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THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY

OF

LONDON.

VOLUME XXIV.

NATURÆ DISCERE MORES

LONDON:

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

SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON-HOUSE;

AND BY LONGMAN, GREEN, LONGMAN, ROBERTS, AND GREEN, PATERNOSTER-ROW.

1864

M.DCCC.LXIV.

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CONTENTS.

PART I.—1863.

TRANSACTIONS

OF

THE LINNEAN SOCIETY.

I. *On* Welwitschia, *a new Genus of* Gnetaceæ.

By Joseph Dalton Hooker, *M.D.*, *F.R.S.*, *V.P.L.S.*, *F.G.S.*

(Plates I.–XIV.*)

Read January 16th, and December 18th, 1862.

The first notice of this singular plant that reached Europe was contained in a letter addressed by its discoverer, Dr. Frederic Welwitsch, A.L.S., to Sir William Hooker, dated St. Paul's, Loanda, August 16, 1860. This letter, which was at once communicated to the Linnean Society and published in its Journal of Proceedings (vol. v. p. 182), was shortly followed by another, announcing the intention of its finder to send the specimens to Kew for examination, and expressing his hope that the results might be published in the Linnean Society's Transactions.

Dr. Welwitsch's botanical attainments being well known and justly appreciated, his brief account sufficed to assure botanists that he had made a most remarkable discovery; and soon after the publication of his letter, inquiries respecting the plant reached Kew from several parts of Europe; indeed I have been assured by those who remember it, that, since the discovery of the *Rafflesia Arnoldii*, no vegetable production has excited so great an interest as the subject of the present memoir.

* The expense of drawing these plates on stone was defrayed by a grant from the fund for the promotion of science, placed annually by Parliament at the disposal of the President and Council of the Royal Society.

Before describing in detail the structure of this plant, and discussing its many anomalies, I shall give a brief general account of its appearance and prominent characters, partly from the descriptions of its discoverer, and partly from the specimens sent home by himself and others.

The *Welwitschia* is a woody plant, said to attain a century in duration, with an obconic trunk about 2 feet long, of which a few inches rise above the soil, presenting the appearance of a flat, two-lobed, depressed mass, sometimes (according to Dr. Welwitsch) attaining 14 feet in circumference (!), and looking like a round table. When full grown, it is dark brown, hard, and cracked over the whole surface (much like the burnt crust of a loaf of bread); the lower portion forms a stout tap-root, buried in the soil, and branching downwards at the end. From deep grooves in the circumference of the depressed mass two enormous leaves are given off, each 6 feet long when full-grown, one corresponding to each lobe: these are quite flat, linear, very leathery, and split to the base into innumerable thongs that lie curling upon the surface of the soil. Its discoverer describes these same two leaves as being present from the earliest condition of the plant, and assures me that they are in fact developed from the two cotyledons of the seed, and are persistent, being replaced by no others. From the circumference of the tabular mass, above but close to the insertion of the leaves, spring stout dichotomously branched cymes, nearly a foot high, bearing small erect scarlet cones, which eventually become oblong and attain the size of those of the common spruce fir. The scales of the cones are very closely imbricated, and contain when young and still very small, solitary flowers, which in some cones are hermaphrodite (structurally but not functionally), in others female. The hermaphrodite flower consists of a perianth of four pieces, six monadelphous stamens with globose 3-locular anthers, surrounding a central ovule, the integument of which is produced into a styliform sigmoid tube, terminated by a discoid apex. The female flower consists of a solitary erect ovule contained in a compressed utricular perianth. The mature cone is tetragonous, and contains a broadly winged fruit in each scale. Its discoverer observes that the whole plant exudes a resin, and that it is called "Tumbo" by the natives, whence he suggests that it may bear the generic name of "*Tumboa*;" but this he withdrew at my suggestion, for reasons which I shall presently give. It inhabits the elevated sandy plateau near Cape Negro (lat. 15° 40′ S.), on the S.W. coast of Africa.

In his letter to Sir William Hooker, Dr. Welwitsch says nothing definite as to the affinities of this plant, but compares the stigma (or, as I consider it, the apex of the ovular integument) to that of certain *Proteaceæ*, the cones to those of certain *Abietineæ*, the resin to that of *Coniferæ*, and the fibrous substance in the integument of the seed to that of *Casuarina*.

After his arrival in Portugal in 1861, Dr. Welwitsch addressed to M. DeCandolle at Geneva a very interesting letter on the vegetation of Benguela and the neighbouring parts of Africa, in which the "Tumbo" was again described. In this letter, which was dated Lisbon, April 20, 1861, and communicated to the 'Bibliothèque Universelle de Genève,' Dr. Welwitsch makes the following remarks:—"This is assuredly one of the most extraordinary plants that exist in intertropical Africa; and notwithstanding certain resemblances of structure with *Coniferæ* and *Casuarineæ*, and even with *Proteaceæ*, I believe we have here the type of a new family."

During the autumn of 1861, and some months before the arrival in England of Dr. Welwitsch's specimens, Sir William Hooker received from Mr. Thomas Baines, an accomplished artist, then travelling in the Damara Country, a box containing some admirable coloured drawings illustrating the vegetation of that country, together with the cones and a sketch of a plant which I at once recognized as generically, if not specifically, identical with that discovered by Dr. Welwitsch. Unfortunately the box was not accompanied by any letter, nor the specimens and drawings by descriptions: they appear to have been collected in lat. 24° or 25° S., about 500 miles south of Cape Negro, where Dr. Welwitsch found his plant. They were gathered on the 10th of May, and were packed without being dried, along with some gigantic succulent aloe leaves and flowers; and not arriving at Kew until late in the following autumn, they were then all in a very decayed state. The cones contained ripe seeds, the albumen of which was perfectly rotten; by careful dissection of them, however, and hardening them with alcohol, I had no difficulty in proving their great similarity in development and structure with the seeds of *Cycadeæ* and *Gnetaceæ*. Mr. Baines's sketch of the plant (Plate I. fig. 2) somewhat differs from Dr. Welwitsch's description, in presenting the appearance of five leaves spreading on the ground, instead of two only; they are, however, curled, and split into thongs, though not so deeply as Dr. Welwitsch describes. Mr. Baines's sketch is, however, more artistic than scientific; the insertion of the leaves is not precisely indicated, nor are their bases separated. From the copy, it will be seen that it may represent a plant with five leaves, or two split respectively into two and three, or even one leaf split into five! The name "Tumbo" is appended by Mr. Baines to the drawing of this plant and also to that of an aloe; but on a slip of paper accompanying the specimen, he has written, "Branch of the cones of a plant called by the Hottentots 'Ghories,' and by the Damaras 'Nyanka-Hykamkop.'"

On the arrival of Mr. Baines's specimens and drawings, I immediately communicated the fact to Dr. Welwitsch, urging him to send his materials to Kew as he had proposed; and as he had done me the honour of desiring that I should publish them, I offered to do so. At the same time I directed his attention to the fact that the name of "*Tumboa*," which he had proposed, was, according to Mr. Baines, applicable to various plants, whilst other names were applied to this; and I suggested the propriety of his withdrawing it, and permitting me to replace it by that of *Welwitschia* * *mirabilis*. To this Dr. Welwitsch at once consented; and two fine young specimens, together with flowers, and cones with unripe seeds, soon afterwards arrived, along with his original drawings, proving the identity of his plant with that of Mr. Baines; and I have now the pleasure of commemorating Dr. Welwitsch's indefatigable and successful botanical labours in tropical Africa by attaching his name to a discovery of his own, and one that I do not hesitate to consider the most wonderful, in a botanical point of view, that has been brought to light during the present century; for an attentive study of the structure of its vascular system, as well as of its reproductive organs, and of the evidences we have of its functional peculiarities and mode of development, will disclose in all these points very singular anomalies, which even

* *Welwitschia*, Reich. Handb. p. 94, is reduced by Bentham to *Gilia* (DC. Prodr. ix. 310).

appear in some instances subversive of theoretical axioms hitherto considered as fundamental in Botany.

After receiving Dr. Welwitsch's specimens, I wrote to my friend Joachim Monteiro, Esq., a very intelligent and successful zoologist residing at Loanda, who had sent many seeds and bulbs to the Royal Gardens of Kew, requesting him to procure some plants of *Welwitschia* for me, through any correspondent he might have in the Cape Negro district. Mr. Monteiro instantly replied to me from Cuio Bay, where he happened to be travelling, informing me that he had found the plant some weeks before the receipt of my letter, and, feeling assured that it would interest me, had already packed a box with six fine specimens, and a bottle of cones preserved in spirits. The following is a copy of Mr. Monteiro's letter :—

"Cuio Bay, February 25, 1862.

"My dear Sir,—I was delighted to receive a week ago your letter of December last, and still more so in being able to comply in part with your wishes with regard to *Welwitschia mirabilis,* as I today forward by the steamer to Lisbon a box containing one large and five small specimens of this plant. I also send you in the same box a glass bottle with the cones that I cut off the large specimen.

"These I myself collected at Mossamedes (Little Fish Bay of the English charts) in December last. For the large specimen I had to send a black with a hoe, to dig it out of the very hard soil in which it was growing ; but the rascal cut the leaves off, as you will see.

"On my journey to visit a copper-mine about thirty miles distant from the coast, I passed a plain about three miles across, on which this plant was growing abundantly ; that is to say, I saw about thirty specimens on my line of march. The plain was perfectly dry, and bare of other vegetation than the *Welwitschia* and a little short grass. The ground was of a hard quartzose schist. The *Welwitschia* was generally growing near the little ruts worn in the plain by running water during the rainy season. The large specimen sent was the largest that I saw ; but I was careful to inquire of several Portuguese belonging to the Possession at Pinda (Cape Negro), whether Dr. Welwitsch's description to me, of these plants being found with tops measuring 6 feet across, was correct or not ; and they all assured me they had seen them of that size and even larger, with the ribbon-like leaves 2 and even 3 'braças' (fathoms) long. I was told that the largest they had seen were on the banks of the River Croquis, a little to the north of Port Alexandre. The main land of this is Pinda, where there is a small Portuguese force, several fishermen, plantations, &c. A friend of mine, the principal trader at Mossamedes, is the owner of a cotton-plantation at Pinda ; and I will write to him by the next steamer to procure for me the very largest specimen of the *Welwitschia* that can be found in the neighbourhood, or that can be transported to the coast.

"I know that Dr. Welwitsch desired several persons at Little Fish Bay to procure specimens of this plant for him, but it is very likely they will never do so ; but I think you can depend on my friend getting one of the largest.

"All the plants I saw were growing flat on the ground ; none with the top raised above the surface, as represented in your drawing ; but I know not whether this may perhaps be the case with the larger ones. I was unable to obtain seeds ; nor had I time to gather more specimens : I transplanted a young one into a box with earth, but it rotted. I have information that the *Welwitschia* is found growing in the vicinity of the River San Nicolau, in 14° 20′ S. lat. About here it is unknown to the natives, so that you may consider 14° S. lat. as its most northern limit.

"Yours very sincerely,

"J. J. Monteiro." *

* This letter also contains the following account of a most curious plant, not yet known to botanists :—

"I found a very extraordinary-looking plant growing rarely near Little Fish Bay, which in appearance is like a great

Again, since the receipt of the specimens mentioned in this letter, I received, only ten days ago, a further supply from the same indefatigable correspondent, consisting of four very large specimens of a much shorter obconic form than any heretofore received, and with the terminal lobes greatly dilated, much divided, and almost erect, so that the crown of the plant, with its dark rugose ridges, bears a fanciful resemblance to the open mouth and palate of some monstrous animal; these I have had figured at Plate V. figs. 1–4.

I have also to acknowledge the receipt of a very fine Damara Land specimen (Plate V. fig. 5) from Mr. C. J. Andersson, the same gentleman who forwarded the cones and drawing from Mr. Baines, and through whom Sir W. Hooker had written to Mr. Baines, begging him to procure some more specimens with as little delay as possible, and to favour him with any information about their habits and habitat. Mr. Baines being absent, this letter was answered by Mr. Andersson himself, and I have now the pleasure of laying its interesting contents before the Society.

"*To Sir William Hooker.*

"Damara Land, Otjim Cinguè, February 12th, 1862.

"SIR,—Mr. J. Logier, of Cape Town, forwarded to me lately a letter from you to Mr. Thos. Baines, artist, now travelling in the interior of these parts. As Mr. Logier correctly conjectured that his friend would not just now be within hail, he requested me to peruse the letter in question, in hopes of my being able to throw some light on the subject of your inquiries. It is on the strength of this that I now address you.

"The plant sent you by Mr. Baines from Damara Land, and which seems so much to have awakened your curiosity, is, I think, well known to me. Indeed, it is so peculiar as scarcely to be mistaken even by the rudest description. In the first instance, it is only found in one single locality—that is, as regards Damara Land—which locality is exceedingly circumscribed. It grows moreover in sandy soil, and luxuriates when it can find a few stones where to fix its extraordinary tap-root, penetrating often several feet deep; so that it is, indeed, a work of labour and patience to extract one single plant. I have been thus occupied more than an hour, and even then I have come away with only a *portion* of the root. It has 'leaves' of a dark-green colour, of which several spring from the same stem or root, spreading and curling along the ground. They will tear into innumerable shreds, each of which is exceedingly strong and tenacious; they are straight-grained—that is, you can tear them from top to bottom without deviating a single line from a straight course; and they attain sometimes a length of several feet. A small portion towards the points, and sometimes the sides, will be found slightly withered; in other respects they might almost be considered evergreen. The plant has cones. The root is usually found flush with the surface, or just rising an inch or two above it, the *soi-disant* leaves springing immediately from it.

"Rain rarely or never falls where this plant exists *. I have crossed and recrossed Damara Land throughout its entire length and breadth, but only found the plant growing on that desperately arid flat stretching far and wide about Waalvisch Bay, or between the 22nd and 23rd degrees of S. lat. It is most

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full wine-skin. I was told that Dr. Welwitsch pronounced it to be a great curiosity: it is called by the Portuguese, from its appearance, 'Odres.' Some of them could not have weighed less than a ton. I have here with me two young plants in a flourishing condition, as well as another plant brought by a Portuguese trader from the Gambos country in the far interior, on account of the wonderful medicinal virtues of its milky juice. It bears most curious unsymmetrical little flowers. These, as well as several other botanical curiosities, I shall forward as soon as your climate allows them a warmer welcome."

* Mr. Galton informs me that, though no rain ever falls, the night dews are so heavy that a small party of men, residing on the coast, is supplied thereby with water throughout the year.

common about the lower course of the river Swakop (see Map of my work 'Lake Ngami'). But I feel my description is very inadequate to the subject, and shall therefore endeavour to procure the plant itself, and forward it at an early date to England, where I trust it will arrive in sufficiently healthy condition to enable you to identify it satisfactorily. Indeed, I would have sent a specimen years ago, had I not been under the impression that you had already specimens of it; for I assisted a Mr. Wollaston once to excavate a couple, which I thought he purposed presenting to the Kew Gardens. I know that the specimens were received at the Botanical Garden at Cape Town; for I saw them there only the other day, pitched away among some rubbish. No one seemed to take the slightest notice of them, which rather surprised me, since the plant cannot well escape even the dullest eye, it is so singular.

"I remain, Sir, your obedient Servant,

"Chas. J. Andersson."

Before proceeding to a detailed description of this plant, I have to record the great obligations I am under to Professor Oliver, who has taken equal interest with myself in its investigation, has verified most of my observations, has directed my attention to several important points which I might otherwise have overlooked, and who has made the greater part of the anatomical drawings contained in Plates XII., XIII., and XIV. But for his unremitting attention to my progress through some of the most minute and difficult points, and especially those connected with its embryogeny, confirming the views I had myself formed, I should have felt great diffidence in laying before this Society some of its most anomalous features.

Welwitschia, gen. nov.

Descr. Gen.—Dioica? *Inflorescentia* strobilacea. *Strobili* oblongo-cylindracei, 4-goni. *Squamæ* 70–90, arcte 4-fariam imbricatæ, latissime ovato-orbiculatæ, 1-flores, utrinque nervis 2–3 flabellatim ramosis aream hyalinam centralem enervem includentibus percursæ. *Flores* in axillis squamarum coriacearum strobilorum parvorum siti, sessiles, compressi. Fl. hermaph. *Perianthium* 4-phyllum: foliola membranacea; 2 exteriora lateralia, falcata, anguste spathulata, acuta, dorso carinata v. subalata; 2 interiora late obovato-spathulata, unguibus in tubum compressum connatis, imbricata. *Stamina* 6, filamentis crassis cylindricis subulatis basi in tubum crassum connatis, post anthesin geniculatim reflexis, æstivatione inflexis; *antheræ* capitatæ, obtuse 3-gonæ, 3-loculares, vertice rima 3-cruri dehiscentes; *pollen* simplex, ellipsoideum. *Carpellum* 0. *Ovulum* in centro floris, solitarium, compressum, ovoideum, lata basi sessile; integumentum simplex, calyptræforme, apice in tubum tortum cylindricum styliformem disco papilloso stigmatiformi terminatum desinens; nucleus conicus, ima basi 2 nervis, sacculo embryonali 0. Fl. Fœm. *Perianthium*: utriculus simplex, hyalinus, compressus, 2-alatus, post anthesin ampliatus. *Ovulum* solitarium, ut in flore hermaphrodito, processu tamen integumenti stricto apice lacero non dilatato, et nucleo sacculo embryonali (endospermio repleto) donato. *Fructus* siccus, e perianthio ampliato (pericarpio) orbiculari medio semen nudum fovente conflatus. *Pericarpium* orbiculare, basi subcordatum v. breviter stipitatum; pars centralis obovoidea, cava, coriacea, ala latissima hyalina eleganter undulata circumdata; loculus superne in canalem tenuem alam percurrentem et processum styliformem integumenti exsertum foventem productus. *Semen* erectum, obovoideum, compressum, sessile, ad apicem calyptra membranacea (integumento ovuli) in processum styliformem producta terminatum; testa (nuclei parietes) carnosula, utrinque ad latera 1–2 nervis, apice in conum carnosum desinens; albumen obovoideum, densum, superne in collum carnosum annulare constrictum. *Embryo* in cavitate albuminis receptus, elongatus; cotyledones parvæ, planiusculæ, compressæ; plumula 0; radicula teretiuscula, v. medio paulo incrassata, extremitate radiculari incrassata, carnosa, abrupte in filum suspensorem longissimum tortum desinente.

Planta lignosa, simplex, 2-phylla, gummi colloideum exsudans. *Truncus* crassus, obconicus v. turbinatus v. subglobosus, plus minus compressus, ambitu infra folia transverse sulcatus v. undulatus, basi in radicem fusiformem brevem v. elongatam inferne ramosam contractus, supra folia in lobos 2 amplos depressos monstrosos rugosos floriferos foliis respondentes dilatatus. *Folia* 2, opposita, longissima, lineari-ligulata, obtusa, crasse coriacea, mox valde dilacerata, et in lacinias angustissimas emarcidas basi sæpe discretas fissa, marginibus integerrimis, utrinque nervis parallelis creberrimis striata; basibus membranaceis truncum fere circumambientibus, et in fissuram horizontalem profundam trunci receptis. *Lobi floriferi* valde indurati, trunco latiores, medio depressi, integri v. multilobati, in vertice jugis concentricis rugosis foveolatis (annis totidem? floriferis respondentibus) operti. *Pedunculi strobiliferi* numerosi, ambitu loborum in jugis externis siti, dichotome ramosi, teretes, pseudo-articulati, ad nodos tumidi et 2-bracteati, bracteis oppositis persistentibus. *Strobili floriferi* parvi; *fructiferi* 2-pollicares, coccinei, squamis persistentibus. *Flores* minuti. *Fructus* amplus, membranaceus.

Welwitschia mirabilis.

Hab. In desertis petrosis oræ occidentalis Africæ tropicæ australis prope Caput Negro (*F. Welwitsch, et J. J. Monteiro*). Damara Land prope Waalvisch Bay (*T. Baines et C. J. Andersson*).

Locus in Systemate Naturali.—Non obstantibus forma et structura trunci, dispositione systematis vascularis, floribus hermaphroditis, et evolutione anomala embryonis, planta ista inter *Gnetaceas* prope *Ephedram*, ob inflorescentiam strobilaceam, squamas 2-nervias, perianthii formam, et stamina, ovula et semina omnino cum *Gnetaceis* congruentia, sine dubio militat.

Genera tres *Gnetacearum* notis sequentibus dignoscas.

1. Gnetum. *Squamæ* strobili heterogami in discos carnosos peltatos confluentes, post anthesin immutatæ, omnes floriferæ. *Flores* conferti, unisexuales, filis articulatis immixti. Fl. ♂. *Perianthium* 2-labiatum. *Stamen* solitarium, filamento 2-nervi, loculis polliniferis 2. Fl. ♀. *Perianthium* ampullaceum. *Ovuli* integumenta 2. *Fructus* drupaceus.—Arbores *erectæ v.* arbusculæ *scandentes.* Folia *opposita, ampla, penninervia.*
2. Ephedra. *Squamæ* strobili homogami per paria connatæ, post anthesin ampliatæ v. carnosæ, inferiores vacuæ, 2 terminales majores 1-floræ. *Flores* unisexuales, filis articulatis 0. Fl. ♂. *Perianthium* membranaceum, 2-labiatum. *Stamina* 2–8, monadelpha; antheræ capitatæ, 2-loculares. Fl. ♀. *Perianthium* ampullaceum, 3-gonum. *Ovuli* integumentum solitarium. *Fructus* siccus, squamis amenti membranaceis v. carnosis inclusus.—Suffrutices *aphylli, rhizomate lignoso; ramis teretibus, articulatis, striatis, ad nodos squamosis.* Folia *squamæformia.*
3. Welwitschia. *Squamæ* strobili homogami 4-fariam imbricatæ, perplurimæ floriferæ, fructiferæ valde auctæ. *Flores* hermaphroditi et fœminei. Fl. ☿. *Perianthium* 4-phyllum, foliolis 2-seriatis, interioribus connatis. *Stamina* 6, monadelpha; antheræ 3-loculares. *Ovuli* integumentum solitarium, disco stigmatiformi terminatum. Fl. ♀. *Perianthium* ampullaceum, compressissimum, 2-alatum. *Ovulum* maris, sed processu styliformi recto apice simplici lacero. *Fructus* siccus, squamis membranaceis strobili velatus.—Truncus *obconicus, lignosus.* Folia 2, *opposita, longissime linearia, dilacerata, nervis parallelis.*

Trunk.—External Characters.

The trunk of *Welwitschia* differs essentially in its mode of development from that of any other plant known to me, and indeed does not even approximate to any. It consists of three more or less distinct portions:—(1) a compressed swollen body, which I shall call the *stock*; this gives off the leaves, and is surmounted by (2) a bilobed *crown* appropriated to the inflorescence; whilst, below, it is more or less suddenly contracted into (3) a subcylindrical *tap-root*, that branches towards its base.

All these parts, at all stages of their growth, are externally of a dark colour, and very hard woody consistence: the terminal lobed mass, from being ever exposed to the scorching rays of a tropical sun in an arid climate, is much the hardest and darkest, resembling, as I have before stated, both in colour and texture, the crust of an overbaked loaf: the stock is the lightest in colour and softest in consistence, and, as well as the root, often has pebbles imbedded in its cortical substance.

All these parts differ a good deal in relative as well as in actual form and dimensions in the several specimens (amounting to fourteen) which I have received. Dr. Welwitsch's largest (Plates III. & IV.) have a flattened turbinate stock with a lobed base, long root, and their crown is neither much dilated nor very concave. Dr. Welwitsch's smallest specimen (Plate II. fig. 1), and Mr. Andersson's very large one from Damara Land (Plate V. fig. 5) have globose stocks, in each case suddenly much contracted into a long root, and rather tumid crowns. Mr. Monteiro's last-received specimens, on the other hand (Plate V. figs. 1–4, & Plate XI. figs. 1, 5 & 7), have all of them conical stocks, gradually or rapidly tapering into the roots, and much dilated crowns, of which the lobes in the older specimens are very concave, or almost erect. The amount of lobing of the periphery of the plant also varies extremely; in Mr. Monteiro's oldest and largest, the periphery is cut into many lobes of various sizes (Plate V. figs. 1 & 2), some of which are contracted at the base, and form appendages singularly resembling in form, marking, and texture *Polyporus fomentarius*, to which a structureless fossil specimen of this part of the plant would probably be referred.

Some of these peculiarities are no doubt to be attributed to age, and others to the nature of the soil, and the depth at which moisture exists in the arid coasts of Cape Negro and Damara Land.

The following are the principal dimensions and weights of the largest specimens :—

	Length.		Girth round the crown.		Weight.
1. Mr. Monteiro's, which arrived December 13, 1862.	ft.	in.	ft.	in.	lbs.
Largest (Plate V. fig. 3)	2	0	4	7	$32\frac{3}{4}$
Second largest (Plate V. figs. 1, 2)	1	8	4	0	$20\frac{3}{4}$
Third largest (Plate V. fig. 4)	1	9	4	8	$19\frac{3}{4}$
2. Mr. Andersson's from Waalvisch Bay (Plate V. fig. 5) . .	2	5	3	5	$26\frac{1}{4}$
3. Dr. Welwitsch's largest (Plates III. & IV.)	1	4*	3	5	$15\frac{3}{4}$

Crown.—This is oblong in outline, with the longer axis parallel to the insertion of the leaves; it is at first very tumid, but as the plant grows older it gradually subsides, especially towards the centre, until in some cases (Plate V. figs. 1, 2, 4, & Plate XI. fig. 1) it becomes so concave that the base of the hollow is far below the level of the insertion of the leaves. The surface is very irregularly marked with concentric ridges that are thickly studded with circular pits, denoting the position of fallen flowering peduncles. The number of distinct ridges in the largest specimens seldom amounts to more than 8 or

* The lower part of the root is cut off.

10, and these are only distinguishable towards the periphery; the others are so indistinct and confused towards the centre that they cannot be accurately estimated. The pits are usually in one series on each ridge; but sometimes, probably from the ridges being confluent, two are seen here and there; and they amount to upwards of one hundred on the circumference of a large specimen, diminishing in numbers on the ridges towards the centre. In old crowns these pits become raised on mammillary eminences. Radiating and concentric fissures of various depths intersect these ridges as the plant grows older. The crown, according to Dr. Welwitsch, sometimes attains 12–14 feet in circumference (Bibl. Univ. Genève, July 1861), and, if Mr. Monteiro's informant be correct, even 6 feet in diameter. It is very possible that the concentric ridges rudely represent annual increments to the plant; for the soft texture of the cones and peduncles is opposed to the view that these are more than annual, as is the fact that the cones sent by Dr. Welwitsch, Mr. Baines, and Mr. Monteiro, respectively, have all advanced to the same state of development. On the other hand, though, as is seen by Mr. Baines's drawing (Plate I. fig. 2), the cones are produced in great abundance, it is very improbable that in old specimens every pit indicates the presence of a fully developed peduncle with cones; for in this case each of the large plants must have borne at one time many hundreds of cones.

The surface of the crown is sometimes hoary, and presents under the microscope scattered, minute, hair-like bodies. These are peculiar spicular cells, hereafter to be described, which are developed within the tissue of the plant, but become exposed through its superficial disintegration.

The *Stock* presents several remarkable features, especially the deep horizontal groove between it and the crown, the transverse ridging of its surface below the leaf, and the occasional presence of flower-buds, and even of the scars of fallen peduncles, on its circumference. It often presents an upper lighter and a lower darker portion, the junction of which probably indicates the depth to which the specimen was sunk in the soil: this is well shown in Dr. Welwitsch's specimen, figured at Plate I. fig. 1., and agrees with his description of the stem being only partially buried; whereas those of Mr. Monteiro, which he states were immersed in the soil up to the origin of the leaves, do not show it.

The stock either terminates more or less abruptly downwards—most conspicuously so in all Dr. Welwitsch's specimens (Plates I., II., III. & IV.),—or tapers into the root, as in Mr. Monteiro's (Plate V. figs. 1–4, & Plate XI. figs. 1, 5, 7). The deep transverse slit dividing the stock from the crown, and at the base of which the leaves originate, is a most curious feature: it is nearly an inch deep in the largest specimen which I cut open; it clasps the leaf-base throughout its extent when the plant is fresh; but as the latter dies, its walls separate, leaving half-an-inch space between the upper and lower surfaces at the widest part (Plate XI. fig. 1). Whether fresh or dry, its orifice is so contracted that there is very little external trace of its existence, and its lips clasp the leaf so tightly that the latter, even when detached at the base, cannot be withdrawn entire. The object of this arrangement is, no doubt, to protect the young growing part of the leaf from the dry atmosphere.

The compression of the stock varies much in amount, and is no doubt proximately due to the dilatation of the base of the leaf, and consequent bilateral character of the trunk.

Towards its upper part, close under the base of the leaf, the circumference of the stock is marked more or less obscurely or deeply by concentric furrows, separating convex ridges, that repeat as it were the ridges of the crown: these are best seen in Plates IV., V., & XI. fig. 1, where they extend far down the stock. On the upper or outer of these ridges of the stock a few pits occur, in which flower-buds are occasionally developed; and, as it would appear, the latter sometimes arrive at maturity; for in one specimen I find the bases of three old peduncles *in situ*. In Mr. Andersson's large specimen there are four of these pits, vertical, superimposed on the four uppermost ridges of the stock. This may be regarded as an anomaly, to which I shall again allude when treating of the development of the plant.

The texture and appearance of the surface of the stock vary at different positions and ages: in the oldest specimens (Plates III., IV., & V.), it is uniformly hard, brown, rugged, and traversed by longitudinal fissures extending through the periderm; the ridges here extend but a little way below the leaf, and the superficial tissue of the periderm is broken up into isolated, distant, angular masses (Plate III.), denoting the great increase of the subjacent tissues. The superficial tissues of the ridges are always smoother and lighter-coloured than those of the rest of the stock; and in Monteiro's and Andersson's fresh specimens these parts are some of a pale yellow-green colour, and others of a bright green, and were still in a living state on their arrival.

The gummy substance (a true collenchyma) which exudes in large tears from the stock and other parts will be noticed when describing the internal anatomy of the stock.

Root.—This varies in my specimens from 1 to 2 feet in length; it is, as I before observed, either continuous with the stock, or else the latter terminates abruptly above it; it is slightly twisted, either nearly cylindrical, or if compressed, not so much so as the stock, although parallel to it; it gives off few fibres anywhere, and branches chiefly towards the base—indicating that the upper stratum of soil is extremely dry. Superficially it is of a much darker colour than the stock, being sometimes quite black; and the periderm peels off in places as a distinct bark. Owing to the nature of its tissues, the root is somewhat flexible.

Anatomy of Trunk. (Plates XI. & XII.)

A vertical section through the axis of a plant of *Welwitschia* exposes the following structure: 1. a brown cortical layer or periderm; 2. a largely developed parenchyma, of which the mass of the plant consists; 3. a fibro-vascular system of a very anomalous character.

Periderm.—This invests almost the whole plant with a very hard layer, of variable thickness and undefined boundary; it is most developed over the crown and towards the lower part of the stock, where it attains a thickness of ½ to ¾ of an inch in the largest specimen, becoming thinner and finally disappearing towards the insertion of the leaf; it is absent from the inner surfaces of the groove enclosing the base of the leaf. Its colour is a dark brown on the crown and stock, and almost black on the root; it is much the hardest on the crown, which is probably owing to the action of the sun's rays in the arid climate which the plant inhabits. The outer surface of this periderm cracks extensively as the plant grows, chiefly longitudinally on the stock, and radially on the crown,—the external portion sometimes breaking up on the stock into distant angular areolæ, as seen in Plates III. & IV. There is no lamination in the substance of the periderm, nor any trace of periodic growth. The epidermal cells, as long as retained, have thicker walls than the subjacent ones; the outer of all (Plate XII. fig. 3) are very large, radially elongated, and their outer walls are excessively thick, hard, and dark brown, almost as if charred by fire. The subjacent tissue (Plate XII. fig. 2) is a transversely elongated parenchyma, full of peculiar rigid spicular cells, hereafter to be described.

This periderm is not an independent growth, but is the outer portion of the parenchyma of which the mass of the plant consists, and which, having lost its vitality, forms a durable integument, in some parts of almost stony hardness, to the tender tissues beneath. In the root, but probably only in a dried state, this periderm is often separable from the subjacent tissues; this is in part owing to the vascular bundles which traverse the root running parallel to the periderm, not more or less transversely to it, as in the stock and crown.

Within the groove that holds the base of the leaf, the periderm is replaced by an exceedingly soft and tender tissue, which in Mr. Monteiro's specimens was still fresh and living. It consisted of a bright yellow-green parenchyma, covered with a delicate membranous transparent glistening layer of epidermal cells, with walls of extreme tenuity, without stomata, and without any appreciable thickening of the outer cell-wall. The cells were loosely filled with a watery grumous endochrome.

Parenchyma.—A *cambium-layer* * of soft parenchyma occurs beneath the periderm, investing nearly the whole trunk of *Welwitschia*: it is in all respects identical in structure with the subjacent parenchyma; but the cell-walls are more delicate, abounding also in the before-mentioned rigid spicular cells. This layer is best developed on the periphery of the crown, where the flower-buds originate, and it also forms the uppermost (outermost) of the ridges of the stock just below the leaf-base, whence it passes inwards surrounding the groove. It is least developed towards the depression in the long axis of the crown, and is perhaps absent under the periderm in its disc; but it otherwise invests the whole trunk with a layer of tissue, endowed with more or less vitality.

Beneath this cambium-layer a cellular tissue, of the ordinary hexagonal form in section, forms the chief substance of the crown, stock, and root. It is most developed in young and middle-sized specimens, and becomes gradually more intruded upon by the fibro-vascular tissues. In the freshest of Mr. Monteiro's specimens, this parenchyma was quite soft, and of a pale straw-colour, due chiefly to the abundance of large yellow spicular cells; it had a faint odour, something like that of fresh-boiled meat †, and contained, scattered through its substance, small cavities full of transparent gum. The cells of this tissue (Plate XII. fig. 1) are thin-walled; they have no markings, and are apparently not nucleated; their contents are insignificant, and present nothing worthy of notice.

The cellular and vascular tissues, though soft, are so interlaced, and spicular cells

* I apply this term here to the stratum of thin-walled cells, capable of multiplication by division, such as is to be found in *Dracæna*, and which is wholly distinct from the closed cambium of the vascular bundles. It is a persistent layer of the "meristem" of Nägeli (Beitr. z. wiss. Bot. i. 3).

† This I have not perceived in other equally fresh specimens; and it may be attributable to decay.

are so abundant in the former, that in a full-grown specimen the tissue cannot be cut smoothly with the sharpest knife, and a saw works through it with considerable difficulty, leaving very ragged surfaces. The root especially, owing to the masses of liber in the wood-wedges, and their waving courses, can scarcely be either cut or sawn, but may be riven if sufficient force be applied.

The spicular cells above alluded to are the most singular feature in the tissues of the plant, and, whether in their size, form, or surface, are quite unlike anything I have seen elsewhere. They are often $\frac{1}{8}$th of an inch long, extremely rigid, fusiform or acicular, acute (even pungent), or more rarely obtuse, at both ends, straight or branched, often more or less angled, curved, or hooked, and more or less thickly covered with minute crystals (Plate XII. figs. 5–8). They are found entangled in the parenchyma of all parts of the plant; but their walls become at a very early period free from the surrounding cell-walls. Their average diameter is that of four or five of the parenchyma-cells. The oldest ones are yellow. In a transverse section their walls appear concentrically laminated, the central cavity becoming all but obliterated with age: in the younger tissues they are smaller, paler, have thinner walls, and the crystals also are smaller and more remote (Plate XII. fig. 8); and, as I shall hereafter show, in the more membranous tissues of the plant (hermaphrodite perianth, &c.) they remain permanently thin-walled, are wholly void of crystals, and resemble the corresponding acicular cells in *Gnetum*, *Balanophoræ*, and other plants (Plate VI. fig. 9; Plate VII. fig. 8; Plate VIII. figs. 26, 27).

