coppery green above; collar and some small spots before and between the wings yellow; the sides and under surface yellow, with two broad dark cupreous bands (almost black in some lights) on the sutures. Legs black; coxæ and under surface of the femora yellow; behind the legs is a thick, short, transverse black stripe, followed by a crescent, behind which is again a black spot. Abdomen with the sides of segments 1–6 spotted with yellow, the spots constantly diminishing in size, and a small longitudinal yellow spot on the back of segment 7, segment 2 thickened; anal appendages rather longer and more pointed than in *T. flavescens*. Wings clear hyaline, very slightly tinged with yellow in some of the cells at the base; pterostigma black, lower basal cell with 1 cross nervure on the fore wings and 2 on the hind wings; fore wings with 8 antenodal and 5–6 postnodal nervures, the first postnodal not continuous; hind wings with 7 antenodal and 5–6 postnodal nervures, the first postnodal not continuous.

Hab. Borneo.

TETRATHEMIS TRISTRIGATA.

Long. corp. 25 millim.; exp. al. 46 millim.; long. pter. $2\frac{1}{4}$ millim.

Female.—Black; head with the frontal tubercle and front green; upper edge of the nasus black, a yellow band covering the lower part and the rhinarium; lower mouth-parts dark reddish brown; sides of the labium yellow; back of the head black, with a transverse yellow spot above the neck. Thorax, legs, and abdomen coloured nearly as in *T. hyalina*; but the yellow at the base of the femora is less extended, the slender bristles on the tibiæ are much longer, and there is a broad belt, interrupted beneath, on the base of the seventh segment of the abdomen. Wings iridescent yellowish hyaline, the shade strongest between the nodus and the tips; pterostigma rather large, dark brown; all the wings with three cross nervures in the lower basal cell; fore wings with 9 antenodal and 6 postnodal nervures; hind wings with 7–8 antenodals and 6 postnodals, the first or first and second postnodals on all the wings not continuous.

Hab. Gilolo.

TETRATHEMIS FLAVESCENS. (Plate LII. fig. 4.)

Long. corp. 22–24 millim.; exp. al. 34–38 millim.; long. pter. 2 millim.

Male.—Head with the front and frontal tubercle steel-blue; face testaceous; the labrum, mandibles, suture of the labium, and back of the head black. Thorax brassy green above collar, two crescents before the wings and the sides ochreous-red, a broad brassy-green stripe descending just before the first pair of wings nearly to the legs, and on the suture at the base of the hind wings another stripe (shining black) descending, meeting below behind the legs. Abdomen with the second segment inflated, black, the sides of the first two segments, the base of the second above, and two smaller spots on the sides of the third reddish. Legs black; coxæ and under surface of the front femora ochreous or reddish. Anal appendages short, about as long as the ninth segment, the upper ones truncated, not longer than the lower, those of the second segment not very prominent. Wings hyaline; fore wings tinged with yellow to beyond the nodus, and hind wings to the pterostigma, which is blackish brown, between black nervures; fore wings with two, hind wings with four cross nervures in the lower basal cell; fore wings with 7 antenodal and 5–6 postnodal nervures, the first postnodal not continuous; hind wings with 6 antenodal and 5–6 postnodal nervures, the first postnodal not continuous.

Hab. Sarawak.

NANNOTHEMIS SYLVIA.

Long. corp. 19 millim.; exp. al. 36 millim.; long. pter. $1\frac{1}{2}$ millim.

Female.—Reddish brown; face yellow, the frontal tubercle and upper part of the front blue; back of the head black, with two yellow dots behind the occipital triangle.

Thorax reddish brown above and in front, with greenish spots between the wings, and two broad pale-green shoulder-stripes, with two broad black bands beneath the wings (slightly divided above), and a short black stripe on the space between. Legs black, long, slender, with slender bristles. Abdomen reddish brown above, with rather indistinct greenish spots on the sides; along the lateral carina runs a broad black band, throwing up black rings on the sutures; the ninth segment is almost entirely black, and the eighth is marked with an oval yellow spot on each side, more distinct than the green ones on the preceding segments. Wings hyaline; pterostigma oblong, yellow, between black nervures; fore wings with 7 antenodal and 5 postnodal nervures, the first postnodal not continuous; hind wings with 5 of each, the first postnodal not continuous; triangle of the fore wings nearly regular, only its outer and upper angle being truncated.

Hab. Ceara.

NANNODYTHEMIS AUSTRALIS, Brauer. (Plate LII. fig. 5, ♂.)

Nannophya australis, Brauer, Reise d. Novara, Neur. p. 99 (1866). Male only.

Long. corp. 20 millim.; exp. al. 30 millim.

Female.—Head yellow; frontal triangle and back of the head shining black; two continuous yellow spots at the back of the occipital triangle, and about four yellow spots on each side behind the eye. Thorax black above, with a sulphur-yellow stripe on each side; the sides yellow, with a black stripe above the middle pair of legs, and the upper part of the suture behind slightly marked with black. Legs black, the coxæ and a short stripe at the base of the femora yellow. Abdomen tawny yellow, with all the sutures and carinæ broadly black.

Hab. Australia (Moreton Bay).

FYLGIA AMAZONICA. (Plate LI. fig. 2, adult male; fig. 3, immature male.)

Long. corp. 21 millim.; exp. al. 38 millim.; long. pter. 2 millim.

Adult male.—Head reddish testaceous. Thorax black, the sutures and legs beneath reddish. Abdomen with segments 1–5 black, the remainder red (or by abrasion golden yellow). Wings clouded hyaline, a little smoky at the base; pterostigma black. In the immature male the sides of the thorax and the base of the abdomen are more inclining to reddish, and the wings are clear hyaline, except at the base; in the still younger male and in the female the insect is yellow, with reddish-brown stripes in the middle of the thorax, obliquely on each shoulder and on the middle and sides of the abdomen, and the wings are clear hyaline.

Hab. Para.

I suspect that this insect is *Nannophya semiaurea*, Hag. MS.; but as this name is inappropriate, being apparently founded on abraded specimens, I have not thought it necessary to adopt it, as no description has been published.

Fylla exigua. (Plate LII. fig. 6.)

? *Nannophya exigua,* Hag. MS.

Long. corp. 16 millim.; exp. al. 24–28 millim.; long. pter. 1 millim.

Head testaceous above; the lower mouth-parts and the back of the head, except the occipital triangle, entirely black. Thorax black above and below, the sides testaceous, with a broad black perpendicular stripe below the front wings, and a small black spot before and behind it; the testaceous colour meets on the back in front of the wings, and in one female specimen it is more extended on the back of the thorax. Legs black. Abdomen (except the first segment, which is black) bright scarlet in the male, but frequently discoloured; in the female the abdomen is brown, with black carinæ and sutures, and the last three segments entirely black, and in the most highly-coloured specimen the space behind the carinæ on the 2nd and 3rd segments and a spot on each side of the 5th and 6th segments in front are whitish. Wings hyaline, with black nervures; pterostigma brown, between thick black nervures, base of the wings tinged with yellow as far as the triangles, in the female this is much fainter, and is confined to the hind wings; membranule very small, whitish.

Hab. China, Borneo (very common), Bouru, Gilolo, and Morty.

EXPLANATION OF THE PLATES.

All the figures are original, and have been drawn on stone from specimens in the collection of the British Museum by Messrs. Green and Mintern, under the personal supervision of the author. The figures on the first four Plates are of the natural size; those on the last three, representing neuration and details, are twice the natural size.

It is to be regretted that it has been found impossible, without very large additional outlay, to give the exact colouring of the wing-veins, for which the descriptions of the species themselves must be consulted.

PLATE LI.

Fig. 1. *Tramea darwinii,* ♀, p. 315.
Fig. 2. *Fylgia amazonica,* ♂, p. 344.
Fig. 3. *Fylgia amazonica,* ♂ (immature), p. 344.
Fig. 4. *Antidythemis trameiformis,* ♂, p. 315.
Fig. 5. *Rhyothemis apicalis,* ♀, p. 319.
Fig. 6. *Rhyothemis cuprina,* ♀, p. 320.
Fig. 7. *Perithemis intensa,* ♂, p. 326.
Fig. 8. *Perithemis bella,* ♂, p. 324.
Fig. 9. *Perithemis bella,* ♀, p. 324.
Fig. 10. *Hydrobasileus vittatus,* ♂, p. 314.

PLATE LII.

Fig. 1. *Pseudothemis zonata*, ♂, p. 270.
Fig. 2. *Celithemis fasciata*, ♂, p. 326.
Fig. 3. *Miathyria pusilla*, ♂, p. 318.
Fig. 4. *Tetrathemis flavescens*, ♂, p. 343.
Fig. 5. *Nannodythemis australis*, ♂, p. 344.
Fig. 6. *Fylla exigua*, ♂, p. 345.
Fig. 7. *Pseudomacromia torrida*, ♂, p. 340.
Fig. 8. *Thermochoria equivocata*, ♂, p. 339.
Fig. 9. *Misagria parana*, ♂, p. 339.
Fig. 10. *Rhodopygia cardinalis*, ♂, p. 299.

PLATE LIII.

Fig. 1. *Cannacria batesii*, ♂, p. 341.
Fig. 2. *Trithemis* (?) *attenuata*, ♂, p. 328.
Fig. 3. *Æthriamanta brevipennis*, ♂, p. 283.
Fig. 4. *Untamo apicalis*, ♀, p. 331.
Fig. 5. *Lyriothemis braueri*, ♀, p. 332.
Fig. 6. *Deielia fasciata*, ♀, p. 330.
Fig. 7. *Pseudoleon superbus*, ♂, p. 274.
Fig. 8. *Nesoxenia cingulata*, ♀, p. 336.
Fig. 9. *Anatya anomala*, ♂, p. 338.

PLATE LIV.

Fig. 1. *Orthemis flavopicta*, ♂, p. 332.
Fig. 2. *Neurothemis affinis*, ♂, p. 323.
Fig. 3. *Macrothemis hemichlora*, ♀, p. 298.
Fig. 4. *Belonia foliata*, ♀, p. 333.
Fig. 5. *Tyriobapta torrida*, ♂, p. 338.
Fig. 6. *Tyriobapta torrida*, ♀, p. 338.
Fig. 7. *Protorthemis celebensis*, ♂, p. 334.
Fig. 8. *Neurothemis disparilis*, ♂, p. 322.
Fig. 9. *Brachydiplax indica*, ♀, p. 329.

PLATE LV.

(Neuration.)

Fig. 1. *Libellula depressa*, ♀, p. 284.
Fig. 2. *Neurothemis fulvia*, ♂, p. 271.
Fig. 3. *Erythemis peruviana*, ♂, p. 305.

Fig. 4. *Sympetrum pallidinervis*, ♂, p. 327.
Fig. 5. *Orthetrum sabina*, ♂, p. 302.
Fig. 6. *Orthetrum cærulescens*, ♂, p. 302.

PLATE LVI.

(Neuration.)

Fig. 1. *Microthemis duivenbodi*, ♂, p. 280.
Fig. 2. *Orchithemis pulcherrima*, ♂, p. 307.
Fig. 3. *Agrionoptera 4-notata*, ♂, p. 292.
Fig. 4. *Raphismia bispina*, ♀, p. 293.
Fig. 5. *Acisoma panorpoides* (?), ♂, p. 309.
Fig. 6. *Palpopleura jucunda*, ♂, p. 273.
Fig. 7. *Nannophya pygmæa*, ♀, p. 313.
Fig. 8. *Tetrathemis hyalina*, ♂, p. 342.

PLATE LVII.

(Neuration and details.)

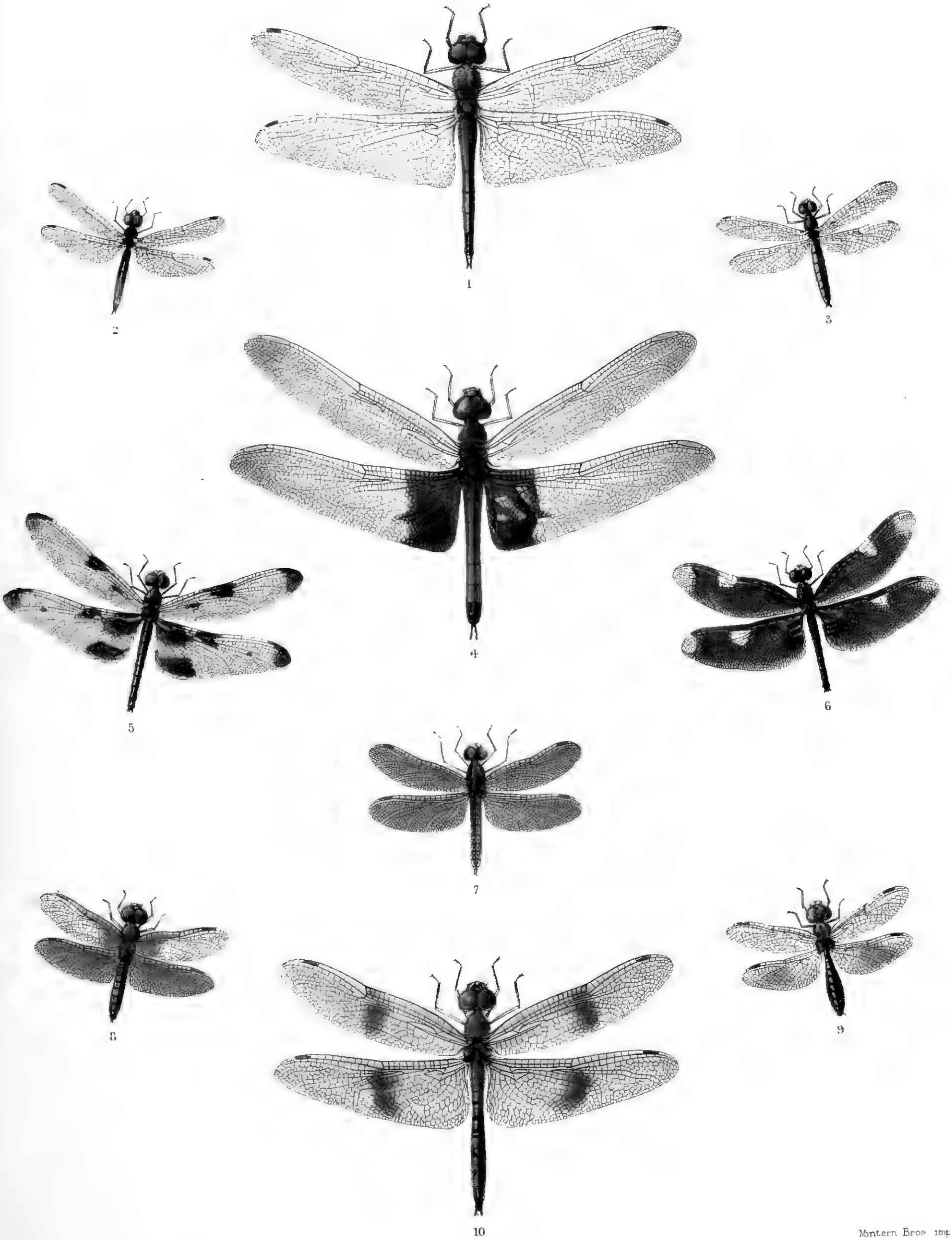
Fig. 1. *Lepthemis vesiculosa*, ♀ (neuration), p. 303.
Fig. 2. *Holotania axilena*, ♂ (neuration), p. 289.
Fig. 3. *Orthemis ferruginea*, ♂ (neuration): 3 *a*, hind leg; 3 *b*, claws; 3 *c*, anal appendages, p. 286.
Fig. 4. *Mesothemis simplicicollis*, ♀ (neuration): 4 *a*, hind leg, p. 303.
Fig. 5. *Orthemis flavopicta*, ♂ (anal appendages), p. 332.
Fig. 6. *Protorthemis celebensis*, ♂ (head): 6 *a*, frontal tubercle, p. 334.
Fig. 7. *Anatya anomala*, ♂ (anal appendages), p. 338.
Fig. 8. *Misagria parana* (side view): 8 *a*, abdominal appendages; *a*, anal appendages, viewed from above; *b*, lower appendage; *c*, lower part of appendages of second segment, viewed from behind, p. 339.
Fig. 9. *Cannacria batesii*, ♂ (anal appendages), p. 341.
Fig. 10. *Zyxomma petiolatum*, ♂ (head), p. 301.
Fig. 11. *Macrothemis hemichlora*, ♀ (claws), p. 298.

Explanation of Neuration (see pp. 252–255).

(Applicable to all the figures of wings on Plates LV.–LVII.)

a. Nodus.
a–m. Nodal cross nervure.
b. Pterostigma.
c–d. Internodal radius, or costal nervure.
e. Antenodal cross nervures.

f. Last antenodal cross nervure.
g. Postnodal cross nervures.
c–h. Principal radius, or subcostal nervure.
k. Upper basal cell.
kk. Lower basal cell.
l. Arculus.
l–s. Upper sector of the arculus.
l–t. Lower sector of the arculus.
m–n. Subcostal radius.
m–o. Nodal sector.
m–p. Subnodal sector.
q. Supratriangular nervures.
r. Triangle.
u. Posttriangular cells.
v–w. Upper sector of the triangle.
v–ww. Lower sector of the triangle.
x. Subtriangular space.
y. Subbasal sectors.
z. Membranule.



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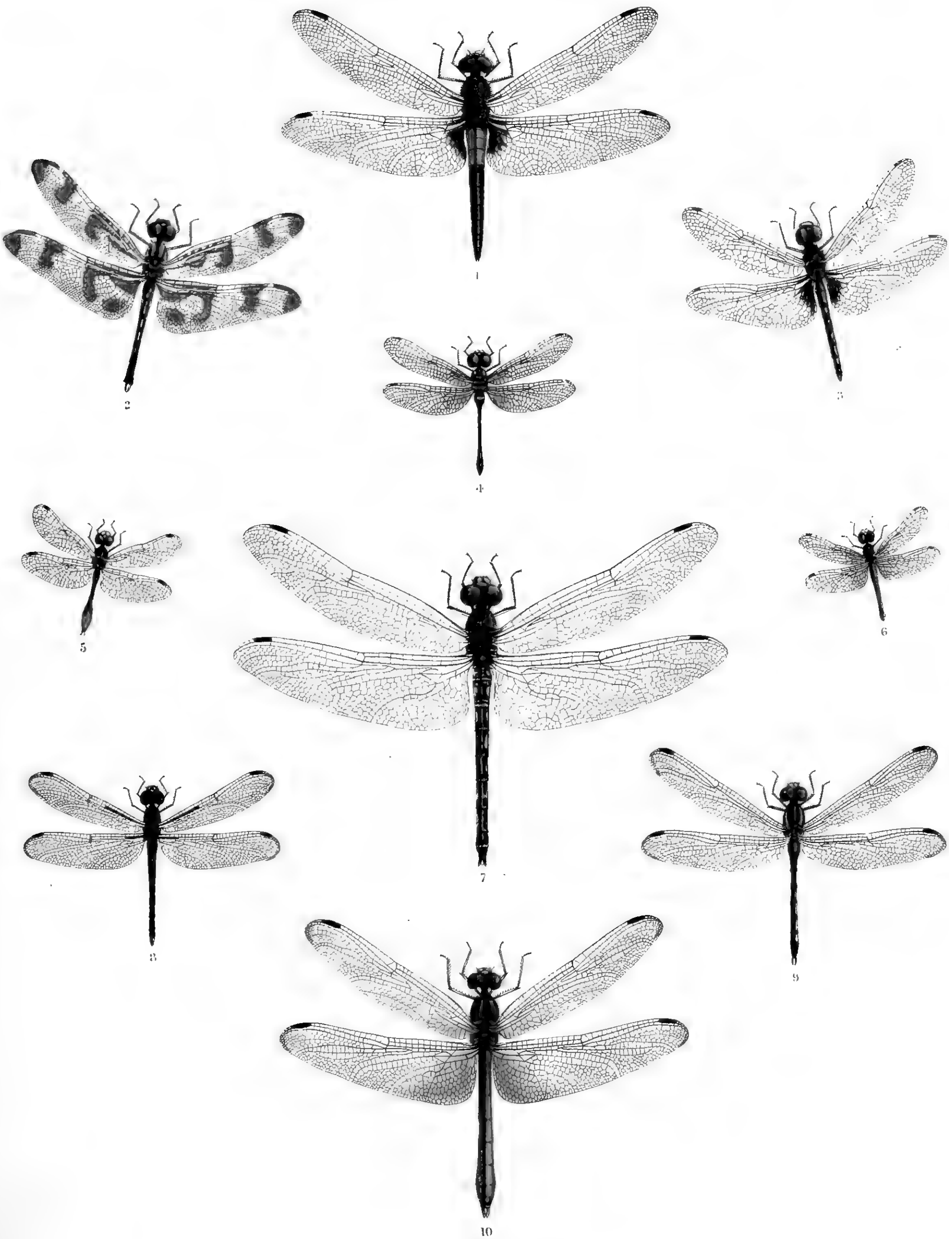

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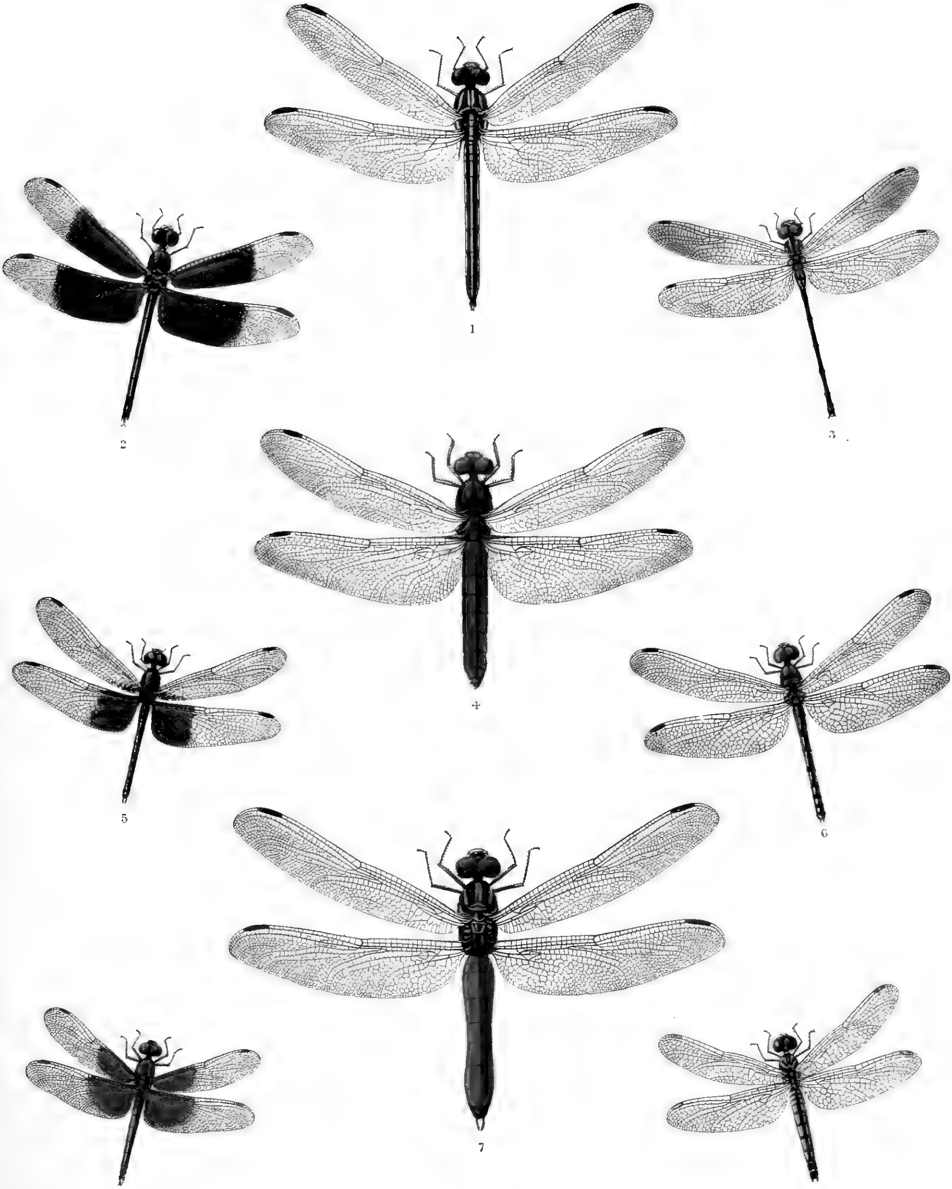

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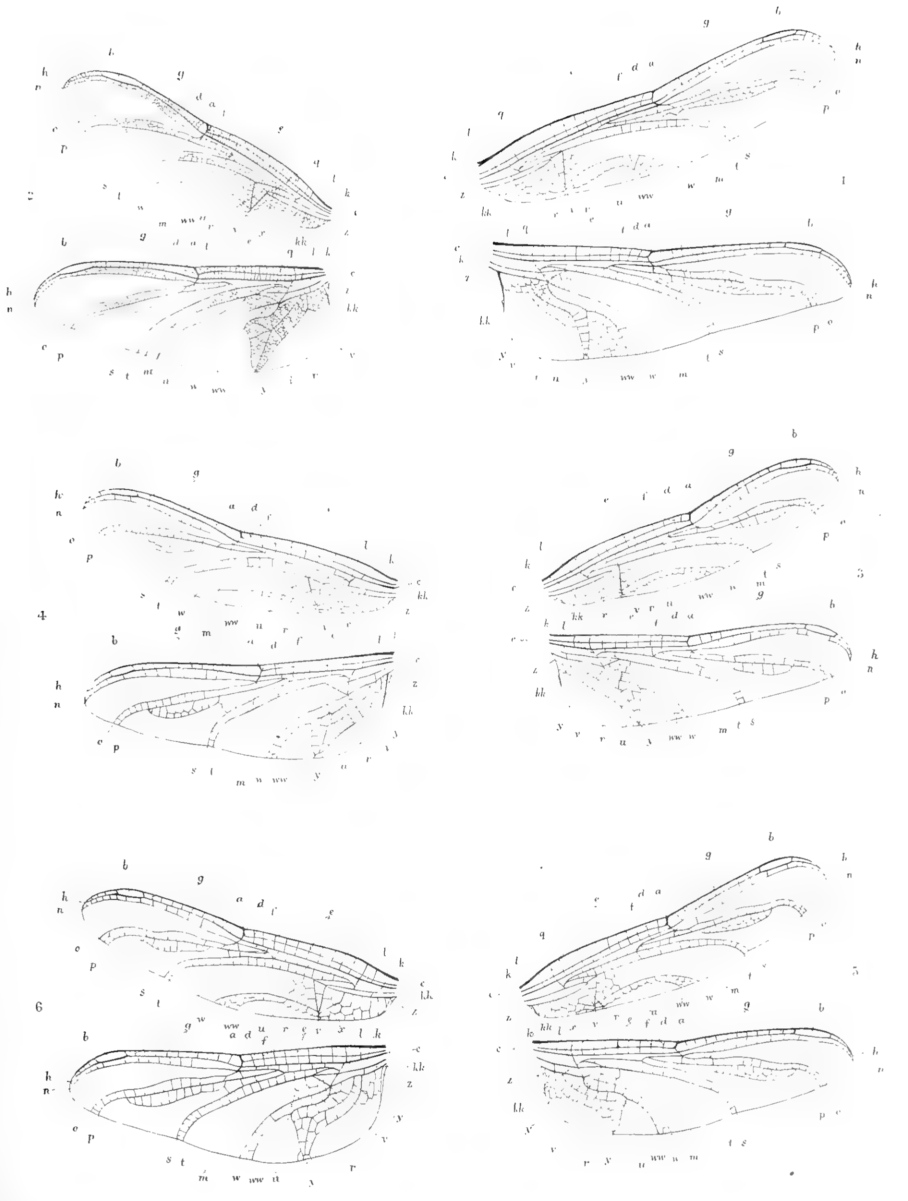

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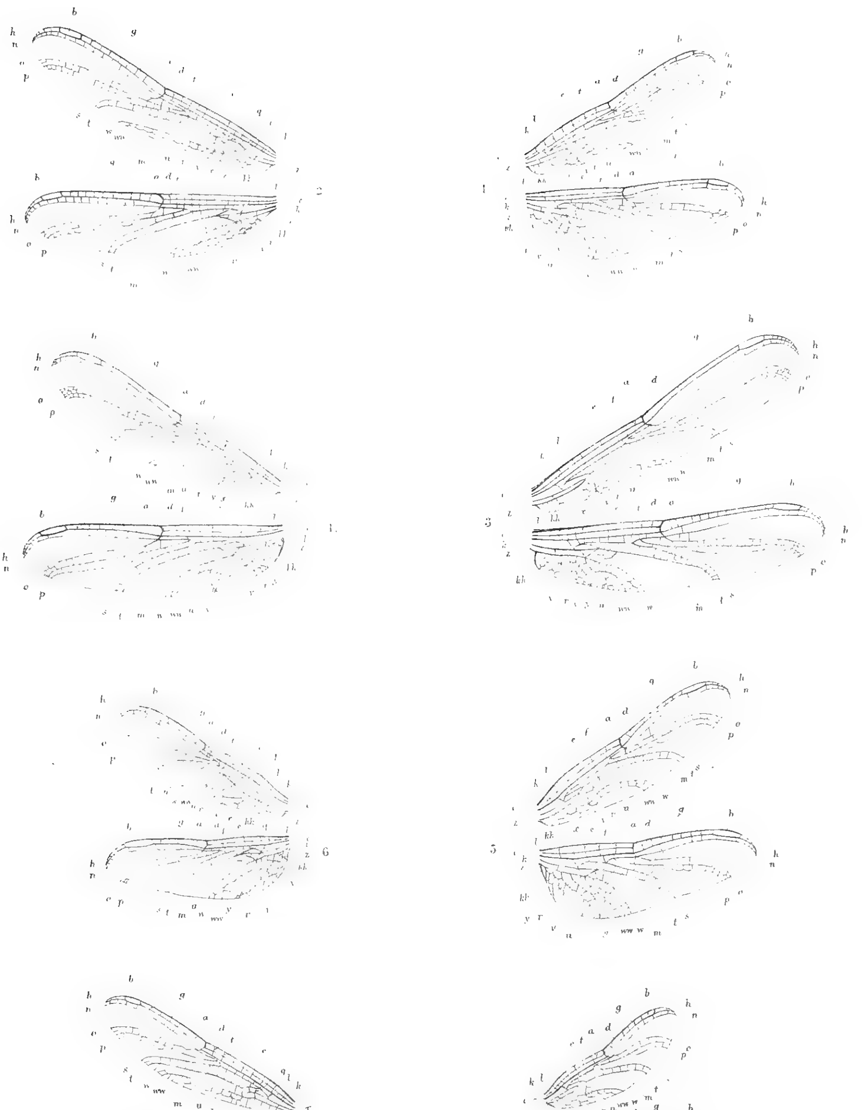