The crystals are flat, and applied to the surface of the cell by their broad faces; they are either rhomboidal or short six-sided prisms, always thin, of various sizes, $\frac{1}{1000}$th of an inch being the average of the larger, though some reach $\frac{1}{800}$th; they often assume irregular forms, as if they were broken, but are always flat and angular; they are often so thickly crowded as entirely to cover the surface of the cell. They are soluble in strong nitric acid, at least when heated. Dr. Frankland, who has attempted to analyse them, informs me that they are neither phosphates nor oxalates, but that after incineration they become soluble in acids, which indicates silica; but there is no test for silica sufficiently delicate to deal with a microscopic substance procurable in such very minute quantities.

As to the use of these spicular cells, they may be supposed to give solidity to the cellular mass of the plant: their abundance in the periderm, great size, curved and angular and often branched forms, surfaces roughened with crystals, and irregular arrangement suggest that this is the purpose they are intended to serve. In the leaf they brace together the several layers of parenchyma; and in the perianth, under a modified form, they give strength to the cellular tissue, acting in this respect like vascular bundles. Under this view they are analogous to the siliceous spicula of sponges, though formed on a totally different plan.

The gum which exudes from the trunk, peduncles, and various parts of the inflorescence, and which is also found abundantly in small cavities of the parenchyma of the leaf and trunk, is formed by the collenchymatous swelling and subsequent deliquescence of the cellular tissue, as is shown at Plate XII. figs. 14, 15. Occasionally the spicular cells are involved in the forming collenchyma, and, being similarly acted upon, their superficial coat of crystals becomes mixed up with the mass. The gum is dry, transparent, pale yellow-brown, inodorous, and insipid.

Fibro-vascular system.—This consists primarily of a thin, elongated or cup-shaped stratum, crossing the axis of the stock (to the surface of which it is parallel), just beneath the crown, and uniting the bases of the leaves. This gives origin to, secondly, an ascending system of definite isolated vascular bundles, which traverse the crown, and terminate in its ridges; and, thirdly, to a descending system of bundles, which in the axis of the stock and root are collected into wedges, but elsewhere in the stock are for the most part definite and isolated, and lose themselves in its cambium-layer.

Owing to the depression of the centre of the crown, or, more strictly speaking, to the upward growth of the lobes of the stock, the vascular stratum, which always keeps at a uniform distance from the periderm of the crown, is never horizontal, but becomes more and more cup-shaped as the plant grows older; the concavity varies, however, extremely in depth in different individuals (Plate XI. figs. 1, 5, 6). The circumference of this stratum (being coincident with the bases of the leaves) is the focus of greatest vitality in the plant; from it the innumerable fibro-vascular bundles which traverse the leaf are given off, and through it that stimulus to growth which is set up by the leaves is transmitted (so to speak) to the living tissues throughout the crown, stock, and root. At the margin of this stratum the cambium-layers of both the stock and crown meet, and having formed the soft walls of the leaf-groove, are continuous with the parenchyma of the leaves. This, then, is the point of greatest vitality in the whole plant; and, as we have seen, the delicate and important tissues here concentrated are protected from external influences by the tightly compressed lips of the groove, described at p. 9.

The vascular stratum itself forms neither a very conspicuous nor well-defined system, though necessarily rendered evident in the sections figured in Plate XI.; but it is sufficiently distinguishable when once understood. The bundles that compose it do not arrange themselves in groups, nor unite into a compact mass, but are arranged side by side, forming a fibrous layer not more than 3–4 lines thick in the largest specimens (Plate XI. fig. 2). They contain more vessels and comparatively less liber than the bundles in the root. In young and middle-aged specimens they run with great regularity; in old ones they sometimes branch, and present many anomalies in their course and arrangement.

This fibro-vascular stratum consists of two very ill-defined parts, in which the bundles are somewhat differently arranged, viz., a central and a circumferential portion. Of these the central is much the smallest; it occupies in the largest specimen a circular area of about 2 inches diameter, and consists of a matted fibro-vascular plexus, in which bundles of liber, barred vessels, spirals, &c., are all confusedly mixed. In a vertical section of the stock through the base of both leaves (*i. e.* at right angles to the lobes) (Plate XI. fig. 1), this central system is very manifest, though merging into the better-defined circumferential portion; and in a vertical section taken in a line exactly parallel to the lobes, and between them (fig. 5), it is hardly apparent. The circumferential portion consists of innumerable, very closely set, laterally compressed bundles, radiating outwards from the central portion to the entire semicircular base of each leaf. The structure of this portion is best seen in a vertical section through one of the lobes, halfway between the leaf-base and medial depression of the crown, and parallel to its long axis (Plate XI. figs. 2 & 6), which section intersects transversely all the bundles.

Each of the bundles forming the stratum consists of the same elements as those seen in the leaf (Plate XIV. figs. 1, 2, 3); but whereas in the leaf they increase only at the base, and give off no branches, in the stock their component elements are continually added to, and they give off bundles upwards to the crown and downwards to the stock. They increase, in short, from mere oblong dots, represented in fig. 6, to the linear bundles seen in fig. 2.

The plexus of the central portion, on the other hand, gives off to the root vascular bundles, which, unlike those of the crown and stock, coalesce into indefinite wedges (Plate XI. figs. 8 & 9).

The ascending vascular bundles which run to the ridges of the crown, and some of which enter the peduncles, are given off in vast abundance from all parts of the vascular stratum. These are very slender, isolated, but crowded, and in a transverse section of the crown, above the stratum (Plate XI. fig. 4, lower left-hand quadrant), appear to run in not very defined concentric lines, answering to the ridges of the crown. Many enter each peduncle, but without manifest order, though after entering they arrange themselves in groups having a relation to the bracts, as hereafter to be described.

The direction of the descending fibro-vascular bundles varies much more than that of the ascending, owing to their having to conform to the requirements, both of the stock, in which the increase of tissue is mainly centrifugal, and of the root, in which it is vertical; and, further, owing to the previously described concavity of this stratum, the outer series of these bundles actually ascends instead of descending. To explain this, it is necessary to refer to Plate XI. fig. 1. Commencing with the last-formed bundles in the stock: these start from the vascular stratum just beneath the base of the leaf, arch outwards and upwards, and, running parallel with and near to the floor of the groove, lose themselves in the cambium of the periphery. Those which are given off from points successively further from the leaf-base follow first a similar course, but successively arch downwards instead of upwards, till the innermost of all, which reach the periphery of the tumid base of the stock, run parallel to its periderm. All these bundles in the stock are usually very slender; they neither anastomose nor collect into bundles nor wedges, except sometimes along the medial line between the lobes of the crown (Plate XI. fig. 3), where the bundles from the contiguous leaf-bases become extremely confused, tortuous, and anastomose, forming very irregular, ill-defined plates. In old specimens, however, many deviations occur.

Those bundles which descend from the central part of the stratum, through the axis of the stock, and traverse the root, are more or less collected into several irregularly concentric series of wood-wedges, surrounding one or two medullary centres, and are separated by wide and interrupted medullary rays and very broad parenchymatous rings. The parenchyma of the axis and root is further traversed by many isolated bundles, scattered between the wood-wedges (Plate XI. figs. 8, 9; Plate XIII. fig. 12).

The wood-wedges are collected into groups of 3 to 6 or more, which are parallel to one another, but often placed obliquely to the radius and to other groups. Those nearest the axis are always larger than those towards the circumference, the outermost of all being extremely small. The individual wedges are radially very much elongated, taper outwards, and are often waved, and split from the centre nearly to the tip by intruded parenchymatous wedges; they are, for the most part, formed of liber, which, in a transverse section of youngish specimens, presents a dense, somewhat horny, pale brown mass; this is succeeded, towards the axis of the root, by a very inconspicuous cambium-layer, and this by a bundle of slit-marked vessels. In old specimens the liber preponderates so inordinately over the parenchymatous and other tissues, that, when riven open, the interior of the axis and root presents the appearance of tangled hemp-yarn, the masses of which, when torn out, are as thick as the little finger, and are matted together with dry parenchyma, full of yellow spicular cells and fragments of vessels. The whole forms a tissue so loose and tough, that an old root can neither be sawn nor cut clean across.

In some specimens, the wood-wedges of the root are obviously arranged round two centres (Plate XI. figs. 8 & 9), a vertical plane passing through both corresponding with the depression between the bases of the leaves.

The elements of the vascular bundles above described are singularly uniform throughout all parts of the plant, and consist of:—First, a great proportion of filiform liber-cells; these are very slender, terete, white, 1 to 2 or more inches long; their cavity is all but obliterated, and their surface marked with very fine transverse striæ (Plates VII. figs. 11, 12; VIII. fig. 25; XII. fig. 14; XIII. fig. 14); they sometimes, but very rarely, are unequal in diameter and branched (Plate XII. fig. 12). Second, slit-marked vessels, or pitted vessels, with thick walls (Plate XIII. figs. 10, 15; Plate XIV. figs. 14, 15): in some of these the whole interior is filled with secondary deposit, except opposite the slits or pits, giving rise to various modifications (Plate XIV. fig. 14); in others the pits seem united by a faint spiral line traversing the interior of the tube (Plate XIV. figs. 14 & 15). These pass into—Third, tubular vessels, with more or less thickened walls, in which the deposits are spirally arranged (Plate XII. fig. 4; Plate XIII. fig. 10). The peculiar disc-bearing tissue which abounds in all other gymnospermous plants seems to be totally absent in this.

On a comparison of the stem of *Welwitschia* with that of other vascular plants, its development seems to be referable to the exogenous plan, of which it is a remarkable and hitherto unique modification. Except, indeed, in the fact of so many of the descending bundles of the stock and root remaining isolated and closed, and in those of the stock losing themselves in the periphery, I do not see any analogy with an endogenous mode of development. The first of these characters is very common in many Orders of Exogens with anomalous wood; and the second is accounted for by the exigencies of the growth of the stock. Nor should I have expected it to be otherwise: the embryo being dicotyledonous, and giving origin (it is to be assumed) to a primary root continuous with its radicle, lays the foundation, as it were, for an exogenous arrangement of the vascular tissues within it, cellular tissue in all cases preceding and regulating the time of appearance, amount, and disposition of the vascular, which is formed as required. Had the embryo presented any monocotyledonous character, as the development of adventitious roots from its radicle, or had it possessed but one cotyledon, then it is to be assumed that the future plant would have been unsymmetrical, and either a further deviation from the exogenous plan or a decided transition to the endogenous might have been expected.

Its discoverer affirms (see p. 2), but on what grounds he does not state, that the two leaves of *Welwitschia* are the developed cotyledons of the embryo: of this there is no absolute proof forthcoming; nor can there be any, short of watching the process of germination. But much may be inferred from the anatomy of the trunk; and all that has been there observed is entirely in favour of Dr. Welwitsch's statement. For, firstly, there is the obvious fact, that the leaves of the youngest specimens as well as those of the oldest all occupy precisely the same position in relation to the axis and cambium-layer; secondly, there is the difficulty of accounting, under any other supposition, for the single transverse vascular stratum, whose bundles are continuous with those of the leaf at every period of growth; thirdly, the absence of anything like an internode in the axis; lastly, the uniformity with which the definite bundles are given off to the crown and stock, and the condition of the tissues within the lips of the transverse groove, both indicate one continuous leaf-formation from the very earliest epoch in the plant's life.

Nor is such a development wholly without its counterpart; for a very analogous case is presented by another Dicotyledonous South African genus, though occupying a widely different position in the natural system. I allude to the cases of *Streptocarpus polyanthus* (Hook. Bot. Mag. t. 4850), *S. biflorus*, and *S. Rexii*, whose germination has been observed by Mr. Crocker at Kew, and his account of which was read before this Society, and published, with illustrations, in our Journal (vol. v. p. 65, t. iv.)*. In these plants the minute, terete, exalbuminous embryo has two short cotyledons, of which one becomes developed in germination into the great oblong penniveined leaf of the future plant, which, like those of *Welwitschia*, lies along the ground; the other cotyledon soon disappears, and the radicle developes a short caulicle terminated by rootlets. The inflorescence of *Streptocarpus* is adnate to the petiole and base of the midrib of the leaf, and consists of a depressed axis, giving off a succession of many-flowered scapes from its upper surface. Here the caulicle answers to the stock of *Welwitschia*, the adnate portion of the inflorescence to the crown, and the scapes to the peduncles. But whereas *Welwitschia* is a perennial symmetrical (bilateral) plant, of which both cotyledons are developed, *Streptocarpus* is an annual (or biennial) unsymmetrical (unilateral) plant, of which but one of the cotyledons is developed.

It is perhaps a fanciful idea, but worth recording, that the mode of growth of both these plants may have originated in a conformity to conditions, inasmuch as *Wel-*

* Some months after the publication of Mr. Crocker's paper, it was found, from a statement in the 'Revue Bibliographique' of the Botanical Society of Paris (vol. vi. p. 148), that the same fact had previously been recorded of *S. polyanthus* and *S. Rexii* by Dr. Caspary, who published it, in 1858, in the 'Verhandlungen des naturhistorischen Vereins d. Preuss. Rheinlandes u. Westphalens,' xv. Jahrg., pp. 74, 75.

witschia, growing in open flat plains, scorched by a powerful sun, and seldom visited by rain, is very slowly and symmetrically developed, while *Streptocarpus*, growing rapidly, in moist localities, out of chinks in vertical rocks, where the two sides of the embryo and of the future plant may be exposed to very different conditions, is unsymmetrically developed.

The last point to which I shall allude in connexion with the axis of *Welwitschia* is the origin of the parts I have called the stock and crown.

The stock I assume to be what is termed the caulicle (tigellum) in germinating Dicotyledons, and to be in fact the radicle of the embryo*; but whereas in most perennial dicotyledonous plants the caulicle becomes obliterated or not apparent after the first year, in this, owing to its assuming the functions of the trunk of the plant, it becomes the most important and bulky of its vegetative organs. Though I know of no exact counterpart to its vascular system in any other plant, such may exist; for M. Clos has pointed out, in his excellent papers on the structure of the tigellum (Ann. des Sc. Nat. sér. 3. t. xiii. p. 1, t. xviii. p. 321, t. xvi. and xvii.), that this part of the axis differs both from the stem and root in the disposition and number of its vascular bundles.

The question of the theoretical origin of the crown is not so easily disposed of; nor can I say whether its ridges should be regarded as plumulary, or as being wholly made up of confluent axillary flower-branches. There being no other vertical axes developed in *Welwitschia*, these ridges, if flowering branches, can scarcely be considered as truly axillary; on the other hand, any development of the embryo from between the bases of the cotyledons must be considered as more or less plumulary; it is therefore easier to conceive the successive ridges of the crown to consist of arrested plumulary axes, with which the flower-buds coalesce, than to suppose them to be wholly plumulary or wholly floral. I am not acquainted with the anatomy of the depressed flowering axis of *Streptocarpus*, which may probably throw some light upon that of this plant. The disposition of the vascular bundles in mature plants of *Welwitschia* is too vague to throw much light on the subject.

It would be most interesting to pursue this inquiry into the structure and development of the axis of *Welwitschia* much further, and especially to follow up the points of affinity between its tissues and the trunk of its allies the *Cycadeæ* and *Gnetaceæ*, on the one hand, and, on the other, the analogous forms of wood presented by *Menispermaceæ* and many other plants; but this would carry me far beyond the limits of the present essay.

Leaf. (Plate XIV.)

The youngest leaves I have seen are those of the specimen figured at Plate II. fig. 1;

* In Jussieu's 'Cours Elémentaire,' § 488, I find it expressly stated that the radicle of Dicotyledons consists almost entirely of tigellum, and becomes the tigellum of the young plant. In Henfrey's 'Elementary Course of Botany' (1857), § 35, 301, &c., the radicle is called the root; in Asa Gray's 'Introduction to Botany' (1858), § 158, 159, the radicle is rightly regarded as an axis, and not a root, but is further considered to be an internode. Of these views I adopt the first, and the first part of the last.

these are four inches long, and about one inch at the broadest diameter: the largest I have seen are those of the specimens sent by Mr. Monteiro, which are two feet broad at the base. Dr. Welwitsch states, in his letter to Sir William Hooker, that the leaves attain a length of six feet; and according to Mr. Monteiro's letter (p. 4) they may attain even a larger size. I have no evidence of the plant ever bearing more than two leaves: there is, however, no reason why more than this number should not be developed; for the embryo may occasionally be tri- or poly-cotyledonous, as is the case with so many other Gymnosperms, including its near ally *Ephedra*. In all my specimens, however, the appearance of more leaves than two arises from the splitting of one or both, and from subsequent interstitial growth of the tissues of the crown and stock completely sundering these portions at their bases. These disruptions may always easily be recognized, from their adjacent margins being ragged, and deprived of cuticle at a greater or less distance from the base, though as the severed portions grow outwards their newer parts acquire a rounded edge, covered with epidermis.

The base of the leaf, which is retained within the groove between the crown and stock, is, in the dried specimens, excessively thin and almost membranous; that this is not entirely, if at all, due to the shrinking of its substance is evident from an examination of the tissues, of which the parenchymatous is almost suppressed, and the fibro-vascular reduced to very narrow cords. The exposed portion of the leaf is of a hard leathery consistence, greenish and glaucous on the upper surface, paler green, suffused with red-brown, on the under; it is $\frac{1}{20}$th of an inch in thickness, quite entire along the rounded margins, longitudinally striated on both surfaces, the striæ answering to innumerable slender, close-set, narrow grooves. The nervation, which is parallel throughout, is scarcely distinguishable on the surface.

The internal structure of the leaf (Plate XIV.) is beautiful and singularly complicated, well supporting the other evidence of its perennial duration. The outer walls of the epidermal cells (Plate XIV. figs. 1 & 2 *a*) are horny and thickened, and their cavities have few contents. Beneath the epidermis of both surfaces is a thick layer of very lax, soft, cellular tissue (figs. 1 & 2 *b*), traversed longitudinally by bundles of liber (figs. 1 & 2 *c*), and strengthened, as it were, by a confused mass of the rigid spicular cells (figs. 1, 2 *d*, & 4) covered with crystals, that have been described as abounding in the parenchyma of the trunk. These spicula are in this part of the leaf of a rather more definite shape, and are in a far more definite position relatively to the other tissues, than in the trunk; they do not either cross or intrude upon the liber-bundles, are placed perpendicularly to the surfaces of the leaf, and are often bent at a right angle at one or the other or even at both ends. The tissue they traverse is so soft that its cellular nature is not very evident; and the effect of the spicula in holding this together is rendered obvious by pulling one with a pair of fine-pointed forceps under the microscope, when, owing to its curved form, rigid texture, and rough surface, it resists withdrawal without complete laceration of the surrounding tissues, at the same time often dragging other spicula with it, these being entangled together by their hooked or branched ends.

Towards the middle of the leaf is a thicker layer of ordinary parenchyma (figs. 1 & 2 *e*) having cell-walls without markings, and almost empty cavities, with a few spicula, and occasionally groups of cells transformed into amorphous gum (collenchyma).

The strong fibro-vascular bundles of the leaf traverse this tissue parallel to one another, and continuously throughout the whole length of the leaf in its medial plane. The vascular bundles (fig. 2 *f* & fig. 3) are of the same character as those of the stock, but more symmetrically developed: in a transverse section they are oval or cuneate, with the broad end upwards. They are surrounded by a single layer of thick-walled pitted cells (fig. 3 *a*), and consist of, superiorly, a large crescent-shaped bundle of liber-cells (fig. 3 *b*), which, like those in the stock and root, have thick walls, narrow or no cavities, and delicate transverse striæ; beneath this is a thick crescent-shaped cambium-layer (fig. 3 *c*), marked in a transverse section with radiating lines (fig. 1), due to an obscurely radiating arrangement of the cells; beneath this, again, is a bundle of slender vessels, of which the uppermost (fig. 3 *d*) are thick-walled, with slit-shaped markings, the next (fig. 3 *e*) thinner-walled, with close-set spirals, gradually passing into loose spirals. Another crescentic layer of liber-cells, like that above the cambium, but with its concavity upwards, closes the vascular bundle below. This second liber-bundle is, no doubt, developed from a second narrower belt of cambium-cells, on the lower side of the vessels.

The stomata (Plate XIV. figs. 5–13) are situated in parallel lines on both surfaces of the leaf, and occupy the striæ, thus overlying the soft cellular tissue (figs. 1 & 2 *b*). They do not differ in any essential point from the usual form of these organs; their guard-cells lie between the bases of epidermal cells which leave a funnel-shaped depression between their contiguous walls. The guard-cells have much-thickened walls, continuous with the equally thickened outer walls of the epidermal cells, and, in a transverse section (figs. 11 & 12), present interruptions of continuity which are not easily explained, except on the supposition that their walls are either perforated or much thinner at those points.

There is much in the permanent character, parallel nervation, and anatomy of the leaf of *Welwitschia* that recalls the foliage of *Dammara*, *Podocarpus*, and many parallel-nerved *Cycadeæ*, and especially of those South African species of the latter Order in which a layer of liber-cells underlies the epidermis. After a cursory examination of the leaf-structure in many species of these families, I find none of which the anatomy, in point of complexity or beauty, approaches that of *Welwitschia*; nor do I know of any plant that is in this respect to be compared with it. It is further to be observed, that in all these plants the vascular bundles of the leaf, unlike those of most Monocotyledons, nowhere anastomose nor communicate by lateral branches; whence each nerve represents a single independent vascular axis, extending from the base to the apex of the leaf, or, in *Welwitschia*, from the axis of the trunk to the apex of the leaf. Such leaves resemble more closely a series of parallel uninerved leaves united by cellular tissue, than a foliar expansion of parenchyma traversed by one system of inosculating vessels; and the frequent presence of many linear cotyledons in these plants seems to favour this view, as does the mixed character of the foliage of *Podocarpus*, of which some species have uninerved and others many-nerved leaves. The numerous flower-buds along the periphery of the crown also further favour this view. The development of the vascular tissue in the early condition of the leaf of *Welwitschia* may be expected to throw some light upon this point.

Considering the origin of the leaf, its permanent duration, and the mode of growth of the trunk to which it is attached, the strictly horizontal and parallel arrangement of its vascular bundles ceases to be suggestive of a monocotyledonous affinity. Here the main increase of the trunk is horizontally outwards (centrifugal); and as the leaf increases in width by the addition of cellular tissue to either side of its base, it follows that the vascular bundles which originate independently in that tissue must occupy the same plane as those previously formed, and be carried outwards parallel to these, by the longitudinal extension of the leaf.

The nervation of the leaf of *Welwitschia* appears at first sight to be singularly unsuited to the requirements of the plant, promoting, as it evidently does, the early splitting-up of the blade into innumerable narrow withered-looking thongs—except, indeed, we suppose that this early splitting is a special contrivance for exposing the cellular tissue surrounding the vascular bundles to the action of the atmosphere when damp, and thus supplementing the function of the stomata in a climate where rain is all but unknown.

Inflorescence.

The floriferous disc, or receptacle of the peduncles, is, as already explained, the lobed crown of the plant, the exact relation of which to a plumule on the one hand, and to a mass of axillary coalesced flower-buds on the other, is not clear, and has been already alluded to.

The flower-buds are developed in deep ovoid cavities in the periphery of the crown, about $\frac{1}{4}$–$\frac{1}{3}$ inch deep, just above the insertion of the leaf. These cavities open by a vertical slit (Plate XI. fig. 1), with prominent lips, and disclose an ovoid bud, enclosed in rigid coriaceous imbricating scales, the two outer of which are opposite, relatively very large (as long as the rest), and placed right and left of the lips of the cavity.

Flower-buds are also occasionally developed in the upper ridges of the stock, beneath the insertion of the leaf,—a very remarkable fact, analogous to the occurrence of shoots proceeding from the caulicle of various plants, and described by Bernardi in *Linaria arenaria* (Linnæa, vii. p. 561, tab. xiv. fig. 1).*

When fully developed, each branch of the inflorescence is essentially a dichotomous cyme, with persistent opposite bracts at the nodes; this cyme is, however, much interrupted by the irregular suppression of some of the internodes, so that the nodes often

* I am indebted to my friend Dr. Maxwell Masters for indicating this analogy, and for the reference to it. The same botanist also informs me that he has observed similar shoots on the caulicle of *Euphorbia Peplus*, and frequently on that of *Anagallis arvensis*.

present tumid masses (Plate VII. fig. 1), from which branches are given off in a more or less umbellate manner.

The internodes are stout, tetere, bright green and even on the surface, somewhat contracted as if articulated at the base, but not easily separating there.

The anatomy of the peduncle presents nothing remarkable, further than the monocotyledonous character of its isolated bundles. The green epidermis is studded with stomata similar to those on the leaf and described under that organ. In a longitudinal section through the centre of an internode (Plate XIII. fig. 6), a cellular axis is seen, with one or more bundles on either side, running parallel to and within the margin, and up to the base of the terminal cone. From a transverse section (fig. 8), these are found to be very numerous indeed; and the largest are placed towards the interior. A tangential section (fig. 7) shows how these bundles anastomose in the periphery of the nodes, at the base of the cone. The parenchyma of the peduncle (Plate XIII. figs. 9 & 10) is a loose tissue of vertically elongated hexagonal cells, with pitted walls, enclosing thick isolated liber-cells, and very rarely a few spicular cells.

The vascular bundles (Plate XIII. fig. 10) are of the same tissues as have been described in the trunk, viz., liber externally, then cambium, then (internally) spiral and slit-marked vessels.

The inflorescence of *Welwitschia* closely resembles that of *Gnetum*, and especially the American species of that genus, both as regards its dichotomous division, the suppression of the internodes, and the often arrested development of the cones themselves. The anatomy of the peduncle of *Gnetum* is, however, quite different, presenting a very elegant system of symmetrical wood-wedges surrounding a medullary axis.

Hermaphrodite Cone and Flowers. (Plate VI.)

I have seen several cymes of cones bearing these, some *in situ* on the specimen figured at Plate V. fig. 3; and one, which was sent by Dr. Welwitsch, is figured at Plate VI. fig. 1. The strobili are $\frac{1}{2}$–1 inch long, ovoid or cylindrical, bluntly tetragonous, and $\frac{1}{4}$–$\frac{1}{2}$ inch in diameter. I find no female cones on the same plants with the male, nor any female flowers in the hermaphrodite cones; but there are in the cymes of both sexes many imperfect cones in the axils of the permanent bracts. The scales are coriaceous, of the same form and general structure as those of the female cones (which will be particularly described), but only $\frac{1}{8}$th to $\frac{1}{6}$th of an inch long: they have two remote vascular bundles, one on each side of the middle, which branch in a fan-shaped manner. The lower are empty and connate in pairs at the base; the upper are rudimentary; the remainder subtend solitary flowers.

In its earliest stage the hermaphrodite flower is a minute papilla, consisting of the naked conical nucleus of the ovule, seated on a broad compressed base, which rises on each side into shoulders; these shoulders represent the earliest condition of the two outer leaflets of the perianth. The outer leaflets grow laterally, and soon exceed in length the nucleus, when two swellings, an anterior and a posterior, appear between the lateral lobes, and gradually develope into the two inner leaflets. These are succeeded by two other rings, formed at the base of the nucleus—the outer being the staminal tube, the inner the coat of the ovule: I cannot satisfy myself which of these two is developed first; but both the nucleus of the ovule and its coat, which is open and truncated, project far beyond the staminal ring for a considerable time; and it is some time longer before either are wholly included in the perianth.

The fully formed flowers (Plate VI. figs. 5, 6, & 7) are sessile and much compressed, broadly obovoid-spathulate, shorter than the scale ($\frac{3}{20}$ths of an inch), plane towards the axis of the cone (on the inner side), convex on the outer face.

Perianth.—The two outer perianth-leaves are strictly lateral, very narrow, spathulate, falcate, acute, and keeled or almost winged at the back; their bases are connate or very closely approximated on the inner side of the flower (Plate VI. fig. 5), and more widely separated on the side opposite to the scale (fig. 6). The two inner segments of the perianth (which are not present in the female flower) are antero-posterior, confluent into a compressed tube below, spreading into two orbicular concave lobes above, of which the inner overlaps the other by its margins all round (Plate VI. figs. 7 & 8).

These four leaflets of the perianth are very thin and transparent, formed of two layers of epidermis (figs. 8 & 9), enclosing slender thin-walled spicular cells, which are so placed as to present the appearance of radiating nerves; these cells have uniform or very obscurely dotted walls and a conspicuous cavity, and they are quite colourless and transparent. There is no vascular tissue in the perianth of the specimens which I have examined, though the two vascular bundles running up to the ovule are evident within the solid base of the flower (fig. 14).

A comparison of the perianth of the hermaphrodite flower with that of the female will be found appended to the description of the latter. In some respects it resembles that of the male flower of *Casuarina* more than any other plant I know; but the comparison cannot be carried far. The two outer leaflets of the perianth may perhaps more properly be considered bracts; but there is no evidence of consequence in favour of this view.

Stamens.—The six stamens (Plate VI. figs. 7, 10, 11, 12) are united halfway up into a fleshy tube, which is adnate at the base to the inner leaflets of the perianth; the filaments above this are fleshy, terete, and irregularly inflexed in æstivation, reflexed and exserted after anthesis. The anthers are capitate, obscurely 3-lobed, 3-celled, and dehisce at the apex by a tricrural slit (fig. 12); the three posterior are much smaller than the others. The pollen (fig. 13) is very minute, ellipsoidal, transparent, and yellow; each pollen-grain is $\frac{1}{600}$th to $\frac{1}{700}$th of an inch long, and consists of a delicate hyaline extine, which is (when preserved in alcohol) longitudinally wrinkled, and encloses grumous contents. I have not been able to determine the nature of the contents of the pollen-grain, nor whether cell-division takes place before the tube is protruded. I have never found pollen-grains on any part of the ovule of the hermaphrodite flower.

In being hexandrous, this staminal whorl presents the only marked exception to the binary arrangement that prevails throughout this plant; the only other apparent exception is in the rachis of the cone, which is traversed by four triplets of vascular bundles, of which triplets the two outer bundles alone seem to supply the scale and flower. I cannot trace any direct connexion between these three bundles of vessels in the rachis and the six stamens, but it is conceivable that they have some relation to one another.

Ovule.—The ovule (figs. 11, 14) occupies the axis of the flower, and is connate, at its base, with the base of the staminal tube; it is conical, and its integument is narrowed upwards into a flexuose tubular styliform body, which terminates in a very broad expanded papillose stigma-like disc, depressed in the centre; the depression communicates with the tube of the styliform body, and thus downwards with the cavity enclosing the nucleus. There is no other integument to the ovule but this; it consists of elongated cellular tissue (fig. 15), and contains a conical, fleshy erect, nucleus (fig. 14), in which I find no trace of embryo-sac, nor other contents, except an opaque line in the centre (fig. 16). Two vascular bundles (fig. 14) proceed to the outer base of the nucleus (one on each side), where they abruptly terminate.

Not only is there a total absence of an embryo-sac in this ovule, but the whole body turns brown and withers after flowering; these circumstances, and a reference to my description of the ovule and development of the embryo in the female flower, will show how far it may safely be assumed that this organ in the hermaphrodite flower, though furnished with an apparently perfect stigmatic summit, is in reality constantly functionless. And if (as I shall hereafter attempt to show when treating of the female flower) impregnation takes place by the direct application of the pollen to the nucleus of the ovule before its integument is produced into a tube, it is a further argument in favour of its sterility in the hermaphrodite flower, that I have never yet found a pollen-grain within or on the ovule.

The hermaphrodite cones and their flowers, here described, accord singularly with the male cones of *Ephedra** in many essential respects. In both the scales are quadrifariously arranged, identical in nervation, single-flowered, and formed of the same tissues and on the same plan. The outer leaflets of the perianth of *Welwitschia* are absent in *Ephedra*; but the two inner are identical in both genera, in structure and appearance. The six stamens united by their filaments, with capitate anthers opening by short terminal slits, and the pollen, correspond in every respect, except that the stamens of *Ephedra* vary in number from two to eight, that its anthers are usually 2-celled, and the staminal column is solid. Lastly, the ovule of the hermaphrodite *Welwitschia*, with its tortuous styliform process and stigma-like apex, is the same in structure and appearance with the ovule of *Ephedra*, differing only in wanting the embryo-sac, and in the stigma-like disc of the latter being narrow-oblong, and not papillose. With *Gnetum* the affinity through the male flower is less obvious, and as, in so far as I can see, it is only traceable through *Ephedra*, it would be out of place to discuss it here.

The most analogous case known to me of an apparently highly perfected stigmatic organ being absolutely functionless, is that of the curious genus *Cardiopteris*, which abounds in the eastern provinces of India, and which I have examined in a living state. In this plant the ovary is unilocular and has two stigmata—one large, globular, and

* In one species of *Ephedra* I have found tristichous female cones, the scales being connate at the base in threes.

papillose, borne on a flexuous style, the other a low mamilla, in no respect resembling a stigma in outward appearance. Mr. Brown has shown* that this fully-formed stigma is, in all probability, functionless and withers away without sphacelation, but that impregnation takes place through the mamilla, which, after performing its function, becomes remarkably developed.

It is difficult to regard this remarkable ovule without speculating on the possibility of *Welwitschia* being the only known representative of an existing or extinct race of plants, in which such a stigma-like organ was really capable of performing the function of a stigma; and when we see this organ occurring in a hermaphrodite flower, it is easy to suppose that we have in *Welwitschia* a transition in function, as well as in structure, between the gymnospermous and angiospermous Dicotyledons, and that the ideal race consisted of hermaphrodite-flowered plants in which the office of the stigma of the carpellary leaf was performed by a stigmatic dilatation of the ovular coat itself. Nor is it difficult to trace the successive variations from this imaginary type which, in the course of many generations, would result, on the one hand, in the obliteration of the embryo-sac and suspension of the functions of the ovule in the flowers of certain individuals, and on the other in the obliteration of the stamens and stigmatic apex of the ovule in the flowers of other individuals,—the once bisexual plants thus becoming unisexual. Singularly enough, *Ephedra* presents one step in advance of *Welwitschia*, in the total disappearance of the ovule in its male flower, and is one step behind it in the retention of a functionless stigmatiform disc in its perfect ovule.

Female Cones. (Plates VII. & VIII.)

The female cones are $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, tetrastichous, of a bright scarlet colour when fresh. They present 40 to 50 decussating pairs of scales, which are more membranous than coriaceous; the seven or eight lowest pairs are empty; and the uppermost six to ten pairs, in the specimens examined, contained unimpregnated flowers only. The two or three lowest pairs of scales are connate at the base, very small; and the uccess ive ones rapidly enlarge up to the floriferous ones (Plate VIII. figs. 28 & 29).

Each scale (figs. 19 & 20) presents a broad central hyaline area of extreme tenuity, on each side of which, but far removed from the margins, two to five vascular bundles ascend, diverge, and branch excessively towards the margin. Structurally, the scales consist of two layers of delicate epidermal cells, enclosing a layer of tortuous filiform liber-cells, which radiate outwards towards the margin, and terminate in rounded apices within its edge (Plate VIII. figs. 21 & 22). These liber-cells are quite free, unbranched, and vary in length. They are much more densely packed nearer the vascular bundles, and are of precisely the same nature as those which occur in the wings of the perianth surrounding the female fruit, but are far less tortuous. The vascular bundles present nothing remarkable. Towards the thickest part of the scale are found short spicular

* In Bennett's 'Plant. Jav. rar.' p. 248, Mr. Brown describes this stigma as not papillose; but it is so represented in my drawings taken from the living plant.

cells, with minute points on their surfaces, but no formed crystals (fig. 27). The outer surface of the scale is provided with stomata; the inner (fig. 23) has none.

The rachis of the cone (Plate VIII. fig. 1; Plate XIII. figs. 1 & 2) is fusiform, broadest below the middle, and almost terete, of a soft spongy texture, and covered with a very delicate epidermis. The arrangement of the vascular cords is curious: of these there are, I believe, normally twelve principal ones, in four sets of three each, corresponding to the positions of the four rows of scales, and various smaller supplementary ones; they all run just within the periphery, in wavy lines from the base to the summit of the rachis, anastomosing here and there by lateral branches. On removing the outer layers of cellular tissue (Plate XIII. figs. 1 & 2, which are diagrammatic sketches), three nearly parallel wavy bundles are seen beneath the scale, of which the middle one is supplementary, not communicating directly either with scales or flowers, but anastomosing here and there with the lateral ones. Below the insertion of the scale, each of the lateral nerves gives off externally one ascending branch, which enters the scale, and ramifies in it (fig. 1), as described under that organ. The two nerves of the perianth, on the other hand (fig. 2), are derived from the lateral nerves themselves, and not from branches of these. It follows, from this arrangement, that the bases of the nerves that ramify in the scale are further apart than the bases of those that ramify in the perianth. I have seen a scale with an additional nerve on one side, placed nearer the margin than the normal one of the same side, and this was supplied by a branch from the adjacent bundle of the adjoining triplet, which anastomosed with its neighbours. Other deviations no doubt occur.