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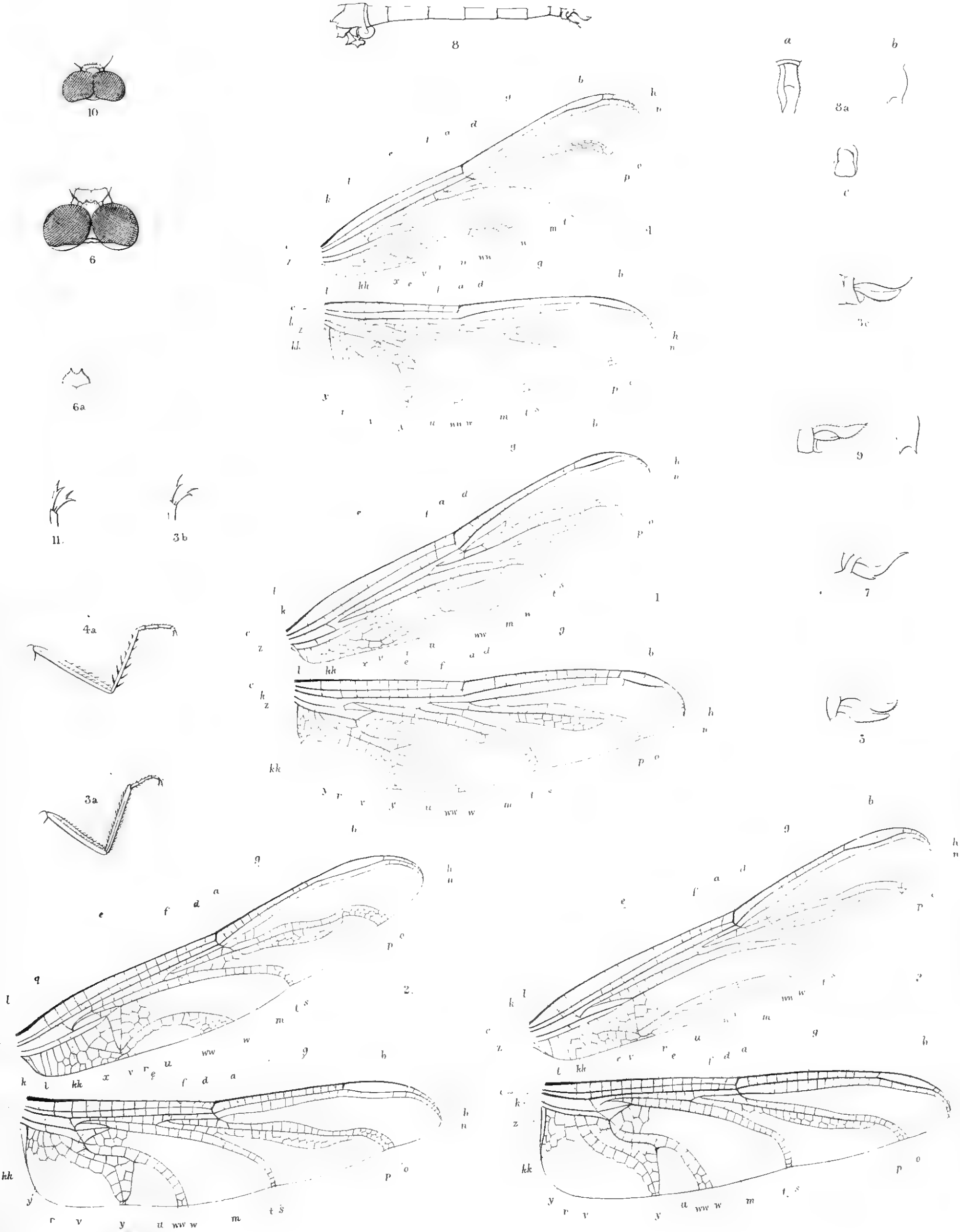

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P. L. SCLATER,
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Continued on page 3 of Wrapper.

XIV. *Observations on the West-Indian Chalinine Sponges, with Descriptions of new Species.* By Arthur Dendy, *B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum.* (*Communicated by* Dr. Günther, *V.P.Z.S.*)

Received June 22nd, 1887, read June 23rd, 1887.

[Plates LVIII.–LXIII.]

Contents.

I. *Introductory Remarks.*

The Natural History Museum has recently acquired a number of very interesting specimens of Chalinine Sponges from the West Indies, which, taken together with those already present in the collection, may reasonably be considered fairly representative of the Chalinine fauna of the locality in question.

On looking into the scanty literature of the subject in the endeavour to find names for the various species, I was only able to identify three, viz.:—*Spinosella sororia*, Duchassaing and Michelotti, sp., *Spinosella plicifera*, Duchassaing and Michelotti, sp., and *Siphonochalina procumbens*, Carter, sp., the last mentioned being represented in the collection by one of the specimens examined and named by Mr. Carter himself. I found, moreover, that our knowledge of the subject was in such an extremely unsatisfactory condition that I resolved to include in the present paper descriptions of all the West-Indian species of Chalininæ represented in the collection, making a total of eight species, three old and five new; I propose also to give brief diagnoses and, when necessary, some discussion of the genera under which the eight species fall.

The Chalininæ evidently form a very important element in the West-Indian sponge-fauna, and it is consequently rather surprising that so very little should be known about them. All the works bearing upon the subject, which can be considered of any importance, are comprised in the following brief list:—

1864. *Duchassaing and Michelotti.*—"Spongiaires de la Mer Caraïbe," Natuurkundige Verhandelingen van de hollandsche Maatschappij der Wetenschappen te Haarlem.

1870. *Oscar Schmidt.*—Die Spongien des atlantischen Gebietes.

1877. *Alpheus Hyatt.*—"Revision of the North American Poriferæ.—Part II.," Memoirs of the Boston Society of Natural History, vol. ii. pt. iv. no. v.

1882. *H. J. Carter.*—"Some Sponges from the West Indies and Acapulco in the Liverpool Free Museum described, with general and classificatory remarks," Ann. & Mag. Nat. Hist. ser. 5, vol. ix. pp. 266, 346.

In the first of these publications we find described a large number of sponges; but I may say, in the words of Mr. Carter, "the work is so full of errors, typographical and others, the descriptions so incomplete, and the representations so coarse, that I have hardly ever referred to it without disappointment, still more increased by the evidence that its otherwise rich contents must thus, for the most part, for ever remain unavailable . . . . Now, as it is essential for recognition that the microscopy and spiculation of each sponge should accompany it, if not in illustration, at least in description, so it is evident that in the absence of this alone, to say nothing of the shortcomings of the publication generally, the 'Spongiaires de la Mer Caraïbe' must for ever remain a kind of 'Eldorado,' in which there are a number of good things, but no one can get at them"[1].

Duchassaing and Michelotti describe nineteen species of Chalininæ all under the generic name *Tuba*, and it is very probable that one or two other species described by them also belong to this group. They have since published (in 1870) a pamphlet entitled 'Revue des Zoophytes et des Spongiaires des Antilles;' but this work I have, unfortunately, not been able to obtain.

Professor Oscar Schmidt, in his work on the Atlantic sponges, retains the generic name "*Tuba*" for *Tuba plicifera*, D. & M. (? Lamarck), which he considers a true horny sponge; but the majority of Duchassaing and Michelotti's remaining species of *Tuba* are referred by him to a single species of his own genus *Siphonochalina*, to which species he gives the unnecessarily new name of *Siphonochalina papyracea*. For *Tuba armigera*, D. & M., Schmidt founds the new genus *Cladochalina*[2].

It is doubtful whether Professor Hyatt's work on the North-American Porferæ ought to have been included in the above list at all, as hardly any direct reference is made to the Chalininæ, and no species are described; but it contains much information with regard to the external conditions under which horny-fibred sponges flourish.

Finally Mr. Carter, in his paper on "Sponges from the West Indies and Acapulco," criticizes, as we have seen above, Duchassaing and Michelotti's work, and records a number of species of sponges, amongst which a new species of West-Indian Chalininæ, viz. *Siphonochàlina (Patuloscula) procumbens*, is described, and six old species are identified and more or less fully dealt with.

The species of Chalininæ which I propose to describe in the present paper are especially interesting from two points of view:—(1) they afford excellent illustrations of the great variability in external form to which species of sponges living in shallow, or comparatively shallow, water are subject; and (2) they illustrate in a very striking way the manner in which the siliceous spicules gradually degenerate and ultimately completely vanish as the horny skeleton becomes more and more strongly developed.

[1] *Loc. cit* pp. 267, 268.

[2] *Loc. cit.* p. 35.

The first of these two general laws is very clearly demonstrated in the case of *Spinosella sororia*, D. & M., sp., of which I distinguish three varieties in addition to the typical form (Pl. LIX. figs. 1, 3; Pl. LXIII. figs. 1, 2), and in the case of *Pachychalina variabilis*, mihi (Pl. LX. fig. 2); but as this will be sufficiently clear from the figures and from the descriptions given in the systematic portion of this paper, I shall not consider the question any further in this place.

The second law has already been very strongly insisted upon by Mr. Ridley and myself in our Report on the Monaxonida collected by H.M.S. 'Challenger,' in which we have endeavoured to show that the so-called "Keratosa" have probably descended, polyphyletically, from several distinct groups of siliceous sponges, amongst which the Chalininæ figure prominently. The view that the Keratosa have been derived from siliceous sponges has been gradually gaining favour with naturalists for some time past, and is now, I believe, very generally admitted to be correct. But I have nowhere found quite such strong arguments in its favour as amongst the West-Indian Chalininæ; for here we can trace in different species of the same genus the gradual degeneration and disappearance of the spicules until we come down to forms like *Spinosella maxima*, mihi (Pl. LXI.), and *Spinosella plicifera*, D. & M. (Pl. LVIII. fig. 5; Pl. LX. fig. 1), which sometimes still contain traces of the spicules imbedded in the horny fibre, and apparently on the verge of disappearance, while at other times they contain no spicules whatever; and yet the specimens with spicules and those without are specifically indistinguishable.

It appears that the spicules may persist as vestigial structures long after they have ceased to be of any functional importance, and that they disappear first from the secondary skeleton-fibres. Thus in the genus *Siphonochalina* we have *S. spiculosa*, mihi (Pl. LVIII. figs. 2, 2 *a*; Pl. LXII. fig. 3), with great numbers of well-developed spicules constituting a most important part of the skeleton-fibre, and, on the other hand, *S. ceratosa*, mihi (Pl. LVIII. figs. 1, 1 *a*; Pl. LXII. fig. 2), in which the spicules have almost completely vanished; while *Siphonochalina procumbens*, Carter (Pl. LVIII. fig. 4; Pl. LXII. fig. 1), occupies an intermediate position in this respect, containing several series of fair-sized spicules in the primary fibres and only a sparse single series of similar spicules in the secondaries.

The classificatory difficulties to which this state of things leads are obvious. It is, in fact, no longer possible to draw a sharp line of distinction between the Chalininæ and the so-called Keratosa; for different specimens of one and the same species may or may not contain spicules, while at the same time it is probable that a large proportion of the Keratosa have no near connection with the Chalininæ at all, but are descended from quite different groups of siliceous sponges [1].

Some of these difficulties are well illustrated by a note at the end of Professor

[1] *Cf.* Ridley and Dendy, Report on the Monaxonida collected by H.M.S. 'Challenger,' p. lv *et seq.*

Hyatt's work on the North-American Poriferæ already referred to; he says, "two specimens, pl. xv. figs. 22, 23, were introduced into the plates under the impression that they were species of *Spongelia*, but the microscopical examination of the skeleton shewed them to be spicular. Subsequently I found a specimen identical in every respect with fig. 22, which, however, had fibres free from spicules, and a new examination of the originals of figures 22, 23 was made, disclosing the fact that the perfect imitation of Chalina presented in my first preparation was accidental. This in its turn led me to make renewed researches among the species of *Tuba*, and I now begin to think that I may be obliged to withdraw from the position taken in the first part of this paper, and admit *Tuba* as a genus of Sponginæ. It is very remarkable that there should be any doubt on such a point; but although I have examined more than fifty microscopical sections of different species of *Tuba*, sometimes several preparations to a species, I cannot make up my mind as yet whether the spicules are indigenous or foreign."

I do not think that there can be much doubt that the spicules observed by Professor Hyatt are to be regarded as "indigenous," and that their presence in some cases and absence in others is to be explained in accordance with the view enunciated above.

The immediate cause of the disappearance of the spicules appears to be the development of the spongin to such an extent as to form by itself a sufficiently strong skeleton. In such a skeleton spicules would probably be not only useless but actually harmful, in that they would tend to make the fibre rigid and brittle when it is desirable that it should be elastic and flexible, in order to facilitate the free contraction and expansion of the various parts of the canal-system, and in order to withstand the action of the waves and currents in the shallow water in which horny-fibred sponges occur.

Spongin appears to develop to a large extent only in warm climates and in tolerably shallow water [1], and under such conditions sponges with a strongly developed horny skeleton are abundant. This general law is well illustrated by the present collection, and also by the sponge fauna of the Eastern Mediterranean and of the Australian area [2].

Concerning the minute anatomy of the Chalininæ I am, unfortunately, not able to give any details in this place, as all the material at my disposal was dry. I have, however, in another paper, given an account of the minute anatomy of a species of *Pachychalina* [3], and Dr. R. von Lendenfeld deals with the subject in the forthcoming paper already referred to.

[1] *Cf.* Hyatt, 'Revision of the North-American Poriferæ,' Part 2, p. 490; and Ridley and Dendy, Report on the Monaxonida collected by H.M.S. 'Challenger,' p. lv.

[2] The Keratosa and Chalininæ of the Australian area are being worked out by Dr. R. von Lendenfeld, who has most kindly forwarded to me a proof of the first part of his paper on the latter group.

[3] Proceedings of the Zoological Society of London, 1887, p. 524.

II. *Description of Genera and Species.*

Genus PACHYCHALINA, Schmidt.

1868. *Pachychalina,* Schmidt, Spongien der Küste von Algier, p. 8.

1886. *Dasychalina,* p. p., Ridley and Dendy, Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 329.

Diagnosis.—Lobose or digitate, solid Chalininæ [1]. Fibres stout, with spicules numerous and arranged polyserially.

This diagnosis is not very satisfactory, but it is the best that I am able to give in the present state of our knowledge; for further information regarding the genus the reader is referred to the Report on the Monaxonida of the 'Challenger' Expedition, p. 19, where the question is fully discussed.

PACHYCHALINA VARIABILIS, n. sp. (Plate LVIII. fig. 3; Plate LX. fig. 2.)

This species is chiefly remarkable from its extreme variability in external form. It is represented in the collection by five large specimens, each of which unites in itself two distinct types of growth, lobose and digitate. The long, subcylindrical, digitate processes may either be united at the base only with the compressed, lobose portions, or they may arise from various parts of the surface of the same, or from the free margin. One very remarkable example consists of a single, crescent-shaped, thick, cushion-like lobe, 19 centim. high, 24 centim. broad, and 5 centim. thick in the middle. The oscula occur thickly scattered over one surface only, and from near the middle of the base, on the side opposite to that on which are the oscula, arises a single, upright, thick, irregular, digitate process, constricted at intervals in a somewhat moniliform manner, with oscula irregularly scattered over the surface, but mostly on one side. This process is a little taller than the lobose portion to which it is attached.

The largest specimen in the collection consists of a great, irregular, broadly expanded lobe, giving off from the base, from the free margin, and from various parts of both surfaces a number of irregular, simple or branched, digitate processes. The oscula occur for the most part scattered irregularly over one surface of the specimen. The height of the entire specimen is about 38 centim., and the greatest breadth 37 centim.; while the average diameter of the digitate processes is about 2 centim.

The colour (in the dry condition) of all the specimens is light yellowish grey, and the texture hard, but fibrous and somewhat elastic. The oscula are large round openings, with slightly raised margins, averaging about 5 millim. in diameter. In the case of the lobose portions of the specimens they are almost entirely confined to one surface, as is usually, if not always, the case in flabellate sponges. Sometimes also they occur uniserially arranged along the margin of the sponge.

The main skeleton (Pl. LVIII. fig. 3) is a very irregular reticulation of strong spiculo-fibre, containing both a large amount of spongin and a great number of spicules.

[1] The term Chalininæ includes, according to my views, only sponges in which the megasclera, when present, are diactinal, and there are no microsclera.

Primary and secondary lines may be distinguished, but they are very confused, and there is a strong development of longitudinal fibres. The spicules are for the most part polyserially arranged, and occur scattered outside the fibres as well as in them. The spongin is of a very pale colour, it usually forms a thick sheath completely enveloping the spicular axis of the fibres.

The dermal skeleton, like the main skeleton, is a very irregular reticulation, composed of spiculo-fibre of extremely variable thickness and with polygonal or rounded meshes varying considerably in size.

The spicules are long and very slender and somewhat curved; they are apparently undergoing degeneration. Although commonly diactinal (oxeote or strongylote), yet monactinal forms (styli) seem to be occasionally forthcoming; but these are perhaps to be regarded as monstrosities, for the nature of the ends varies much. They measure about 0·126 by 0·003 millim.