The smaller vascular cords which traverse the rachis anastomose together; they generally run between the main ones, but are for the most part free; more rarely they overlie the main cords, and sometimes they unite with them.

The parenchyma of the rachis (fig. 3) is by far the most delicate in the whole plant, and consists of loosely packed, very thin-walled utricles (figs. 4 & 5), with pitted walls; these pits are remarkably oblique (fig. 5), so as to present the appearance of an overlapping double boundary.

The female cone of *Welwitschia* resembles that of *Ephedra* in very many particulars, and especially in the remarkable bilateral venation of its scales, in the abundance of stomata, in the liber-cells ramifying through its wings, and in the presence of spicular cells; furthermore, in *E. alata* and other species the scales are as beautifully membranous, and the two vascular bundles enclose a similar hyaline transparent area. *Ephedra*, as elsewhere stated, differs in all the scales being connate at the base, and in their becoming larger upwards to the terminal pair, which alone are floriferous.

Female Flower, Perianth, and Pericarp (Plates VII., VIII., IX., & X.).

Perianth.—This, which ultimately attains a great size, as the pericarp of the seed, does not appear till after the formation of the nucleus of the ovule. I have traced its development in the immature flowers taken from the apical scales of the half-ripe cones. In all these the eight or ten uppermost scales (Plate IX. fig. 1) were extremely minute, and the terminal ones invariably subtended a minute papilla, which is the naked nucleus of the ovule; lower down, in the same cones, I find this nucleus surrounded at the base by a compressed thickened ring, rising into shoulders on each side (Plate IX. figs. 2 & 3), which ring is the first appearance of the perianth.

In the next stage (fig. 4) the perianth is dilated upwards, and, by the time that the integument of the nucleus appears, the perianth is saucer-shaped (fig. 5); and becoming more concave, its upper margin rises to a level with the apex of the nucleus (fig. 6). When about $\frac{1}{300}$ inch long, the orifice dilates and becomes obscurely 2-lobed (fig. 7), the lobes being right and left, or parallel to the scale of the cone. At this period the nucleus is often surmounted by its integument, but as often it remains exposed till a considerably later period. The perianth next dilates above the base, and contracts at the orifice, becoming much compressed and urceolate (fig. 8); the orifice is manifestly lobed, but most deeply opposite the scale.

The next manifest change is when the perianth is about $\frac{1}{20}$ inch long, and the lobes of its mouth converge (fig. 9). The wings next appear as narrow membranous margins running up to the lobes of its mouth; and the ovular integument is produced far beyond the nucleus (Plate VIII. figs. 6, 7, 8). When $\frac{1}{4}$ to $\frac{1}{3}$ inch long (Plate VIII. figs. 9 & 10), the perianth is flattened, membranous, and translucent, with a flagon-shaped cavity, is much dilated below, and has a bifid dilated mouth (fig. 11), which opens towards the scale.

The nascent female flower is at first formed in close contiguity to the base of the scale, but on the rachis of the cone, and is sometimes torn away with the subtending scale, and sometimes not; but it is gradually carried up, as it were, beyond the scale, and becomes placed on a conical prominence of the rachis, which is confluent below with the narrowed base of the scale (Plate VIII. figs. 4, 9, 10). At about this stage, or soon after it, two pairs of vascular bundles appear in the perianth, one pair ascending on each side at the base; the inner bundle of each pair runs to the base of the ovule, the outer traverses the walls of the perianth.

The wings next rapidly dilate upwards and outwards, till the perianth becomes obovoid in circumscription (Plate VIII. fig. 12), its orifice almost closes, leaving a small notch at its apex, through which the styliform prolongation of the ovular integument often protrudes. Finally, as the wings dilate further, and the base contracts into a stipes, it assumes its nearly orbicular form, and acquires almost the dimensions of its subtending scale.

The above-described flowers have rarely presented evidence of being fertilized; and it is probable that the development of the flowers in the lower parts of the same cones, which were all formed at a much earlier period, and duly impregnated, has presented some deviations from the above described, as these vary to a very considerable degree amongst themselves,—the relative dimensions of the perianth and its wings, the ovular coat and nucleus, differing much in one and the same cone.

Pericarp.—The persistent pericarp, enclosing the ripe seed of *Welwitschia* (Plate VII. figs. 2 & 3), consists of a central cavity surrounded by a very large membranous hyaline wing of exquisitely beautiful structure and appearance. The central portion is obovoid or pyriform, suddenly contracted above into a narrow canal, traversed by the styliform process of the ovular integument, and below into a flat stipes; it is compressed, almost flat towards the axis, and tumid opposite the scale. The walls of the cavity are thin, coriaceous or chartaceous, and slightly thickened at the edges; they consist of four layers of tissue: 1, a cellular epidermis; 2, a thick layer of felted filiform liber-cells (Plate VII. figs. 11 & 12), which are cylindrical, transparent, tortuous, and blunt at either end; 3, a very delicate layer of thin-walled, spirally-marked, fusiform cells, the markings very close and delicate (fig. 10); 4, an inner epidermis, often broken up at the edges. A few spicular cells (fig. 8) are scattered here and there in the substance of the walls of the cavity. The hyaline wings have an undulated appearance, owing chiefly to the arrangement of their tissues: these consist of two layers of epidermis, enclosing thread-like liber-cells: the latter, towards the cavity, form a loose cottony mass that is very conspicuous when the pericarp is torn open, but in the wings they are reduced to a very thin stratum, and run in so tortuous a manner towards the periphery as to give the wings the undulated appearance mentioned above; they terminate close to the margin, in blunt apices. The vascular bundles that traverse the wings, run in arches from the main bundles along the edge of the cavity, and are lost before reaching the periphery.

The perianth of the female flower corresponds to the outer (lateral) leaflets of that of the hermaphrodite; for not only is their position the same (right and left of the axis), but the winged keel of the hermaphrodite leaflets answers to the beautiful wing of the female; and the greater distance apart of the bases of the hermaphrodite leaflets on the side towards the scale, corresponds with the mouth of the female perianth opening in the same direction.

The female perianth corresponds to the outer coriaceous covering of the ovule in *Ephedra* and in *Gnetum*, differing only in form, and perhaps in being developed after the nucleus of the ovule makes its appearance. In anatomical structure it is almost identical with *Ephedra*, in which I find the same abundance of liber-cells (though running in straight lines) and a similar layer of delicate spirals. The perianth of *Ephedra* differs in being trigonous, unwinged, and having three vascular bundles: in *Gnetum*, again, it is, as in *Welwitschia*, often compressed and bifid when young, of a much denser texture, and traversed by many vascular bundles*; it possesses comparatively little liber, and no spiral vessels†, but a profusion of rigid acicular cells; and the mouth of the perianth surrounds and tightly embraces the styliform process of the ovular integument.

Ovule of the Female Flower previous to Fertilization.

I have described the earliest observed condition of the ovule in the flowers contained in the uppermost scales of the half-ripe cones, as presenting a minute naked blunt papilla, about $\frac{1}{200}$th of an inch long (Plate IX. fig. 1), around the base of which the

* In *G. scandens* there are seven or eight bundles in the short stipes of the immature fruit, which divide into two series of numerous parallel branches: one series traverses the pericarp, the other supplies the ovular coats.

† These, however, probably occur in *Gnetum*; for Griffith describes these rigid acicular cells in the outer or baccate coat of the fruit of that genus as sometimes being spirally marked (Linn. Trans. xxii. 303).

perianth is developed; and I have stated that its solitary integument appears, as a tumid ring, round the base of the nucleus within the perianth, immediately after its first appearance.

Up to the stage figured at Plate VIII. fig. 6, the perianth is seen by transmitted light to have grown much more rapidly than the ovule, the nucleus of which is now wholly immersed in its integument, and the embryo-sac has made its appearance. At fig. 7 the ovular coat has risen far above the nucleus, and forms a conical body with a tubular mouth, as is also shown in the section of another ovule (Plate IX. fig. 9), which is about $\frac{1}{25}$th of an inch long. At this period the embryo-sac (Plate VIII. fig. 18) may easily be removed entire from the nucleus, and is a circular or transversely oblong, compressed, hyaline sac, containing a pale yellow transparent mass of endosperm-cells. In the next stages (Plate VIII. figs. 8, 9, 10), the apex of the ovular integument is more produced into a tube (better seen at figs. 15 and 16), which is contracted above the middle, and browned at the lacerated apex: the browning indicates that the parts so coloured have ceased to grow, having become almost horny in consistence. The nucleus, which varies a good deal in form, is now either conical or subhemispherical, with a terminal mamilla, depressed at its apex.

The ovule of the female flower has now attained about the same stage of development and dimensions as that of the hermaphrodite flowers figured at Plate VI. figs. 11 & 14; but there are the following essential differences between them:—in the female flower the styliform apex of the integument of the ovule is straight, rigid, browned, and lacerated at its apex; whilst that of the hermaphrodite flower is shorter, stouter, with more fleshy walls, is never sphacelated, is bent in a sinuous manner, and terminates in a broad, papillar, expanded disc, with a funnel-shaped orifice.

The tissues of the ovule present nothing different from those of other plants; the nucleus consists of a dense, soft, cellular tissue. The integument is a very delicate cellular membrane (Plate VI. fig. 15), becoming rigid towards the tubular portion, which consists of three to six layers of delicate cells, of which those of the inner layer have their inner walls much thickened and rendered horny by secondary deposits (Plate VII. fig. 17). There is no vascular tissue in the ovule itself; but, as in the hermaphrodite flower, two vascular bundles ascend the axis below, and terminate abruptly exactly at the insertion of the integument round the base of the nucleus (Plate IX. figs. 11, 12).

The general resemblance of the ovule here described to that of other Gymnosperms is very obvious, whether as regards the structure and position of the integument and its tubular prolongation, or the large embryo-sac, so easily removed, in which cell-formation has commenced previous to impregnation. In all these plants, too, the ovular integument (or the innermost, when there are two of these) is more or less carried up by the growing ovule, and often forms a small calyptriform pileus at the apex of the seed,—a fact which will call for attention when considering the relations of the seed, after the description of that body and its contents.

The ovule of *Welwitschia* entirely accords with that of *Ephedra*, except in the discoid apex of the integument of the latter, which is oblong and obliquely truncate. The ovule of *Gnetum*, again, differs from that both of *Ephedra* and *Welwitschia*, in having two integuments, of which the interior corresponds to the single one of the other genera, and, as in these, terminates in the styliform process. In *G. scandens*, however, this styliform process is shorter, far more rigid, swollen below the middle, and again much contracted at the base; as the seed developes, it dilates, becomes almost woody, and its cavity is closed up by the pressure of the thickening lips of the outer integument of the ovule, which closely embraces its lower portion, as the orifice of the perianth does its upper portion. The outer integument of the ovule of *Gnetum* is developed after the inner or styliform; but, as nothing analogous to it exists in *Welwitschia*, I need not further allude to it here *.

Viewed in reference to its position on the rachis of the cone, and its terminating the axis of the flower, the ovule of *Welwitschia* presents many puzzling points for consideration. Though subtended by a scale, the female flower does not bear organically the same relation to the vascular cords in that scale that usually obtains between flowers and the cords of their subtending bracts; for not only is each organ (scale, perianth, and ovule) bilateral, and each furnished with a double vascular system, but the insertion of the scale is, as shown in Plate XIII. figs. 1 & 2, at a considerable interval below that of the perianth; and the scale is not supplied by vessels directly from the principal bundles on its own side of the rachis of the cone (as the perianth and ovule are), but from lateral branches, which leave the principal bundles almost at a right angle.

The structure of the scale, and its relation to the rachis, would thus have favoured the *à priori* supposition that it was a compound body, and that still stronger traces of composition would be found in the floral organs. Such, however, is only partially the case. The female perianth appears, indeed, at its earliest stage as a lobed or double organ (which the scale does not), and its form and obvious correspondence with the male perianth

* The development of the coats of the ovule of *Gnetum* is the subject of a communication from Dr. Griffith to Dr. Lindley (Veg. King. p. 233); and his detailed memoir on the same subject were afterwards published by the late Prof. Henfrey in our Transactions, vol. xxii. p. 299.

My observations on Griffith's specimens of *Gnetum scandens*, *G. Gnemon*, *G. Brunonianum*, and others, differ much, however, from those of that skilful investigator, whose account of the development of the ovular coats is certainly erroneous. In none of these species do I find the appearance of the inner coat to be either sudden or subsequent to the formation of the outer; on the contrary, the inner coat is first gradually developed around the nucleus as a cup with a fimbriated mouth, and it often overtops the nucleus before the outer coat makes its appearance. The latter first appears as a ring round the base of the inner coat, with a lobed or irregularly crenate, often oblique mouth; both integuments grow together, but the inner at all periods exceeds the outer. The tissues of both are similar, viz. elongated cells; neither contains vascular tissue when young, nor does the inner at any time; but the outer becomes full of parallel vascular cords. I have found female flowers of *G. scandens* in which there has been no trace of the outer coat, though the inner had already grown far beyond the nucleus. There is a common monstrous state of the flower of *G. Brunonianum*, in which the perianth is globose and fleshy, and the nucleus of the ovule is elongated, naked, and seated on a fleshy disc.

It should be borne in mind that, at the time Dr. Griffith's paper was written (Aug. 4, 1835), he was unacquainted with the true nature of the gymnospermous ovule, and also with Brown's remarks on *Gnetum*. I cannot, however, but consider that his observations relating to the ovule, and to the discrimination of the species (of which all the original materials and drawings are preserved at Kew), were probably not intended for publication *in extenso*. Both his figures and descriptions are inferior in accuracy to the beautiful analyses of Decaisne, in Blume's 'Rumphia,' iv. t. 176, where the development of the ovular coats is represented (figs. 18 & 19) as I have found it to be.

tend to show that it is compound. The ovule, on the other hand, up to this period of growth, shows no further traces of composition than the double vascular system which terminates at the base of its nucleus; it is organically absolutely terminal, being erect, central, and continuous with the axis of the perianth, without constriction, both in the male and female flowers: lower down, these two vascular cords are confluent with the two main vascular bundles of the perianth; and the cellular tissue which is contained between these cords is similarly continuous with that of the nucleus of the ovule.

I believe that, in respect of this anomalous disposition of vascular cords at the base of the ovary, *Welwitschia* presents but a slight deviation from the arrangement which obtains in other *Gnetaceæ*, of which *Ephedra* has three corresponding bundles, and *Gnetum* many; but it presents a remarkable contrast to what occurs in *Coniferæ*, and, in connexion with the other peculiarities of the ovule, and with the relations of the flower to the scale, it renders it impossible to reduce the inflorescence of the three genera (*Ephedra*, *Gnetum*, and *Welwitschia*) to the same type with that of Conifers as generally understood.

Assuming Brown's view of the ovule of Conifers, and mine of that of *Gnetaceæ*, to be correct, that each presents a nucleus with one or more integuments which are not of carpellary origin, we have, then, in biovulate *Coniferæ* two ovules lying on an open scale, regarded by most as carpellary, but by some as ramal, and this again subtended by another scale, which is regarded as bracteal. The obvious mode of harmonizing the relations of these organs is, to regard the ovuliferous scale of *Coniferæ* as not carpellary, but perigonial, or the perianth of *Gnetaceæ* as carpellary. It would be out of place to discuss here the first proposition, because (though by no means proven) the balance of evidence is decidedly in favour of the carpellary nature of the ovuliferous scale, at least in the *Abietineæ*; and the second proposition is entirely negatived by the structure of the hermaphrodite flower in *Welwitschia*. Then, again, the ovuliferous scale in *Abietineæ* supports two ovules; and the fact that Braun and Caspary * have found it replaced by two leaves would indicate that, if carpellary, either the ovarium is here compound, or each bract supports two flowers, each flower being represented by a uniovular carpel, and that, for comparison with *Welwitschia*, we must resort to the uniovulate *Coniferæ*, such as *Araucaria*, *Dacrydium*, *Podocarpus*, &c., the correspondence of whose scales with those of *Abietineæ*, &c., is not in all cases ascertained.

There is nothing in the development of this ovule that favours the opposite theory, that the integument of the nucleus in gymnospermous plants is of carpellary origin, except the singular form and relative position of that organ in the hermaphrodite flower. In position, texture, structure, and development, it entirely resembles the coat immediately investing the nucleus in all other Gymnosperms; like these, and unlike carpellary organs, it is entirely devoid of vascular tissue in its substance, and of conducting

* Caspary "On the Morphology of the female Flower of the Abietineæ;" translated in Nat. Hist. Review, 1862, p. 19. Parlatore (Ann. Sc. Nat. sér. 4. xvi. p. 215) considers the scale to be a shortened branch, having its leaves or bracteoles more or less confluent together and with the bract and the pistil (ovule).

tissue in its styliform prolongation; unlike a carpel, it rises symmetrically round the nucleus, and in the hermaphrodite flower presents a symmetrical terminal disc, and it ceases to grow long before the maturation of the seed; and still more unlike a carpel, it is carried up with the growing seed, till its base is on the apex of the latter. In all these respects, except in the long styliform process, it accords with the inner ovular integument of phænogamic plants, which, indeed, have not unfrequently tubular orifices prolonged beyond the nucleus, though not so far as that of *Gnetaceæ*.

To these considerations must be added that of the exterior integument of *Gnetum*, which is as clearly an appendage of the ovule as the interior, but which must be considered to be either staminal or a production of the disc, if the inner coat is considered as carpellary.

Lastly, ovular integuments are singularly uniform in their structural anatomy, which seldom deviates from one common type; and in the normal condition of the ovule, it is devoid of appendages, or of other external or internal characters whereby those of allied species, or even genera and orders, can be distinguished from one another. I am not aware that a single natural family or genus of Angiosperms presents any structural peculiarity of the outer or inner coats of its ovule: on the other hand, the carpel is, of all the floral whorls, one of the most various; and, as often happens with other organs, the more reduced it is, and the more it deviates from the foliar type, the more liable it is to vary: whence it is all but inconceivable that the ovular integument of Gymnosperms should be carpellary, and yet constant in structure.

If, then, we were to assume the ovular integument of Gymnosperms to be carpellary, we must admit, first, that it has neither the form, structure, nor functions of an angiospermous carpel; secondly, that it has those of an angiospermous ovular coat; and thirdly, that while the carpel is a singularly varying organ in the genera and even species of Angiosperms, it is a singularly uniform one in those of Gymnosperms.

Fertilization and Embryogeny. Seed.

Fertilization.—I know nothing definitely of the epoch at which fertilization normally takes place in *Welwitschia*, nor indeed of its flowering and fruiting seasons. Dr. Welwitsch gathered young male flowers, together with nearly mature fruit, in September; and the fine specimens last sent by Mr. Monteiro, on which are old male cones, must have been gathered at about the same period of the year. Mr. Baines's sketch, again, which represents ripe cones, bears date May 10th.

It is reasonable to suppose that impregnation is effected by insect agency, and that when the pollen is ready for transport the female cones are still very small, and the nucleus of their ovules is neither covered by the ovular integument nor by the perianth. At such a period the staminate and female cones are probably of about the same size, and their scales more patent than they afterwards are in the female. Such an arrangement, indeed, appears necessary; for it is obvious that, after the ovular integument has assumed its styliform shape (which is long antecedent to any change taking place in the nucleus), it would be extremely difficult to introduce a single grain of pollen by any conceivable means to the apex of the nucleus, and impossible to convey there the forty and more grains that I have found with their tubes all produced. Furthermore, as is stated above, I have found pollen-grains on the nucleus before the elongation of its integument, and this in ovules contained in the extremely immature uppermost scales of an otherwise half-mature cone—ovules which, as I have reason to suppose, are developed long after the usual period of fertilization.

In connexion with this subject, I may mention that the nearly mature cones are often bored through and through after the manner of flower-buds attacked by the larvæ of *Curculionidæ*, and that a pollen-feeding group of Coleoptera, the *Cetoniæ*, abound in the regions inhabited by *Welwitschia*.

The pollen remains on the apex of the nucleus for some time before any change takes place in the embryo-sac; and its large solitary tubes are apparently slowly emitted, and slowly make their way down the dense tissue of the nucleus. I have never seen more than one tube emitted; but this, after emission, sometimes elongates in both directions, or even forms a crutch or fork, between the arms of which the empty wall of the pollen-grain persists (Plate IX. fig. 38). The tubes reach about one-third down the conical apex of the nucleus, apparently always keeping near its periphery; they are terete and even, they never branch, and swell at the base, only when they touch the secondary embryo-sac.

Changes after Fertilization.—These commence within the nucleus of the ovule after it has assumed the form, &c., represented in Plate VIII. fig. 7, Plate IX. figs. 8, 9, and are conspicuous after it arrives at the stage seen in Plate IX. figs. 11, 12, which represent ovules taken from a perianth such as is figured at fig. 10. From this time onwards the nucleus developes rapidly in all directions, but the parts above the embryo-sac grow less than those below it; and as the greatest increment of all takes place at the very base, below the level of the insertion of the integument, the latter is carried up, and, assuming a higher and higher relative position as the seed ripens, is found at last towards the apex of the seed. This mode of ovular development is common, in a greater or less degree, to all *Gnetaceæ*, *Cycadeæ*, and to many *Coniferæ*.

At the period last mentioned, the embryo-sac (Plate VIII. fig. 18, & Plate X. fig. 2) is a delicate membrane, more or less loosely investing an ovoid, orbicular, or transversely oblong compressed mass of endosperm-cells, in which, however, there is no visible differentiation of parts, nor any defined sharp boundary to the individual cells. At the next stage (Plate X. fig. 1) the nucleus is elongated both upwards and downwards, is dilated opposite the sac, and its integument is carried up considerably above its base; the contained sac is also elongated, and rather broader above than below, becoming obovoid. Still later (fig. 4), the integument is carried up above the middle of the nucleus, and the yet more elongated sac has descended, as it were, below the level of the insertion of the integument. The nucleus is now divisible into two distinct portions—an upper one above the embryo-sac, which I shall call the *cone*, and a lower one, containing the embryo-sac, which I shall call the *body* of the nucleus: the insertion of the integument marks externally the positions of these parts. Sometime between the last two stages, the membrane of the embryo-sac is found to have disappeared over the summit of the endosperm, and blunt tubular processes (Plate X. fig. 3) appear rising above the endosperm-mass and becoming entangled with the cellular substance of the cone above it. I have made many dissections of the embryo-sac at about this stage, and before it, but have failed to detect any cells of the endosperm set apart, as it were, for this purpose. I find the whole endosperm-mass at the now open mouth of the sac to consist of loose or slightly coherent transparent ovoid utricles, with dark contents, of which many elongate upwards, and many do not. Of those which elongate, some, towards the centre of the mass, are quite free; others, towards its margin, remain firmly coherent to the denser tissue of the margins of the endosperm-mass. The central ones become the secondary embryo-sacs, and correspond to the corpuscula of *Coniferæ* and *Cycadeæ*.

At Plate X. fig. 3, a few of these secondary sacs are seen protruding from the embryo-sac; at figs. 5 & 7 they are still further developed; and above fig. 5 is represented a small portion of the endosperm-mass, from immediately above the main body contained in the sac. At fig. 6 some of the young secondary sacs are shown, all the surrounding endosperm-mass being cleared away.

Though at first entirely resembling the other cells of the endosperm, the secondary sacs rapidly assume a different character, become tortuous, often inflated in parts, and, when preserved in alcohol, contain very diffused amorphous contents, together with minute globular vesicles, which turn bright yellow with iodine. Some of the transition stages are represented at Plate X. fig. 8.

There next appear, in the substance of the cone of the nucleus, interrupted dark lines, radiating upwards and outwards from the summit of the embryo-sac. The lower portion of the embryo-sac is still quite evident, and may be readily withdrawn from around the endosperm, which forms an oblong body, pendulous from the base of the cone. The endosperm-mass is oblong (Plate X. fig. 9), its cells are well defined, and the outermost of the upper series cohere with the tissue of the cone above. A dark area now occupies the base of the axis of the cone, consisting of a tissue intermediate between that of the cone and of the endosperm-cells; and within this tissue the secondary embryo-sacs lie (Plate X. fig. 11), being, as it were, lifted out of the mouth of the sac by the interstitial growth of cells therein.

The secondary sacs are now elongated, club-shaped, membranous, with rounded apices and bulbous bases (fig. 12), in which are very opaque amorphous contents; transparent globules abound in the upper part: they vary in number from 20 to 40 or 60, are nearly erect, and radiate outwards, their bases being in close contiguity.

As the nucleus elongates with the growing sac, it contracts at the base into a broad stipes; and vascular cords, either simple or branched, traverse it on each side. In some nuclei it happens that there is an apparent arrest of development of the endosperm; this I found to be the case in many of Mr. Baines's specimens, where (Plate IX. figs. 18, 19) the endosperm forms a flat tongue-shaped body in which the cells were irregularly developed (fig. 25), very loosely invested by the embryo-sac*. There are, however, in the various

* In the cavity of these embryo-sacs, which were not filled by the endosperm, I fancied I detected a filamentous net-work, resembling a very delicate cellular tissue. At the time, I was at a loss to explain it; but in looking over Hoffmeister's valuable work on the Higher Cryptogamia, I find a structure described in *Pinus*, which, if my observation was correct, may throw some light on it. In this genus, at one period, when the endosperm-mass is much

specimens examined, great differences to be found in the relative size of the nucleary cavity, embryo-sac, endosperm-mass, secondary embryo-sacs, and cone of the nucleus.

As the endosperm-mass increases, it becomes hollowed out at the top, below the base of the cone, into a cavity containing loose endosperm-cells; and the body of the nucleus becomes reduced to a thick fleshy coat, on the sides of which the vascular bundles ramify but little. This endosperm, now densely cellular, is the whole albumen of the seed, and consists of a *body* of granular substance and a constricted collar or *neck*, of a very different, looser, more fleshy, but very elastic tissue, which surrounds the cavity, and coheres with the base of the cone of the nucleus above.

The cone of the nucleus is next found to present an outer very cellular periphery, and an inner substance of much firmer, tougher tissue, traversed, along the dark radiating lines mentioned above, by many canals of various lengths and dimensions, which ascend outwards towards the periphery, to about two-thirds of the total length of the cone. Plate X. figs. 20–24 represent horizontal sections of a cone, taken at different heights, and show its loosely cellular epidermal layers of cells and dense interior substance, which is cancellated by these canals. The secondary embryo-sacs have grown upwards into these canals in great numbers, their bases being still gathered together, as it were, at the base of the axis of the cone, where they hang over the mouth of the cavity in the apex of the endosperm (Plate X. fig. 10). If the cone be now torn away from the top of the endosperm, and the tissues surrounding its base removed, the lower ends of these secondary sacs may be very easily exposed.

Fully formed secondary sacs taken out of these canals are shown at Plate IX. figs. 30, 31, and at Plate X. figs. 13, 14. These vary much in length and breadth, but always taper downwards, and are bulbous and very rarely branched (fig. 14) at the base. They are sometimes solitary in the canals, sometimes in twos or threes. When drawn out, they are often found to be longer than the cone itself, either from having been folded or from the canals being sinuous; but, owing to the transparency of these secondary sacs, and the tough, elastic, opaque nature of the tissue of the cone, I have never been able so to lay a cone open as to see the undisturbed sacs *in situ*. The sacs are, however, so large, so well defined, and so easily removed, that there is no difficulty in ascertaining their numbers, form, position, &c. with sufficient precision.

Another change that occurs about this time is the separation of the tissues of the nucleus forming the walls of the seed, into two layers (Plate IX. fig. 19) around the upper part of the endosperm. Of these layers, which are both continuous with the cone above, the outer one is the denser; and the inner one, like that of the neck of the endosperm-mass, is so tough, elastic, and troublesome to sever, as to render it difficult to expose the base of the cone and the apex of the endosperm-mass without tearing away the latter. This splitting of the nucleary walls into two layers is shown at the base of the cone, in Plate IX. figs. 26, 27, 29.

Development of Embryo.—At the period last described, and very often earlier, one or

smaller than the sac, the inner wall of the sac is covered by a very delicate cellular endosperm-tissue, filling up the space between it and the previously formed endosperm. The representation of this tissue would answer not inaptly to the appearances I saw. (See Currey's excellent translation, p. 408, t. lx. fig. 4.)

more of the secondary embryo-sacs is found to have elongated downwards into the cavity in the neck of the endosperm, and to have commenced to develope a suspensor at its base (Plates IX. fig. 28; X. figs. 20, 21). In almost every such case, when I have removed the secondary sac entire from the cone (which I have done many times), I find a pollen-tube adherent to its apex (Plate X. figs. 15–19). In every such case, also, I have found pollen-grains on the apex of the nucleus, and their tubes penetrating the tissue of the cone just within its margin, and passing downwards near the periphery. I have never succeeded in removing a pollen-tube entire from the apex of the secondary sac to the pollen-grain, but I have on several occasions so nearly done so, as to have seen its continuity before rupturing it; and in two instances (sketched before the dissection was completed, Plate X. figs. 15, 16) I failed at one point only, leaving no possible room for doubt. The fertilized secondary sacs, in every case examined, had advanced from one-half to two-thirds up the cone; and their apices occupied the termination of the canal, which was always close to the periphery of the cone, in the direction of the descending pollen-tubes.

The number of secondary embryo-sacs which are thus impregnated varies. Usually, I think, only one is so; but there are often two or three (Plate IX. figs. 26–29 & 32), and I have several times found four, six, and even eight (Plate X. fig. 20). I have, however, never found more than one embryo in the seed, nor seen a secondary sac branching downwards, as might be expected to occur in the one figured at Plate X. fig. 14.

After the contact of the pollen-tube, great changes commence in the bulbous base of the secondary embryo-sac, which elongates, and its contents collect into an obovoid mass —the germinal vesicle.

After elongating, the bulbous base of the secondary embryo-sac first presents a constriction at the neck, and its basal contents, now bounded by a cellulose wall, are obscurely lobed, first on the summit and sides, and later at the apex (Plate X. fig. 22). Soon the constriction becomes more marked, separating the bulb, which is now a rounded cone with the broad end uppermost, from the tubular portion above it, whilst the lobing has so far advanced that the upper part of the contents of the terminal cell consists of eight or ten separate masses (fig. 23); these shortly acquire proper cell-walls, and become the first series of cells of the suspensor (fig. 24). The terminal cell now again divides as before, longitudinally and transversely, and adds a second series of cells to the suspensor (fig. 19).

The cells of the suspensor elongate with rapidity, and are developed in great numbers; and as they go on forming and elongating faster than the secondary sac elongates, the base of the latter is removed further and further from the terminal cell. At the same time that the base of the sac elongates, it becomes excessively attenuated, and finally forms a slender tube sheathed by the upper tubular cells of the suspensor (fig. 27).

I have never had any difficulty in dissecting out the end of the secondary sac from the top of the suspensor (fig. 27); indeed, I have frequently pulled it out perfectly entire to the tip: but I have found much difficulty in tracing the early development of the suspensor from the terminal cell at the base of the secondary sac, and especially in proving the early retirement of the tubular prolongation of the sac after its bulbous base has been cut off by that terminal cell (as shown in Plate X. fig. 24).

Though well convinced that the contents of the bulbous base of the fertilized secondary embryo-sac thus gives rise to the suspensor by the division of its mass and the formation therefrom of long tubular cells that sheath the retiring portion above the bulbous base, I am by no means clear as to the exact process. It would, probably, be necessary to examine fresh specimens to prove whether the germinal vesicle may not burst through the base of the sac, and whether it may not divide longitudinally into four, as in the *Coniferæ,* and thus give rise to four rudimentary suspensors, of which, in *Welwitschia*, only one is developed. All I can affirm is, that I saw no evidence of either of these phenomena, and that the figures (22 to 24) are faithful (camera-lucida) representations of the structures, whose deficiencies in matters of detail are owing to the specimens having been preserved in alcohol.

The number of cells thus developed upwards, as it were, from the terminal cell of the suspensor, varies at different parts of the suspensor and in different individuals; the first series often consists of six, eight, or ten, and the subsequent series always of more, till, towards the end of the fully formed suspensor, they are thrown off (so to speak) in great numbers, and coalesce into a fleshy mass continuous with the apex of the embryo. The first formed (Plate X. figs. 18 & 24) are of nearly equal length, and elongate most of all, attaining sometimes nearly $\frac{1}{4}$th of an inch; the next series (fig. 19) are more irregularly developed. Finally, towards the lower end of the suspensor, as the power of production declines, they lengthen upwards less and less, and form an imbricating bundle, of which the outermost are free and patent, and sometimes recurved wholly or in their upper parts (fig. 25). After this last stage of funicular development, the terminal cell commences rapidly to enlarge and form an embryo.

The suspensor appears to be very rapidly formed: it is developed wholly within the cavity at the apex of the endosperm, and in a loose tissue of endosperm-cells; it is extremely tortuous, and sometimes attains the great length of three inches. The terminal cell appears to burrow amongst the endosperm-cells at the sides of the cavity; sometimes it gets entangled amongst the coalescing cells of the rapidly-forming albumen, but I think, in all such cases, it never produces a mature embryo.

In most cases it is easy, after carefully dissecting away the tissues of the neck of the endosperm, to free the cone of the nucleus, and in removing it to draw out the whole suspensor from the cavity of the endosperm (Plate IX. figs. 26, 28; Plate X. fig. 20). As the endosperm hardens and the embryo becomes developed, this can rarely be done; for then the suspensor usually is retained within the endosperm, whilst the tubular prolongation of the secondary sac is stretched (Plate IX. fig. 27) and may often (as observed above) be withdrawn, quite entire, from out of the apex of the suspensor.

During these changes the endosperm has been rapidly acquiring bulk and consistency, becoming an obovoid, compressed, granular mass, with an obconic central cavity (Plate IX. fig. 32), whilst its fleshy annular neck detaches itself from the cone of the nucleus above. The membranous remains of the embryo-sac may often be found on the surface of the nearly mature endosperm: arrested secondary sacs may up to a very late period be found adhering to the margins of its fleshy annular neck; and numerous unimpregnated secondary sacs are always present within the canals of the cone of the nucleus.

Ripe Seed.—This (Plate VII. fig. 13) occupies the centre of the pericarp (figs. 3, 4), is obovoid, compressed, terminated by the calyptriform membranous integument of the ovule, with its rigid styliform apex. Removing the calyptriform integument (fig. 14), the cone comes into view, the outer tissues of which are continuous with the walls of the nucleus, now the only integument of the albumen. The granular albumen, with its fleshy neck, is quite free; and the suspensor forms a coil within or over the mouth of the neck, on the summit of the contained embryo; the connexion between the suspensor and cone (by means of the tubular prolongation of the secondary embryo-sac) is usually ruptured, but sometimes persists (fig. 15).

The embryo (figs. 15, 16) is linear, terete, or slightly flattened, about $\frac{3}{4}$ths the length of the albumen, and occupies the cavity in the axis of the latter. The lower end is contracted into two small flat cotyledons, which are closely applied to one another, and include no plumule. The radicular end swells out into an uneven fleshy mass, which is the cellular base of the suspensor, and is lodged in the equally fleshy annular neck of the albumen.

I have throughout described the thick vascular investing coat of the seed, which is developed as the endosperm enlarges and descends, as appertaining to the nucleus, because it is continuous downwards uninterruptedly from the body of the nucleus as that nucleus existed previous to impregnation, at the time when the insertion of the ovular integument coincided with the base of the ovule; but Prof. Oliver has forcibly directed my attention to the claims which this seminal integument may have to be regarded as an urceolate prolongation of the axis of the flower, and not a development of the nucleus, which the parts above the insertion of the calyptriform integument indisputably are. In favour of regarding it as belonging to the axis are, 1, the two or more vascular bundles which are carried up in its walls, and whose terminations coincide at all periods with the base of the calyptriform integument, thus marking in the seed, as they did in the ovule, the boundary of what is certainly ovular, and what axial; 2, some important considerations suggested by the embryogeny of *Loranthaceæ*, upon which Prof. Oliver is at present engaged.

Against this axial view may be urged, 1, the absence of any ring or thickened margin on the integument of the seed, at the point of union of the axial and ovular portions, and the unbroken continuity of the tissues of the integument, externally with the calyptriform integument, and internally with the substance of the cone; 2, the circumstance that, of the two integuments investing the albumen of *Gnetum*, the inner one corresponds with that of *Welwitschia*, and must thus also be considered axial; which requires us to believe, either that the axis of the flower of *Gnetum* is produced upwards within the base of the outer integument of the ovule (whose insertion, unlike that of the inner coat, is found at the base of the seed), or that this outer coat of *Gnetum* is not ovular at all; 3, that in respect of the carrying up of the integument immediately investing the ovule of *Welwitschia*, that ovule differs only in degree from those of many angiospermous plants, and that under this view the two vascular cords do not inaptly represent a double raphe of very anomalous development and character.

I am unable further to discuss this curious point, which, for further elucidation, must await Prof. Oliver's researches on the embryogeny of *Loranthaceæ* and *Gnetaceæ*, both of which Orders present many correspondences in the structure and functions of their organs of fertilization with *Welwitschia*. It must, however, be borne in mind, that as yet no "Ovular Theory" has been advanced that meets general acceptance, and that, until one shall be forthcoming, all such questions can only be answered by guess: at present, the whole subject is in a state of confusion, to which the ovule described in the present monograph adds not a little. Under many points of view, every ovule must be considered a terminal organ, and hence axial in relation to the vascular system of the plant, whether developed in the apex of a floral axis, as in *Welwitschia*, or on the surface of a carpellary leaf, as in *Nymphæa*, &c., or on the edges of the same, as in most plants. Its integuments may correspond to floral discs, or may represent hairs or other epidermal appendages, or may be foliar in origin. However this may be, the desideratum is, some general view of the relations of the ovule to the other floral organs, under which all the apparent deviations from any hitherto received theory of its origin shall be harmonized.

I am unable to indicate an exact counterpart to the process of impregnation and embryo-formation above described, amongst either angiospermous or gymnospermous plants. There is a general agreement in many most essential particulars with *Cycadeæ* and *Coniferæ*, especially in the structure of the ovule, its simple integument, the application of the pollen-grain to the nucleus, the free embryo-sac being filled with endosperm-cells previous to fertilization, the numerous secondary embryo-sacs, the position of the germinal vesicle at the base of these sacs, and in the high development of the long tortuous suspensor. The prominent differences are,—the absorption of the membrane of the upper part of the embryo-sac; the growth upwards of secondary embryo-sacs from out of the embryo-sac into the cone of the nucleus, apparently without the intervention of "rosette cells;" the impregnation of those secondary sacs in the cone of the nucleus when far removed from the embryo-sac (impregnation thus being, in one sense, extra-uterine); and the germinal vesicle at the base of the secondary sacs not giving origin to a plurality of suspensors and embryos. In this character of the secondary embryo-sacs, which answer in function to the embryo-sac itself in angiospermous plants, being for the most part developed and always fertilized in the nucleus outside the primary sac, *Welwitschia* presents an embryogenic process intermediate between that of Gymnosperms and Angiosperms.

There seems to be much variety in the early development of the secondary embryo-sacs in *Coniferæ*. In *Juniperus* especially many irregularities are described, the sacs sometimes originating in a remarkable increase of size in the deep-seated cells of the endosperm; and sometimes a secondary sac opens in the middle of one of the lateral surfaces of the endosperm (Hoffmeister, 'On the Higher Cryptogams,' &c., Currey's transl. p. 410). This is a step towards what occurs in *Welwitschia* when they actually leave the endosperm.

In *Coniferæ* it would appear that there are always two separate periods of the elongation of the pollen-tube; that is to say, that after the pollen has been placed on the apex of the nucleus, its tube descends and rests within the nucleus at a certain distance from its apex and from the embryo-sac, and that, after a considerable interval, the tube elongates further, and reaches the sac (Hoffmeister, *l. c.* p. 415). Perhaps the whole course of the pollen-tube in *Welwitschia* corresponds with its first growth in *Coniferæ*, and the necessity for a second elongation is obviated by the ascent of the secondary embryo-sac. In *Coniferæ* the lower part of the pollen-tube always dilates more or less as it approaches the embryo-sac; in *Welwitschia* it behaves as in angiospermous plants, only dilating, if at all, on reaching the secondary sac.

My very imperfect knowledge of the embryogeny of *Gnetum* does not enable me to compare it with that of *Welwitschia*; but in *G. scandens*, *G. Brunonianum*, and *G. Gnemon* I find many remarkable points of coincidence with it. In *Gnetum*, the cone of the nucleus is comparatively very small indeed; the embryo-sac is early filled with endosperm, of which the upper cells are in *G. scandens* so very large, lax, and oblong, that I at first supposed them to be young secondary sacs, but abandoned the idea in favour of numerous filiform tubular delicate cells that traverse the endosperm longitudinally, within the embryo-sac. These thread-like secondary sacs (?) closely resemble those of *Welwitschia* in many respects, and they appear to be developed from cells which originally are not distinguishable from the surrounding endosperm-cells; but they want the bulbous base, are found at all heights in the axis of the endosperm, and even towards its base, they sometimes branch downwards, and very few of them ascend and project beyond the mouth of the sac. Of those that did so ascend, one or two appeared to me either to enter the cone or to adhere to its base—I could not make out which; and I thought I found a pollen-tube adherent to the apex of one. As in *Welwitschia*, the apex of the sac in *Gnetum* seems to disappear early, and the large endosperm-cells to protrude from its cavity. I have failed to detect any canals or structure of any sort in the cone; and I have never found an embryo or funiculus in the very young state of the seed.

From angiospermous plants *Welwitschia* differs in the naked ovule, free embryo-sac full of endosperm previous to fertilization, in the presence of secondary sacs, in the position of the germinal vesicle at their base, and in the compound highly developed suspensor; it, however, agrees with them in the germinal vesicle giving rise to one embryo only.

There is a remarkable analogy in one respect between the processes of fecundation in *Welwitschia* and *Santalum**, and still more in *Loranthus*†, as described by Griffith, in both which genera the embryo-sac is produced beyond the nucleus of the ovule, ascends in the cavity of the ovarium, sometimes penetrating up the style, where it meets the pollen-tube descending an open cavity leading downwards from the stigma. The canaliform style of *Loranthus* thus representing the canal in the cone of the nucleus of *Welwitschia*, it follows that in this respect the latter plant presents an intermediate stage between most Angiosperms, in which the pollen-tube perforates style and nucleus to reach the embryo-sac, and most Gymnosperms, in which it perforates the nucleus and embryo-sac too, and *Loranthaceæ*, in which it perforates the style only. If, as I suspect may be

* See Griffith in Linn. Trans. xviii. 59 & 71; xix. 171 & 487; also Henfrey, *ibid.* xxii. 69.

† Linn. Trans. xix. 178. The late Prof. Henfrey possibly alludes to this, when he observes (Linn. Trans. xxiii. 299) that his investigations on *Gnetum* lead him to regard favourably the opinion expressed by Prof. J. G. Agardh, that the *Gnetaceæ* are related even more closely to *Loranthaceæ* than to *Coniferæ*.

the case, the secondary sac of *Gnetum* is impregnated below the cone of the nucleus, and externally to the embryo-sac, it will complete the network of cross affinities thus afforded by the behaviour of the pollen-tube and embryo-sac respectively in plants which, in many other respects, differ very widely.

Summary.

From the anatomy of the trunk of young and middle-aged specimens of *Welwitschia*, it appears to be the only perennial flowering-plant which at no period has other vegetative organs than those proper to the embryo itself,—the main axis being represented by the radicle, which becomes a gigantic caulicle, and developes a root from its base and inflorescences from its plumulary end, and the leaves being the two cotyledons in a very highly developed and specialized condition. The consequence of the persistence of the cotyledons, and of their performing all the functions of leaves, is the arrangement of the principal vascular system in one horizontal stratum, which increases at its periphery, and which transmits vascular bundles upwards and outwards to the inflorescence, and downwards to the stock and root.

Owing to the centrifugal direction of growth in the stock and crown, above, below, and beyond the leaf-insertions, these enclose between them a deep slit or groove in which the bases of the leaves are lodged and protected from external injury throughout the life of the plant.

There is no proper separable bark to the plant, which is invested by a hard periderm, formed by the indurated outer cellular system of the stock, crown, and root, and is absent only over the growing tissues at the circumference of the trunk, and within the groove between the crown and stock. A general cambium-layer underlies the periderm everywhere, and there are special cambium-layers within the vascular bundles throughout the plant.

The parenchyma is crowded with rigid spicular cells of great size, covered with crystals, and which, by their arrangement, form, and surface, give solidity to the delicate cellular tissue of which the main part of the plant is composed,—acting in a manner analogous to the siliceous spicula of sponges. The vascular system is referable to the exogenous plan; but its arrangement into concentric wood-wedges is very rude, and confined to the axis of the stock and root. In the root the wood-wedges are frequently disposed round two cellular axes, a plane passing between which is continuous with that passing between the leaf-bases.

The gum which flows freely from various parts of the plant is due to a collenchymatous swelling of the cell-walls of the parenchyma, and sometimes also of those of the spicular cells.

Occasionally flower-buds are developed in the periphery of the stock, below the insertion of the leaves. This is an analogous case to the recorded ones of the formation of buds on the caulicle of species of *Euphorbia* and *Linaria*.

The venation of the leaf is strictly parallel and free, like that of Monocotyledons in general appearance; but there is a total absence of lateral vascular communications between the bundles, in which respect it more closely resembles the venation of many

Cycadeæ, *Dammara*, some *Podocarpi*, and other *Coniferæ*. This venation favours the early splitting up of the leaf into innumerable laciniæ—an arrangement that subserves some purpose in the economy of the plant.

The binary arrangement of its parts and bilateral venation of the floral organs of *Welwitschia* are remarkable characters, and seem to be interrupted in the staminal whorl only (which is senary): thus, there are two leaves, two floriferous lobes, often two medullary axes in the root, a dichotomous panicle, decussating bracts to the cone, vascular cords in pairs in its rachis, two vascular bundles in each bract, two in the perianth of the female flower, two at the base of each ovule, two leaflets in each whorl of the hermaphrodite perianth, and two cotyledons to the embryo.

The general plan of the plant is that of a Dicotyledon, as the structure of its embryo indicates; the principal deviations being the straight venation of the leaves, the six stamens, and the isolated vascular bundles which are superadded to the generally exogenous vascular system of the stock and root.

The male flowers are structurally hermaphrodite, and contain a naked ovule in the axis of the flower, which, though containing no embryo-sac, is provided with a very highly developed stigma-like disc at the apex of the ovular integument. *Welwitschia* thus presents the hitherto unique case of a structurally hermaphrodite-flowered gymnospermous plant.

The cones of *Welwitschia* are functionally unisexual, and the plant is probably truly diœcious; fertilization being effected by insects, before the nucleus of the ovule of the female flower is enclosed by its integument or by the perianth.

The membrane of the embryo-sac, which is full of endosperm before fertilization, ruptures or disappears at its summit; and the secondary embryo-sacs, which are developed at its apex, ascend into canals in the substance of the nucleus, where they meet the descending pollen-tubes, and are thereby impregnated outside the embryo-sac, and removed from it.

After impregnation, the bulbous base of the secondary embryo-sac elongates, and descends into the cavity of the endosperm, when the germinal vesicle at its base gives rise by cell-division to a single suspensor, at the apex of which the embryo is developed.

Welwitschia is a Dicotyledon and an exogenous exorhizal perennial plant, belonging to the gymnospermous group of that class, and having a very close affinity with both *Ephedra* and *Gnetum*, but differing from all previously known Gymnosperms in wanting the disc-bearing wood-cells. Notwithstanding this peculiarity, I place it in the same Natural Order with the above genera, and after *Ephedra*, of which genus it is the South-African representative.

In its hermaphrodite flowers, its want of disc-bearing wood-cells, and in the impregnation of its secondary embryo-sacs taking place in the nucleus of the ovule exterior to the primary sac, *Welwitschia* is intermediate in character between angiospermous and gymnospermous plants.

In common with *Gnetum* and *Ephedra*, *Welwitschia* presents some very curious points of resemblance with *Loranthaceæ* and *Santalaceæ*, a further investigation of which will, I doubt not, lead to important discoveries, and to some further modifications of our accepted theories regarding the classification and morphology of flowering plants.

DESCRIPTION OF THE PLATES.

Plate I.

Fig. 1. Copy of a drawing of the entire plant, made by Don Ferdinand da Costa Leal for Dr. Welwitsch, said to be about 15 to 20 years old, and apparently from the specimen figured, Plate II. fig. 1.

Fig. 2. Copy of the coloured sketch made by Mr. Thomas Baines in Damara Land.

Plate II.

Fig. 1. Two views of the youngest specimen sent by Dr. Welwitsch, of the natural size, showing the leaves in an entire condition.

Figs. 2 & 3. Side and end views of a more advanced specimen, also from Dr. Welwitsch, showing the laceration of the apex of the leaf; of the natural size.

Fig. 4. Transverse section of the root of the same, showing an unusually regular arrangement of the root-bundles.

Plate III.

Side view of Dr. Welwitsch's largest specimen, reduced to about half the natural size. A portion of a leaf is cut away to show the areolated surface of the stock.

Plate IV.

The same, viewed from one end. To the left-hand side of the right-hand leaf, at its base, are seen the pits left by peduncles developed on the upper ridge of the stock, and below the leaf-insertion. Some pebbles are imbedded in the root, near its summit.

Plate V.

Figs. 1–4. Much-reduced sketches of the largest specimens sent by Mr. Monteiro.

Fig. 5. The large specimen sent by Mr. Andersson, also very much reduced.

Plate VI. Hermaphrodite flowers (p. 21).

Fig. 1. Peduncle and cones of hermaphrodite flowers, immediately previous to the expansion of the flowers; of the natural size.

Fig. 2. The same, magnified about 2 diameters.

Fig. 3. Bract of the peduncle, with imperfectly developed cone in its axis.

Fig. 4. Imperfect cone, from the same.

Fig. 5. Scale of the cone, with bud of hermaphrodite flower in its axis.

Fig. 6. Flower-bud just before expansion, seen from the opposite side of fig. 5.

Fig. 7. Flower with the inner perianth-lobe drawn back, showing the staminal tube and discoid apex of the ovule.

Fig. 8. One of the inner perianth-lobes, showing the disposition of the spicular sclerogen-cells in its tissue.

Fig. 9. Epidermal cells and spicular cells, from the same.

Fig. 10. Stamens and enclosed ovule.

Fig. 11. The same laid open, showing the position of the ovule.

Fig. 12. Summit of filament and anther.

Fig. 13. Pollen-grains, magnified about 240 diameters.

Fig. 14. Ovule, with the lower part of the integument removed in front, exposing the nucleus.

Fig. 15. Tissue of the integument of the ovule.

Fig. 16. Transverse section of the nucleus of the ovule, showing a dark line occupying the position of the embryo-sac in the ovule of the female flower.

Fig. 17. Diagram of the scale of the cone and floral whorls.

(All the above magnified, except fig. 1.)

Plate VII. Female cones (p. 24) and fruits (p. 37).

Fig. 1. Branch of the panicle, sent by Mr. Baines, of the natural size.

Fig. 2. Scale and pericarp, containing a nearly ripe seed, of the natural size.

Fig. 3. Pericarp, with the styliform apex of the integument of the seed protruding at the top.

Fig. 4. Transverse section of pericarp and seed.

Fig. 5. Portion of wing of apex of pericarp, and of styliform process of integument of the seed.

Fig. 6. Portion of wall of the cavity of the pericarp, showing the cottony liber-cells.

Fig. 7. Very highly magnified view of wing, showing the tortuous course of the liber-cells.

Fig. 8. Spicular cells from wall of cavity of pericarp.

Figs. 9 & 10. Spirally marked cells from cavity of pericarp.

Figs. 11 & 12. Liber-cells from cavity of pericarp.

Fig. 13. Ripe seed, and base of pericarp to which it is attached, showing the ramifications of vascular bundles in its walls.

Fig. 14. Longitudinal section of seed, showing the calyptriform integument at its apex, the only other integument being the nucleus terminating upwards in its fleshy cone. The obovoid mass in the interior is the albumen, crowned by the coiled-up suspensor.

Fig. 15. Longitudinal section of the albumen, showing the embryo with its suspensor still attached to the cone of the nucleus above.

Fig. 16. Two views of the embryo.

Fig. 17. Transverse section of the styliform process of the outer coat of the seed, showing the thickened inner walls of the innermost layer of cells.

(All the above, except figs. 1 & 2, are more or less magnified.)

Plate VIII. Development of female flower (p. 25) and scales of cone (p. 24).

Fig. 1. Rachis of cone of female flower, with the uppermost scales remaining, of the natural size.

Figs. 2 & 3. Two of the upper scales, also of the natural size, with an advanced female flower in each.

Fig. 4. View of a young scale (as viewed from the rachis), with the female flower seated on a conical prominence of the rachis, which is confluent with the base of the scale, and removed with it.

Fig. 5. Back view of the same scale.

Fig. 6. Very young female flower, the wings developing on the perianth, and the integument of the ovule overtopping the nucleus, as seen by transmitted light.

Fig. 7. More advanced flower, with the embryo-sac distinctly seen.

Fig. 8. More advanced flower on its conical receptacle.

Figs. 9 & 10. Female flowers at the period when changes commence in the embryo-sac.

Fig. 11. Apex of perianth, showing the anticous position of its mouth (towards the scale).

Fig. 12. Perianth more advanced, with immature ovule.

Fig. 13. Perianth at the stage where it assumes its intermediate or oblong form.

Fig. 14. Perianth still further advanced, and becoming orbicular.

Figs. 15 & 16. Ovules of different forms from figs. 13 & 14.

Fig. 17. Longitudinal section of body of ovule, showing a very large embryo-sac.

Fig. 18. An embryo-sac of unusual broadly transverse-oblong form.

Fig. 19. Front and (fig. 20) back views of two scales from different parts of a female cone.

Fig. 21. Membranous margins of the scale, showing the course of the liber-cells.

Fig. 22. Small portion of ditto, showing the individual liber-cells running towards the margin, and terminating within it, in blunt apices.

Fig. 23. Epidermis from inner surface of coriaceous green part of a scale.

Fig. 24. Epidermis from membranous outer part of a scale, showing the liber-cells.

Fig. 25. Portion of a liber-cell, showing its transverse striation.

Fig. 26. Epidermis of central area of scale, with liber-cells and spicular cells.

Fig. 27. Spicular cells, with minute points on their surface, from the coriaceous part of the scale.

Fig. 28. Lowermost free, but empty, scales of cone.

Fig. 29. Lowermost connate (empty) scales of cone.

(All these figures, but 1, 2, & 3, more or less magnified.)

PLATE IX. Development of female flower (p. 25) and embryogeny (p. 31).
Chiefly from Mr. Baines's specimens.

Fig. 1. Uppermost imperfectly developed scale of cone, with naked nucleus of ovule at its base.

Fig. 2. Another, more advanced, the nucleus surrounded with a thickened ring.

Fig. 3. Very young ovule from the same.

Fig. 4. Ovule with the thickened ring, which becomes the perianth.

Fig. 5. More advanced flower, the perianth supporting the still exposed nucleus, girt by another ring (its integument).

Fig. 6. Flower still further advanced, the perianth having risen to a level with the ovule.

Fig. 7. Flower further advanced, the perianth becoming 2-lipped.

Fig. 8. The perianth much more advanced, in its urceolar compressed stage; the ovular integument produced far above the nucleus.

Fig. 9. Longitudinal section of the same.

Fig. 10. Perianth in its oblong condition (of the natural size).

Figs. 11 & 12. Ovule and longitudinal section of the same, showing the embryo-sac and the two vascular bundles beneath the nucleus.

Fig. 13. Perianth at a much later period, from which the ovule, fig. 15, was taken (of the natural size).

Figs. 14 & 15. Ovules from the perianths, figs. 10 & 13.

Fig. 16. Ovule with the outer integument carried up halfway, and the embryo-sac descending.

Fig. 17. Ovule advanced still further, when the vascular bundles are developed on its walls.

Fig. 18. Ovule at a still later stage of development, but much shrivelled, the growth of the endosperm not appearing to have advanced with that of the nucleus and its cone.

Fig. 19. Longitudinal section of ditto, showing the loose embryo-sac loosely investing the tongue-shaped endosperm-mass. The dark lines have appeared in the cone above it.

Figs. 20–24. Transverse sections of the cone of a nucleus, after the canals are fully formed in its substance.

Fig. 25. An endosperm-mass apparently in an arrested condition, lying on a portion of the embryo-sac.

Fig. 26. Cone of a nucleus removed, showing the rudimentary embryos continuous by their suspensors with the tubular terminations of the secondary embryo-sacs.

Fig. 27. Apex of endosperm-mass and embryo-sac, surmounted by and dissected away from the cone of the nucleus, showing the stretched tubular ends of the secondary embryo-sacs between them.

Fig. 28. Another cone of a nucleus, with three rudimentary suspensors, which sheath as many tubular ends of secondary embryo-sacs.

Fig. 29. Longitudinal section of cone of nucleus, traversed with canals, and one suspensor descending into the cavity of the endosperm ; the membrane of the sac still remaining.

Fig. 30. Secondary embryo-sacs of the usual clavate form, but without bulbous bases.

Fig. 31. Another secondary embryo-sac attenuated at both ends.

Fig. 32. Longitudinal section of a half-ripened endosperm-mass, showing its constriction above into an annular fleshy neck, its cavity containing the rudimentary embryo, and its suspensor attached by the tubular base of the secondary sac to the cone above.

Fig. 33. Very young embryo; its cotyledons formed at the base, the radicle very short, and above it the large cellular fleshy end of the suspensor; the whole covered with endosperm-cells.

Fig. 34. Apex of a nucleus, covered with pollen-grains.

Fig. 35. Portion of another, more magnified.

Figs. 36 & 37. Pollen-tubes of the ordinary form.

Fig. 38. Branching pollen-tube.

(All the above, except figs. 10, 13, 14, 15, more or less highly magnified.)

Plate X. Embryogeny, *continued* (p. 31).

Fig. 1. Longitudinal section of an ovule on the first disappearance of the summit of the embryo-sac over the endosperm.

Fig. 2. An embryo-sac very loosely investing the endosperm.

Fig. 3. Endosperm with the secondary embryo-sacs appearing above its apex.

Fig. 4. Longitudinal section of an ovule, when the endosperm has elongated, and dark lines appeared in the cone of the nucleus.

Fig. 5. Embryo-sac from the same, with the secondary embryo-sac protruding. The figure above represents the tissues torn away from the summit of the endosperm.

Fig. 6. Another embryo-sac, with the secondary sacs still further advanced.

Fig. 7. Apex of another embryo-sac and endosperm-mass, with secondary sacs protruding.

Fig. 8. Endosperm-cells and secondary embryo-sacs in a very early condition.

Fig. 9. Longitudinal section of an ovule, after the embryo-sacs have taken a position above the endosperm, in the base of the cone of the nucleus.

Fig. 10. Part of another, more highly magnified, showing the bases of the secondary sacs.

Fig. 11. Secondary embryo-sacs, in rather a younger state, *in situ*.

Fig. 12. A young secondary embryo-sac, showing the transparent globules and rudimentary germinal vesicle in its base.

Fig. 13. An older secondary embryo-sac (unimpregnated), with a hooked projection at the side.

Fig. 14. A mature secondary embryo-sac (unimpregnated), with a branching base, and appearance of two germinal vesicles.

Fig. 15. A pollen-tube, having penetrated the nucleary tissue of the ovule, is in contact with the apex of a secondary embryo-sac.

Fig. 16. Another secondary embryo-sac, with the pollen-tube at its apex, and its base sheathed by the suspensor.

Fig. 17. Apex of another, with base of pollen-tube applied to its side.

Fig. 18. End of pollen-tube, attached to a secondary embryo-sac, of which the terminal cell is free, and the lower end above it sheathed by the first series of cells of the suspensor.

Fig. 19. Another embryo-sac, with pollen-tube attached, and suspensor forming; the second series of cells here being developed.

Fig. 20. Cone of the nucleus removed, showing pollen-grains on its apex; eight impregnated secondary embryo-sacs, with their bases sheathed in the apices of their suspensors; between these the bulbous bases of the unimpregnated secondary embryo-sacs are seen.

Fig. 21. Base of cone from another ovule, with bases of many unimpregnated secondary embryo-sacs and four impregnated ones, of which two are cut off, one apparently aborted, and the fourth sheathed by the upper cells of the suspensor.

Fig. 22. Base of impregnated secondary embryo-sac after elongation, showing the lobed germinal vesicle and contracted base of the sac.

Fig. 23. The same further advanced, the lobes of the upper part of the germinal vesicle having given rise to six incipient cells above it.

Fig. 24. The same, with the cells above the terminal one developed and elongating, showing also the attenuated tubular base of the secondary embryo-sac retiring, as it were, from the terminal cell.

Fig. 25. Apex of a suspensor when nearly fully developed, but before the embryo commences to grow; showing the great accumulation of cells, of which the outer are gradually smaller, free wholly or in part, and often recurved.

Fig. 26. First series of cells of a young suspensor, torn away from the terminal cell.

Fig. 27. Attenuated base of an impregnated secondary embryo-sac, exposed by the removal of all but two of the upper sheathing-cells of the suspensor.

(All the above are very highly magnified figures.)

Plate XI. Vascular system of trunk (p. 13).

Fig. 1. A longitudinal section through the middle of both leaves of a full-grown but small specimen, reduced to about one-half; showing, to the right, the insertion of a peduncle and a bud; the deep groove in which the leaf-bases are inserted; the principal vascular stratum running across the trunk, parallel to the surface of the crown; the ascending vascular bundles in the crown, the descending ones in the stock, and the indefinite bundles in the axis and root.

Fig. 2. Transverse section of one of the lobes of fig. 1, taken at right angles to the plane of the cut surface, of the natural size. This section cuts through each vascular bundle of the principal vascular stratum in its course from the leaf-base to the axis of the plant.

Fig. 3. A longitudinal section of a portion of the stock, taken through the centre of the depression of fig. 1 (that is, between the bases of the leaves), of the natural size. This section shows how confused the vascular bundles are in the stock, towards the contiguous bases of the leaves, and that those in the crown pass inwards, parallel to the surface.

Fig. 4. Transverse sections of the crown and stock of one specimen, diminished less than one-half, showing, in the upper half, a section of the stock below the leaf-insertion; in the lower left-hand quadrant a section of the crown, and in the other quadrant the surface of the crown.

Fig. 5. Longitudinal section of part of a small specimen, between the bases of the leaves, of the natural size, showing the vascular bundles rudely collecting into plates (or wedges) on each side of the stock, thus giving rise to the two axes seen in fig. 8.

Fig. 6. Another section, from the same specimen, of the natural size, taken parallel to that in fig. 5, but through the base of a leaf (the same as fig. 2), showing the arched form of the vascular stratum, corresponding with the arched vertex of the crown.

Fig. 7. Longitudinal section through both leaves of another small specimen, of the natural size, in which the vascular stratum is very obscurely developed, though the ascending and descending bundles are very manifest.

Fig. 8. Transverse section of the root of fig. 5, of the natural size, showing great confusion of the wood-wedges.

Fig. 9. Transverse section of root of fig. 7, of the natural size, and showing two medullary axes.

PLATE XII. Tissues of the stock, &c. (p. 10).

Fig. 1. Parenchyma of the stock, including vessels, liber-cells, and sclerogen-cells covered with crystals. Magnified 60 diams.

Fig. 2. Periderm of stock in longitudinal section, consisting of transversely elongated parenchyma and spicular cells.

Fig. 3. Epidermis and subjacent cellular tissue of periderm near the leaf-base. Magnified 400 diams.

Fig. 4. Vessel from the peduncle, showing that the narrow spiral bands are spaces between the secondary deposits. Magnified 400 diams.

Fig. 5. Portion of a spicular sclerogen-cell, covered with crystals. Magnified 240 diams.

Fig. 6. Smaller portion of ditto, magnified 430 diams., showing crystals of two forms.

Fig. 7. Transverse section of a very large spicular cell, enclosed in parenchyma. Magnified 240 diams.

Fig. 8. A thin-walled spicular cell, with the crystals very small. Magnified 60 diams.

Figs. 9 & 10. Small, branched spicular cells, with secondary deposits. Magnified 60 diams.

Fig. 11. Section of a small portion of another, after boiling in caustic potash. Magnified 60 diams.

Fig. 12. Branched liber-cell of very irregular diameter and unusual form. Magnified 240 diams.

Fig. 13. Portion of a liber-cell of the ordinary form, with transverse striæ. Magnified 240 diams.

Fig. 14. Parenchyma of stock, becoming colloid. Magnified 240 diams.

Fig. 15. The same, involving a spicular cell with crystals.

Fig. 16. Transverse section of the parenchyma and vascular bundles of the roots, showing, to the left, liber-bundles, to the right, barred vessels, to the extreme right, spicular sclerogen-cells with crystals. Magnified 60 diams.

PLATE XIII.

Fig. 1. Portion of rachis of cone, with scale *in situ*, showing the disposition of its vascular bundles. Magnified 2 diams. (see p. 25).

Fig. 2. The same, with the scale removed, showing the relation of the vascular bundles to the perianth.

Fig. 3. Transverse section of rachis of cone. Magnified 2 diams.

Fig. 4. Pitted cellular tissue from the same. Magnified 60 diams.

Fig. 5. The same, showing the obliquity of the pits. Magnified 240 diams.

Fig. 6. Longitudinal section through the base of a cone and peduncle, taken through the centre; of the natural size.

Fig. 7. The same section, taken close to the periphery, showing the anastomoses of the bundles.

Fig. 8. Transverse section of the peduncle, showing the irregular arrangement of the vascular bundles. Magnified 2 diams.

Fig. 9. Transverse section of pitted parenchyma of central part of peduncles, with a few liber-cells. Magnified 240 diams.

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Fig. 11. Transverse section taken through the peduncle, showing the isolated vascular bundles and scattered liber-cells.

Fig. 12. Transverse section of a quadrant of a root, magnified $2\frac{1}{2}$ diams., showing the form and disposition of the wedges and isolated bundles.

Fig. 13. Transverse section of a root-fibre, showing the periderm, parenchyma, vascular bundles, and scattered sclerogen-cells. Magnified 60 diams.

Fig. 14. Liber-cells, &c., from the same.

Fig. 15. Pitted vessels from the root.

(All the above, except figs. 6 & 7, are more or less magnified.)

Plate XIV. Leaf-tissues (p. 18).

Fig. 1. Transverse section of a portion of a leaf, magnified 40 diams.: *a*, epidermal cells; *b*, lax pulpy cellular tissue, into which the stomata open; *c*, bundles of liber-cells; *d*, spicular sclerogen-cells; *e*, parenchyma of leaf.

Fig. 2. Longitudinal section of ditto, taken through a vascular bundle: *a*, epidermal cells; *b*, pulpy tissue; *c*, liber-bundles; *d*, sclerogen-cells; *e*, parenchyma of leaf; *f*, vascular bundle.

Fig. 3. Vascular bundle in longitudinal section: *a*, bounding cells with thick and pitted walls; *b*, liber-bundles; *c*, cambium-layer; *d*, pitted and slit-marked vessels; *e*, closed spirals and open spirals.

Fig. 4. Tissue from beneath epidermis of old leaf after boiling in caustic potash, consisting of masses of sclerogen-cells in pulpy cellular tissue and liber-cells.

Fig. 5. Epidermis of upper surface of leaf and opening of stomata. Magnified 240 diams.

Fig. 6. The same, of lower surface of leaf.

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Fig. 12. The same, through the confluent extremities of the guard-cells.

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(Figs. 5–13 are all magnified 240 diams.)

Fig. 14. Vessels from an old root, showing how their cavities become filled with secondary deposits.

Fig. 15. Vessels from old vascular stratum in the stock, showing the pits of the vessels united by a delicate spiral line.