The species, as I have already indicated, is interesting chiefly owing to the manner in which it demonstrates how cautiously external form must be used as a guide to classification. Yet, although the different specimens, and even the different parts of the same specimen, differ so much in this respect, still there is a close general resemblance between them all, which, although extremely difficult to express on paper, a careful observer can scarcely fail to detect (*vide* Pl. LX. fig. 2).

Locality. Nassau, Bahamas.

Genus Siphonochalina, Schmidt.

1868. *Siphonochalina,* Schmidt, Spongien der Küste von Algier, p. 7.
1881. *Tubulodigitus,* Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 367.
1882. *Patuloscula,* Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. ix. p. 365.

Diagnosis.—Tubular Chalininæ; tubes smooth, both inside and out, usually narrow, each with a large round opening at the summit.

For further details with regard to this genus I must again refer to the Report on the Monaxonida collected by H.M.S. 'Challenger,' p. 29.

Siphonochalina spiculosa, n. sp. (Plate LVIII. figs. 2, 2 *a*; Plate LXII. fig. 3.)

The single specimen in the collection (Pl. LXII. fig. 3) consists of about twenty long, upright, cylindrical tubes, united together at the base, and also occasionally anastomosing at points where they come into contact with one another laterally. Height of entire specimen 27 centim., greatest width 21 centim. The tubes are of nearly the same diameter all the way up, but slightly larger at the top, where they measure about 3 centim., than elsewhere; their walls average about 6 millim. in thickness. The outer surface, though smooth, is rather uneven. The true oscula are very small, and occur scattered over the inner surface of the tubes. The colour of the specimen, in its present condition (dry), is light yellowish grey, and the texture is rather brittle.

The main skeleton (Pl. LVIII. figs. 2, 2 *a*) is a network of stout, coarse, spiculo-fibre, composed of very numerous, polyserially arranged, oxeote spicules, united together by rather a small proportion of spongin, which is not sufficient, at any rate in most cases, to form a distinct sheath around the fibre. One can readily distinguish with the naked eye the primary fibres, running at right angles from surface to surface of the tube-walls, and secondary fibres crossing them at right angles, and thus giving rise to a more or less rectangularly meshed but rather irregular reticulation with wide meshes. Towards the outer surface the reticulation becomes closer, owing to the interpolation of new fibres, both primary and secondary, between the old ones. The average diameter of the primary fibres is about 0·06 millim., and of the secondaries somewhat less; both contain a large quantity of imbedded foreign matter, such as grains of sand &c., lodged amongst the spicules. The proper spicules of the sponge also occur fairly abundantly scattered between the fibres as well as in them.

In addition to the primary and secondary fibres thus described, one may trace, on the inner surface of the tube-wall, a system of longitudinal fibres.

The dermal skeleton, on the outer surface of the tubes, consists of a fairly close, polygonally meshed reticulation of stout spiculo-fibre, containing a very large proportion of spicules and but little spongin; the average diameter of the fibres is about 0·03 millim. The ends of the primary fibres of the main skeleton form projecting nodes in the dermal network.

The spicules are slightly curved, sharp-pointed oxea, measuring about 0·138 by 0·006 millim.

This species appears to be closely related to Esper's *Siphonochalina* (*Spongia*) *tubulosa*[1], from the Cape of Good Hope; but we learn from Ehlers[2] that the spicules of that species are twice as thick as here, and there would also appear to be no foreign bodies in the fibre. The external form is also decidedly different in the two cases, as will be seen by comparison with Esper's figure.

Siphonochalina intermedia[3], Ridley and Dendy, from Port Jackson, Australia, also appears to be closely related, but differs considerably in the condition of the dermal skeleton, in the slender fibre, containing much spongin, and in the absence of the foreign bodies.

Locality. Turk's Island, Bahamas.

SIPHONOCHALINA PROCUMBENS, Carter, sp. (Plate LVIII. fig. 4; Plate LXII. fig. 1.)

1882. *Patuloscula procumbeus,* Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. ix. p. 365.

This species has already been pretty fully described, but unfortunately not figured,

[1] Fortsetzungen der Pflanzenthiere, vol. i. p. 196, pl. liv.

[2] Die Esper'schen Spongien, p. 19.

[3] Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 331, and Report on the Monaxonida collected by H.M.S. 'Challenger,' p. 30, pl. vii. fig. 1 and pl. xlvi. fig. 3.

by Carter. As it is a West-Indian species, and is represented in the collection, I must for the sake of completeness include it in this place.

It is described by Carter as follows:—"Cauliform, rhizomatous, procumbent, solid, throwing up thumb-like hollow processes, or simply branched, with large patulous vents; processes short, erect, annularly inflated, increasing in size upwards, and somewhat contracted at the orifice, which is large and circular. Texture resilient. Colour pale amber or deep dark amber, bordering on purple, which is probably the real colour when fresh. Surface smooth, even. Composition fibrous, resilient. Spicule of one form only, viz. acerate, smooth, curved, fusiform, sharp-pointed, 20 by $1\frac{1}{2}$–6000ths inch in its greatest dimensions, small, and scanty. Size of specimen $5\frac{1}{2}$ inches high by $1\frac{1}{2} \times 7$ inches square. *Hab.* Marine. *Loc.* West Indies, Grenada."

There is an authentic specimen of this sponge, from Grenada, in the British Museum, and I am therefore able to add a few observations to the above description. The sponge (Pl. LXII. fig. 1) consists of a dozen short tubes, arising side by side from an elongated, compressed basal portion and mostly fused together laterally. The average diameter of the orifices of the tubes is about 12 millim., and the thickness of their walls about 5 millim.

The skeleton (Pl. LVIII. fig. 4) is a beautifully symmetrical, rectangularly meshed reticulation of stout horny fibre, rather sparsely cored by short, hastately pointed oxea. In the secondary fibres the spicules are arranged uniserially and at some distance from one another; but in the primary fibres they are polyserially arranged and form a continuous axial core. The diameter of the fibres is about 0·07 millim., there being little difference between the primaries and secondaries in this respect. Towards the inner surface of the tube-wall the network becomes irregular and very wide-meshed.

The dermal skeleton is a polygonally meshed reticulation of stout horny fibre, cored by sparse, uniserially arranged, oxeote spicules.

The spicules are rather short, hastately pointed oxea, or tornota, measuring about 0·075 by 0·0042 millim.

As regards the structure of the skeleton this species occupies an intermediate position between *Siphonochalina spiculosa* and *Siphonochalina ceratosa*, from both of which, however, it differs markedly in external form.

Locality. West Indies, Grenada. (Mr. Carter also identifies[1] with this species several specimens from South Australia, collected by Mr. Bracebridge Wilson; but having had the opportunity of examining these specimens, which are now in the British Museum, I cannot agree as to their identity with the types of *Siphonochalina procumbens.*)

Siphonochalina ceratosa, n. sp. (Plate LVIII. figs. 1, 1 *a*; Plate LXII. fig. 2.)

Here, again, there is only a single specimen in the collection, consisting of about twenty

[1] Ann. & Mag. Nat. Hist. ser. 5, vol. xvi. p. 286.

upright, cylindrical, thick-walled tubes, united together in an irregular basal mass and also united laterally in places by the development of horizontal trabeculæ of tissue or by direct fusion of adjacent tubes.

The height of the entire specimen (Pl. LXII. fig. 2) is 24 centim., and the breadth about 30 centim. The tubes are not of the same diameter all the way up, but narrow somewhat suddenly at a distance of about 6 centim. from the top: the diameter of the different tubes varies considerably; that of the orifice of the tubes ranges from 6 millim. (in the case of a young branch) to about 3·5 centim. (in the case of two tubes which have completely fused and have a common aperture), while the average diameter of the orifice in an ordinary full-grown tube may be taken as about 1·5 to 2 centim. The thickness of the walls of the tube averages about 6 millim. The outer surface is smooth but uneven, the tubes being irregularly swollen in some parts and constricted in others. The colour of the specimen (dry) is clear, pale yellow, and its texture is firm but elastic. The true oscula are small, round openings, abundantly scattered over the inner walls of the tubes.

The main skeleton (Pl. LVIII. figs. 1, 1 *a*) is a beautifully regular and symmetrical, rectangular and close-meshed reticulation of stout horny fibre, composed as usual of primary fibres running vertically to the surface, and secondary fibres crossing them at right angles. The primaries average about 0·053 millim. in diameter, and the secondaries but little less. The fibres contain a few very small and slender vestigial spicules (Pl. LVIII. fig. 1 *a*), apparently on the verge of complete disappearance; these are much more abundant in the primary than in the secondary lines, as is usually the case.

The dermal skeleton on the outer surface of the tubes is represented by a polygonally meshed reticulation of stout, horny fibre, not really distinct from the underlying main skeleton.

The spicules are represented by mere traces of slender oxea, which have been almost completely absorbed.

This beautiful species is characterized chiefly by the large amount of spongin, and the corresponding almost entire absence of spicules of the fibre, thus forming a striking contrast to *Siphonochalina spiculosa*, mihi, which bears a considerable external resemblance to it.

Locality. Nassau, Bahamas.

Genus Spinosella, Vosmaer.

1864. *Tuba*, Duchassaing and Michelotti, "Spongiaires de la Mer Caraïbe," Natuurkundige Verhandelingen van de hollandsche Maatschappij der Wetenschappen te Haarlem, 1864, p. 44.

1870. *Siphonochalina*, pars, Schmidt, Grundzüge einer Spongien-Fauna des atlantischen Gebietes, p. 33.

1885. *Spinosella*, Vosmaer, Bronn's 'Klassen und Ordnungen des Thierreichs,' Porifera, p. 342.

Diagnosis. Simple or branched, tubular Chalininæ, having the inner surface of the tubes smooth, and the outer surface covered with spines, warts, or prominent ridges.

This genus is synonymous with Duchassaing and Michelotti's genus *Tuba* (*loc. cit.*) of which the authors give the following description :—" Ces spongiaires se présentent sous forme de tubes tantôt simples et isolés, tantôt réunis par leurs côtés et prenant une disposition flabellée. La cavité centrale se prolonge jusqu'à la base de la masse, et sa paroi intérieure offre des faisceaux de fibres disposés sous forme de nervures qui après avoir parcouru toute l'étendue du tube, viennent souvent se terminer en dépassant l'orifice, ce qui lui donne une garniture de cils plus ou moins longs; d'autres fois ces nervures ne se prolongent pas sous forme de cils autour de l'ouverture qui alors peut être garnie seulement d'une espèce de frange ou collerette d'un tissu très-mince et très-transparent; chez quelques-uns il n'y a ni cils ni frange, l'orifice du siphon ou tube est alors nu.

"Chez les tuba, les oscules ne s'observent guère sur la face extérieure du siphon; ils sont au contraire agrainés et très-nombreux entre les nervures qui sillonnent la cavité intérieure. Celles qui ont bien conservé leur encroûtement ne présentent même jamais d'oscules sur leur paroi extérieure; ce n'est que lorsqu'elles ont été roulées ou en partie décomposées que l'on aperçoit des oscules sur la face extérieure. D'autres, quoique bien conservées dans toutes leurs parties, semblent présenter aussi des oscules, mais les traces circulaires que l'on observe ne sont que les loges du Zoorthus (*sic*) parasitica.

"Toutes les espèces de ce genre sont d'un jaune assez clair et présentent le plus souvent à leur surface extérieure un léger encroûtement de même couleur; quand cet encroûtement a disparu par une circonstance quelconque, cette face extérieure paraît criblée de trous plus ou moins grands qui sont les orifices extérieurs des caveaux qui parcourent l'épaisseur des parois.

"Les espèces du genre tuba habitent en général les eaux profondes, et c'est surtout à la suite des gros temps qu'on peut les recueillir sur le rivage."

Vosmaer in 1885 (*loc. cit.*) substituted the generic name *Spinosella* for *Tuba*, as he found that the latter had already been used by Fabricius and Lea. He gives the following diagnosis of the genus:—" Platte, dünne Lappen, welche oft allmählig in weite, dünnwandige Röhren übergehen. Oft auch verästelt. Eine Seite (innen) ziemlich glatt, die andere (äussere) mit zahlreichen langen, dornartigen Fortsätzen. Nadeln in Bündeln. Spic. indic. ac^2." This diagnosis is scarcely so satisfactory as the original description, though it has the advantage of brevity. I do not know a single species of the genus which forms "platte, dünne Lappen;" so far as my experience goes they are not only often, but always, tubular, as originally described by Duchassaing and Michelotti. Mention of the spicules in the generic diagnosis is superfluous, as oxeote spicules ($=ac^2$, Vosmaer) are characteristic of all the Chalininæ alike (when spicules are present), and, indeed, even of the entire family Homorrhaphidæ[1]; moreover, it so happens that in the genus *Spinosella* the spicules may dis-

[1] *Cf.* Ridley and Dendy, Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 326; Report on the Monaxonida collected by H.M.S. 'Challenger,' p. 1.

appear altogether, leaving only the horny fibre, a circumstance to which I have already referred, and with which I shall have to deal more fully later on.

Duchassaing and Michelotti have arranged the species of the genus in three groups, according to the nature of the mouth of the tube, as follows:—

Orifice du Siphon fortement cilié.	Tissu fin, surface extérieure munie de processus spiniformes encroûtés.	Tuba. Sancta crucis. ,, Sororia. ,, Conica. ,, Lineata. ,, Megastoma. ,, Bursaria. ,, Armigera.
	Tissu grossier, surface extérieure hérissée de pinceaux de fibres non encroûtés.	,, Digitalis. ,, Incesta. ,, Pavonina. ,, Crispa.
Orifice du Siphon plutôt frangé que cilié		,, Longissima. ,, Vaginalis. ,, Lævis. ,, Subenervia. ,, Plicifera. ,, Scrobiculata.
Orifice nu, c. à d. n'offrant ni cils ni pinceaux bien formés, ni frangés .		,, Irregularis. ,, Sagoti.

The material at my disposal is sufficient to show in a very conclusive manner that this arrangement of the species is a very unsatisfactory one. There is in the collection a specimen of *Spinosella* (*Tuba*) *sororia*, var. *elongata*, mihi, consisting of about thirty tubes, some of which are "ciliated" at the orifice while others are "naked." Indeed, this appears to be a character of but slight importance and even of extremely doubtful specific value, and it is, consequently, rather surprising that so practised an observer as Mr. Carter should have adopted it [1], more especially considering that Schmidt [2] had already come to the same conclusion as myself with regard to its value and for a precisely similar reason.

The genus *Spinosella* is very closely related to Schmidt's *Siphonochalina*, and it is an open question whether or not the two should be united. The degree of development of the spines on the surface varies much even within the species. Thus, in my variety *elongata* of Duchassaing and Michelotti's species *sororia*, the spines are almost entirely obsolete, while in the typical form and in other varieties of the same species they are strongly developed; and yet, as will be seen later on, there are so many

[1] Ann. & Mag. Nat. Hist. ser. 5, vol. ix. p. 278.

[2] Spong. atlant. Gebiet. p. 34.

connecting-links between the variety in question and the spinose specimens, that it is impossible to make a specific distinction between them.

It is, however, very convenient to keep the two genera distinct, and I have therefore not united them[1].

The first species described by Duchassaing and Michelotti is "*Tuba Sancta crucis;*" but this is not even figured, and we have only a very meagre description of the external form. The second, however, viz. *Spinosella (Tuba) sororia*, is recognizable with tolerable certainty from the figure.

Spinosella sororia, Duchassaing and Michelotti, sp. (Plate LVIII. fig. 7; Plate LIX. fig. 1.)

1864. *Tuba sororia*, Duchassaing and Michelotti, Spongiaires de la Mer Caraïbe, p. 46, pl. viii. fig. 1.

1870. *Siphonochalina papyracea*, Schmidt, Spong. atlant. Gebiet. p. 33.

This species is shown by the British Museum collection to be an extremely variable one, and it is very probable that several of the forms described by Duchassaing and Michelotti as distinct should be united with it, as already pointed out by Schmidt (*loc. cit.*) in his valuable remarks on the subject.