F. da Costa Leal, fec.


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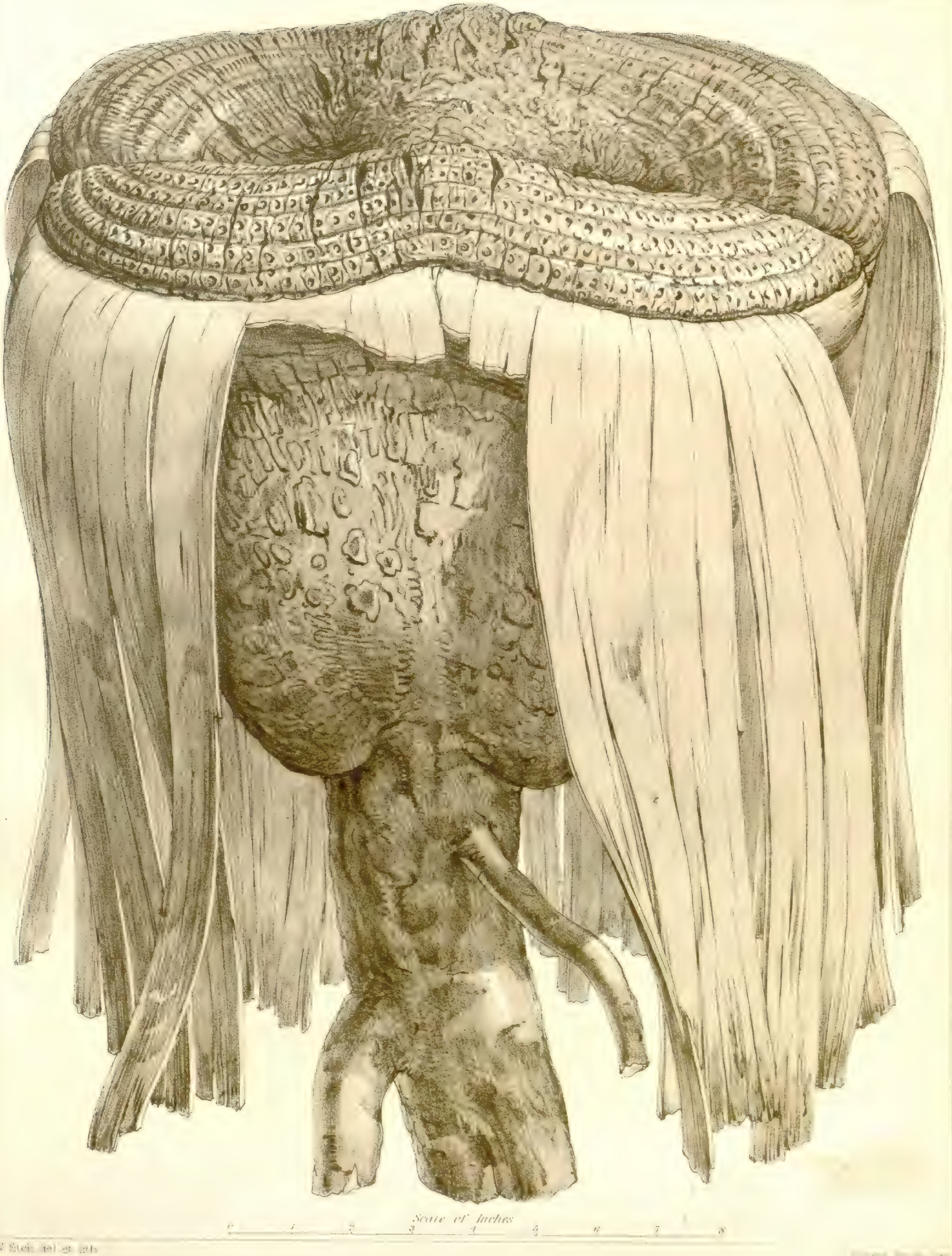

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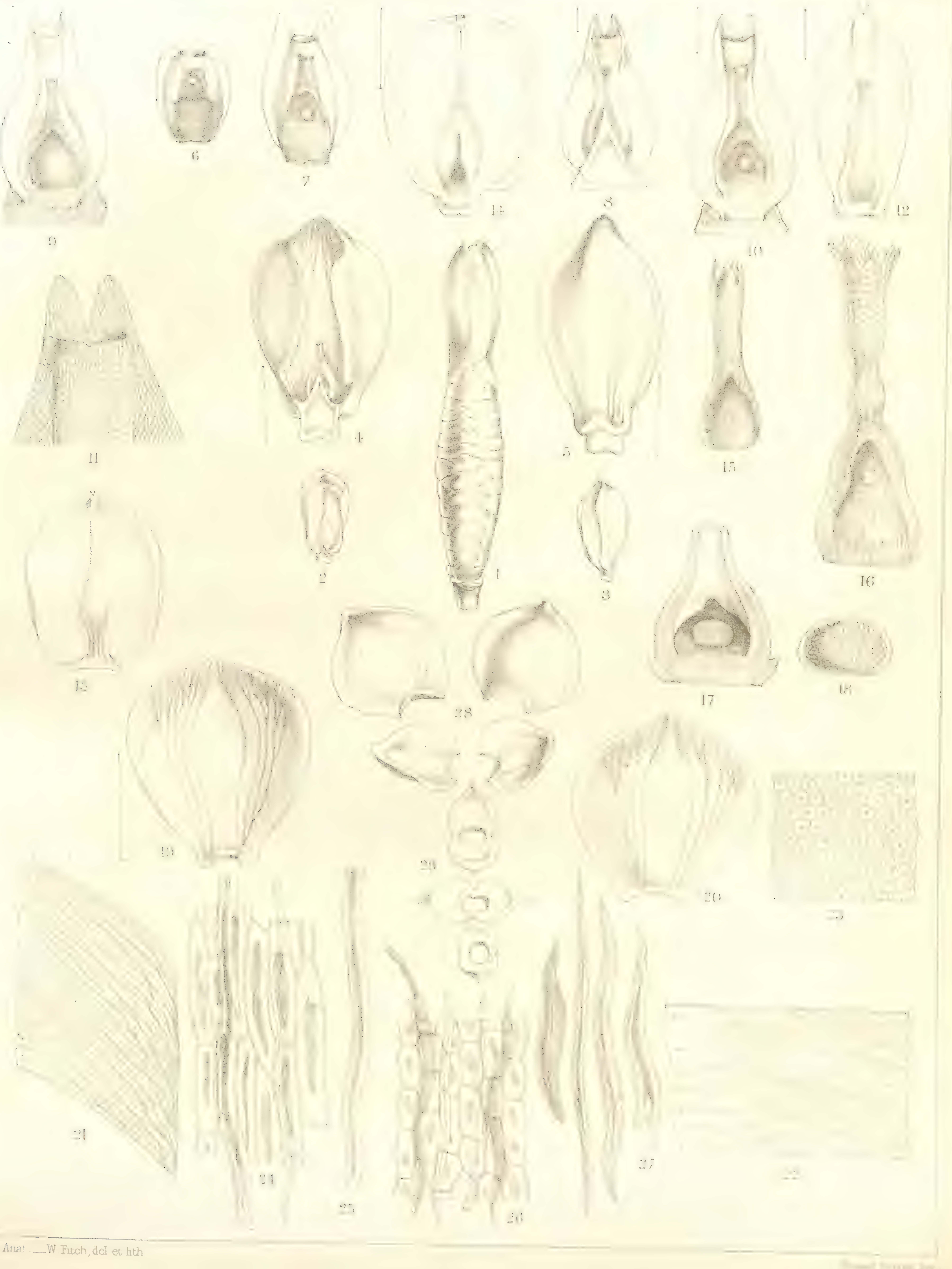

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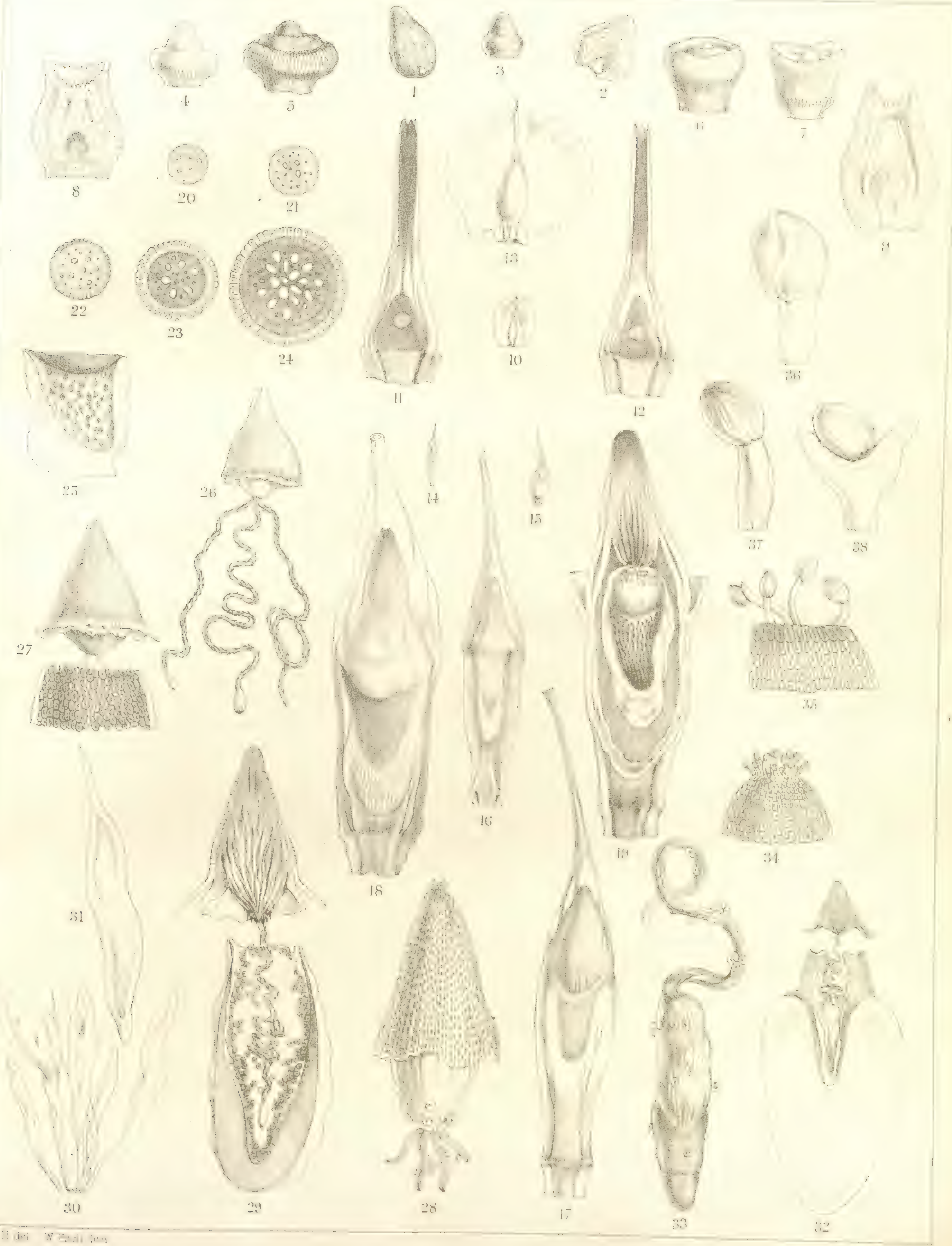

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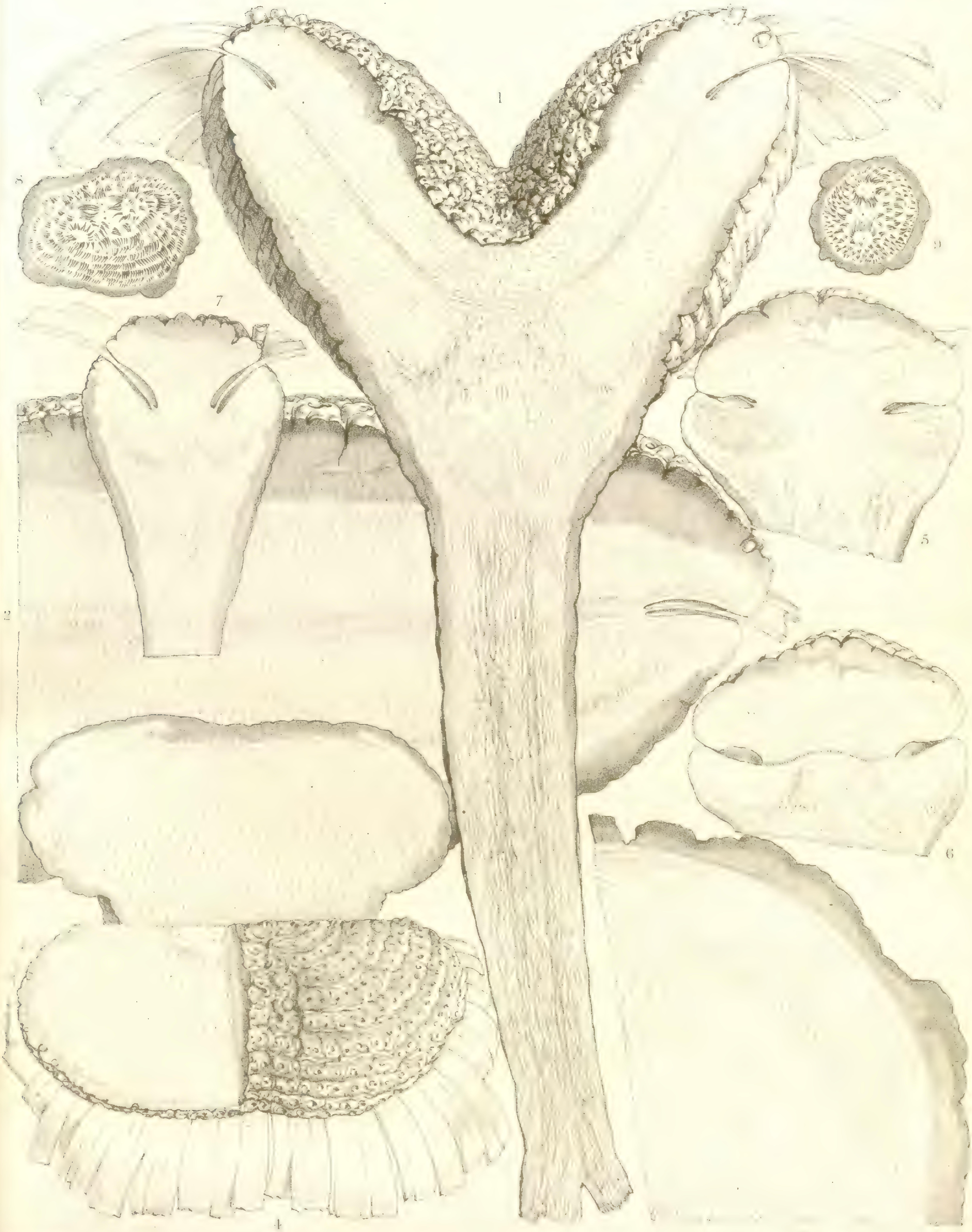
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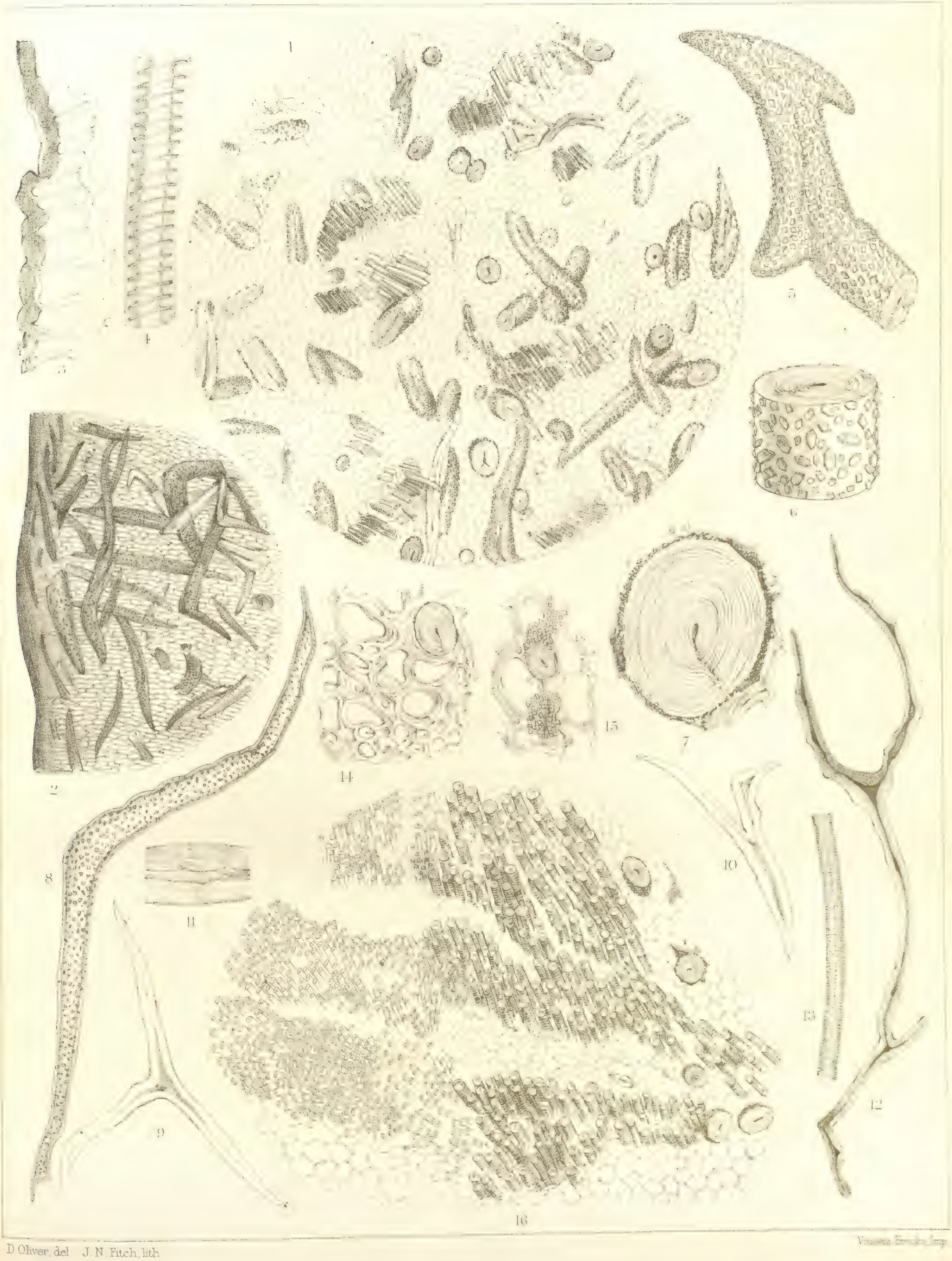

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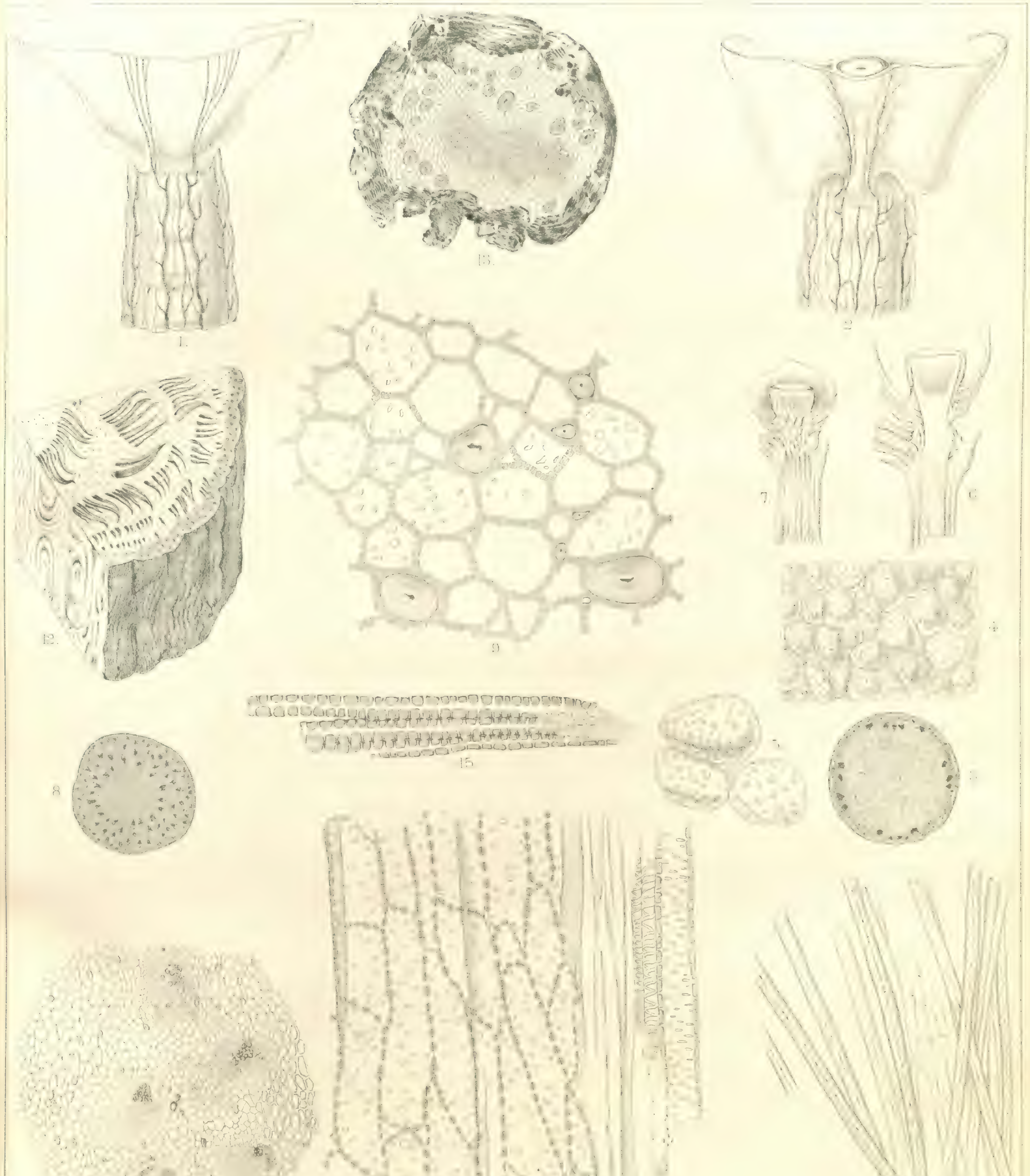
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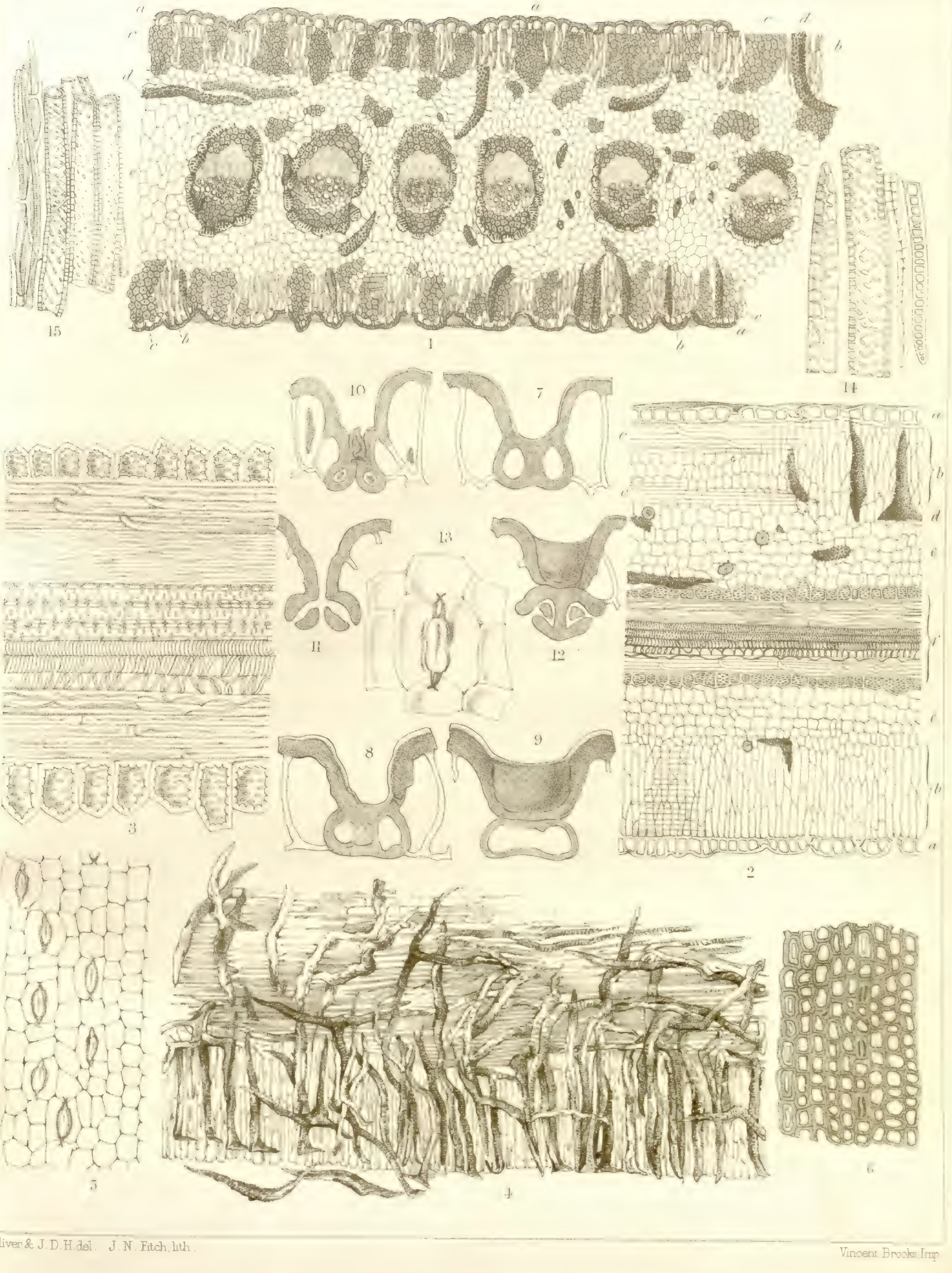

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M.DCCC.LXIII.

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PART II.—1863.

II. *On* Splanchnotrophus, *an undescribed Genus of Crustacea, parasitic in Nudibranchiate Mollusca. By* Albany Hancock, F.L.S., *and the* Rev. Alfred Merle Norman, M.A.

(Plates XV. & XVI.)

Read November 6th, 1862.

In the 'Monograph of the British Nudibranchiate Mollusca,' Messrs. Alder and Hancock briefly described and figured three or four new forms of Entomostraca which had been found infesting the Nudibranchs. This was done partly to illustrate the history of these beautiful Mollusca, but mainly with the view of directing the attention of those naturalists who might be interested in the subject to the parasites. It was therefore unnecessary on that occasion to go into much detail; and, indeed, the material then at disposal was too limited to enable this to be done. Recently, however, Mr. Hancock has obtained a fresh supply of specimens of two of the forms; and as their characters are very abnormal, and consequently possess much interest to the systematist, we propose to give in this communication as complete a description of them as we are able—though this description must still be imperfect in many anatomical details, since the number of specimens even now at our command is not great.

The species which occurred in *Doris tuberculata*, figured plate 45. fig. 10, as well as that which was taken on *Antiopa cristata*, were referred in the monograph to *Ergasilus*. Leydig has, however, constituted a genus under the name of *Doridicola* *, to which these parasites would appear more properly to belong. We hope, however, hereafter to have the opportunity of giving a more detailed account of these animals, which are active little beings, and have been observed flitting about from place to place on the surface of the infested animals, or resting and anchoring themselves by their long prehensile antennæ amidst the gills of *Doris* or the papillæ of *Eolis*, there, no doubt, to seek their required nourishment.

It is not, however, with such neat, agile, and sprightly forms that we have to do on the present occasion. The creatures which now claim our attention are ill-formed and monstrous-looking; they live constantly attached to one place, and are almost motionless.

Two species of these curious animals have occurred. Both are internal parasites, lying buried within the visceral chamber of their victims. The minute caudal extremity and the ovigerous sacs of the female, however, appear at the surface.

The one species was obtained in *Doris pilosa* from the coast of Devonshire, and has since also occurred in *Idalia aspersa*, taken on the west coast of Ireland, either at the Isles of Arran or Birterbury Bay. The other species has been found in *Eolis rufibranchialis* and *Doto coronata*, captured on the shores of Northumberland. Mr. H. T. Mennell and Mr. Hancock found three individuals of the latter species in April of last year, which

* Leydig, "Neuer Schmarotzerkrebs auf einem Weichthier," Zeitschr. f. wiss. Zool. vol. iv. (1853) pp. 377–382.

were infesting the *Doto* in rock-pools at Cullercoats; and it is chiefly from these specimens that the description of the species has been drawn up.

These two animals are so unlike all known forms, that it is necessary to establish a new genus for their reception, which we propose thus to characterise:—

Fam. CHONDRACANTHIDÆ.

Genus SPLANCHNOTROPHUS *, n. g.

Feminæ cephalothorax uni- vel bi-annulatus, appendicibus utrinque elongatis, simplicibus, cylindricis instructus. Antennæ primæ minutæ; secundæ majores, prehensiles. Maxillipedes cum mandibulis maxillisque juxta os positi. Pedum thoracicorum duo paria non natatoria, unguiculata. Abdomen biannulatum; annulus posterior appendicibus caudalibus stiligeris confectus. Ova externa, in sacculos ellipticos aggregata.

Mas perpusillus, a femina cephalothorace quadriannulato, appendicibus lateralibus carente differt.

Species nobis cognitæ Molluscorum Nudibranchiatorum viscera habitant.

Female. Head and thorax either blended into a single segment, the thoracic portion of which is furnished on each side with unarticulated arm-like appendages or lobes, or the first part only of the thorax is united with the head, and the last part forms a second, but comparatively minute, segment. In this case, however, all the thoracic appendages are attached to the first segment. First antennæ minute and few-jointed; second larger, in the form of prehensile hooks. Labrum large, overhanging the mandibles, which organs, together with the maxillæ and two pairs of foot-jaws, are minute and crowded round the mouth. Thoracic feet, two pairs, minute, simple or two-branched, terminating in hooks. Abdomen two-jointed, the last joint ending in two caudal appendages, which are furnished with one or two simple setæ. Ovigerous sacs elliptical.

Male minute. Cephalothorax without lateral appendages, and divided into four segments, the first of which bears the two pairs of thoracic feet.

The species which have as yet been discovered inhabit the bodies of Nudibranchiate Mollusca, lodged beneath the skin, and feeding on the viscera.

The presence of true thoracic feet, and the extent of development of the abdomen in both sexes, and also the perfect segmentation of the thorax in the male, all point to the claim which *Splanchnotrophus* has to take its position at the head of the family to which we have assigned it.

The genus shows affinity to many allies in the development of its several organs. In the structure of the antennæ, and the general arrangement of the parts about the mouth—in the deficiency of segmentation of the thorax of the female, and the atrophy of the posterior pairs of feet—in the character of the egg-sacs, and in the vast disproportion of size between the sexes, we find our authority for associating *Splanchnotrophus* with the Chondracanthidæ. Again, in the presence of the curious produced appendages which take their origin from the sides of the thorax, we are reminded of *Chondracanthus* more especially, while the exact structure of the oral organs finds its nearest counterpart in the mouth of the male of that same genus, as will be more particularly pointed out in the specific descriptions; the presence of ambulatory thoracic feet is paralleled in

* σπλάγχνα, the viscera; τρέφειν, to nourish.

Kroyer's genus *Selius*; while a similarly well-developed abdomen is to be found in *Tucca impressa*.

The most remarkable characteristic, however, of this genus is to be found in the degree of development of the thorax of the male. Posterior to the two pair of foot-jaws, and, like them, attached to the first cephalothoracic segment, we find two pairs of feet, the representative appendages of two thoracic segments; and posterior again to these, and between them and the first abdominal or genital segment, there are three distinct segments, and these constitute therefore the third, fourth, and fifth of the thorax. We search in vain throughout the whole order of the Pœcilopoda for an analogous instance of thoracic development. Even among the Caligidæ, where we meet with four pairs of thoracic appendages, the representative of the fifth segment cannot be distinguished, since that segment which is the seat of the external generative organs, from which issue the ovigerous sacs, and which has been regarded by Milne-Edwards and other authors as the last thoracic, is not so, but the first or, according to Dana, the equivalent of the first and second abdominal segments.

Splanchnotrophus gracilis, n. s. (Pl. XV. & Pl. XVI. figs. 7–10.)

Parasite of *Doris pilosa*, Alder and Hancock, Brit. Nud. Moll. p. 26, pl. 45. figs. 6–9.

In *feminis* cephalothorax elongatus, gracilis. Appendices thoracicæ utrinque tres, longissimæ, maxime attenuatæ, toto corpore longiores dimidio. Pedes biramei (ramus unus perbrevis), articulati; ungues graciles. Annulus genitalis lageniformis, cephalothorace angustior, postice dilatatus, bilobatus. Appendices caudales minutæ, stilo uno non plumoso instructæ.

Long. vix $\frac{1}{4}$ unciæ; lat. (appendicibus lateralibus computatis) $\frac{3}{8}$ unciæ.

In *maribus* cephalothorax quadriarticulatus; annulus primus oblongus, pedum duobus paribus at non appendicibus lateralibus instructus; annulus secundus, tertius quartusque ejusdem latitudinis primoque segmento multo angustiores. Abdomen capitisque membra iisdem feminæ similia.

Long. $\frac{1}{16}$ unc.; lat. $\frac{1}{32}$ unc.

Sub pelle tectus *Doridis pilosæ* et *Idaliæ aspersæ* visceribus vescitur.

The Female.

The body is elongated, slightly depressed, of nearly equal diameter throughout, and covered with a tough though yielding membrane. The cephalothorax, which occupies by far the greatest portion of the body, is produced at the sides into three pairs of lateral processes, placed a little apart from each other. These processes (Pl. XV. fig. 1 *b*) are inarticulate, soft, and cylindrical, very long and slender, being fully half as long again as the total length of the body, and gradually taper to fine points. The head, though blended with, is somewhat narrower than the thorax, and projects a little forwards. The posterior extremity of the thorax is prolonged backwards beyond the origin of the last pair of thoracic processes. The sides of this portion are concave (Pl. XV. fig. 2 *a*); and it is produced behind into two obtuse lateral lobes, and in some instances has the appearance of forming a distinct segment—a depressed line dividing it from the thorax at the very point where analogy with *S. brevipes* would lead us to expect such a division. We should therefore perhaps be wrong to describe the cephalothorax as consisting of one segment only.

The first antennæ (Pl. XV. fig. 3 *a*), which are minute and concealed beneath the head, are three- or four-jointed. The basal and largest joint is furnished with three, and the second joint with one or two, stout spines on the inner margin. The second antennæ (Pl. XV. fig. 3 *b*) are comparatively large. They consist of a large, fleshy basal joint and a tapering, hook-formed second joint. The stout hook is bent inwards, and has on its outer margin two spines, that nearest to the extremity being the longer; at the base of the hook there is also a stout process, terminating in a short spine. The mouth lies between the second antennæ, and is provided with a largely developed subtriangular labrum. The rounded apex of the triangle (Pl. XV. fig. 3 *c*) is situated between the roots of the second antennæ, while the base overhangs the oral orifice, and to a considerable extent conceals the underlying mandibles with its produced and rounded angles. The mandibles (Pl. XV. fig. 3 *d*, and Pl. XVI. fig. 8) are small, and placed close to the sides of the mouth; the basal portion is soft and flexible, and, tapering a little, gives support to a flattened chitinous process, which is a little enlarged, obtuse, and recurved at the extremity, and bears three or four denticles. The maxillæ (Pl. XV. fig. 3 *e*), which are so minute as to be quite rudimentary, lie immediately behind and within the mandibles, in the form of ovate fleshy processes, bearing, though it could not always be seen, an exceedingly delicate styliform organ, slightly curved, and inclining inwards and forwards. The first pair of foot-jaws (Pl. XV. fig. 3 *f*, and Pl. XVI. fig. 9) are of about the same size as the mandibles. They project inwards and forwards, are soft and flexible at the base, which, after slightly tapering, is surmounted by a styliform process, a little curved at the point, and, as seen in some positions, appearing a little denticulated; but whether this was really the case could not be satisfactorily determined. The second pair of foot-jaws (Pl. XV. fig. 3 *g*) are very peculiar in character, and difficult to observe. They are small, like most of the other oral organs. At first they are considerably attenuated, but, passing inwards and forwards, they suddenly enlarge; their inner margins come into contact with each other, and are thus projected side by side between the first foot-jaws and maxillæ, until they almost reach the labrum. The extremity of each appears to be furnished with a curved process; but its exact form could not be ascertained.

There are two pairs of thoracic feet (Pl. XV. figs. 1 *a*, 5, & 6). These feet are of similar structure to each other. Those of each pair are widely separated. They are composed of three or four indistinct articulations, which gradually taper, the last joint being very slender and terminating in a delicate hook. The basal joint is stout and thick, and gives off from its inner margin a short, obtuse process (*a*, figs. 5 & 6), which represents the usual second branch or member of these feet; and the second or third is furnished with three or four minute spines.

The abdomen (Pl. XV. fig. 1 *c*) is composed of two articulations, the first of which (fig. 2 *b*), or genital segment, is somewhat flask-shaped, considerably narrower than the posterior extremity of the cephalothorax in front, but widening behind and produced into two blunt lobes on each side of the origin of the second abdominal segment. This second segment is quite rudimentary, but suffices to give support to two extremely minute caudal appendages, each of which has a short terminal seta.

The ovigerous sacs have not been seen entire; but in most instances the remains of them were found adhering to the sides of the first abdominal segment, and in some cases they contained a few eggs of a yellow colour. The sacs were of an elongated-oval form, and the eggs agglomerated within,—an arrangement which appears to be as universal in the family of Chondracanthidæ as is the disposition of the ova in single file among the Caligidæ.

Length of the body nearly a quarter of an inch; breadth, from tip to tip of the lateral processes, upwards of three-quarters of an inch.

The Male.

The cephalothorax in the male (Pl. XV. figs. 7, 8) is composed of four articulations. The first of these is very large as compared with the rest, subquadrilateral in form, and having the posterior angles well rounded. The cephalic portion is narrower than the thoracic, and projects considerably forward. It is somewhat squared in front, and bears a single eye near the centre. The first antennæ (Pl. XVI. fig. 7) are similar to those of the female, except that there is a strong seta on the outer margin of the second or third, and several of less size on the terminal joint. The second antennæ and organs of the mouth (Pl. XV. fig. 9) are likewise similar to those of the female. The male, too, has two pairs of thoracic feet, which in position and character agree with the same organs in the other sex, only that they are relatively larger, and the second or rudimentary branch springing from the basal joint is more largely developed (Pl. XV. fig. 10 *a*), and the minute spines on the second and third joints have not been observed. The second, third, and fourth segments, in consequence of their greatly diminished size as compared with the first, both in length and breadth, and their close agreement in these respects with the segments posterior to them, might readily be mistaken for abdominal members, were it not that their position anterior to the genital segment clearly proves them to be thoracic. They are scarcely one-third the width of the first segment; the breadth of each slightly exceeds the length; and they are unprovided with appendages. Taken together with the abdominal segments, they form, as it were, a gradually tapering tail, appended to the greatly developed anterior segment.

The abdomen is two-jointed. On each side of the first of these segments, at its junction with the second, is seen a tubercular swelling, which is perforated, and through which a curved process—the male intromittent organ (Pl. XV. fig. 11 *e*)—is usually protruded. The last segment is small, tapers backwards, and supports two caudal processes, each of which terminates in a short, stoutish seta.