I cannot, however, agree with Schmidt in suppressing Duchassaing and Michelotti's name and giving a new one, viz. *Siphonochalina papyracea*, to a species which has already received far too many. I have therefore retained the specific name *sororia*, which represents the first recognizable species of Duchassaing and Michelotti's genus *Tuba*, and propose to describe in this place four well-marked varieties of the species, all of which agree so closely with one another in microscopical structure and are connected by so many links that it is impossible to separate them specifically.

The typical form (Pl. LIX. fig. 1), agreeing closely with Duchassaing and Michelotti's original figure, is represented by several specimens. The one which I have selected for description consists of a number of long tubes united together in an irregular basal mass. The whole sponge is compressed and fan-like, but this condition may be partly due to artificial pressure. The tubes vary in length from 8 to 16 centim., and in greater diameter from 2 to 3·5 centim.; they may be entirely free from one another except at the base, or more or less united laterally. The inner surface of the tubes is smooth and appears strongly veined, the venation being due to an unusually strong development of the main skeleton reticulation in the places where it occurs. The outer surface is strongly spined. The spines average about 7 millim. in length, and are caused by projections given off obliquely outwards and upwards from the longitudinal veins just mentioned. Around the margin of the tubes the ends of the veins project freely, and cause the orifice to appear "ciliated." The true oscula are small and circular, and abundantly scattered on the inner surface of the tubes.

[1] *Cf.* Ridley and Dendy, Report on the Monaxonida collected by H.M.S. 'Challenger,' p. 29.

The main skeleton (Pl. LVIII. fig. 7) is a well-developed, more or less polygonally or subrectangularly meshed reticulation of stout horny fibre. The fibre is stouter and the reticulation closer in the veins than elsewhere. The average diameter of the fibre is about 0·04 millim., but there is a good deal of variation in this respect; it is sparsely cored by slender oxeote spicules, which are much more abundant in the primary than in the secondary lines, being commonly arranged in the former in a somewhat plumose manner, while in the secondary lines they are for the most part scattered singly.

The dermal skeleton is a polygonally close-meshed reticulation of slender fibre, averaging in diameter about 0·012 millim.; cored occasionally by single spicules. On the inside of the tubes there is no dermal reticulation distinguishable, as such, from the main skeleton.

The spicules are slender oxea, usually slightly curved, measuring about 0·082 by 0·0025 millim.

Locality. West Indies.

Spinosella sororia, var. dilatata, nov. (Plate LVIII. fig. 6; Plate LXIII. fig. 2.)

This variety may be disposed of very briefly; it is represented in the collection by one fine specimen (Pl. LXIII. fig. 2), which differs from the typical form of the species in its more luxuriant and bushy habit and in the much greater width of the larger tubes.

The specimen in question is 35 centim. in greatest breadth and 21 centim. high. The tubes vary greatly in size; the larger ones are more or less compressed, and the largest measures 11·5 centim. across the longer diameter of the mouth. The spines on the outer surface of the tubes are very strongly developed and very sharply pointed; but the venation on the inner surface is not nearly so strongly marked as in the typical forms. Otherwise there are no differences worthy of note. The dermal skeleton is represented in Plate LVIII. fig. 6.

Locality. Bahamas.

Spinosella sororia, var. fruticosa, nov. (Plate LIX. fig. 3.)

This variety, of which there are two specimens in the collection, again differs from the typical forms in its bushy habit, and the spines on the surface are again very strongly developed. The tubes, moreover, are cylindrical and somewhat narrow in diameter; their walls are thicker than in the typical form, and the venation on the inner surface is strongly marked.

The specimen (Pl. LIX. fig. 3) which I consider as most typical of the variety measures 30 centim. in greatest breadth, and 27 centim. in height; the diameter of the mouth of the largest tube is 3 centim., but this is somewhat exceptional.

Both specimens are remarkable for the presence of a fine calcareous deposit or crust on the outer surface of the tubes, which gives them a peculiar greyish-white appearance. When treated with hydrochloric acid it effervesces strongly, and on microscopical examination it is seen to consist of a finely granular precipitate, mixed, however, with larger particles apparently derived from the breaking-up of various calcareous organisms. This calcareous precipitate is not confined to the surface of the sponge, but occurs also within the horny fibres of the skeleton in the form of very abundant granules. There can be no doubt that it has been deposited from solution in the surrounding water.

There is also in the collection another variety of the species, not, however, sufficiently distinct to require a varietal name, which possesses a great quantity of a similar finely granular deposit in the skeleton-fibres. Duchassaing and Michelotti further inform us that "un encroûtement calcaire très-mince, facile à détruire, lequel est appliqué sur un réseau très-fin formé par les fibres de la surface," exists in their tribe, "Spongiæ Heterogenæ," whatever these may be, comprising the sole genus *Callyspongia*. It appears also to exist in *Tuba vaginalis*, in which "la surface extérieure est légèrement encroûtée effervescente avec les acides et armée de tubercules aigus, comprimés latéralement et encroûtés à leur surface." The presence of a calcareous deposit is hardly, however, a character which can be considered of any classificatory importance.

SPINOSELLA SORORIA, var. ELONGATA, nov. (Plate LXIII. fig. 1.)

This variety is represented in the collection by several fine specimens. It differs from the typical form in having the tubes much elongated and rather narrow; moreover they are cylindrical and approximately of the same width all the way up. The margin of the tube is usually, though not always, smooth, and the spines on the outer surface are almost entirely obsolete. The venation on the inner surface of the tubes is in most cases not discernible.

The specimen (Pl. LXIII. fig. 1) which I have selected as the type of the variety consists of about thirty tubes, most of which present the characters described above, while a few closely approach the typical form and show the spines around the margin and on the outer surface of the tube and the longitudinal venation on the inner surface quite distinctly. The entire specimen is somewhat compressed, as also are the outer specimens of this variety in the collection. This compression may be in part artificial; but I do not think that it is entirely so. The sponge measures 24 centim. in greatest breadth, and about 30 centim. in height. The diameter of the widest tube is 3 centim. at the mouth, but this is above the average. The tubes are often united laterally for a greater or less portion of their length.

Almost all the specimens of this variety are infested with very numerous zoanthid polyps, which cause the outer surface of the tubes to appear as though perforated by very abundant small oscula. The polyps themselves, in the dry condition, are of a white colour, and evidently contain a very large amount of calcareous matter, as they effervesce very strongly on the application of hydrochloric acid. They are evidently the same as those referred to by Duchassaing and Michelotti, viz., "*Zoanthus parasitica.*" Another slight variety of the species, already referred to by me as containing a large quantity of the calcareous precipitate, is also infested by this polyp.

SPINOSELLA PLICIFERA, Duchassaing and Michelotti, sp. (Plate LVIII. fig. 5; Plate LX. fig. 1.)

1813. ? *Spongia plicifera,* Lamarck, Annales du Muséum d'Histoire Naturelle, tome xx. p. 435.
1864. *Tuba plicifera,* Duchassaing and Michelotti, Spongiaires de la Mer Caraïbe, p. 53, pl. x. fig. 2.

Duchassaing and Michelotti describe the species as follows:—"Espèce commune, mais dont on ne connaît aucune bonne figure, car la planche de Seba citée par Lamarck se rapporte à une autre espèce. L'orifice du siphon est plutôt frangé que cilié, et la paroi intérieure offre des nervures encore bien distinctes.

"La couleur du tube à nervures obsolete (subnervia) est jaune-clair tant à l'état vivant qu'à l'état sec. Sa surface ne présente pas d'encroûtement.

"Elle habite les Antilles."

Whether or not this species is the same as that described by Lamarck (*loc. cit.*), under the name "*Spongia plicifera,*" it appears to me to be impossible to decide with any degree of certainty.

According to Schmidt[1] there would appear to be no spicules at all in the skeleton-fibre, for he includes the species amongst his "Ceraospongiæ," retaining for it the generic name *Tuba*; he says "Die meisten der unter dieser Gattung in den '*Spongiaires de la Mer Caraïbe*' beschriebenen Arten sind gar keine Hornschwämme, sondern Chalineen, und mit Bestimmtheit kann ich nur eine einzige Art als einen ächten Hornschwamm anerkennen, die *Tuba plicifera* (Sp. de la M. C., Taf. x. 2). Es scheint einer der gemeineren Schwämme der Antillen zu sein, seltener bei Florida vorzukommen, auch die grössere Tiefe zu lieben und unter diejenigen zu gehören, die nach schweren Stürmen ausgewaschen am Ufer gefunden werden. Er erreicht die Höhe von $1\frac{1}{2}$ Fuss bei einem Durchmesser von $\frac{1}{4}$ bie $\frac{1}{3}$ Fuss und führt seinen Namen von den höchst unregelmässigen Kämmen und thalartigen Vertiefungen der äusseren Oberfläche. Die meisten Exemplare sind monozoisch, Personen, doch kommen auch solche vor, wo an der Basis sich eine Knospe entwickel that. Stöcke aus mehr Personen bestehend, scheint es nicht zu geben."

Mr. Carter[2], however, identifies with the species a specimen which does contain spicules in the fibre:—"The specimen of *T. plicifera* is composed of thick ridged fibre, with a circular fringed orifice, about 10 inches high by 5 inches in diameter; and that of *T. eschrichtii*, which is long and trumpet-shaped, is more or less covered with a remarkably irregular form of the outgrowth mentioned, about $16\frac{1}{2}$ inches high and $3\frac{1}{2}$ inches in the longest diameter at its orifice, which is elliptical and *not* fringed.

[1] Spong. atlant. Gebiet. p. 23.
[2] Ann. & Mag. Nat. Hist. ser. 5. vol. ix. p. 366.

All three specimens have the same light fawn-colour, and all three the same kind of acerate spicule; that of *T. plicifera* is 18 by $\frac{2}{3}$–6000ths inch, and that of *T. eschrichtii* 18 by $\frac{1}{2}$–6000ths inch, in their greatest dimensions respectively, so that it is finest in the thickest fibre, but very scanty in all three.

"Each specimen presents a young one at its base, which is *blind* at the free end (that is, without orifice)."

In the specimen from the Bahamas which I am about to describe, I have not succeeded in detecting any spicules at all; but, on the other hand, there is in the collection of the British Museum a microscopical preparation labelled in Professor Schmidt's handwriting "*Tuba* D. et Mich. (*plicifera* ?)," and in this preparation there are traces of spicules in the fibre still quite distinct, but very slender and apparently on the verge of disappearing.

Whether or not there were spicules in the specimens examined by Duchassaing and Michelotti, we cannot, of course, tell; but in the fragment of the skeleton reticulation figured by them none are visible.

It might here be urged that we ought to distinguish two species—one with spicules, however few and vestigial, and one without any spicules at all. But it is impossible to draw such a hard-and-fast line in this particular case, which is simply an excellent illustration of the manner in which the spicules gradually disappear as the horny fibre becomes more and more strongly developed; and it is better to say of the species that the spicules are either present in a vestigial condition, and in very small numbers, or else entirely absent.

The single specimen in the collection (Pl. LX. fig. 1) is 43 centim. in height and 20 centim. in greatest breadth; and the outer surface is thrown into strongly developed transverse folds, while the inner surface is irregularly pitted. The tube is at first single, but at a distance of 12 centim. from the top it bifurcates into two. These two remain connected externally almost up to the margin, but the two apertures are quite distinct. Each aperture is approximately circular and provided with a delicate fringe; the one measures about 8 centim. in average diameter, the other only about 7·5 centim. The specimen is of a light brownish-yellow colour.

The skeleton is a very well-developed reticulation of stout horny fibre; but there appear, as I have already stated, to be no spicules. The main skeleton (Pl. LVIII. fig. 5) is, for the most part, very symmetrically arranged, consisting of a rectangularly meshed reticulation of stout primary and secondary fibres. The primary fibres are but little stouter than the secondaries, which latter average about 0·08 millim. in diameter. The meshes of the reticulation, when seen in vertical longitudinal sections, appear oblong in shape, the secondary fibres forming the longer side of the oblong. From various points on both primary and secondary fibres of the main skeleton spring much slenderer fibres, which branch and anastomose in an irregular manner, so as to form a kind of additional reticulation spread between the meshes of the principal one. The diameter of these additional fibres is about 0·013 millim. Towards the inner surface of the tube the main skeleton becomes extremely irregular in its arrangement.

A special dermal skeleton is, as usual, developed only on the outer surface of the tube, where it consists of a polygonally-meshed reticulation of comparatively slender fibre, averaging about 0·025 millim. in diameter, but varying considerably in this respect. The fibre throughout is very pale and transparent.

The species may be readily recognized by its very remarkable and characteristic external form. As no satisfactory figure has yet been given of it, that of Duchassaing and Michelotti being very poor, I have thought it desirable to take the present opportunity of giving one.

Locality. Bahamas.

SPINOSELLA MAXIMA, n. sp. (Plate LXI.)

There are two large specimens of this remarkable species in the collection and one smaller one. The latter presents certain minor differences from the other two and may be best regarded as a slight variety.

The largest specimen is a great irregular mass, composed of about twenty tubes of various shapes and sizes, all united together at the base and some also united laterally at points of contact. Sometimes the tubes are constricted at the mouth, and sometimes they are much expanded so as to become funnel-shaped. The wider ones are commonly compressed. The largest orifice, which is much compressed, measures about 36 centim. in width, but this is formed by the lateral fusion of at least four different tubes which have all a common orifice. The orifice of the smallest tube, on the other hand, measures not quite 1 centim. in diameter. The total height of the entire specimen is 45 centim. and the greatest breadth nearly 50 centim.

The outer surface of the sponge is aculeated by extremely numerous, closely placed, blunt, spinous processes, of various lengths up to about 1·25 centim. The margin of the orifices is extremely thin and papyraceous and delicately veined in a dendritic manner. The colour of the specimen, which is of course a mere skeleton, is pale yellow and the texture is firm and hard but elastic. The true oscula are irregularly scattered over the inner surfaces of the tubes.

The main skeleton is composed of strong horny fibre, of very various diameter, completely destitute of spicules. The arrangement is very irregular, but one can distinguish between a large-meshed reticulation of very stout fibres and very irregular meshes, and a smaller-meshed reticulation of fine fibres which take their origin from the stouter ones and also from an irregular network. The stouter fibres average about 0·12 millim. in diameter, and the fine ones about 0·013 millim.

On the outer surface of the tubes there is a well-developed dermal skeleton, composed of a reticulation of stout horny fibres with comparatively small, rounded meshes. Here, again, there are no spicules.

The smaller of the two large specimens (Pl. LXI.) differs slightly in external appearance from the one just described. The tubes are broader in proportion to their length, and more inflated, narrowing towards the mouth. The spinous processes on the surface also show a strong tendency to become confluent, and frequently form longer or shorter ridges, running in various directions, with deep grooves between. This tendency to form ridges is visible also to a certain extent in the larger specimen, but is not nearly so well marked.

Locality. Nassau, Bahamas.

The third specimen in the collection, already referred to as belonging to a slight variety, consists of a single wide tube, 24 centim. in height and about 8 centim. in diameter across the mouth. It is now of a dirty greyish-yellow colour. It differs from the types in two respects:—(1) the processes on the outer surface are not nearly so strongly developed, being represented by low warts and ridges; (2) there still exist within the fibre a very few vestigial oxeote spicules, apparently in the last stages of absorption. The specimens agree so closely in other respects that it is impossible to separate them specifically; so that we have here, as in the case of *Spinosella plicifera*, an excellent illustration of the gradual replacement of spicules by spongin.

Locality. Jamaica.

SPINOSELLA VELATA, n. sp. (Plate LIX. fig. 2.)