Length of body $\frac{1}{16}$th of an inch; breadth of the same $\frac{1}{32}$nd of an inch.

Several females of this species have been obtained from specimens of *Doris pilosa*, which had been taken on the Devonshire coast; and one has occurred in *Idalia aspersa*, from the West of Ireland. There is never more than one individual found in the same Nudibranch, and this invariably occupies the same position, resting upon the under surface of the liver-mass and embracing two-thirds of it with its long, attenuated lateral processes. The under surface of the parasite is pressed to the liver, the anterior extremity forward, but the posterior extending as far back as the region of the branchial circle; here the two last segments of the body penetrate the skin of the Nudibranch, to which they are firmly attached, so that the parasite becomes thus fixed in its position. It is a remarkable fact that this penetration and attachment always take place within the branchial circle; and consequently the ovigerous sacs must float amidst the plumes, and be always exposed to the constant flow of water brought thither by the branchial cilia.

The males are found only in those mollusks in which the females have taken up their abode; and generally several of the former are associated with a single example of the latter: as many as a dozen are occasionally thus found with the female, though more generally three or four, and sometimes only one or two. They always live immediately beneath the skin, either adhering to the viscera (usually the liver-mass, consisting of the ovary and liver) or to the female, close to the vaginal openings of the first abdominal articulation. It is from these facts, and more especially from the circumstance of its frequent attachment to the body of the female, as is the case with the males of *Chondracanthus*, *Lerneonema*, *Brachiella*, *Ancorella*, *Lerneopoda*, and other allied genera, that this animal is assumed to be the male of the present species. The characters of its antennæ, oral organs, foot-jaws, and thoracic feet (all of which, as before shown, closely resemble those organs in the female) strongly corroborate this opinion; and this similitude of parts could scarcely have been expected in such dissimilar animals on any other hypothesis. That they are males seems, moreover, to be established by the fact that, although between thirty and forty individuals have been examined, not one possessed ovigerous sacs or presented any appearance of such sacs having ever existed, whilst in every instance those organs which we take to be the male intromittent apparatus were present.

The startling fact of these individuals being furnished with an eye appears to bear upon this question. It is very extraordinary that we should meet with a visual organ in an internal parasite; and its presence in this case is an assurance that some peculiar necessity demands its existence.

The male lives free within the visceral cavity of the animal it inhabits, and undoubtedly enjoys a limited degree of locomotion. The thoracic feet, which are well placed for such a purpose, are therefore relatively larger than those of the female, in which they seem merely to assist in holding the parasite in its proper position. The male, being thus endowed with the power of transferring itself from place to place, might be liable to wander among the viscera into the interior of the body. It is required, however, to remain on the surface of the visceral organs, immediately beneath the skin, where the female resides permanently attached, and where the male is therefore required to exercise its sexual function. An eye is therefore given to it, which, though extremely low in structure, is sufficient for the perception of light, which is all that is necessary to enable the creature to retain its position on the surface of the viscera immediately below the skin. That the skin possesses the requisite degree of transparency for this purpose is proved by the fact that the comparatively highly organized eyes of the *Doris* itself are placed beneath the dermal envelope.

SPLANCHNOTROPHUS BREVIPES, n. sp. (Pl. XVI. figs. 1–6.)

Cephalothorax *feminæ* brevis, robustus. Appendices thoracicæ crassæ, corporis longitudine breviores. Pedes uniramei, inarticulati; ungues fortes. Annulus genitalis transversim oblongus, postice incisus. Appendices caudales setis tribus non plumosis instructæ.

Mas ignotus.

Longitudo $\frac{1}{14}$ unc.; lat. $\frac{1}{8}$ unc.

Doto coronata atque *Eolis rufibranchialis* huic speciei visceribus victum præbent.

The first segment of the cephalothorax in the female is thick, a little depressed, and not much longer than broad. That portion of it which belongs to the head projects slightly in advance, and is rounded in front, while, behind, the segment suddenly tapers to its junction with the second. On each side there are three stout, inarticulated, tapering processes, the bases of which meet each other at their junction with the thorax. These lateral processes are shorter than the length of the segment from which they originate. The radiating disposition of these curious arm-like appendages give to the animal a stellate appearance; and with them it clasps the viscera of the Nudibranch within which it has taken up its abode.

The antennæ and the whole of the apparatus of the mouth closely resemble the same organs as they have been described in *S. gracilis.* In neither species could the exact form of the extremely minute maxillæ be determined; nor could it be satisfactorily ascertained whether the extremity of the first pair of foot-jaws was denticulated, though in this as well as in the first species, as viewed in certain aspects, it appeared to be so.

The two pairs of thoracic feet (Pl. XVI. figs. 2 *a* & 5) are quite in a rudimentary condition, and reduced to mere hooks of no great size. The first pair are placed on the anterior portion of the thorax, rather far apart from each other, with their points inclining inwards. The second pair are situated at some distance behind the first, and in a line with them.

The second cephalothoracic segment (Pl. XVI. fig. 4 *b*) is minute, transversely oblong, and unprovided with appendages. It is of the same width as the tapering extremity of the first segment, and the sides are gently rounded.

The first abdominal (Pl. XVI. fig. 4 *c*) is slightly narrower than the preceding articulation. In form it is transversely oblong, with the posterior margin hollowed out centrally. The second abdominal segment (fig. 4 *e*) is very small, and subquadrilateral. It gives support to the tail, which is of the usual bifid form, each portion being apparently composed of two articulations, the last of which is much the smaller, and terminates in a short seta. There are also two minute setæ at the external margin of each of the caudal processes.

The ovigerous sacs (Pl. XVI. fig. 2 *c*) are oval, and nearly as long as the body of the animal. They issue from the posterior angles of the first abdominal segment. The eggs are rather large, and of a pale yellow colour.

The male has not been observed.

Three individuals of this grotesque form were obtained from as many specimens of

Doto coronata found in rock-pools at Cullercoats, on the Northumberland coast, by Mr. A. Hancock and Mr. H. T. Mennell, in the early part of last year. A few specimens had occurred some years ago on the same coast, and are mentioned in the 'Monograph of the British Nudibranchiate Mollusca,' at p. 26. One of these latter examples was imbedded in *Eolis rufibranchialis*, and had the ovigerous sacs, which were large and more irregular in form than usual, of a rose-colour and protruding in the region of the dorsal tentacles. This may probably prove to be a distinct species.

The three specimens obtained at Cullercoats had all taken up their residence immediately below the dorsal skin in the neighbourhood of the heart. They lay across the visceral chamber, resting with their under surface upon the alimentary tube and ovary, which they clasped with their lateral processes; the thorax, moreover, is undoubtedly held close to these parts by the two pairs of hook-formed thoracic feet, while the large uncinate antennæ lock the head also to the part attacked.

As in the former species, the abdomen penetrates the skin, in this instance amidst the dorsal or branchial papillæ. Here the ovigerous sacs, which are about as large as those organs, float, bathed, no doubt, by the branchial currents of the unfortunate *Doto*; so that the eggs are thus vivified by the organic labour of the sustaining animal, as is the case also in the species first described.

The two parasites forming the subject of this communication are remarkable for their great size in comparison with the animals which they infest. *Splanchnotrophus gracilis* is not very much shorter than the length of the liver upon which it lies, and which it almost encircles with its arm-like processes; while *Splanchnotrophus brevipes* nearly occupies one-third of the visceral cavity of *Doto coronata*, and lives in a position where it might be thought to interfere with the central organs of circulation; and in the case of *Eolis rufibranchialis*, before alluded to, the parasite must have been in contact with the cerebral ganglions. Yet these animals seemed perfectly unconscious of the presence of the insidious foe that was feeding upon their life's blood. They moved about apparently quite at their ease, and were in no way distinguishable from unafflicted individuals, except by the presence of the protruding ovigerous sacs of the parasite. They had mostly attained their full growth, and there seemed every probability of their living the usual time allotted to the life of the species. When they perish, the contained parasite must perish also; for it is an inert, helpless creature, quite incapable of any active exertion in search of food or for self-preservation. No doubt, however, in the larval state it is endowed with the locomotive powers necessary to enable it to approach, select, and take up its abode in the creature most suited to its economy, where, soon losing the higher powers of its youthful state, never again to assume them, it becomes fixed for the remainder of its life.

The parasite, lodged within the body of its selected victim, is entirely cut off from the aërating influence of the surrounding water, with the exception of the tip of its microscopic abdomen and the ovigerous sacs. In the male, however, no part of the animal is exposed. Gills to a creature so situated could be of no use, and here it is quite impossible for any part of the surface of the parasite to act as their substitute. All internal parasites are similarly circumstanced as regards their respiration, and they, as well as the species under consideration, must derive their oxygen from that absorbed by the animals they infest. They extract it, most probably, either directly from the blood or from the exuded serum, which will at once nourish and aërate the tissues of the parasites, in the same manner as it acts upon the tissues of the animals from which they extract it. It is apparently in consequence of this low condition of the respiratory function that the ovigerous sacs of the parasite are placed, as we have seen, in the vicinity of the gills of the Nudibranch, where the ova obtain the advantage of the branchial currents of the infested animal. And it is interesting to remark that most of the allied forms of Lerneoidea, in which there are no respiratory organs, take up their abode on the gills of the sustaining animal, or at least in such a position that the branchial currents must pass over them. The Caligoidea, moreover, in which the respiratory organs are of low functional significance, avail themselves of the aid thus afforded by the animals they inhabit, some taking up their abode on the gills, others near to the fins of various fishes, whilst even those which attach themselves to the surface of the body are exposed to the almost perpetual currents occasioned by the general movements of the fish through the water.

In consequence of the opacity and soft condition of the specimen examined, the internal anatomy could not be made out; but, from the perfectly animalized nature of the food, we may fairly assume that the alimentary canal is very simple in its structure. We have seen that the organs of the mouth are minute and feeble, formed apparently for piercing and wounding the tissues, so that the fluids may escape. The fluids are imbibed perhaps chiefly by the aid of the largely developed labrum; for, although it is not in the form of a suctorial proboscis or tube, yet the posterior angles, which we have described as considerably produced, may, in life, be still more so, and perhaps entirely encircle the mandibles, so that an incomplete suctorial disk or tube may thus be extemporized.

Neither has much respecting the reproductive system been satisfactorily determined. The ovaries are lobulated organs, and occupy the greater portion of the cavity of the thorax, extending into the arm-like lateral processes even to their extremities. The ovigerous sacs are appended to the lateral angles of the first abdominal segment, through which each communicates with its ovary by a slit-like orifice placed diagonally (Pl. XV. fig. 4 *b*, & Pl. XVI. fig. 3). In one instance the sacs disappeared the second day after capture, and in the course of a few hours were replaced by others, in which the ova were evidently in a much less advanced condition of development.

The testes appear to be irregular-formed masses, lying in the thoracic cavity, in contact with and on either side of the alimentary canal. There are two elongated pyriform seminal vesicles (Pl. XV. fig. 11 *d*), placed in the posterior thoracic segments, with their attenuated extremities directed downwards, and terminating at the sides in two tubercular swellings (Pl. XV. fig. 11 *e*, & Pl. XVI. fig. 10) situated at the junction of the genital and succeeding abdominal segments. These swellings are the roots of the intromittent organs, through which their extremities may be seen occasionally protruding in the form of curved processes of no great length. They each communicate with their respective seminal vesicle by a short constricted duct-like tube, but the connexion of these vesicles with the testes could not be determined.

There can be no doubt that our two new parasites are rightly associated with the

Chondracanthidæ. In comparing the genus *Chondracanthus* with *Splanchnotrophus*, we see this relationship in the structure of the antennæ, the first pair in both being formed of few joints, the second pair in both assuming the form of strong prehensile hooks. It is, however, in the oral apparatus that this connexion is most evident. Both genera are provided with a largely developed labrum, which overhangs the oral orifice and mandibles, and is apparently capable, both in the one and the other, of encircling these latter organs within a sort of short imperfect suctorial tube or disk. In both, too, we observe the same peculiar rudimentary condition of the maxillæ; while the two pairs of foot-jaws have much in common: they are closely approximate to the mouth in each; but the second in the female of *Chondracanthus* are large, and have a transverse direction, instead of being directed forwards side by side as in *Splanchnotrophus*; it is satisfactory, however, to find that in the male of the former genus the second pair of foot-jaws are no larger than the first, and assume a longitudinal position between them and the maxillæ, exactly as is the case in the new forms described.

The connexion of *Splanchnotrophus* with *Chondracanthus* is likewise seen in the peculiar lateral appendages of the former. The remarkable conformation of these structures, together with the fact that they are used as clasping-members with which the animal enwraps the viscera on which it feeds, might lead the observer to entertain the impression that they were the homologues of thoracic feet. This, however, is not the case: they arise from the sides, not from the front, of the thorax, and are clearly digitiform processes of that division of the body, similar to those we find to exist in *Chondracanthus*; for the thorax of this latter genus is furnished in front with two pairs of organs, which are transformed thoracic feet, and these are homologues of the two pairs of feet we have described as existing in *Splanchnotrophus*, but, in addition to these two pairs of feet, the sides are produced into more or less numerous lobular or digitiform appendages homologous with the three pairs of simple arm-like processes in our new genus. This is evident from the general resemblance of the parts, and by the fact that in both cases portions of the ovaries are pushed into them. They are thus of a similar nature also to the lateral wing-like expansions of *Nicothoë*, within which portions of the ovaries are also placed; and in *Nicothoë* these expansions cannot be homologous with the thoracic feet, because the full number of these limbs is present in the usual form. Moreover, in *Splanchnotrophus* it is quite impossible for these processes to form part of a series with the thoracic feet, whether or not the latter are the first and second pairs. Indeed, the anterior and posterior lateral processes are respectively in the same transverse line with the two pairs of thoracic feet, and consequently they must be members of the same segments to which the feet belong. If therefore those organs which we have called thoracic feet be really so (and of this there can scarcely be a doubt), then the lateral arm-like appendages cannot represent them, and the conclusion is forced upon us that they are merely thoracic processes.

In further proof of the close relationship existing between *Splanchnotrophus* and *Chondracanthus* it is only necessary to look at the males of the two forms. In both genera they are minute, and in general appearance resemble each other, having the anterior cephalothoracic segment large, and the rest of the body attenuated and produced.

In the male *Chondracanthus*, too, the thorax and abdomen are nearly as well developed as in the new forms, only the segments are not so distinctly marked; and on the under side of the thorax, immediately behind the oral organs, there are two pairs of minute appendages, each bearing a seta and a stout process, which are the homologues of the two pairs of thoracic feet, and go far to prove the intimate relation of the genera. The oral organs also in the two males are even more alike than they are in the females—the second pair of foot-jaws closely resembling each other, while in the latter they exhibit some disparity.

Nicothoë likewise seems to be in some degree connected with our new form, though not by any means so intimately as is *Chondracanthus*. The lateral thoracic ovigerous appendages in the female, and the aggregation of the external ova in sacs, are evidences of this connexion. But the complete segmentation of the body and limbs in both sexes seems to place this genus in close proximity to the Cyclopoidea, though the peculiar character of the oral organs shows its affinity to the Pœcilopoda.

EXPLANATION OF THE PLATES.

Plate XV.

Fig. 1. *Splanchnotrophus gracilis*, femele; ventral view, much enlarged: (*a*) thoracic feet; (*b*) lateral arm-like processes; (*c*) first abdominal segment, with portions of the ovigerous sacs attached.

Fig. 2. Ventral view of the posterior portion of the body of the same, more highly magnified: (*a*) terminal extremity of the thorax, exhibiting the appearance of forming a distinct segment; (*b*) first abdominal segment, with remains of ovigerous sacs appended; (*c*) second or terminal segment, forming the bifid tail; (*d*) posterior pair of thoracic feet; (*e*) roots of posterior pair of lateral processes.

Fig. 3. Much-enlarged view of the oral organs of the same, as observed under slight compression: (*a*) first antennæ; (*b*) second antennæ; (*c*) labrum; (*d*) mandibles; (*e*) maxillæ; (*f*) first foot-jaws; (*g*) second foot-jaws.

Fig. 4. View of the abdomen of the same, as seen in the compressor: (*a*) first segment; (*b*) orifice for the passage of the eggs into the ovigerous sacs (*c*); (*d*) second segment; (*e*) tail.

Fig. 5. Anterior thoracic foot, much enlarged: (*a*) second member of the same.

Fig. 6. Posterior thoracic foot: (*a*) second member.

Fig. 7. *Splanchnotrophus gracilis*, male; enlarged lateral view: (*a*) first antennæ; (*b*) second antennæ; (*c*) thoracic feet; (*d*) first abdominal segment.

Fig. 8. Ventral view of the same, exhibiting the antennæ, oral organs, and thoracic feet.

Fig. 9. Much-enlarged view of the oral organs of the same, seen by reflected light: (*a*) labrum; (*b*) mandibles; (*c*) maxillæ; (*d*) first foot-jaws; (*e*) second foot-jaws.

Fig. 10. One of the thoracic feet of the male, highly magnified.

Fig. 11. Highly magnified view of the terminal tail-like segments of the body, seen by transmitted light: (*a, a, a*) the three posterior thoracic segments; (*b, b*) abdominal segments; (*c*) tail; (*d*) seminal vesicles; (*e, e*) male intromittent organs.

PLATE XVI.

Fig. 1. Enlarged view of *Doto coronata*, laid open along the back, to exhibit an enclosed *Splanchnotrophus brevipes* in its natural position : (*a*) dorsal surface of the parasite ; (*b*) ovigerous sacs.

Fig. 2. *Splanchnotrophus brevipes*, female, ventral view : (*a*) thoracic feet ; (*b*) lateral processes ; (*c*) ovigerous sacs.

Fig. 3. Ventral view of the abdominal segments of the same, as seen in the compressor, much enlarged : (*a*) first segment, exhibiting the orifices for the escape of the eggs into the external sacs ; (*b*) portions of the sacs ; (*c*) posterior segment ; (*d*) tail.

Fig. 4. Dorsal view of terminal extremity of the body of the same : (*a*) portion of the first thoracic segment ; (*b*) second thoracic segment ; (*c*) first abdominal segment ; (*d*) fragments of the ovigerous sacs attached to the same ; (*e*) second abdominal segment, supporting the tail.

Fig. 5. A thoracic foot of the same.

Fig. 6. Enlarged view of one of the first antennæ, as imperfectly observed.

Fig. 7. First antenna of male of *Splanchnotrophus gracilis.*

Fig. 8. Mandible of the same, much enlarged.

Fig. 9. First foot-jaw of the same, as it occasionally appears, denticulated.

Fig. 10. One of the male intromittent organs, highly magnified.

W West imp.

E. M. Williams [illegible] W. West [illegible]

III. *On the Development of* Chloëon (Ephemera) dimidiatum.—Part I.

By JOHN LUBBOCK, *Esq., F.R.S., F.L.S., F.G.S.*

(Plates XVII. & XVIII.)

Read January 15th, 1863.

Introductory Remarks.

BURMEISTER expresses, I believe, the opinion general among entomologists when he says that, excepting a few very rare anomalies, "we may observe four distinct periods of existence in every insect, namely, those of the egg, the larva, the pupa, and the imago" *. In most cases (as, for instance, in Diptera, Lepidoptera, Hymenoptera, and Coleoptera), the larva is said to be a fleshy maggot or caterpillar, quite unlike the imago; and these insects are therefore called by Prof. Westwood "Heteromorpha." In the Orthoptera, Hemiptera, Euplexoptera, and many Neuroptera, on the contrary, the larvæ much more closely resemble the imago; and these groups are therefore called by Prof. Westwood "Homomorphous" insects. In them, the pupa is said to differ from the larva in possessing wing-rudiments on the back of the two posterior thoracic segments.

These differences, however, relate only to what we see in insects after birth; while, if we are to treat the question in a philosophical manner, we must examine the development as a whole, from the commencement of the changes in the egg, up to the final completion of the animal, and not suffer ourselves to be misled by the circumstance that insects do not all leave the egg in the same stage of embryonal development. Quatrefages has well said, "La larve n'est qu'un embryon à vie indépendante" †, expressing with his usual brilliancy the idea which we owe, I believe, to Prof. Owen‡, who says, "The insects which are said to be subject to the semicomplete and incomplete metamorphosis pass through the same kind and amount of change as those characterized by the obtected or coarctate pupa. The differences resolve themselves essentially into the place where, and the time in which, they assume and quit the vermiform state." And again, "The Orthopterous and Hemipterous insects, characterized in entomology by a semicomplete metamorphosis, are, at one stage of their development, apodal and acephalous larvæ, like the maggot of the fly; but, instead of quitting the egg in this stage, they are quickly transformed into another, in which the head and rudimental thoracic feet are developed to the degree which characterizes the hexapod larvæ of the *Carabi* and *Petalocera*." I know not upon what authority this broad statement rests. Mr. Murray, indeed, at one time supposed that in some eggs of *Blatta* he had seen the larva in this grub state, but this statement has since been abandoned by its candid and

* 'Manual,' translated by Shuckard, p. 30. See also Curtis in the Journ. Agricult. Soc. vol. ii. p. 192.

† Métamorphoses de l'Homme et des Animaux, p. 133.

‡ Lectures on the Comparative Anatomy, &c., of the Invertebrate Animals, 2nd edit., pp. 423, 424.

ingenuous author. With the exception of this genus, I am not aware that the development of any Orthopterous or Hemipterous insect has been worked out.

Two memoirs bearing on the subject have, however, since appeared, namely, Zaddach's "Die Entwickelung des Phryganiden-eies," and Huxley's memoir on *Aphis*, which appeared in the Transactions of this Society. Zaddach figures (fig. 19) and describes a state in which the embryo of *Phryganea* is a grub, with an imperfect, though segmented, body, but without any appendages; yet, he says, this condition lasts only for a short time, and may therefore easily be overlooked. Prof. Huxley also * has shown that there is, in the development of *Aphis*, a particular period at which the embryo presents, on the sternal side, traces of segmental divisions, without having even rudiments of legs. Thus then it appears that in both these cases the so-called "larva" is preceded by an apodal body, corresponding in some respects with the grubs of Diptera. It is unnecessary to remark, that the change from this grub-like embryo to the so-called "larva" is produced by gradual modification, and not by any process of moulting. But, in considering the matter, we must also bear in mind that the apodal body of the embryonic *Aphis* or *Phryganea* is in a very different condition from the maggot of a fly. Not only are the internal organs, so far as our information goes, entirely undifferentiated, but the dorsal walls themselves are not as yet formed.

But however this may be, and even in the case of insects with an incomplete metamorphosis, it is the general opinion of entomologists that the life may be divided into three periods, each marked by a change of skin and an alteration of form. "After the first change," says Burmeister †, "the larva has merely increased in size; but during this second period of its existence, the rudiments of the wings form beneath the skin; consequently, after the second moulting, these incipient wings present themselves externally as small leaves, which cover the sides of the first abdominal segment: these larvæ are called nymphs, being analogous to the pupa-state of other insects. When this pupa again moults, the insect attains its perfect condition."

Prof. Owen also, although, as we have seen, he considers that the period corresponding to the larva of Diptera, Lepidoptera, &c., is, in insects with an incomplete metamorphosis, passed in the egg, still appears to consider that the life even of these last falls into three well-marked periods.

I shall, however, show that in several insects there is no such well-marked, threefold division; and that, in the Ephemeridæ at least, the young insect gradually attains its perfect condition through a series of more than twenty moultings, each accompanied by a slight change of form. Fig. 10 represents the state at which the first rudiments, or rather indications, of wings make their appearance, in the form of a scarcely perceptible production of the posterior meso- and metathoracic angles; and it will at once be perceived that the amount of change is very slight indeed.

Probably our opinion has been too much influenced by the well-known metamorphoses of Lepidoptera, and we have expected to find the same changes and the same uniformity throughout the insect-world.

Even now, however, a certain number of exceptional cases are upon record, and we

* "On the Organic Reproduction and Morphology of *Aphis*," Linn. Trans. vol. xxi. part 3. † *Loc. cit.* p. 429.

shall probably find that there are far more variations than we are most of us, at present, prepared to accept.

Among Coleoptera, we owe principally to Newport and Fabre a knowledge of the curious and complicated metamorphoses through which *Meloë* and *Sitaris* arrive at maturity.

Among the Diptera, the interesting case of the "Pupipara" has long been known; and I have also shown * that the curious larva of Lonchoptera turns into a simple grub inside the cast skin, before it developes the rudimentary, or at least imperfect, organs which are characteristic of the pupa.

The metamorphoses of the Physapoda (*Thrips*) are thus described by Mr. Haliday †:—"Metamorphosis incompleta, per duas ætates intermedias progrediens, scilicet, propupa et pupa, asitophaga, tardigrada. Larva oculorum lenticulis paucis dissitis."

M. Yersin has described several stages in the development of *Gryllus campestris.*

Among the Homoptera, I have satisfied myself that in *Typhlocyba*, a genus of Cercopidæ, there are at least five well-defined stages, while in *Aphis* also there are more than three.

Among the Neuroptera also, the genus *Psocus* seems to pass through at least four conditions.

No doubt this list might easily be augmented; but it is at least sufficient to show that the presence of three stages, and three stages only, is far from being so generally true of insects as has been supposed.

If now we attempt to ascertain the secondary laws which regulate the form under which any given family of insects is hatched, we shall find that, the whole development being in a certain sense in all cases the same, the rapidity with which the different organs are developed varies in different insects; and that the condition at birth depends partly on the group to which it belongs, but perhaps still more on the manner in which it is to live.

Thus, those larvæ which are internal parasites, whether in animals or plants, belong to the vermiform state; and the same is the case with those which are intended to live in cells, and to depend on their parents for food. On the other hand, larvæ which are to burrow in wood have strong jaws, and somewhat weak thoracic legs; those which are to feed on leaves have the thoracic legs more developed.

Now the Hymenoptera, as a general rule, belong to the first category: the larvæ of the Ichneumons, &c., which live in animals,—those of the Cynipidæ, which inhabit galls,—and those of Ants, Bees, Wasps, &c., which are fed by their parents, are all fleshy, apodal grubs. On the other hand, the larvæ of *Sirex*, which are wood-burrowers, quit the type which is common to the majority of the order, and remain in the egg until they have developed small thoracic legs. Again, the larvæ of the Tenthredinidæ, which feed upon leaves, closely resemble the caterpillars of Lepidoptera, even to the presence of abdominal prolegs. There is, however, some little variety in this respect, some species having eleven pairs, some ten, some nine, while the genus *Lyda* has only the three thoracic pairs.

Perhaps, however, the most remarkable cases of all are the genera *Meloë* and *Sitaris* among the Coleoptera. The insects of this group are at first active hexapod larvæ; but

* Entomological Transactions, 1862.

† British Museum Catalogue of Homopterous Insects, p. 1094.

having introduced themselves into the cells of certain species of Hymenoptera, they undergo a retrograde metamorphosis, lose their legs, and emerge as grubs, not altogether unlike those whose places they have usurped.

When an insect is destined throughout life to exist in the same manner and to use the same food, then it leaves the egg with the principal organs constituted in the same manner as in the imago.

Thus, then, we may lay it down as a general rule, that the form of an insect at its birth is a function of the life which it is to lead, and of the group to which it belongs; and that insects are generally born at a period in their development as early as is consistent with the life to which they are destined.

There are doubtless many apparent exceptions. Thus, among the Diptera, lignivorous larvæ, like those of some Tipulidæ, terricolous larvæ, like those of others, and predaceous larvæ, as in *Syrphus*, are all fleshy, apodal grubs. A better acquaintance with their habits would probably explain the anomaly: the lignivorous Tipulidæ, for instance, principally affect decaying wood; and in the case of *Syrphus*, we may already see that the condition of the young larva, surrounded by crowds of helpless Aphides, differs in reality but little from that of an internal parasite.

But while the preceding has reference to the degree of change which takes place after birth, the manner also must be considered. In some insects the development is slow and gradual, while in others the growth is effected without any material change of form, and the metamorphosis, if not sudden, is at least comparatively rapid.

Now, as long as any organ continues to be in a state of functional activity, the changes taking place in it must be slow and gradual; when therefore the metamorphoses are rapid, and are accompanied by only one or two changes of skin, we at once see that they necessitate a period of quiescence. When, moreover, as in the Lepidoptera, a mouth, originally mandibulate, is destined to become suctorial, any such gradual change would be inconvenient or impossible; the insect might starve in the meantime. Here, therefore, it becomes desirable that the change should be rapid. The Hemiptera, indeed, which are suctorial, are also active through life; but in them the mouth of the larva is constituted in the same manner as that of the imago.

Again, when extensive changes have to take place in the muscular system, a period of enforced quiescence is the result. Some of the aquatic Diptera offer, indeed, an apparent exception; but in these the muscles which move the pupa are those of the abdomen, while those of the imago are situated in the thorax.

It may still be asked, to what general cause can we ascribe these metamorphoses? why should not insects remain in the egg until their generic and specific characters are fully developed? Omitting for the present all consideration of terrestrial animals, we cannot but be struck by the poverty of the freshwater fauna when compared with that of the ocean. The Mollusca are far less numerous and less varied; of the Fish the same may be said; compared with those of the sea, our freshwater Bryozoa are quite insignificant in numbers; the Hydrozoa are represented by only two genera. Among Crustacea, the Podophthalms have in this country but one freshwater species, the Isopods one, the Amphipods very few; Entomostraca, indeed, are well represented, but Cirrhipedes are altogether absent; neither the Actinozoa nor the Echinodermata have a single freshwater representative.

But while so many families are absent, their places are not left unoccupied. Not only do the insects themselves in a great measure restore the balance, but their larvæ also do much to relieve the monotony. Many situations are thus filled; much food is thus perhaps made available which would not otherwise contribute towards the support of animal life.

Insects, indeed, are not the only animals which undergo metamorphoses even after birth; every subkingdom supplies some instance. In this manner perhaps the world supports more life, and the sum of happiness is therefore greater, than would be the case if every creature arrived at its perfect form before quitting the egg.

I have still used the old word "larva" to denote the first part of the life of an insect after birth. If, however, there is any truth in the preceding observations, it is evident that the so-called "larva" of a Fly corresponds properly neither with that of a Moth nor with that of a Grasshopper, and it is always inconvenient to use one word with several meanings. Much of the confusion in political economy has arisen from the unfortunate use of the word "money" to mean either capital in general or the circulating medium in particular.

And yet it would be very difficult to remedy the inconvenience in the case of the word "larva." Not only is it almost necessary for entomology that there should be one word to denote the early stages in the life of an insect, but it would be perhaps impossible to give the word a more definite meaning without restraining it within very narrow limits. In fact, insects leave the egg in every possible stage of development. The maggots of Flies, in which the appendages of the head are rudimentary, belong to a lower grade than the grubs of Bees, &c., which have antennæ, mandibles, and maxillæ, labrum, labium, and, in fact, all the mouth-parts of a perfect insect.

The caterpillars of Lepidoptera are generally mentioned with the larvæ of Diptera and Hymenoptera, and placed in opposition to those of Orthoptera, Hemiptera, &c. But, in truth, the possession of thoracic legs places them, as well as the similar larvæ of the Tenthredinidæ, on a decidedly higher level, while in the development of the cephalic appendages there is, as already mentioned, a marked difference between the maggots of Flies and the grubs of Bees.

Thus then the period of growth (that in which the animal eats, and increases in size) occupies sometimes one stage in the development, sometimes another; sometimes, as for instance in the case of *Chloëon*, now to be described, it continues through more than one,—or, in other words, growth is accompanied by development.

But, in fact, the question is even more complicated than this. It is not only that the larvæ of insects at their birth offer the most various grades of development, from the grub of a Fly to the young of a Grasshopper or a Cricket; we have not to deal only with a simple case of gradation, but we have a series of gradations, which would be different according to the organ which we took as our test. We have already seen that the larvæ of *Phryganea* and those of Diptera and Hymenoptera differ in the development of the viscera and of the appendages,—the viscera being in the two latter orders formed before the appendages, while in *Phryganea* and some other insects the reverse appears to be the case; and we shall even find in the same species minor variations in the relative development of different organs.

The Development of Chloëon.

With these few introductory observations, I will pass on to consider the development of the larvæ of *Chloëon dimidiatum**, which are very common in our Kentish ponds.

They have not escaped the notice of previous observers, but I am not aware that either they or any other insects belonging to the homomorphous series have ever been watched through their various changes. The development of the Ephemeridæ is thus described by Pictet †:—"Les métamorphoses sont incomplètes. Les larves vivent dans l'eau, s'abritant dans la vase ou sous les pierres. Elles rappellent plus ou moins la forme de l'insecte parfait, sauf qu'elles manquent d'ailes, qu'elles sont plus fortes, que leur bouche est mieux armée, qu'elles ont toutes trois soies caudales, et que leur abdomen est muni sur ses côtés d'organes respiratoires externes de forme variable. La nymphe, agile comme la larve, n'en diffère que parce qu'elle porte des rudiments d'ailes." Prof. Westwood, again, says that the larvæ differ from the pupæ "only in the absence of rudimental wing-covers;" and other naturalists have, I believe, but repeated this statement.

First State (Pl. XVII. fig. 1).

The smallest specimens which I have seen were only $\frac{18}{800}$ths of an inch in length, quite colourless and transparent. Not having hitherto had an opportunity of breeding the insect from the egg, I am of course unable to state whether this is really the condition in which the young *Chloëon* leaves the egg; but for the present I shall, for convenience, assume that it is so. The head is shaped somewhat like a capital A, and is $\frac{3}{800}$ths in width. The eyes are five in number, round, and equal in size. Two are situated on the posterior angles of the head; two are in front, and somewhat further apart, so that, being placed on the sloping side of the head, they look elliptic, though in reality round. The fifth, which perhaps is normally composed of two, lies more in front and in the middle line. The general appearance of all five is similar; and I could see no trace of any facets.

The antennæ (fig. 18) are $\frac{11}{800}$ths in length, and consist of thirteen segments. The first is short, and tapers from the base to the apex; the second is also short, but tapers in the opposite direction, *i. e.* from the apex to the base. The third segment is long and cylindrical; it has two or three hairs near the apex. The four following segments are together about equal in length to the third; the divisions between them are, however, but slightly marked, and the seventh only has the usual hairs at the apex; so that it may be doubted whether it would not be perhaps more correct to consider this division of the antenna as constituting only a single segment. The same description applies to the four following segments; the twelfth tapers to the apex, and bears a fine, needle-like body, which might be called a seta almost as well as a segment.

* The name has been kindly determined for me by my friend Mr. F. Walker.

† Histoire naturelle des Névroptères: Ephémérines, p. 5.

The separations between the three thoracic segments are not very distinct. The prothorax is rather the largest of the three, and, as does also the metathorax, equals the head in breadth.

The legs are well developed, and are adapted for walking, but not for swimming; still they are not strong enough to support the body out of water. They consist of the usual five divisions: the two basal are short, and might almost be considered as one; the other three are long and cylindrical, the femur being the longest, and the tibia rather shorter than the other two.

The claw is large, and resembles a clasp-knife in shape. There are a few strong simple hairs scattered over the legs, two or three at the apex of each segment, in addition to which the tarsus has one near the middle. Those which are on the upper side of the leg are delicate and thin; but those on the under side are much stronger, as the insect rests on them when walking. The tarsus has only one of these supporting hairs.

The abdomen consists of ten segments, which decrease gradually in breadth from the first to the last. The eighth, ninth, and tenth are rather longer than the rest. The second and four following segments increase slightly from in front to behind: this condition is no doubt connected with the subsequent production of the so-called gills; it is most strongly marked in the third, fourth, and fifth segments, just as the gills attached to these segments will at first be the largest.

No tracheæ are as yet visible; respiration must therefore take place by the outer surface of the body.

The posterior segment bears two long, many-jointed caudal filaments or tails. They are rather longer than the body, though very slightly so, and consist of nineteen segments. The basal is $\frac{5}{800}$ths in length, cylindrical, slightly enlarged on the inner side near the base, and has several transverse ridges, which have at first sight much the appearance of joints, but which are in reality rather comparable to those numerous minutely toothed ridges, which, when the insect is rather older, give the whole skin a shagreened appearance. The apex is surrounded by a circle of strong teeth, near which, or rather closer to the terminal ridge, are one or two minute hairs.