The single specimen in the collection (Pl. LIX. fig. 2) consists of five irregularly cylindrical or somewhat compressed tubes of various sizes, united together at their bases, and two of them also united laterally at points where they come into contact with one another. The height of the sponge is 19 centim., and the greatest breadth 13 centim. The largest tube measures about 45 centim. in diameter at the top. The actual aperture of the tube, however, is very much reduced in size by the presence of a broad, horizontal, circular diaphragm, which projects inwards from the wall of the tube at a distance of some two or three millimetres below the free margin. This diaphragm is the most characteristic feature of the species and that from which the specific name has been derived. It exists in all the tubes, but is more developed in some than in others, and is broadest in the largest tube, measuring 1·5 centim. in greatest width. The free margin of the three larger tubes is only slightly irregular in outline and not spinose, while that of the two smaller tubes is distinctly spinose. The diaphragms also are for the most part smooth, but bear spinous processes on the upper surface in the case of the two smaller tubes. The outer surface of all the tubes is distinctly spinose.

The true oscula are small and circular and occur abundantly scattered over the inner surface of the tubes. The walls of the tubes are marked with a distinct series of longitudinal veins.

The main skeleton consists for the most part of an irregular reticulation of fairly stout horny fibre, but in parts a distinctly rectangular arrangement is visible. Both the primary and secondary lines are cored by oxeote spicules, which are fairly abundant in the primary fibres, but scarce in the secondaries. The longitudinal veins above mentioned are, as in the case of *Spinosella sororia*, due to local concentrations of the skeleton reticulation. The fibres of the skeleton average in diameter about 0·044 millim., and there is no noteworthy difference between the primaries and secondaries in this respect.

A special dermal skeleton, distinguishable from the underlying main skeleton, appears, as usual, to be developed only on the outside of the tubes. It consists of an irregularly, polygonally meshed reticulation of slender horny fibre cored by fairly abundant oxeote spicules.

The spicules are slightly curved, sharp-pointed oxea, measuring about 0·1 by 0·0045 millim., when found perfect; a large proportion of them, however, appear to be undergoing absorption and are much slenderer. A few spicules occur scattered outside of the fibres.

It will be seen that in most respects this species comes very near to the typical forms of *Spinosella sororia*, but it is at once marked off from that species, and, indeed, from all other species of Chalininæ with which I am acquainted, by the presence of the very remarkable diaphragms in the orifices of the tubes.

Locality. Bahamas.

III. EXPLANATION OF THE PLATES.

PLATE LVIII.

Fig. 1. *Siphonochalina ceratosa.* Portion of main skeleton as seen in section at right angles to the surface; ×25. *p*, primary fibres; *s*, secondary fibres.

Fig. 1 *a*. *Siphonochalina ceratosa.* Portion of the above; ×115. *p*, primary fibres; *s*, secondary fibres; *sp*, spicules.

Fig. 2. *Siphonochalina spiculosa.* Portion of main skeleton as seen in section at right angles to the surface; ×25.

Fig. 2 *a*. *Siphonochalina spiculosa.* Portion of the above; ×115.

Fig. 3. *Pachychalina variabilis.* Portion of main skeleton as seen in section at right angles to the surface; ×25.

Fig. 4. *Siphonochalina procumbens.* Portion of main skeleton as seen in section at right angles to the surface; ×25. *p*, primary fibres; *s*, secondary fibres.

Fig. 5. *Spinosella plicifera.* Portion of main skeleton as seen in section at right angles to the surface; ×25. *p*, primary fibres; *s*, secondary fibres; *a*, reticulation of very fine fibres lying between the stouter ones.

Fig. 6. *Spinosella sororia*, var. *dilatata*. Portion of dermal skeleton as seen in surface section; $\times 25$.

Fig. 7. *Spinosella sororia*. Portion of vertical section showing the arrangement of the main skeleton; $\times 25$.

PLATE LIX.

Fig. 1. *Spinosella sororia*, $\times \frac{1}{2}$.
Fig. 2. *Spinosella velata*, $\times \frac{1}{2}$.
Fig. 3. *Spinosella sororia*, var. *fruticosa*, $\times \frac{1}{2}$.

PLATE LX.

Fig. 1. *Spinosella plicifera*, $\times \frac{4}{7}$.
Fig. 2. *Pachychalina variabilis*, $\times \frac{2}{5}$.

PLATE LXI.

Spinosella maxima, $\times \frac{3}{4}$.

PLATE LXII.

Fig. 1. *Siphonochalina procumbens*, $\times \frac{1}{2}$.
Fig. 2. *Siphonochalina ceratosa*, $\times \frac{1}{2}$.
Fig. 3. *Siphonochalina spiculosa*, $\times \frac{1}{2}$.

PLATE LXIII.

Fig. 1. *Spinosella sororia*, var. *elongata*, $\times \frac{1}{2}$.
Fig. 2. *Spinosella sororia*, var. *dilata*, $\times \frac{1}{2}$.

Fig. 3.

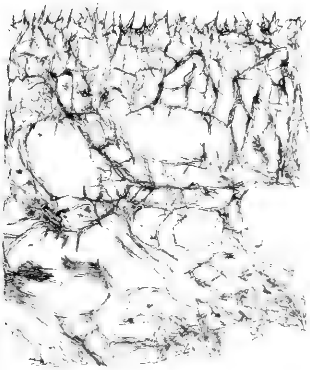

Fig. 2

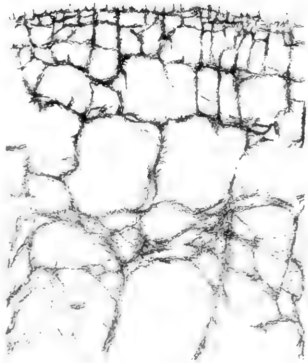

Fig. 1

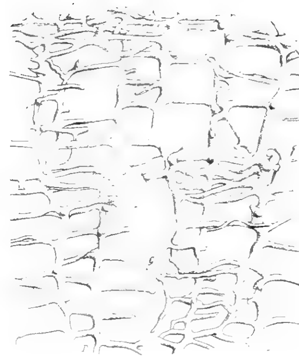

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Fig. 4.

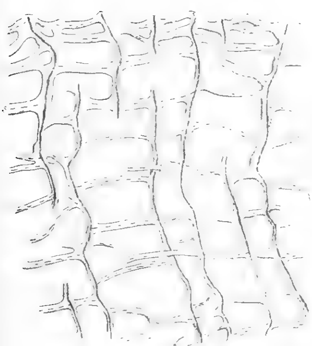

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Fig. 2a

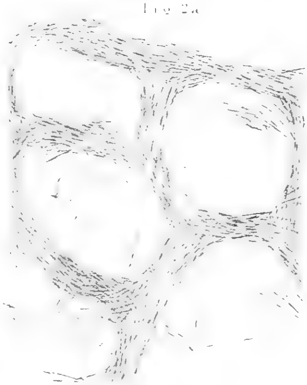
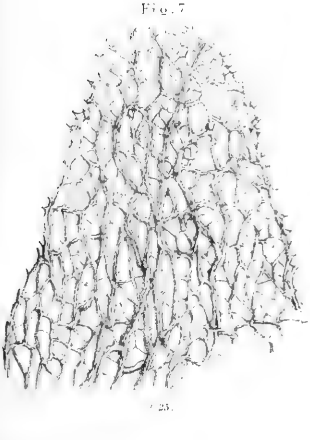


Fig. 1a.

× 115

Fig. 7



× 25.

Fig. 6

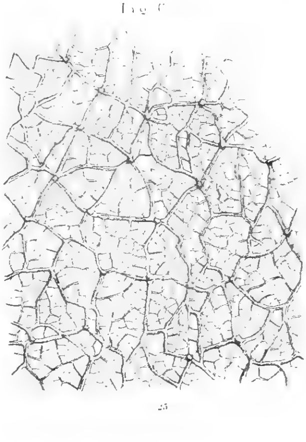


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Fig. 5.

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PACHYCHALINA, SIPHONOCHALINA, SPINOSELLA.

Fig. 1.

½.

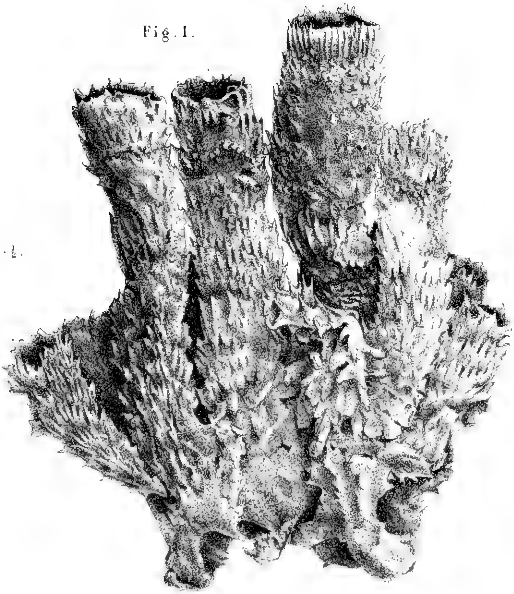


Fig. 2.

½.

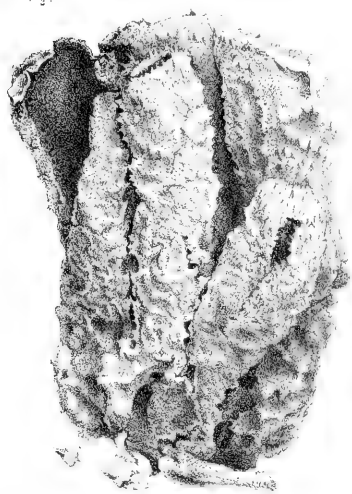
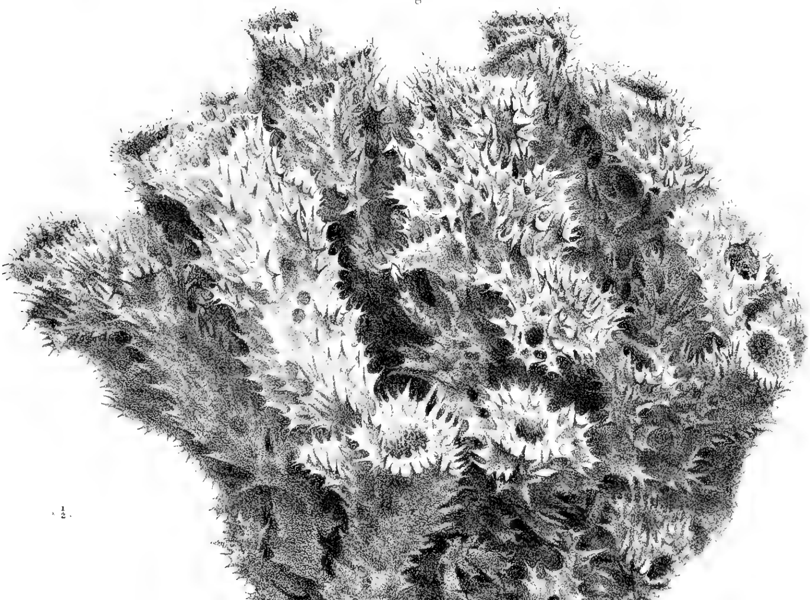


Fig. 3.

½.



Mintern Bros. del et lith.

FIG. 1. SPINOSELLA SORORIA.
„ 2. „ VELATA.
„ 3. „ SORORIA VAR. FRUTICOSA.

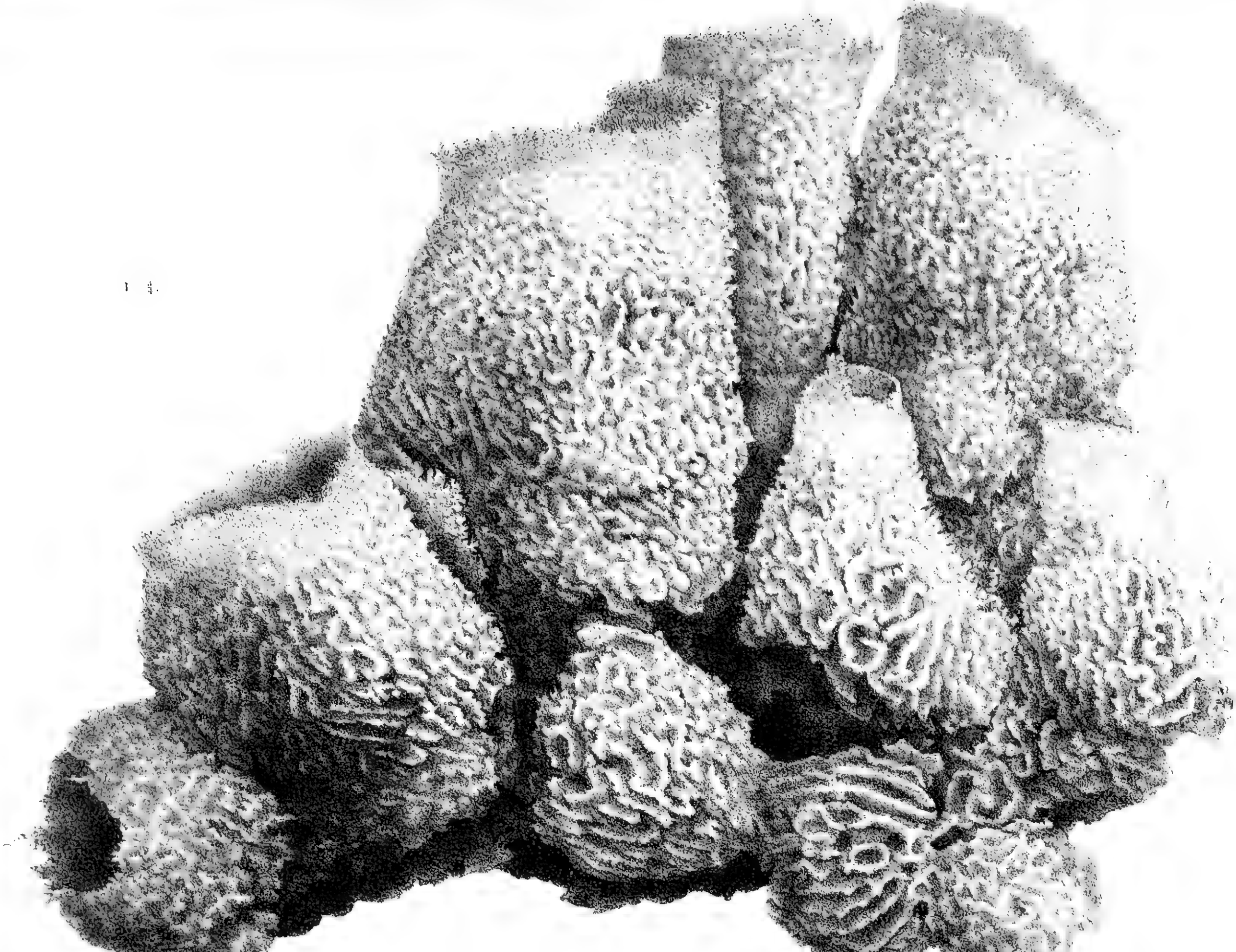
Fig. 1.

× 4/7.

Fig. 2. × 3/5.

Mintern Bros. del et lith.

FIG 1. SPINOSELLA PLICIFERA.
" 2. PACHYCHALINA VARIABILIS



1 ¼.

SPINOSELLA MAXIMA

Mint. n. i.

Fig. 1.

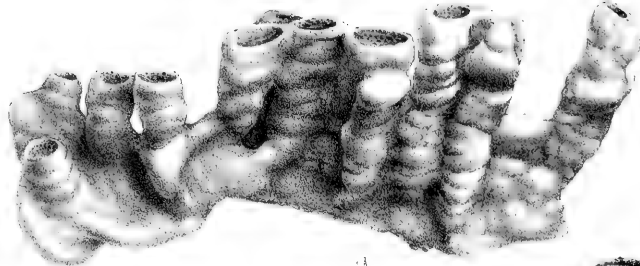


Fig. 3.