The second division of the tail is $\frac{4}{800}$ths in length; it is divided into five segments by ridges which, though resembling those above described, are (and especially the apical one) more strongly marked and more persistent. As in the basal segment, the terminal ridge bears three or four hairs, and the apex of the division is surrounded by a circle of short spines.

The third division of the organ is likewise divided by ridges into five segments, which, except that they are slightly slenderer, in all respects resemble those of the second division.

The six following segments call for no special description. The twelfth, thirteenth, fifteenth, sixteenth, and seventeenth are of moderate length, the fourteenth being shorter. The sixteenth and seventeenth segments have each a hair near the apex. The eighteenth is longer and slenderer; the nineteenth, like the terminal segment of the antennæ, tapers to a very sharp point, and resembles a hair almost as much as a segment.

These appendages do not appear to be as yet of much use in swimming, which is, I think, at this age effected principally by means of the abdomen. This latter is very moveable, and is continually jerked upwards, even so much as to throw the caudal setæ in front of the head, which gives the young insects a singular resemblance to the caterpillars of the Puss-moths. I have especially noticed that this movement takes place when any still minuter creature touches the young *Chloëon*; the tails, therefore, most likely serve as organs of defence, but perhaps also partly for sensation. The larger larvæ never bring them forward over the body, perhaps because the continual vibration of the branchiæ renders such a movement unnecessary.

In moulting the insect does not split the skin of the thorax, as is so generally the case, but merely that on the upper part of the head. It is wonderful, indeed, how it can escape through so small an orifice.

Second State (fig. 2).

A specimen, which I met with in the above-described condition on the 21st September, had undergone a moult by the following morning. From the analogy of subsequent development, it is most probable that the first state lasts only two or three days at most. In the second state the total length is still only $\frac{20}{800}$ths. The general form of the body is the same as before; but the posterior angles of the second and four following segments are, especially those of the third, fourth, fifth, and sixth, more strongly produced.

The antennæ (fig. 19) are $\frac{15}{800}$ths in length, but they consist of only the same number of segments as before. The first two and the last ten, moreover, have scarcely increased in size; but the third, which in the first stage was only $\frac{5}{1600}$ths in length, has about doubled itself. We shall presently see how great a part this segment takes in the subsequent development of the organ.

The tarsi have two "supporting" hairs.

The two tails have increased to a length of $\frac{25}{800}$ths, and consist of twenty segments. Here again, as in the antennæ, almost the whole change has taken place in one segment, which, however, is in the present case the basal one. The remainder are almost exactly as they were before. As already mentioned, the basal segment was in the first stage $\frac{5}{800}$ths in length; in the present it has divided into two segments, which, taken together, are $\frac{9}{800}$ths; and we see therefore that almost the whole increase of length is in this one part. The second segment is somewhat shorter than the first. The minute ridges surrounding the basal segment have almost disappeared.

Between the two tails is a minute knob, which, as we shall see, is destined to become far more important than its present appearance would indicate.

The whole skin of the insect, including not only that of the body, but also the antennæ, legs, and caudal appendages, is beset with little teeth, which fall more or less into regular rows. The last row on each segment consists of teeth much larger than the others, and forms a sort of fringe of spines. This applies not only to the body, but also to the legs and basal part of the antennæ and tail. On the segments of the body, these spines are most distinct on the central part of the dorsal margin, and especially on the posterior segment, where also two or three of the spines are much larger than the rest.

On the sides of the body are several small circles, which look almost like holes, but of which I cannot explain the function. In very young larvæ they are few in number, but in the later stages they become very numerous. A specimen which I found on the 21st of September, and which then resembled fig. 1, changed its skin on the following morning, and then remained without much alteration until the 25th, by which time it had grown to $\frac{22}{800}$ths, when it moulted once more, and so entered the

Third State (fig. 3),

which lasts for two or three days, during which the insect grows from $\frac{22}{800}$ths to $\frac{26}{800}$ths or $\frac{28}{800}$ths in length.

The posterior eyes are now about twice as large as the three front ones; so that the distinction between eyes and ocelli begins at this early stage, though we have seen that at first they are very similar. I could not distinguish any facets.

The antennæ (fig. 20) are $\frac{20}{800}$ths in length, and now consist of fifteen segments, the two new ones being formed at the expense of the third, in which also almost the whole increase of length has taken place. The apices also of these three segments differ from those of all the others in being surrounded by a circle of teeth, as was, indeed, the case with the third segment in the preceding state, when, however, the teeth were smaller and less conspicuous. Of the two new segments, the basal one is rather the shorter. The terminal segments have increased slightly in size, but not in number; indeed, several of them are even less strongly marked than before; this is particularly the case with the two which are now the tenth and eleventh, and between which scarcely any division is visible.

The tarsi have three supporting hairs.

The posterior angles of the second and four following abdominal segments are much less produced than before; but then, on the other hand, each of them supports a small, oval, leaf-like appendage, the first appearance of the branchiæ. Those attached to the third and fourth segments are the largest, and are almost as long as the segments themselves; the second and fourth are somewhat smaller; the fifth still less; while the first is almost rudimentary. The seventh segment has the posterior angles somewhat produced, in preparation for the posterior branchiæ, which will make their appearance after the next moult. I could see no tracheæ either in the body or in the gills, even in this, the third stage in the animal's free existence.

The two tails are now $\frac{34}{800}$ths in length, and consist of twenty-four segments,—the whole increase in the number of joints, and almost all that in the length, being due to the basal portion, which is almost double as long as it was before, and constitutes now just half of the total length. I believe that what was in the last stage the second segment now forms the fifth and sixth, the four basal being due to the subdivision of the first. Each of these segments has a ring of teeth round the apex; but the rings are not all equally well marked, those round the second, fourth, and sixth being larger than the other three. Each of the six basal segments has also one or two hairs near the apex. The eighteen terminal segments are almost unaltered.

The little knob between the two tails is larger than before, and pyriform.

Fourth State (fig. 4).

The fourth state, like the third, lasts only two or three days, at the end of which time the insect has attained a length of about $\frac{32}{800}$ths.

The antennæ (fig. 21) are $\frac{24}{800}$ths in length, and the segments are seventeen in number, the increase both in length and number being again due to the third segment, the rest of the organ having remained almost stationary.

Owing to the fact that the split, through which the insect emerges, runs along the top of the head, it is difficult to study the development of the eyes; but I noticed that on each side of the upper part of the head there was a group of the curious "rings" which I have already mentioned.

The tarsi still have three or four supporting hairs, the number being the same on all the legs.

The gills are more developed than before; the five intermediate pairs stand out at right angles with the body, while the first and last are still rudimentary, the first, however, being the more advanced of the two. The five intermediate gills begin to vibrate soon after the change of skin, but the motion is not so continuous as it subsequently becomes. The tracheæ in them, though small, are easily visible, and communicate with the great longitudinal trunks. The circulation of the blood is also apparent, and the beating of the heart can be distinctly seen. In form the gills resemble a sharp pear; they are about $\frac{1}{400}$th in length; the front margin is, for half its length, strengthened by having the border somewhat thickened; the margin is more or less waved; and each gill, excepting the first and last, which are still rudimentary, has a small hair in the middle of the free edge, as well as sometimes one or two elsewhere.

The caudal appendages are about $\frac{35}{800}$ths in length, with twenty-eight segments.

The basal part now consists of ten segments, instead of six: my impression is that the four basal have divided.

The terminal segments are almost unaltered. The circles of spines are largest round the second, fourth, sixth, and eighth segments. In addition to the two or three hairs near the apex of each segment, the ninth has on the inner side, somewhat nearer to the apex than the base, a long hair, which is the commencement of the swimming-fringe.

The knob between the two tails is again larger, but still consists of only one segment.

Fifth State (fig. 5).

The fifth state, like the third and fourth, lasts for two or three days, beginning when the insect is about $\frac{32}{800}$ths in length.

The antennæ are $\frac{25}{800}$ths to $\frac{32}{800}$ths in length, and consist of twenty segments. The ten apical ones are almost unaltered: the arrangement of the hairs is as before, and, what is very remarkable, these segments have scarcely increased at all in size; indeed, their length is little greater than in the smallest specimen examined. Some, however, of the segments are much less strongly marked, and, indeed, but for their homologies with the same parts in earlier stages, I should have considered that there were only five segments in this portion, as practically the first four on the one hand and the second three on the other have coalesced.

I did not, in this state, see any facets to the eyes; but the posterior pair differ from the anterior three not only in size but in appearance, the posterior ones being brown, with indistinct traces of the separate eyes,—the ocelli, on the contrary, being composed of a greyish mass set in a black substance.

The supporting hairs on the tarsi are five or six in number.

The anterior gills have increased in size more than the others, and are now larger than the sixth pair. The posterior ones are still rudimentary. The first pair now commence to vibrate, but less continuously than the others, being often quiet when the five following pairs are in motion. The posterior gills differ from all the rest in possessing no power of vibration, either at this age or at any subsequent period.

The caudal appendages are $\frac{44}{800}$ths in length. The eighteen terminal segments are unaltered, except that the first five of them have coalesced, so that they can no longer be distinguished as separate segments. The basal portion now consists of seventeen segments; so that there are thirty-five altogether. As before, the circle of spines is larger round the second, fourth, sixth, and eighth than on the other segments. The swimming-fringe commences on the eleventh segment, and is represented by a single hair on the inner side, and somewhat nearer the apex than the base. Some of the segments, however, have two such hairs.

The central caudal appendage is again about twice as long as before, and almost equals the basal segment of the lateral tails. It is, however, still unjointed.

Sixth State (fig. 6).

The animal moults again when it has attained the length of from $\frac{35}{800}$ths to $\frac{40}{800}$ths.

The antennæ have a length of $\frac{35}{800}$ths, and the third segment has again divided into three parts, of which the basal is the longest and the middle the shortest; so that, from the fourth to the twelfth inclusive, the segments increase in length as they diminish in diameter. If no other change had taken place, the total number of segments would, of course, under these circumstances, be twenty-two; but, practically, there are only eighteen, those four segments which were originally the fourth, fifth, sixth, and seventh having completely coalesced, and the same thing having taken place also with the two following.

The large posterior eyes now consist of a number of dark spots on a paler ground.

The tarsi have seven supporting hairs.

The lateral tails are $\frac{50}{800}$ths in length, and consist of twenty-six segments. The three terminal segments have undergone little alteration, the two basal divisions of five segments and the four basal segments of the third quintet (if I may use the expression) having respectively coalesced, so as to form now only four segments. This terminal portion of the tail, therefore, resembles the terminal part of the antennæ in the gradual coalescence of originally distinct segments, and offers an additional resemblance in the remarkable fact that it has not at all increased in length. The basal segment, on the contrary, like the third segment of the antennæ, has rapidly developed itself. When the whole organ was $\frac{21}{800}$ths in length, it measured $\frac{5}{800}$ths; in this sixth state it has produced, directly or indirectly, nineteen new segments, which have a length of $\frac{34}{800}$ths, and have therefore almost monopolized the whole increase.

In the antennæ, however, the new segments appeared to me to be always detached from the apical extremity of the third segment itself; in the tails, on the contrary, the young segments again subdivided,—a difference connected perhaps with the much more rapid increase of length. Only a few, however, subdivide at each moult: thus, the number, which in the last stage was seventeen, is now twenty; the consequences are that the length of these segments does not increase so regularly as is the case with the growing part of the antennæ, and that the circles of spines round the apices are of different sizes, being of unequal age. The two basal segments appear generally to divide, so that the spines at the apices of the second and fourth segments are larger than those on the first and third. In some specimens, however, the two tails differ slightly in this respect. The fringe now commences on the eighth segment, which, with the three following, has a single hair on the inner side; the next two or three have each two hairs, then follow two or three with three, after which they again decrease. They are confined to the developing part of the tail, and are independent of, and in addition to, the ordinary apical setæ.

The central tail is now $\frac{4}{800}$ths in length, and consists of two or three, but indistinctly separated, segments. It is stout in proportion to its length, and terminates in a rounded, soft extremity, very much as the lateral tails do if by any accident they have been injured. This mode of termination is not, however, in the present case the result of injury, but is probably connected with the rapid growth which is taking place.

Seventh State (fig. 7).

The sixth state does not last much longer than the earlier ones. In my specimens, the next moult took place when the insects were from $\frac{38}{800}$ths to $\frac{40}{800}$ths in length.

The antennæ are about $\frac{36}{800}$ths, and consist of twenty segments, the third having again divided into three.

The supporting spines on the tarsi have again increased in number.

Up to this time the branchiæ have been single, and, indeed, they are so still; but the larger ones already show on the posterior margin a slight lobe, which eventually becomes a second plate (Pl. XVIII. fig. 22).

The lateral tails are slightly longer than the body, and consist of thirty-two segments. The hairs forming the commencement of the fringe are rather more numerous. The terminal portion of the tail is unaltered.

The middle tail is from $\frac{8}{800}$ths to $\frac{12}{800}$ths in length, and consists of about six segments, one or two of which, however, are sometimes very indistinct.

Eighth State (fig. 8).

The insect moults again in about three days, when it has a length of from $\frac{45}{800}$ths to $\frac{50}{800}$ths.

In a specimen $\frac{55}{800}$ths in length, the antennæ were $\frac{46}{800}$ths in length. They consist of twenty-three segments, the third having divided into four; the penultimate segment has been becoming a little shorter at each moult.

The secondary lobe of the branchiæ is larger and more distinct.

The lateral tails are about $\frac{60}{800}$ths in length, and consist of about thirty-six segments. The circles of spines are most strongly marked on the second, third, fifth, seventh, ninth, eleventh, and thirteenth segments. The fourteenth and five following segments are slightly darker than the rest. The fringe begins on the ninth segment, and extends to the twenty-sixth, inclusive. None of the segments have as yet more than four setæ.

The middle tail has increased to $\frac{25}{800}$ths, and possesses twelve segments. At its base it is almost as broad as the lateral ones. As in them, the apex of each segment is surrounded by a circle of small spines, and has two or three small hairs, in addition to which the tenth and eleventh have on each side, near the apex, a longer hair. These are the commencement of the swimming-fringe. The skin of the central tail has the usual shagreened appearance.

Ninth State (fig. 9).

While large specimens are often as much as $\frac{50}{800}$ths when they enter the eighth stage, small ones, even in the present condition, are only $\frac{48}{800}$ths in length. This, together with the fact that out of the specimens which I examined not one in twenty had escaped some injury to the tails or antennæ, rendered a precise determination of the exact length and number of segments in each appendage very difficult and very slow *.

I do not indeed suppose that mutilation is so frequent while the insects are in their native ponds, but the process of capture must necessarily be very injurious to such delicate little creatures.

A specimen $\frac{60}{800}$ths in length had antennæ of almost exactly the same length, and lateral tails $\frac{68}{800}$ths in length.

The antennæ consist of about twenty-six segments, the third having again divided into four. I say, however, about twenty-six, because the upper part of the third segment shows indications of another joint, which will become distinct at the next moult, and which some naturalists might even consider so now.

Up to this time no traces of wings have been present. Now, however, the posterior dorsal angles of the meso- and metathorax are slightly produced, so slightly, however, that it is indeed scarcely perceptible. The mesothorax is a little larger than the metathorax, but in form they are almost exactly similar.

The apical circles of spines on the lateral tails are most strongly marked on the second, third, fifth, seventh, and eleventh segments. On some of the segments the fringe is represented by five setæ.

The central tail is about $\frac{32}{800}$ths in length, and consists of eighteen segments. The fringe is appearing on the twelfth and five following segments. The circles of spines are most strongly marked on the second, fourth, sixth, and tenth segments.

* As the insects grow older, these mutilations become more deceptive. It is always easy to distinguish them at first; but when after several moults the injury is almost repaired, individuals thus altered may easily be taken for normal specimens.

Tenth State (Pl. XVIII. fig. 10).

In the ninth stage the insect adds about $\frac{1}{100}$th of an inch to its length; as, however, they are not all of equal size when they enter it, so also at the next moult they vary from $\frac{55}{800}$ths to $\frac{75}{800}$ths.

A specimen $\frac{55}{800}$ths in length had antennæ $\frac{58}{800}$ths in length. They consisted of twenty-nine segments; but the penultimate has almost disappeared; and the apical would, I think, certainly be considered as a mere seta by any one who saw it in its present condition for the first time.

The posterior angles of the mesothorax are more produced: in the last stage the two posterior thoracic segments were similar, but already the difference between them is well marked.

The central tail is $\frac{40}{800}$ths in length, and is composed of about twenty-four segments. The fringe commences on about the ninth segment, and in some of the segments nearer to the apex it consists of four hairs on each side.

The circles are most conspicuous round the third, fifth, seventh, eleventh, and fifteenth segments. Thus there are now two groups, each consisting of four segments.

On the lateral tails the fringe extends to the thirty-first segment. The apices most strongly marked are the second, third, fifth, seventh, eleventh, and fifteenth. Comparing this with the same organ in the preceding state, it appears that the four segments which were then the eighth to the eleventh are now the twelfth to the fifteenth; that, on the other hand, the sixth and seventh have each divided, and, thus forming the quadruple group from the eighth to the eleventh, have added two segments to the whole organ; the other two new ones having originated in the division of the first and third. In some specimens the apices of the seventh, eleventh, and fifteenth, with the whole of the four following segments, are slightly darkened, a character which is much more strongly marked in some specimens than in others. Some, indeed, have scarcely a trace of it.

The larger branchiæ are now about $\frac{6}{800}$ths in length, and near the middle are almost as broad. Figs. 22, 23, & 24 give an idea of the distribution of the air-vessels in them; the details, however, vary a good deal, even in the two branchiæ forming a single pair, the most usual differences being in the magnitude of the branches *a* and *b*, which are often so large that the main trunk appears to divide into four subequal divisions. The main trunks, as well as the two great longitudinal vessels in the body, are surrounded by a variable deposit of brownish pigment.

Near the base are scattered a few markings, consisting of double circles, which, in subsequent stages, become much more numerous. They resemble those which occur in the skin of the body.

The little lobe already mentioned has become quite distinct. It is more or less reniform, and as yet only $\frac{2}{800}$ths in length. The first and last pairs of branchiæ, however, which have throughout been less advanced than the middle ones, are still single.

A specimen which I isolated on the 8th of September, while it was in the third state, and the account of whose subsequent development, confirmed and checked by comparison with others, has been given above, arrived at the tenth stage on the 27th of September, being then $\frac{65}{800}$ths in length.

Eleventh State (fig. 11).

This specimen moulted again, and so entered the eleventh stage, on the 30th of September, when it measured $\frac{75}{800}$ths in length; sometimes, however, the insect attains a length of $\frac{80}{800}$ths before it moults again.

The posterior angles of the mesothorax cover rather more of the metathorax, the angles of which also are a little more prominent than before.

In a cast skin, which was $\frac{85}{800}$ths in length, the central tail was $\frac{65}{800}$ths, and consisted of thirty-seven segments, without, however, being quite perfect. The circles of spines were, as before, most conspicuous round the third, fifth, seventh, eleventh, and fifteenth, to which was now added the nineteenth segment; here again, therefore, the sixth and seventh had divided into two, while the other two new segments at the base had been produced by the first and third.

Compared with the description given of a specimen in the preceding state, this still leaves three segments unaccounted for; the above specimen was, however, imperfect.

The sixth and seventh segments already show indications of a division—so much so, indeed, that I have some doubt whether they should not be counted as four.

The darkened part extends from the nineteenth to the twenty-fourth segment. The fringe extends to the thirty-second.

In the lateral tails the fringe extends to the thirty-sixth segment, beyond which are nine more, though the organ is evidently imperfect. The principal circles are now the third, fifth, seventh, eleventh, fifteenth, nineteenth, and twenty-third. The twenty-fourth and three following segments are darkened.

Here again, therefore, the plan of development is evidently the same as before.

This stage lasts for about a week, and the insect increases to about $\frac{95}{800}$ths in length. Some specimens, however, like the above, moult again, and so enter the twelfth stage, when they are no more than $\frac{85}{800}$ths.

Twelfth State (fig. 12).

At the next change of skin there is even less alteration in form than has been, up to this time, usual. One of my specimens, which moulted on the 3rd of November, seemed to have the wing-rudiments almost exactly of the same length as before.

The fringe on the lateral tails extends to the thirty-eighth, and that on the central one to the thirty-fourth segment; but they are otherwise without alteration.

In this stage the insect attains a length of about $\frac{90}{800}$ths to $\frac{100}{800}$ths.

Thirteenth State (fig. 13).

In this state the posterior angles of the mesothorax, or, as they may now be fairly called, the rudimentary wings, cover three-quarters of the metathorax, while the posterior angles of the latter segment have undergone little alteration.

The number of new segments added to the antennæ at each moult is larger than at first; and as the growth of the third segment has not increased proportionately in rapidity, both itself and the new segments which are produced from it are much shorter than they were at an earlier period.

The basal segments have changed again in the manner already described, so that the strongest circles of spines are those on the third, fifth, seventh, eleventh, fifteenth, nineteenth, twenty-third, and twenty-seventh, in addition to which, that on the thirty-first segment has also distinguished itself by an increased development; so that the four darkest segments, which, until now, have immediately followed the last of these fourfold sections, now constitute the last quartet.

This division of the central part of the tails into well-marked divisions, consisting of four segments each, is to my mind a very curious phenomenon. When the sixth and seventh segments divide, the old circle round the apex of the sixth, which is at first more conspicuous than the corresponding circles of the two new segments, tones itself down, until the three closely resemble one another; on the other hand, the apical circle on the segment which in the last stage was the seventh resembles that of the surrounding segments. It, on the contrary, in accordance with some mysterious law, has become more conspicuous; so that the subdivision of the organ into sections of four segments is effected partly, and indeed principally, by the mode of growth, but partly also by the modification, sometimes by diminution, sometimes by development, of the apical circles belonging to old segments.

The thirteenth state lasts for about a week, during which time the insect adds about $\frac{10}{800}$ths to its length.

Fourteenth State.

The rudiments of the wings now cover five-sixths of the metathorax. The antennæ are still of about the same length as the body.

The secondary plates have increased considerably in size on the five intermediate pairs of branchiæ, but the first and last pairs have hitherto remained simple; now, however, the former show at their base a small thumb-shaped lobe (fig. 22).

The lateral tails have grown as before: the last division of four, which is also the darkened portion, includes the thirty-second and three following segments; the fringe extends to the forty-third, beyond which there were at least seven more segments.

The central tail now closely resembles the two lateral ones; it is, however, fringed on both sides, while the lateral tails have on their outer margin only the usual small hairs at the apex of each segment. There were twelve segments beyond the fringe.

Fifteenth State (fig. 14).

This stage commences when the insect has a length of about $\frac{115}{800}$ths to $\frac{120}{800}$ths, and the rudimentary wings reach to the end of the metathorax.

The secondary lobe of the anterior branchiæ reaches almost halfway up the large plate.

The more developed circles are now on the third, fifth, seventh, ninth, thirteenth, seventeenth, twenty-first, twenty-fifth, twenty-ninth, thirty-third, and thirty-seventh segments. The thirtieth and nine following segments are darkened, and the fringe extends to the fifty-first segment. The terminal segments were nine in number, though the organ was imperfect.

In this case it would seem that only the first and third segments of the preceding state had divided; the sixth and seventh, which were now the eighth and ninth, showed, indeed, traces of commencing subdivision, but they could not yet be considered as constituting joints.

Sixteenth State (fig. 15).

The rudimentary wings cover one-third of the first abdominal segment.

The anterior and second gills are figured in figs. 23 & 24; the former have the secondary lobe slightly longer and narrower than before. As is shown by the figures, its form is quite different from that of the corresponding part of the other branchiæ.

The development of the caudal appendages has proceeded as before, so that the most strongly marked joints are now the third, fifth, seventh, ninth, thirteenth, seventeenth, twenty-first, twenty-fifth, twenty-ninth, thirty-third, thirty-seventh, and forty-first. The thirty-third and six following segments are darkened, and the fringe extends to the fifty-fifth.

In some specimens, however, the forty-fifth, forty-ninth, and fifty-third segments also were more strongly marked than the intermediate ones.

These, indeed, seemed to me (and this was especially the case near the base) to be less distinct than before; while of the newly developing ones it was difficult to draw any line between true segments and joints which were merely indicated.

Seventeenth State (fig. 16).

The wing-cases cover more than half of the first abdominal segment.

The secondary lobes of the anterior gills reach almost to the summit of the primary lobes; their form is, however, almost the same as before.

The divisions into groups of segments, beginning as before with those lying between the ninth and thirteenth, extends now to the sixty-first, where also the fringe terminates. The darkened part extends from the thirty-eighth to the forty-fifth, inclusive, but the first four are very slightly affected.

Thus I have endeavoured, as far at least as my observations at present reach, to describe the different stages through which these larvæ pass, in their progress from birth to maturity. There is, however, one other point, in which these changes remind us rather of growth than of metamorphosis, which is, that the development of the different organs does not seem in all cases to progress with equal rapidity. There are, of course, many differences which are merely the result of injuries; but, on the other hand, there are many which cannot, I think, be so accounted for.

One specimen which had the posterior angles of the mesothorax more developed than those of the metathorax, without, however, covering quite half of that segment, would be considered, if we took these organs as our test, as belonging to the tenth or perhaps the eleventh state. It was $\frac{68}{800}$ths in length. The lateral tail had the most conspicuous circles round the third, fifth, seventh, eleventh, fifteenth, and seventeenth segments, and the fringe reached to the twenty-eighth.

The middle tail in this specimen closely resembled the lateral ones, at least in the number and position of the "chief segments," and in the development of the fringe, which on some of the segments consisted of five setæ. Some segments of the lateral tails, however, had six. There was no trace of darkening.

Again, a specimen which I began to watch on the 27th of November, when it was apparently in the eighth stage, moulted on the 29th, and again on the 8th of December, when therefore it ought to have been in the tenth state. And, in fact, the length of the central tail, as well as the number of its segments, agreed with the description given in page 74, and the organ differed only in one little point, viz. that the circle round the fifteenth segment was scarcely more developed than its neighbours. In the lateral tails the sixth and seventh segments already showed traces of a subdivision, and the nineteenth segment had already distinguished itself. On the other hand, the posterior angles of the mesothorax were not more produced than those of the following segment. This specimen was $\frac{55}{800}$ths in length.

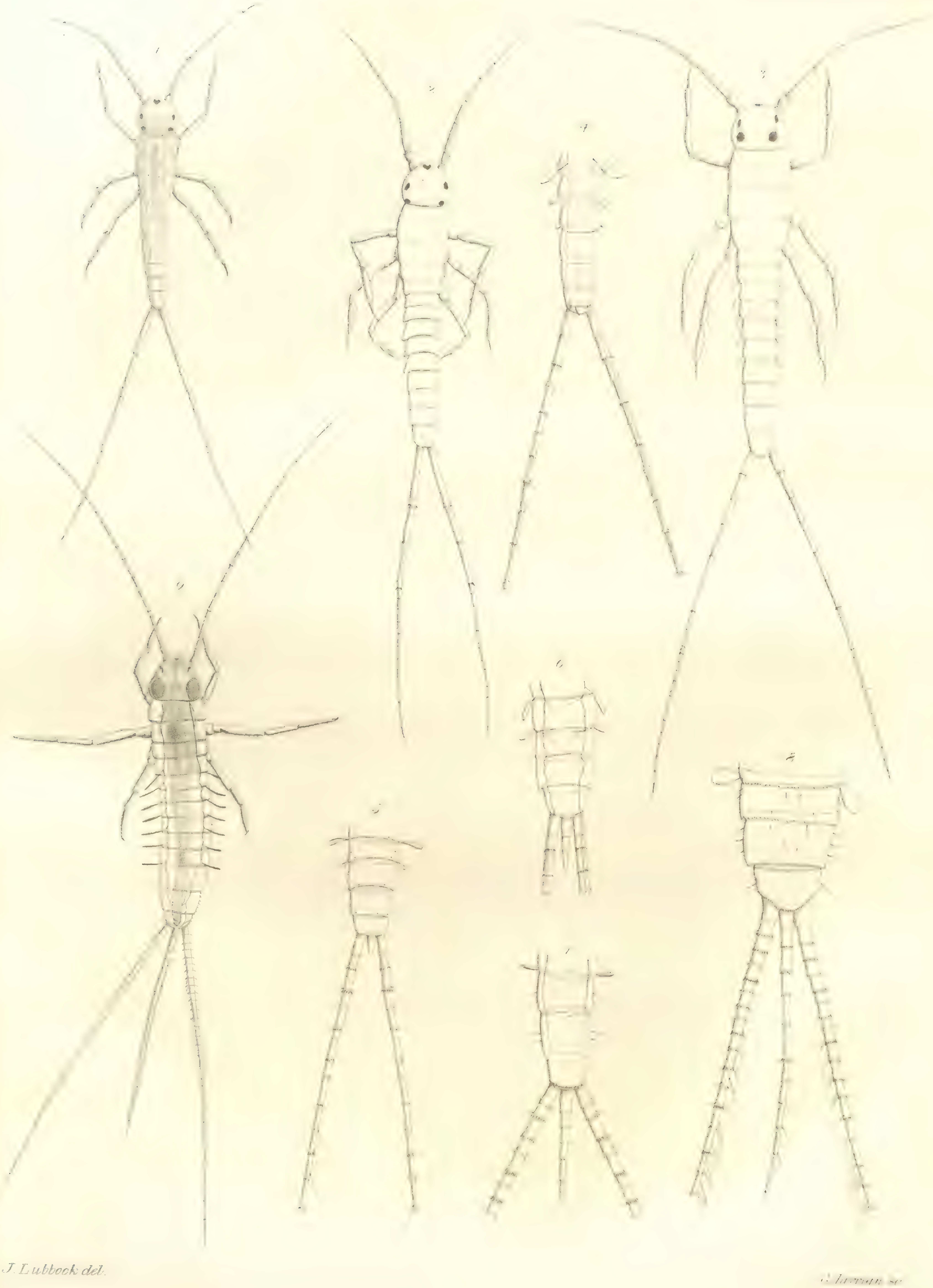
DESCRIPTION OF THE PLATES.

Plate XVII.

Fig. 1. *Chloëon* in the First State, × 60.
Fig. 2. Outline of *Chloëon* in the Second State, × 60.
Fig. 3. „ „ Third State, × 60.
Fig. 4. Five posterior abdominal segments of *Chloëon* in the Fourth State, × 60.
Fig. 5. Four „ „ „ „ Fifth State, × 60.
Fig. 6. Four „ „ „ „ Sixth State, × 60.
Fig. 7. Three „ „ „ „ Seventh State, × 60.
Fig. 8. Three „ „ „ „ Eighth State, × 60.
(In the last five figures the basal part only of the lateral tails is figured.)
Fig. 9. Larva in the Ninth State, × 30.
(In this figure neither the segments nor the hairs on the antennæ and the tails are quite correct.)

Plate XVIII.

Fig. 10. Outline of the head, thorax, and first abdominal segment of a specimen in the Tenth State to show the commencement of the wings, × 30.
Fig. 11. Ditto ditto in the Eleventh State, × 30.
Fig. 12. „ „ Twelfth State, × 30.
Fig. 13. „ „ Thirteenth State, × 30.
Fig. 14. „ „ Fifteenth State, × 30.
Fig. 15. „ „ Sixteenth State, × 15.
Fig. 16. „ „ Seventeenth State, × 15.
Fig. 17. „ „ a subsequent State, × 15.
Fig. 18. Antenna of larva in First State, × 125.
Fig. 19. „ „ Second State, × 125.
Fig. 20. „ „ Third State, × 125.
Fig. 21. „ „ Fourth State, × 125.
Fig. 22. Anterior gill of larva in Fourteenth State, × 60.
Fig. 23. „ „ Fifteenth State, × 60.
Fig. 24. Second „ Sixteenth State, × 60.



J. Lubbock del.

G. Jarman sc.

J. Lubbock del.

G. Jarman sc.

IV. *On the Hairs of* Carcinus mænas. *By* W. Carmichael M^cIntosh, *M.D.*, *F.L.S.* *Communicated by* T. S. Cobbold, *M.D.*, *F.L.S.*

(Plates XIX. & XX.)

Read December 4th, 1862.

THE peculiar appearances presented in certain hairs of *Carcinus mænas*, remarked in the course of other observations on the same animal, prompted the following inquiry, which, although it may not have revealed anything very striking, nevertheless appears to possess some interest, inasmuch as it demonstrates the varied aspects assumed by the hairs in a single species, which, again, may be regarded as typical of the brachyurous Decapods. However simple and superficial the investigation may seem, it is by no means an easy matter to give an account of the manifold diversities in the form of the hairs even on a single organ, and when the inquiry is extended to the whole body, it is impossible to compress it into a very small compass.

Fresh and living specimens, as well as spirit-preparations, were used in the examination; for the remarkable tenacity of life enjoyed by this Crustacean rendered its safe transportation a matter of ease and certainty, existing as it does for about a month in a botanic vasculum, either with or without a little damp sea-weed. Peculiarities in different individuals, as regards presence or absence, thickness and length of the hairs, of course abounded; yet, throughout all the specimens of this species, a wonderful sameness in the essential structure of the hairs in like situations prevailed.

I shall commence with the examination of the

Hairs of the Eyes (Pl. XIX. fig. 4).—The calcareous cone which supports each compound eye has a regular circlet of hairs on the outer or convex side, which lends to it a peculiar interest. They are short, branched, closely packed together, and slant in general towards the apex of the eye. I have elsewhere* stated that these hairs "present a most remarkable microscopic appearance, and one which strikes the investigator of the vertebrate forms with astonishment. The peculiarity of structure is not so much in the hair itself (confining this description solely to the hairs on the circlet of the eyeball), as in certain curious appendages which adapt it to its varied functions." The hair is of the usual chitinous nature, and pale, "with a light-coloured central space apparently filled with a semigelatinous substance. Its surface is almost everywhere clothed with growths of a fungoid appearance, some presenting the form of a floating mass attached to the surface of the hair by a filiform pedicle, whilst others are of a delicate, filmy structure, not tapering, of a pale-greenish hue, and having the aspect of pigmy fungi. Many are thickened and roughened with a black cohesive substance which entirely obscures the normal structure of the hair, allowing it to glance through only at intervals; while the dark parent mass appears in striking contrast with the filmy appendages, which glisten as they stretch from

* Observations and Experiments on the *Carcinus mænas*, p. 15.

it. Numerous other forms cluster around the hair—large and soft bodies of a cellular nature, Infusoria and other Protozoa, as well as many anomalous structures." However unlikely it may seem, it is by no means improbable that this circlet of hairs, when rendered more or less impervious by fungoid growths and mud-particles, may form an accessory sucker-arrangement by which the compound eye may be most powerfully retained in its socket. In addition to their giving a certain amount of sensibility to the calcareous cone on that side (a state all the more necessary since this Crustacean is liable to be attacked in this region by young specimens of the bearded Mussel), these hairs doubtless, too, serve as a buffer to the delicate organ when it is rapidly drawn in.

Hairs of the External Antennæ.—The tip, when perfect, has four or five straight simple hairs, best seen in a soft specimen. At the upper or distal end of each segment there are one or two short hairs. Around the basal segment are numerous hairs with lateral spikes.

Lesser or Internal Antennæ (Pl. XIX. fig. 14).—On the hollow basal swelling a ridge of somewhat short hairs runs along the external or ventral surface, a little behind the prominent anterior margin of the part. They are of various kinds, smooth, spiked, and serrated at the tips, many being both spiked and serrated. They have parasitic growths, but less conspicuously than the foregoing. At the base of the limb of this organ, on the inner or dorsal edge of the ridge or socket, there is a tuft of short hairs, spiked in the usual manner. The long segments of the limb are quite bare, except at the origin of the two small appendages, where there are a few short simple hairs. The hairs on the larger of the two little jointed appendages at the extremity of the organ begin a little above its base, on the concave side of the curve, and extend to the fourth segment from the tip, only a few simple ones occurring at the distal end of the last three segments. The former take their origin in rows from about half the breadth of each segment of the appendage, and are pale and translucent; even a number pressed together do not darken the field of the microscope. They are of a beautifully jointed structure, not unlike a single filament of an Alga, and are essentially different from an imbricated hair, such as the sheep's, both in the appearance of the other parts and in the nature of the transverse markings. The tip in some cases is very slightly serrated, and not much tapered. In many the delicately serrated tip appears to have suffered abrasion, for only faint markings are visible. When viewed with the naked eye or with a pocket lens, they present a lustrous golden hue. In Crabs which have recently cast their shells they are found still paler; some, as in the former case, having distinct notchings at the tip, others without them. It would thus seem that the latter is quite as normal a condition as the former, since no abrasion could have affected these under such circumstances. The tip of this appendage has a tuft of three or more long, delicate, and smooth hairs. The segments of the smaller appendage have a few short bristles at the distal end of each, arranged in a very regular manner. At the end of the last segment there is a tuft of very short and delicately set hairs.