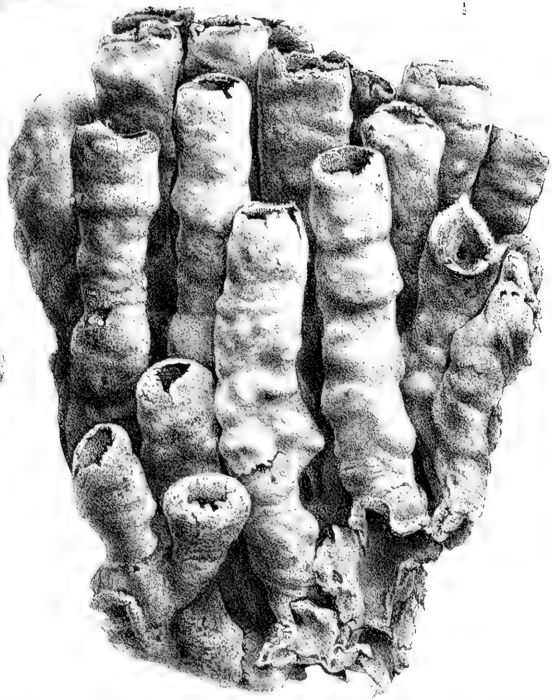


Fig 2

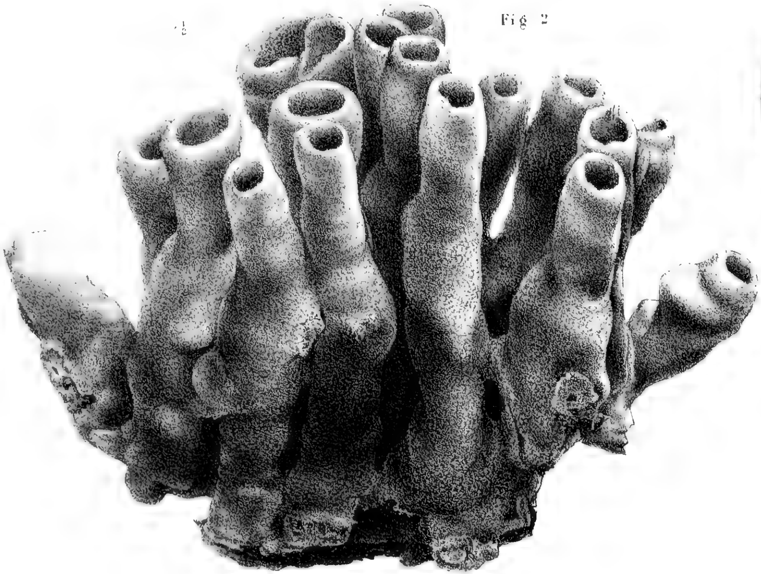


FIG 1 SIPHONOCHALINA PROCUMBENS
„ 2 „ CERATOSA
„ 3 „ SPICULOSA

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Fig. 1.

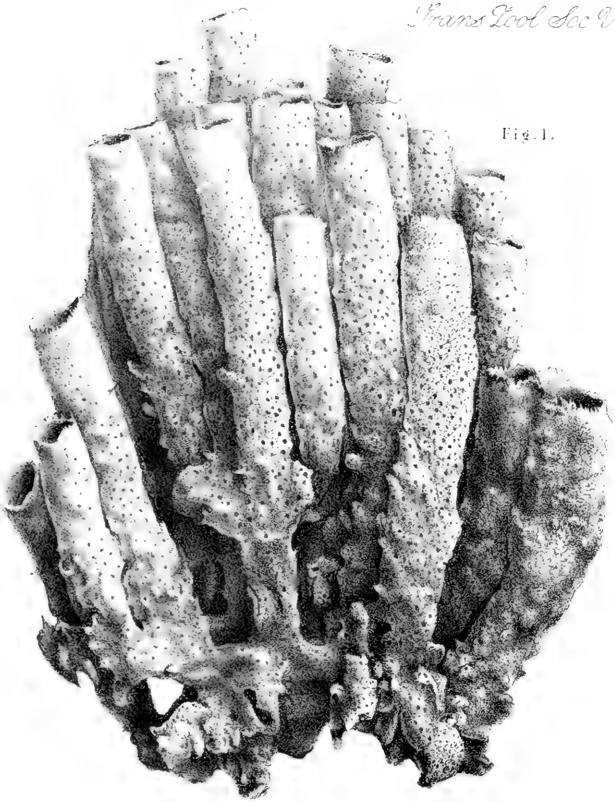
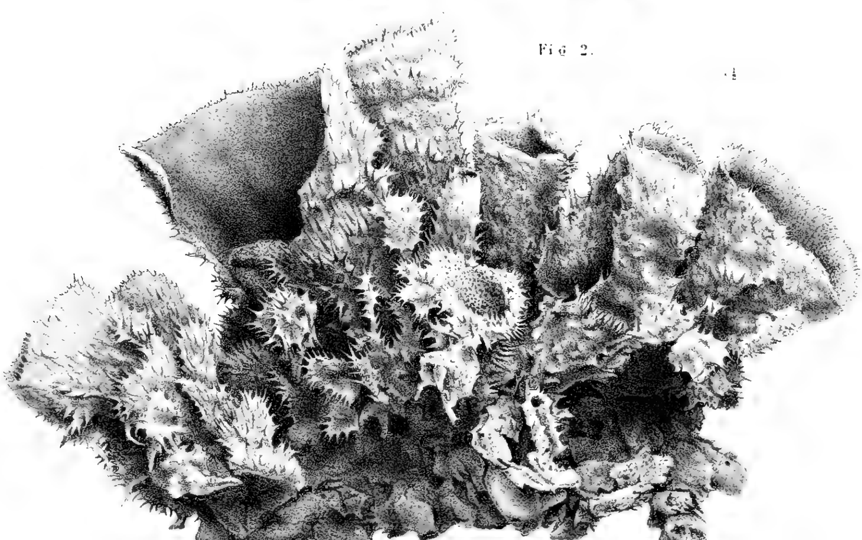


Fig. 2.



Mintern Bros del et lith

FIG. 1. SPINOSELLA SORORIA, VAR ELONGATA.
„ 2. „ „ „ DILATATA.

XV. *On the Structure of Hooker's Sea-Lion* (Arctocephalus hookeri). *By* Frank E. Beddard, *M.A., Prosector to the Society and Lecturer on Biology at Guy's Hospital.*

Received December 20th, 1887, read December 20th, 1887.

[Plates LXIV. & LXV.]

Contents.

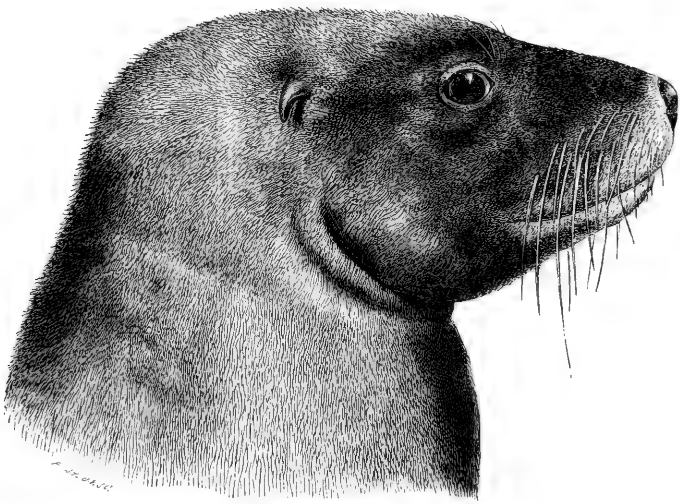
I. External Characters.

THE accompanying drawings (Plate LXIV.) illustrate the three specimens of Hooker's Sea-Lion which were on view a short time since in the Society's Gardens. The drawings exhibit a striking difference in colour between the three individuals. The largest individual (the nearest of the three, as represented) is much darker, and of a greyer colour along the back; the specimen on the left, which is the one dissected by me, is not so dark in hue, and brown, rather than grey, upon the back; finally, the smallest individual (that on the right) is the palest of the three. These differences in colour are not sexual, since all three specimens are males; they are evidently differences due to age. Of the specimen dissected by myself the skin and skeleton have been preserved; the colour of the ventral parts of the body and of the limbs agrees perfectly with that of the largest specimen figured; it will not, therefore, be of much use to give a written description of it.

The external characters of the head of this species are represented more enlarged in the accompanying drawing (woodcut, fig. 1, p. 370). With Hooker's Sea-Lion may be compared *Otaria jubata* and *O. pusilla* (figs. 2 and 3), of both of which species examples are at present living in the Society's Menagerie. *Otaria jubata* is at once distinguishable from the other two by the long hairs upon the neck, which form a kind of mane, whence the name Sea-Lion. This appearance, which is very characteristic of the species and apparently confined to that species, is not, by any means, so clearly seen when the animal is wet.

As compared with those of *O. hookeri* and *O. pusilla*, the ears of *O. jubata* are small in relation to the size of the head; this difference is considerably more marked in the case of *O. pusilla*; a glance at the drawing (fig. 3, p. 372) at once shows how very much longer in proportion to the head are the ears in this species than in *O. jubata*. Attention has been already drawn by Peters[1] to the varying length of the ears, which have been made use of as "subgeneric characters" to distinguish all his subgenera except *Otaria* and *Zalophus*. Dr. Gray, in a short note published some years ago in the 'Annals and Magazine of Natural History'[2], has remarked upon the great length of the ears in the Cape Sea-Lion (which is figured, p. 372), and concludes with the question "Do the elongated palate and the short ears of the Sea-Lion and the long ears and short

Fig. 1.



Head of *Otaria hookeri*.
(One third of the size of nature.)

palate of the Sea-Bear characterize the groups?" I am inclined, as will be pointed out presently, to answer Dr. Gray's question in the affirmative; but Gray himself, so far as I am aware, never attempted to classify Sea-Lions and Sea-Bears on this basis of fact. In *O. hookeri*, however, measurements show that the length of the ear is one tenth of that of the head at the level of the ear. In *O. jubata*, on the contrary, the same measurements give the proportions 1 : 12. In the Californian Sea-Lion, again, *O. gillespii* (the head of which is shown in fig. 4, p. 372), the proportions

[1] "Ueber die Ohrenrobben, *Otariæ*, insbesondere über die in den Sammlungen zu Berlin befindlichen Arten," Monatsb. Ak. Wiss. Berlin, 1866, pp. 261–281 and pp. 665–672.

[2] Ser. 4, vol. ix. p. 483.

of the ear to the head are about the same as in *O. hookeri*. The ear in the three species *O. pusilla*, *O. hookeri*, and *O. gillespii* appears to me to be also decidedly narrower in proportion to its length than in *O. jubata*. Dr. Burmeister, in a paper[1] upon *Arctocephalus hookeri*, refers to the length of the ears in that species as contrasted with *Otaria jubata*.

Another character to which I wish to direct the attention of the Society is the form of the nose (which is illustrated in the accompanying drawings, figs. 1–7) in the four species already referred to. In the lateral views the nose of *Otaria jubata* is seen to

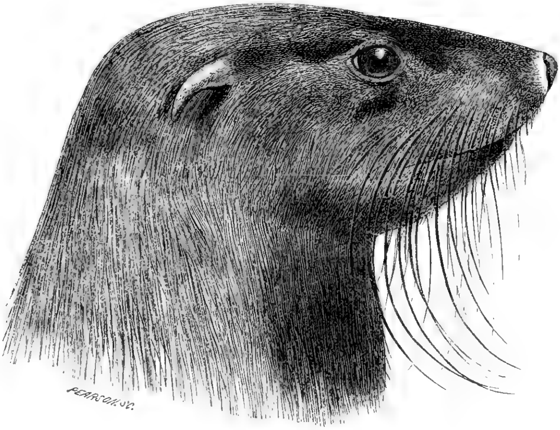
Fig. 2.

Head of *Otaria jubata*.
(One fourth of the size of nature.)

be distinctly larger than in the other species, and in the front views the breadth is considerably greater. In fact the external characters of the nose in these Otariidæ seems to divide them into two groups, which are also to be distinguished by the characters of the ear.

[1] "Notes on *Arctocephalus Hookeri*, Gray," Ann. & Mag. Nat. Hist. ser. 4, vol. ix. (1872) p. 89.

Fig. 3.

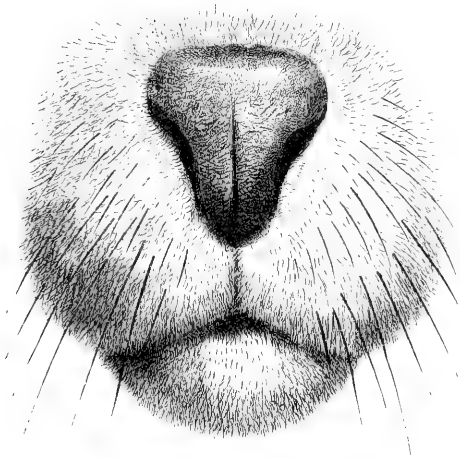


Head of *Otaria pusilla.*
(One half of the size of nature.)

Fig. 4.

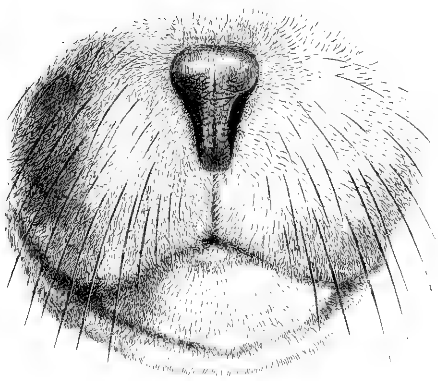
Head of *Otaria gillespii* (after Forbes, Trans. Zool. Soc. vol. xi. pl. xlix.).
(One fourth of the size of nature.)

Fig. 5.



Muzzle of *Otaria jubata*. (Front view.)
(Two thirds of the size of nature.)

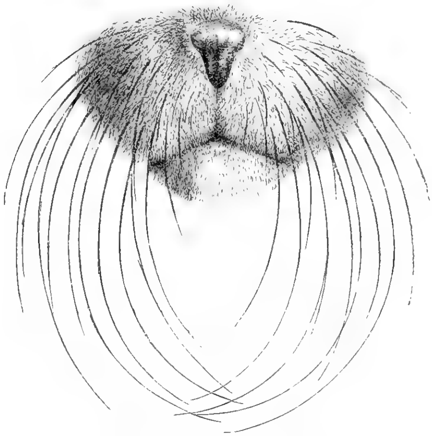
Fig. 6.



Muzzle of *Otaria hookeri*. (Front view.)
(Two thirds of the size of nature.)

Judging from the drawings which illustrate Mr. J. W. Clark's paper upon *O. forsteri*[1], it seems to be not at all improbable that this species resembles *O. hookeri* and its allies in the shape and size of the nose; in the figure[2] which represents the lateral aspect of the nose in that species, it seems distinctly to want the truncated extremity of that of *O. jubata*; in the drawings which the author reproduces from Dr. Hector[3] this is even more marked. If it be permissible to found any deductions upon these sketches,

Fig. 7.



Muzzle of *Otaria pusilla*. (Front view.)
(Two thirds of the size of nature.)

I would also point out that the considerable length of the ear as depicted therein is perfectly in harmony with what has been said above.

Mr. Clark's drawings of *Otaria ursina*[4] are too small to permit of any comparison with other species in the points indicated above. The figures in the 'Voyage de l'Astrolabe' of *O. cinerea* and *O. australis* give no information upon these points. I have also endeavoured to discover from Burmeister's figure of *O. falklandica*[5] what evidence can be deduced as to the affinities of that species. The attitude of the animal in the figure, which is three-quarters full face, precludes the possibility of any accurate description of the nose from the lateral aspect: but it seems highly probable, from

[1] "On the Eared Seals of the Islands of St. Paul and Amsterdam &c.," P. Z. S. 1875, p. 650.

[2] *Ibid.* p. 664, fig. 4. [3] *Ibid.* p. 660, figs. 1 and 2.

[4] "Notes on three stuffed Specimens of the Sea-Lion of the Pribilov Islands (*Otaria ursina*)," P. Z. S. 1878, pl. xx. p. 371.

[5] 'Atlas de la description physique de la République Argentine,' pls. xii., xiii., xiv.

that figure, that the nose agrees with *O. hookeri*. The ears of *O. falklandica* are evidently of considerable length compared to the length of the head; so that, on the whole, this species probably comes nearer to *O. hookeri*, *O. pusilla*, and their allies than it does to *O. jubata* [1].

O. hookeri has been already figured by Dr. Gray in the illustrated account [2] of the zoological material gathered during the voyage of the 'Erebus' and 'Terror.' In that figure a character is assigned to the species which I cannot believe to be correct from what I have myself observed in *O. hookeri* (see Pl. LXV. fig. 2). The nails on the digits of the pes are drawn as being of nearly equal size, those of the first and fifth being only a very little smaller. This is certainly not the case in the two individuals examined by myself; in both these the three middle digits of the pes have long and well-developed nails, while those of the first and fifth are only rudimentary. The drawing, however, which illustrates Dr. Gray's 'Report' was made from a stuffed specimen, and is, on this account, less reliable. Even the skeleton of the foot shares in this peculiarity; the middle digits have the terminal phalanx ridged and pointed from the insertion of a long claw; the first and last digits have a flattened terminal phalanx.

Dr. Burmeister [3] uses this character to distinguish *O. hookeri* from *O. jubata*; but I am quite unable to confirm the accuracy of Dr. Gray's illustration of the hind limbs [4]. I lay particular stress upon these points, because it might be imagined, from some figures and descriptions which have appeared, that these points are of value in specific, if not in generic, diagnosis. As the object of the present communication is mainly the discrimination of the genera of Sea-Lions, I need not apologize for giving prominence to the discussion of all such characters.

Dr. Murie, in his valuable and exhaustive treatise [5] upon the external characters and anatomy of *O. jubata*, has described and figured the manus and pes [6] of that Sea-Lion. The former limb has five extremely minute flattened nails corresponding to the five digits; the same is the case with *O. hookeri* (see Pl. LXV. fig. 1) and apparently with other species. The pes of *O. jubata* presents exactly those characters which have been already referred to in describing *O. hookeri*; and, moreover, the skeleton of the limb presents a completely similar modification to that which occurs in *O. hookeri*.

In Mr. Clark's figure of the corresponding limb of *O. forsteri* [7] the number and

[1] Mr. Clark (P. Z. S. 1875, p. 664) remarks, with a figure (fig. 5), upon the peculiar nasal cartilages in his *O. forsteri*; exactly the same disposition occurs, according to Burmeister's figure, in *O. falklandica*. Unfortunately I omitted to examine these structures in *O. hookeri*.

[2] Voyage of the 'Erebus' and 'Terror.' Description of Mammalia, by Dr. J. E. Gray, pl. xiv.

[3] *Loc. cit.*

[4] Mr. J. A. Allen (Bull. Mus. Comp. Zool. Harvard, vol. ii. no. 1, p. 40), emphasizing these unlikely points of difference, is inclined to unite again the two species; I think that, apart altogether from the new facts which I am able to bring forward in the present paper, this proceeding could not be justified.

[5] Trans. Zool. Soc. vols. vii. and viii.

[6] *Loc. cit.* vol. vii. pl. lxvii. figs. 1, 2.

[7] P. Z. S. 1875, pl. lxxi.

character of the nails are similar; so, too, in Mr. Forbes's drawings[1] of *O. gillespii.* In the 'Voyage de l'Astrolabe' the pes of *O. australis* is figured as having five complete digits, and Mr. Clark not unnaturally makes use of this character to distinguish between this species and his *O. forsteri.* I feel certain, however, that five complete nails are not found in any of the different species of Sea-Lions with which we are at present acquainted. The only evidence, in fact, for the presence of five complete nails is in Quoy and Gaimard's figure; and these do not, to my mind, bear the stamp of accuracy.

It is possible that the shape of the pes (and of the manus also) may present characters of specific value; the depth of the incisions between the toes, as well as the relative sizes of the first and last toe, appear from the published figures to be subject to some variation; as, however, half of the figures extant are from dried skins, it does not seem to me to be safe to base any discussion upon differences in the figures, which may present appearances unknown in nature.

II. Visceral Anatomy.

After the very laborious and complete account of the anatomy of the viscera in *O. jubata* which is to be found in Dr. Murie's memoir, I did not expect to be able to add much to our knowledge of the structure of the *Otariidæ.*

I examined the viscera of *O. hookeri* with much interest, because I wished to discover whether that species was most nearly allied to *O. jubata* or to *O. gillespii*; materials for further comparison do not exist; these two species only have been hitherto studied by dissection.

The tongue of *O. hookeri* is bifid at the apex, like that of *O. jubata* and *O. gillespii*, and in other respects appears to agree with the same organ in these two species.

The *stomach* is decidedly less globular than in the figures given by Murie; the measurements of the undistended viscus are as follows (they are to be compared with the accompanying measurements of *O. jubata*):—

	O. jubata.	*O. hookeri.*
	inch.	inch.
Length along outer circumference . . .	31	21
Length of lesser curvature	11	14

I cannot compare these measurements exactly with those of *O. gillespii*; but Forbes distinctly states, and other measurements which he quotes support the statement, that the stomach is considerably more elongated and less globular than in *O. jubata.* It appears, when comparing the measurements given by Forbes and Murie of the length of their examples with the length of the stomach with my own measurements in

[1] Trans. Zool. Soc. vol. xi. pl. 1. fig. 2.

O. hookeri, that in *O. jubata* the stomach is larger in proportion to the length of the body than in either of the other species; although naturally there was not an absolute agreement between *O. gillespii* and *O. hookerii* in the proportions of this viscus, the difference was markedly less than between either of these species and *O. jubata*. The *spleen* of *O. hookeri* was 16 inches in length; its breadth varies from 2–3½ inches; the greater part of the organ was of the greater breadth. So far as I can gather from Mr. Forbes's description, the spleen of *O. gillepsii* is nearly of the same shape, but is proportionately smaller in size. In both these species there is no "beak-like process," such as that which Dr. Murie describes and figures in *O. jubata*.

Neither Dr. Murie nor Mr. Forbes refers to the attachment of the omentum of the spleen; this is peculiar, and is closely paralleled in the case of the *Rhinoceros*, where it has been lately described by Mr. Treves and myself[1]. It probably occurs in other animals. The splenic omentum, instead of being attached to the spleen along the middle line, is attached along two parallel lines.

With regard to the liver, this organ presents a general agreement with the liver in the other species of Sea-Lions, being characterized, as they are, by the breaking up of the lobes into a very large number of lobules. The right lateral lobe is rather more lobulated than in Dr. Murie's figure of that of *O. jubata*; the left lateral lobe is perhaps less so, inasmuch as the furrows which break it up into lobules are nearly confined to the base of the lobe; the left central lobe (that marked V in Murie's figure) is also rather less lobulated. I do not know that very much weight can be attached to such small differences as are here recorded; still in these minute points of difference *O. hookeri* comes nearer to *O. gillespii*, where, as Mr. Forbes has said, "the liver . . . . differs chiefly (from that of *O. jubata*) in the more regular outlines of its lobes, and the much smaller development of additional sulci on its inferior aspect, in these respects more resembling the liver of ordinary Mammalia, and presenting less approximation to the greatly complicated liver of the Seals."

A description of the lungs of *O. hookeri* would be a mere repetition of the descriptions given by Murie and Forbes. I may mention, however, that the "lobus impar" belongs to the right lung, as Murie states to be the case in *O. jubata*. Forbes refers to the presence of the "lobus impar" in *O. gillespii*, but neglects to say what relation it bears to the right and left lungs.

The *heart* of *O. hookeri* agrees with that of *O. gillespii* in the origin of the great arterial trunks; that is to say, an innominate artery gives off both carotids and one subclavian; the left subclavian takes its origin independently from the arch of the aorta. In *O. jubata* the left carotid, as well as the left subclavian, arise separately from the aorta, while the innominate gives rise to the right subclavian and right carotid.

[1] Trans. Zool. Soc. vol. xii. pt. 6.

III. Osteology.

I have been able, through the kindness of Mr. Thomas, to study the large collection of skulls of Sea-Lions which are in the Natural History Museum. I do not, however, consider it necessary to illustrate the skull of *O. hookeri* by figures, as this has been already done by Mr. Clark in his paper [1], and also by Dr. Gray; these zoologists have, between them, figured the skulls of both sexes. Mr. Clark adds to his figures a somewhat detailed description of the cranial characters of *O. hookeri*; its salient points have also been noted by Gray.

The following are the principal characters (partly noted here for the first time, partly already recorded) which distinguish the skull of *O. hookeri* from that of *O. jubata*. They are arranged for convenience' sake in a tabular form:—

Otaria jubata.	*Otaria hookeri.*
1. Palate excavated behind.	1. Palate not excavated behind.
2. Posterior nares on a level with the articulation of squamosal and jugal.	2. Posterior nares on a level with middle of jugal.
3. Muzzle truncated.	3. Muzzle more pointed.
4. Pterygoids massive and somewhat triangular in form, the apex pointing downwards.	4. Pterygoids ending in a hooked process, as in most of the Mammalia.
5. Palatal bones with a perfectly straight posterior margin.	5. Palatal bones with convex posterior margin.
6. Anterior margin of nasals on a line with zygoma and suborbital foramen.	6. Line drawn through nasals at right angles to long axis of skull falls much anterior to this point.

This tabular statement does not take any account of numbers of minute points of difference, but it contains, I believe, the principal distinctive features, which are by no means few.

As to these points, I have compared the skulls of *O. jubata* and *O. hookeri* with those of the other species contained in the National Collection, viz. those labelled *O. stelleri*, *O. ursina*, *O. gillespii*, *O. pusilla*, *O. nigrescens*, *O. cinerea*, *O. forsteri*. I find that the skull of *O. jubata* differs from all of these in exactly the same points that I have already referred to as distinguishing that species from *O. hookeri*; likewise that all the other species, *O. stelleri* &c., though doubtless presenting certain points of difference among themselves, yet agree in the structural features to which attention has been already called in the tabular statement above given.

These characters may not be important ones, but, if not, they are at least numerous, and must therefore be considered as being collectively of some importance. Their importance is also clearly increased by the fact that they absolutely concur with other structural features to which particular attention has been directed in the previous portion

[1] "On the Eared Seals of the Auckland Islands," P. Z. S. 1873, p. 750.

of this paper. I there took pains to point out that, from certain external characters afforded by the nose and ears, the Sea-Lions already known to us could be very distinctly separated into two groups.

Again, the visceral anatomy of the Otariidæ, although known within very narrow limits, affords grounds for specially uniting together certain forms, and separating these from others.

So far as they go, all these characters—external, visceral, and osteological—point the same way, and tend to divide the Otariidæ into two divisions: the one comprises only *Otaria jubata*; the other will contain all the rest of the known forms. This distinction will be best emphasized by applying separate generic names to the two divisions; I am, however, quite of opinion that it is, in many respects, not advisable to separate so well-marked a group as are the Sea-Lions into two genera. As for the numerous genera which Dr. Gray and Prof. Peters have from time to time proposed, most of them appear to me to be quite unnecessary. These two genera should be *Otaria* and *Arctocephalus*, and they will be defined as follows:—

Otaria.	*Arctocephalus.*
Nose broad and truncated.	Nose narrow and pointed.
Ears short.	Ears relatively long.
Palate deeply hollowed out and truncated posteriorly.	Palate not excavated nor truncated posteriorly.
Pterygoids without a hook-like process.	Pterygoids with a recurved process.
Posterior margin of nasals on a level with zygoma and suborbital process.	Posterior margin of nasals behind zygoma and suborbital process.

On the whole, the osteological characters which separate the two genera are more specialized in *Otaria* than in *Arctocephalus*; that is to say, the young skulls of *Otaria* are more like the adult *Arctocephalus* than the young skulls of *Arctocephalus* are like the adult skulls of *Otaria*.

The genus *Otaria* will have to be limited to the species *Otaria jubata*, for it may be now, I think, asserted with safety that the following species—viz., *O. minor*, Gray, *O. pygmæa*, Gray, *O. byronia*, Gray, *O. leonina*, Gray, *O. godeffroyi*, Gray, and *O. ulloæ*, Peters—are synonyms of *O. jubata*. *Arctocephalus* will contain all the remaining Sea-Lions. I had at first intended to go into the question of the species of Otariidæ in connexion with the present communication; this, however, proved to be impossible, owing to the absence from our collection of representatives of a considerable number of species or reputed species.

It will be noticed that the conclusion to which the facts described in the present paper lead, viz., that there are, at most, only two distinct genera of Sea-Lions (*Otaria* and *Arctocephalus*), is not a new one; although some recent authors, such as Gray, Peters, Gill, Allen, Burmeister, and others, have allowed a considerable number of genera, while others, such as Clark, have, not unreasonably, referred all species to a single genus—*Otaria*. Fr. Cuvier, in 1834, instituted two genera, among which he divided all the species; these were termed *Arctocephalus* and *Platyrhinchus*. The name *Platyrhinchus*, however, cannot stand, since Peron[1] had previously applied the name *Otaria* to the same species, viz. *O. leonina* (=*O. jubata*). I believe therefore that I am right in retaining the generic name *Otaria* for *O. jubata*. Moreover, as the species which F. Cuvier[2] named *Arctocephalus* was apparently *O. pusilla*, or *O. antarctica*, as it appears to be more correctly termed, this generic name is retained in the present communication for that species and the others which I believe to be allied to it.

A division of Sea-Lions which practically corresponds with that urged in the present paper was made by Dr. Gray in 1865[3]. He then placed *O. jubata* in a section by itself equivalent to the remaining species, which, however, were divided into numerous genera. This classification, as regards the separation of *O. jubata* from all the remaining species, was retained in a later communication published in 1869[4].

DESCRIPTION OF THE PLATES.

PLATE LXIV.

Three specimens of Hooker's Sea-Lion (*Otaria hookeri*) living in the Society's Gardens, December 1887.

PLATE LXV.

Fig. 1. Fore flipper of *Otaria hookeri*.
Fig. 2. Hind flipper of the same.
(Both figures one half of the natural size.)

[1] 'Voyage au terr. Austr.' ii. p. 40 (1816).

[2] "De quelques Espèces de Phoques et des groupes génériques entre lesquels ils se partagent," Mém. Mus. Hist. Nat. t. xi. (1824) p. 205.

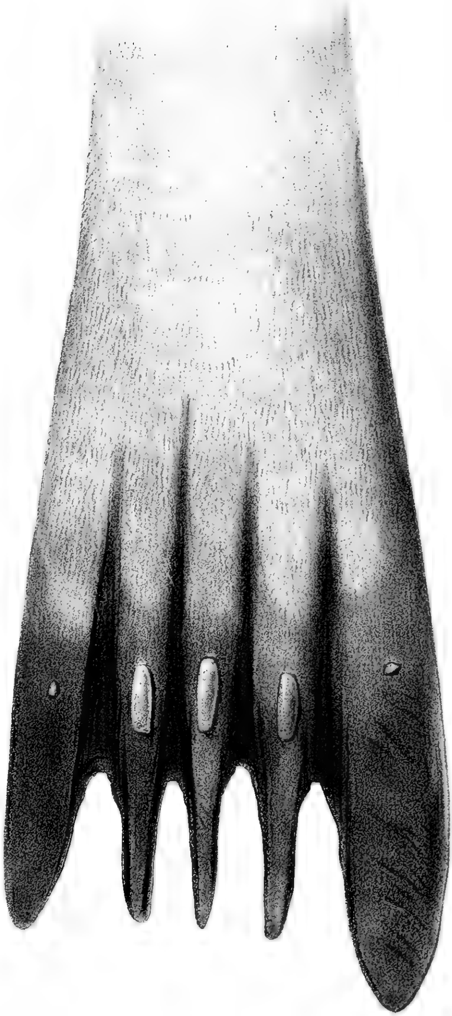
[3] "Notes on the Skulls of Sea-Bears and Sea-Lions (Otariadæ) in the British Museum," Ann. & Mag. Nat. Hist. vol. xviii. 1866, p. 228.

[4] "Additional Notes on Sea-Bears (Otariadæ)," *Ibid.* vol. iv. 1869, p. 264.

OTARIA HOOKERI

Fig. 1

Fig. 2



OTARIA HOOKERI

Fig. 1. foreflipper, ½ nat. Size. Fig. 2. Hindflipper. ½ nat. Size.

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April 1890.

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