The sensitive nature of the parts of the internal antennæ supplied with hairs, especially along the curve of the joints of the larger terminal appendage, is well shown in the healthy animal when the organ is irritated and the results are compared with a like irritation of other parts, and even of the external antennæ. When the latter are pulled or pinched, little or no movement of the limbs results; but irritation of the hairs above mentioned on the larger appendage of the internal antennæ immediately causes convulsive startings and intense commotion. When the Crab is swimming in the water, it is very apparent that these organs are of great moment to the animal, and they constantly move with a jerking vibratile action, by which the hairs may be used to the best advantage. On being interfered with, these antennæ are immediately withdrawn, while the external, which want the same development of hairs, move but little. Instead of its having, like the Lobster, antennæ possessing only a sparse distribution of hairs at the joints, there exists in this animal and in its allies an immense aggregation of peculiar hairs at a single part, which have a direct and special connexion with the soft parts in the interior. M. Lavalle was amongst the first to point out the fact that the hairs of Crustacea have a special connexion with the soft parts in the interior*. He was followed by Hollard†, and Häckel in Müller's 'Archiv.' Neither of the latter, however, recognized any connexion between the shell and hair-canals and the soft vascular and nervous layer below the cuticle or chitinogenous membrane. The most recent observer on the subject is Mr. Campbell De Morgan‡, who more clearly defined the exact relation of the hairs in the Lobster, Shrimp, and Prawn with the inner integument, in which the nerves terminate. In regard to the organ under notice in *C. mænas*, before becoming acquainted with the papers above mentioned, observing the great delicacy of the cuticular layer, and the position of the hairs of the terminal antennulæ with regard to the pale granular matter contained therein, I had stated, "May not these hairs resemble our finger-nails, in that, though quite insensible in themselves, they form a most accurate knowledge of the qualities of surrounding objects by the admirable adjustment of the nervous elements in proximity?"§ Notwithstanding the greater number of joints in the external antennæ, and their extensive powers of motion, they are somewhat rough tactile organs when compared with the internal, whose special hairs render them the most sensitive organs in the entire animal. Whether these hairs are solely connected with common sensibility, or are subservient to the exercise of a special sense in connexion with the basal organ, I have not been able to determine with certainty‖.

Hairs of the Foot-jaws. 1. *The External or Great Pair.*—The hairs spring in a single row along the oral margin of *a*, fig. 1, but form a double fringe to the elongated

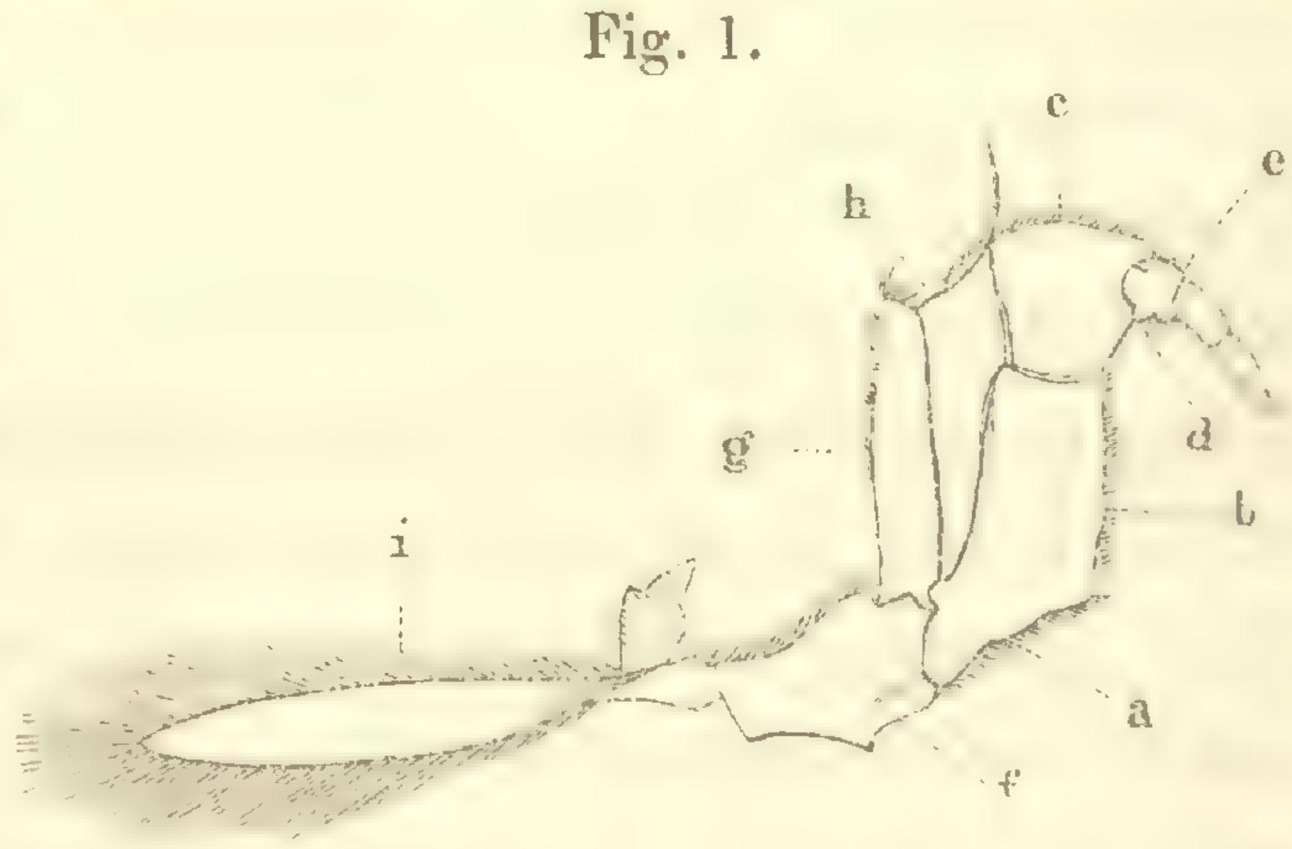
* Ann. des Sci. Nat. 1847, 3e sér. (Zoologie), tom. vii. Speaking of the hairs of Decapod Crustacea, he says, "ils sont toujours en communication avec l'intérieur du test par un canal qui traverse en droite ligne toute l'épaisseur de la carapace, et qui est tantôt vide et tantôt rempli d'une matière semblable à celle qui existe à l'intérieur des poils."

† Revue et Magasin de Zoologie, 1851. ‡ Phil. Trans. 1858, pp. 895–903, pl. 71. § *Op. cit.* p. 21.

‖ This antenna is considered the auditory organ in this animal and its allies by Mr. Spence Bate (Ann. Nat. Hist. 2nd ser. vol. xvi.), the principal argument of this excellent naturalist resting on the suppositions (1) that the above-mentioned hairs are auditory cilia; (2) that the calcareous "chamber having walls" in the basal swelling is the cochlea; (3) that in the external antenna "there is no internal structure of any kind which could identify it as being an organ of sound." Unprejudiced by a knowledge of these arguments at the time of my first examination, I have found no reason as yet to alter my opinion as regards this animal, after repeated observations and experiments and when aware of the above views. In the first place, no proof has been found of the hairs being auditory cilia any more than olfactory cilia; secondly, in the intimate anatomy of the basal swelling of the internal antenna, the delicate sac and the calcareous prominence do not favour the above supposition more than the other, in this animal; thirdly, in the cavity at the base of the external antenna there are otoliths or their homologues in *Carcinus mænas*.

Dr. Farre is of opinion that the internal antennæ are the auditory organs in the Lobster; and Prof. Huxley, who segment, *b*. Those at the base of this organ are greatly brushed, especially towards the terminal half of the hair, as shown in Pl. XIX. fig. 1. A peculiar marking is observed at some distance from the insertion, after which the setæ of the hair become far more numerous. It indicates, in fact, the point where the brush-like covering of the hair supersedes the more scanty bristles. Some of their points are bristled to the tip, others are smooth, while fungoid growths obscure not a few in the perfect condition of the Crab. In some cases, the spikes at the base of the hair are very sparsely distributed. By the side of the raised line of shell, towards the oral margin on the ventral aspect (at the inner end of the dotted line from *b*), there is a row of hairs with smooth shafts and serrated tips. The external margin of the segment has numerous short serrated ones. Dotted at somewhat regular intervals near the internal margin of the dorsal surface are groups of short smooth hairs, with a peculiar marking towards their middle, as if jointed. Towards the outer margin of the same side are a considerable number of short hairs, smooth, slightly bristled or serrated. In several parts of this segment, especially on its ventral surface, the papillæ of the cutis and the groups of hairs are in rows together.

Fig. 1.



On the irregular segment, *c*, fig. 1, beyond this, the following arrangement exists. Along the dorsal margin of the somewhat triangular groove in which the joints settle when folded, there is a conspicuous row at *d*. Most of these are covered with long spikes, which everywhere stud their surface and give them a beautiful feathery aspect. Amongst them, however, is one, a short piece of which bears no distant resemblance to a head of wheat with its elliptical chaff (Pl. XIX. fig. 2). The peculiar appendages appear to be modifications of spikes, and there is a double row on each hair. Sometimes, from the position of the latter, there seems to be only one; but on closer examination, the other is seen to be shaded by the contour of the central stalk. In the interval between the serrated margins of the hair, a series of short bristles frequently occurs. The basal or root portion of the hair is smooth for a considerable way up; the serrations then begin, small at first, afterwards swelling out into full proportions, and gradually diminishing again as the hair tapers to its termination. Most of such hairs are stronger than the others, and they are seen to best advantage in the soft state of the Crab. The brushed hairs of this part often have a plentiful supply of fungoid growths and other external appendages. The opposite or ventral margin of the before-mentioned pit has very short brushed hairs, with a few feathered ones at each end; and following the course of the ridge which runs obliquely outward from this are some short serrated ones. The cuticle on the ventral surface of this segment is sparsely studded with small hairs, and the tubuli seem to be

examined a small transparent *Palæmon* from the South Pacific, also considers that the internal antennæ contain the auditory organs, but no mention is made of the outer antennæ (Ann. & Mag. Nat. Hist. vol. vii. 1851).

I have endeavoured to test the true function of these organs by experiments on living animals, but the results are by no means definite; indeed, after the removal of both internal and external antennæ and the organs at their base, together with the eyes, the animals started sharply when the glass vessel containing them was struck.

collected in small patches, as in other portions of the same animal. It may be here mentioned that, besides the hairs on the investment of the Crab, there are a number of minute processes, in the form of sharp spicules, which project from the cuticle, occur most abundantly in the neighbourhood of hairs, and are absent from the papillæ of the cutis (Pl. XX. fig. 20). They are easily seen on this portion by softening it in dilute nitric acid, and removing the external layers of the shell by tearing a fragment with the forceps. They are well marked in the soft Crab, and are found fully developed on the soft carapace of those having the old shell still adherent.

Along the anterior margin, *c*, two kinds of hairs are met with, the feathered or spiked, and the smooth. There are none of the serrated variety. A peculiar brush-like appearance, not unlike a miniature *Thuiaria thuja*, characterizes many. One or two are covered with very long branches which slope gently from their sides (Pl. XIX. fig. 3).

The first joint (basal) of the terminal appendage, *e*, which succeeds, is covered with long hairs, those on the anterior edge being most excellent specimens of the feathered variety. Some smooth ones are also found, chiefly congregated in a long tuft at the beginning of the row, *i. e.* next the base. The ventral surface of this portion abounds with the minute sharp bodies mentioned previously, and they darken the cuticle under the microscope. The addition of caustic potash brings out these bodies as sharp, slightly curved spikes. There are a considerable number of cuticular apertures for papillæ on this surface. On the inner or dorsal aspect (the animal being in its normal position) there are none of the minute cuticular spikes over the general surface, and only a few blunt projections near and amongst the hairs. The papillæ were generally found in the same region. The hairs are pale and mostly serrated—in short, presenting the latter arrangement in perfection. The serrations vary, some being close and small, others large and distinct; but both are very interesting microscopic objects.

The next segment is covered on its inner or dorsal surface with many strong bristles, which have the serrated character strongly marked. Some of the serrations are large, blunt, and broad, others sharp and narrow, while a third set are intermediate. An oblique view of part of one is given in Pl. XIX. fig. 2, where the teeth are seen on their most extensive surfaces. On the ventral surface the hairs are much smaller, but also serrated. The cuticular areolæ of Profs. Huxley and Williamson (cells of Profs. Carpenter and Quekett) are generally bolder and better-marked on exposed surfaces such as the present. The tuft on the terminal division is composed of finely-set serrated hairs of strong formation; indeed, when viewed laterally, they call to mind the incisive bones of a well-armed *Pristis*. A few short smooth hairs, and some of smaller size and more finely serrated than the former, also occur.

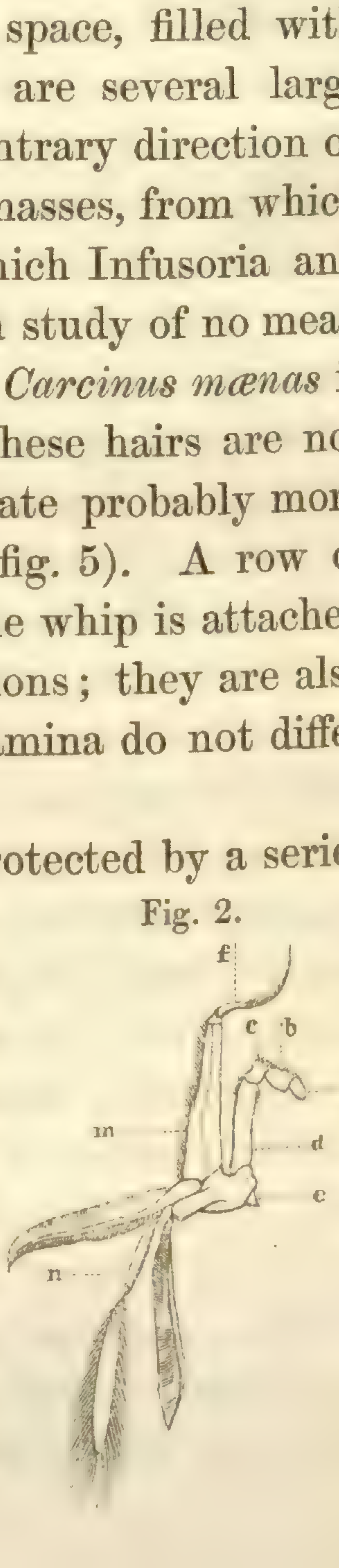
Attached to the base of the great foot-jaw is a large accessory limb, whose terminal portion consists of a flabelliform appendage of delicate proportions, jointed and covered with hairs. Those of the basal portion, *f*, from which both this accessory limb and the foregoing part of the foot-jaw spring, are mostly in two rows; one, the thickest and longest, slants over the ventral surface, while the other crests the anterior ridge. They are branched, and often quite darkened by parasitic structures. On the external surface there are numerous well-marked microscopic cuticular spikes.

At the outer ridge of the first segment of the accessory limb, *g*, there is a row of short but strong hairs of the branched kind, abounding in parasitic appendages. On the dorsal surface is found a row of branched hairs near the oral or inner margin, from the base forward to the anterior edge, where they end in a projecting spike, which is covered with a long tuft of the same hairs. On the ventral surface there are few hairs, and the minute cuticular bodies are scarce. The delicately jointed process which is attached to the extremity of this segment has its hairs mostly of the branched form. After passing the sickle-shaped portion, *h*, they run in a double row along one side of the flabellum to the tip, two on every joint; and they increase in length as they approach the extremity. In the ordinary state of the Crab these hairs are much covered with extraneous growths. The filmy forms, resembling minute fungi, abound, and, together with the other parasites, make the hair more impenetrable than a thickly coated feather; just as the climbers of the tropical forests weave neighbouring boughs into one impervious web. Each seta of the branched hairs is coated with its load of growths; nor are the simple hairs exempt from a like covering. In the newly-moulted Crab they are clean and distinct, and, like those subjected to nitric acid, show a somewhat jointed aspect at the tip and for some way down.

The hairs of the branchial whip pertaining to this foot-jaw are large and powerful, their tips being finely serrated. They have a well-defined central space, filled with cellulo-granular materials. Just where the serrations begin, there are several large canine-like fangs, far surpassing the rest in size, and curved in a contrary direction or towards the root of the hair. Many are covered with dark parasitic masses, from which shoot transparent filmy threads of gossamer fineness, and amongst which Infusoria and other Protozoa lurk. The observation of the latter, indeed, would be a study of no mean extent; and the natural history of these companions and satellites of *Carcinus mænas* is calculated to excite wonder by their number and interest. Most of these hairs are not terminated by a sharp point, but end in a somewhat strong tip, a state probably more suitable for the due performance of their functions (see Pl. XIX. fig. 5). A row of hairs along the sharp ridge of the thin lamina to which the base of the whip is attached is composed of hairs similar in structure, but of much smaller dimensions; they are also frequently covered with parasitic masses. The other hairs on this lamina do not differ so much as to require separate mention.

Second pair of Foot-jaws.—The tip of the strong limb, *a*, fig. 2, is protected by a series of thick-set bristles of a highly striated aspect, best seen after subjection to nitric acid. They terminate in blunt points, which give them an aspect of hard service; but this is not the case, since they are not much sharper in the soft Crab (Pl. XIX. figs. 6 & 8). Interspersed amongst these vigorous cutaneous appendages are others of smaller size, but of similar structure. The hairs on the margins and general surfaces of the last three segments, *a*, *b*, and *c*, are serrated, but not deeply. A few feathered ones are now and then met with, but they do not influence the general picture. The long segment, *d*, has a mixture of serrated and branched hairs on its inner margin. A few hairs

Fig. 2.



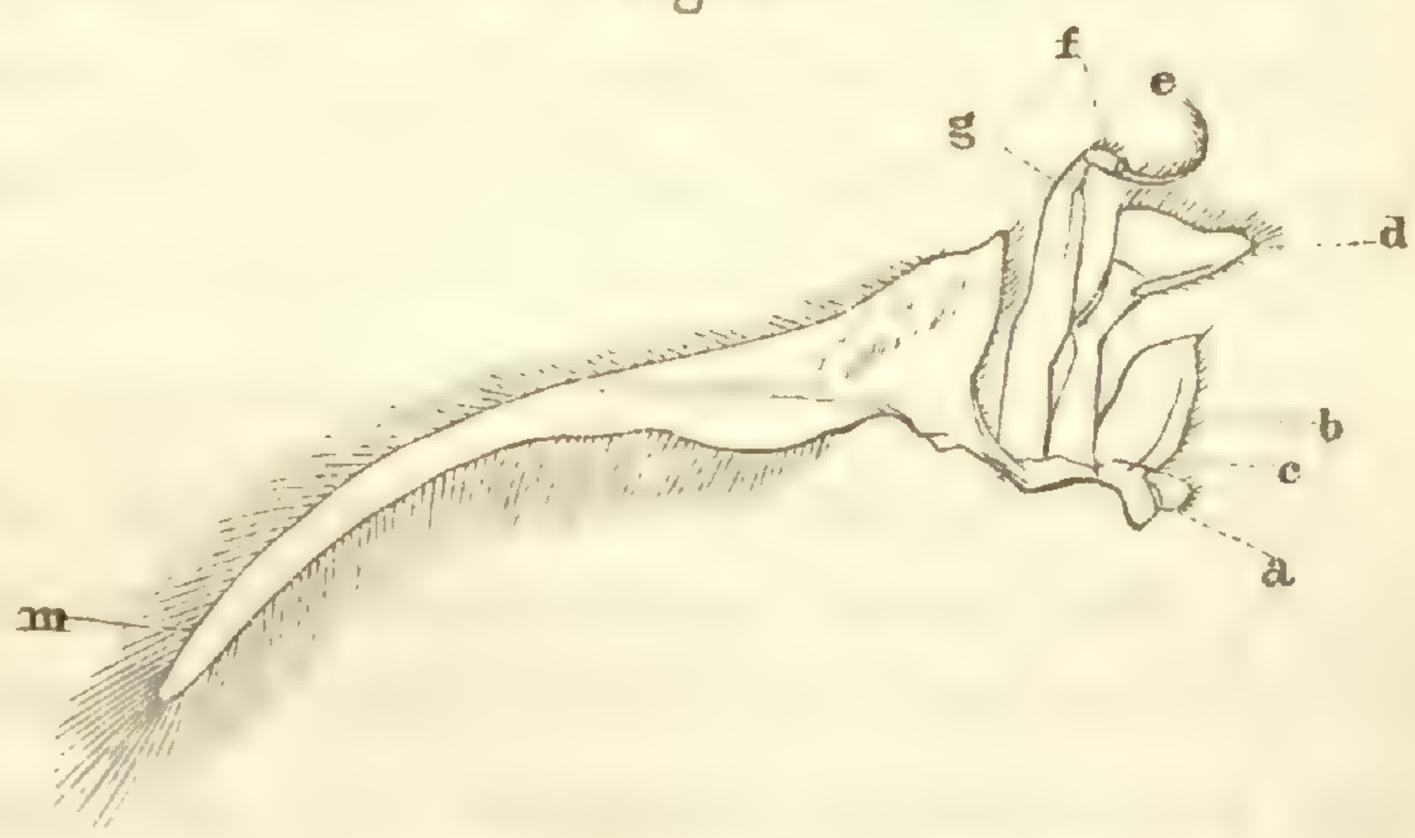
on the outer margin are both serrated and feathered; two of these, with a portion of the cuticle, are seen in Pl. XIX. fig. 7. The ventral surface has few hairs and few minute cuticular spikes. At the basal portion, *e*, on the inner side, they are of no great size, and branched. Some at the upper angle have a tendency to become serrated at the tip, as well as branched in other parts. The larger hairs on this portion are of the same form, but more boldly serrated at the tip.

The hairs of the flabelliform appendage of the horny accessory limb pertaining to this foot-jaw are most interesting. They are branched in a very regular manner to the tip, have a somewhat jointed aspect (best seen in the recently moulted or in those softened by the action of an acid), and have a distinct double outline and a large central space. In Pl. XIX. fig. 9 a peculiar ending of the organ is sketched, showing smaller hairs and a different aspect generally, probably the effect of injury, since in the normal state it has nearly the same appearance as that of the next pair of foot-jaws (Pl. XIX. fig. 10). In the process of either foot-jaw it will be observed that the hairs spring both from the dark horny portions and the intervening lighter ones, though most of them certainly arise from the former by broad joint-like attachments. On the first joint, *f*, of this segment the hairs are of two kinds—very small smooth hairs, shaped like those on the nettle, and slightly bristled ones of larger size, though much less than those on the tip. These cover the falciform edge of *f*. The long horny segment, *m*, has its outer margin clothed with short and prettily serrated hairs towards its distal, and branched ones at its proximal portion; while its inner edge, having likewise branched hairs, possesses, in addition, some serrated at the tip and others quite smooth. The latter, with a few small serrated ones, are also spread over part of the general surface. The hairs at the tip of the whip, *n*, are delicately serrated, and have several large, recurved fangs, as in the case of the previous foot-jaw; they are smooth from the base to the latter fourth. In other respects they agree with those of the first pair, though more slender. It may be mentioned here that these and similar hairs throughout the Crab (more especially in the soft condition), when preserved in spirit, have their central portion rendered more distinct by being tinged yellow, while the cortical remains pale.

Third pair of Foot-jaws.—The tip of the accessory organ, *a*, fig. 3, at the base, has rather long and finely serrated hairs; some, however, are so minutely marked that the serrations are almost unnoticeable. Along the upper or anterior margin they continue serrated, but mingled with others quite smooth from base to extremity. In the angle between this and the other limb, *b*, a few feathered ones are visible. Over its ventral surface feathered ones predominate, accompanied by many short simple hairs. On the under (dorsal) surface they are chiefly serrated, some being both serrated and branched.

At the tip of the flattened limb, *b*, the hairs are pale, pretty strong, and minutely serrated for more than a third of their terminal length. Under the microscope, one side is often seen serrated and the other margined with bristles, probably because that is the position in which the hair lies most easily and flatly; they have, in reality, two rows of serrations, with an intervening one of minute bristles, as in the case of the coarser ones observed previously. The extremity of one is shown in Pl. XIX. fig. 5. The other hairs on this portion are of the following nature:—Along the free or oral border they are powerful and comparatively short, most being slightly serrated—some nearly throughout their whole extent; towards the base of the segment they become more slender, though also serrated at the tip. There are generally a few smooth hairs here and there amongst these and on the general surface of the segment. At the base of the external margin, and for some way up, are feathered hairs. There is a row of smooth hairs, *c*, on the ventral surface, short and interrupted towards the tip of the organ, but afterwards becoming denser and more continuous. In regard to the rows of strong hairs generally, it is found that there are a number of smaller hairs or hair-roots always present at the one side of the series, so as to blend them gradually with the general surface of the organ, or else to supplant the others in cases of necessity.

Fig. 3.

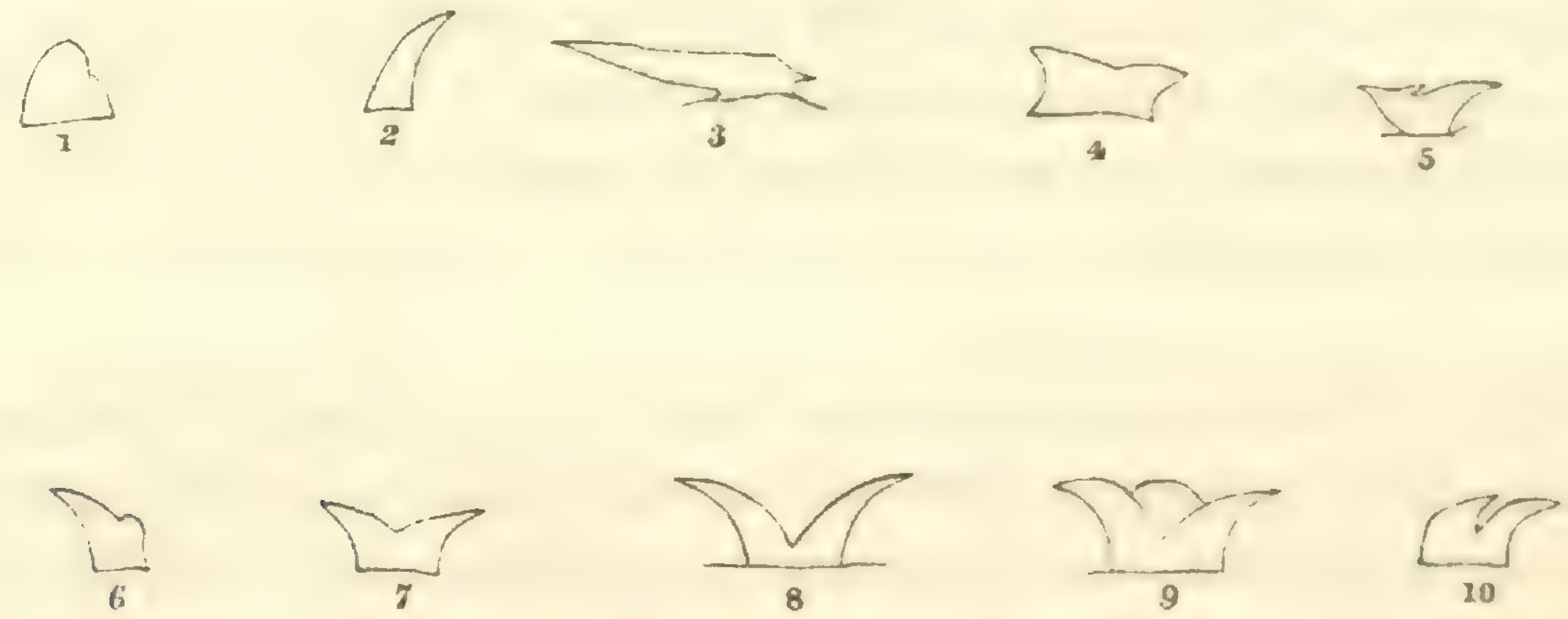


On the accessory limb, *d*, the anterior broad margin is covered with long slender hairs minutely serrated at the tip. Towards the inner sharp end they become broadly feathered. Scattered amongst the roots of the larger hairs are some small, simple, and a few short feathered ones. Having begun at the inner sharp anterior angle, the line of the hairs splits, one well-marked series of feathered ones continuing along the oral edge, after passing the oblique portion common to both, to the base. Some are most powerfully bristled, the latter appendages being of considerable bulk themselves. Interspersed with them are some short, simple, and a few serrated ones, the latter, however, generally possessing bristles also. The other line (dorsal), which starts from the inner anterior angle likewise, has only a few short, smooth, and some feathered hairs, and soon disappears. At the base of the outer margin of this limb is a short row of spiked hairs.

At the delicate extremity of the elongated organ to the outer side, the hairs are feathered in the same manner as those of the analogous structure in the previous pair of foot-jaws; and the tip, *e*, is sketched in Pl. XIX. fig. 10. In the soft Crab they are best shown, as they are free from confusing parasitic structures, and possess the usual joint-like structure, with the central portion bounded by a somewhat wavy internal line. The thinness of the cuticular layers and the large size of the base of the hairs, which evidently have an intimate connexion with the cavity of the limb, would all favour the use of these hairs in regard to sensibility, as has been shown by Lavalle, De Morgan, and others. On the anterior or convex portion of the projecting sickle-shaped base, *f*, there are a few thinly spiked hairs, some serrated ones and some smooth. Along the outer margin of the segment, *g*, the hairs are chiefly of the feathered variety; they occur in two sets, one at the distal extremity and for some way down, the other at the base. They are of much smaller size than those on the tip. The inner edge is rather scantily supplied with short smooth hairs, principally present near the base.

The extremity of the branchial whip, *m*, is covered with serrated hairs of considerable strength; they are of the same structure all the way down, the only variety worth noticing being some of smaller size, and wanting the recurved fangs. The latter, speaking generally, vary considerably in form from the simple tubercle (1) to the single (2) and double hooks (3, 4, 5, *et seq.*), and all the varieties of the compound unciform conformation, as seen in the accompanying outlines (fig. 4). They are translucent, solid structures, clearly a development of the cortical substance of the hair. Most, but not all, of the simple ones are directed towards the base of the hair. It is difficult to assign

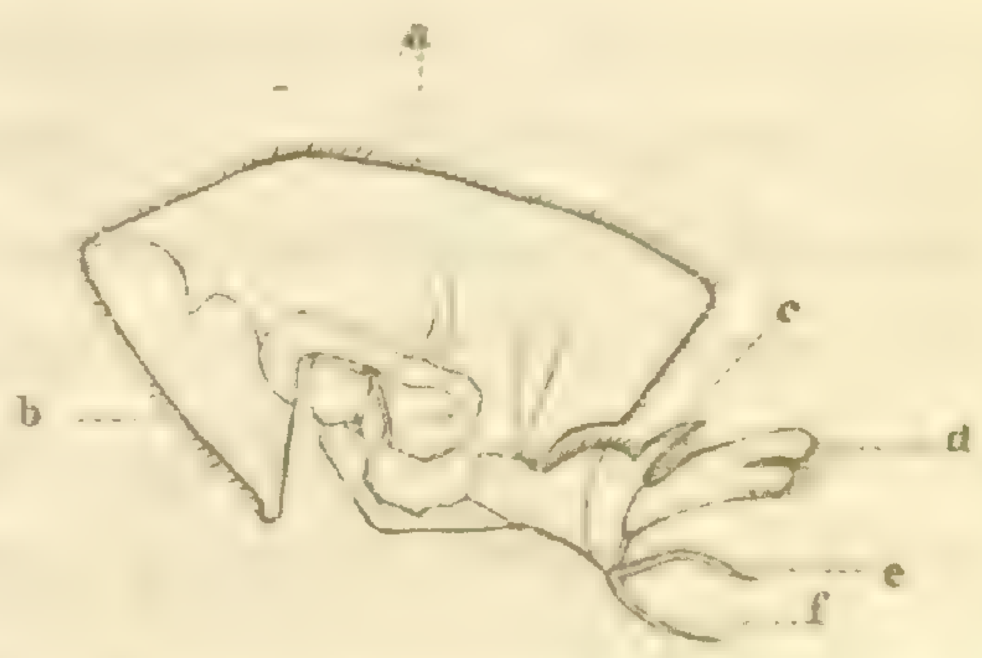
Fig. 4.



the exact function of these bodies on the hair, but it is probable that they may be of service to the Crab in denuding the branchial laminæ from parasitic structures, such as the minute zoophyte afterwards to be described. If any of the recurved hooks caught the root-portion of such a structure during the ordinary motion of the whip and its hairs, the parasite would most certainly be destroyed.

Fourth pair of Foot-jaws.—The three sides of the fan-shaped organ, *a*, fig. 5, are surrounded by a fringe of beautifully feathered hairs, some long, others short, the former somewhat like those in Pl. XIX. fig. 10. They run in a very regular manner round its margin, and sometimes appear to be internal to it. Each hair has its little dark bulb and insertion, which lend to the hairy line a dotted or moniliform appearance. The hairs are largest on the outer edge, *b*. The portion *c* has a very acute spine-like tip at the oral side, which bears a slightly serrated bristle or two. Along the oral margin the hairs are mostly long and serrated; on the outer side they are less numerous, shorter serrated ones next the spine, but towards the outer part becoming feathered. Both kinds are often laden with parasitic structures. Some of the serrated hairs are peculiar, in that their serrations are coarser near the tip than they are lower down. The limb, *d*, conspicuous by its deep terminal fissure, has its oral end on each side of the latter covered with moderately long smooth hairs, with a few serrated ones. On the border next the two following there are none, while its opposite or convex margin has a goodly number of long serrated hairs. At the base of this portion two filiform processes arise, the upper or anterior of which, *e*, has a few serrated hairs on its surface near the tip, and a terminal tuft of some smooth and one or two faintly serrated ones. The lower process, *f*, has some smooth hairs on its posterior border at the base, and towards the tip of the same side exhibits long, slightly dentated ones; on the tip itself are slightly serrated and long smooth hairs.

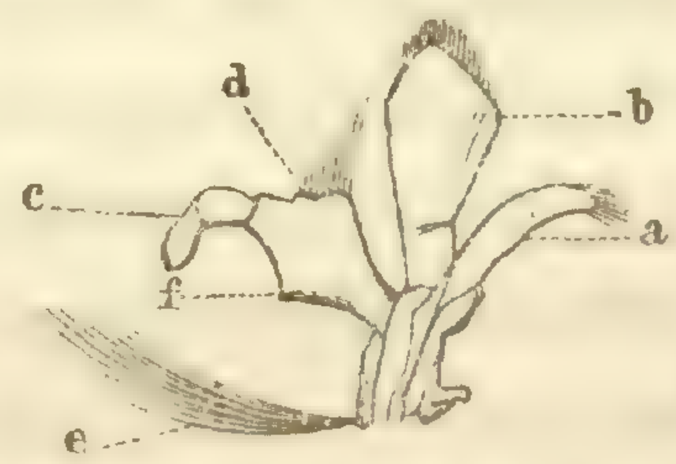
Fig. 5.



Fifth pair of Foot-jaws.—At the extremity of the innermost organ, *a*, fig. 6, are a series of strong smooth hairs, towards one end of which one or two more slender and elongated hairs, slightly serrated in the soft Crab, project conspicuously beyond the others, all the more so as they are placed next a margin (posterior) devoid of hairs. Towards the convex margin there are a number of very powerful bristles, short, smooth, and having the peculiar marking about midway previously noticed. Springing from the cuticle by a broad base, the hair for fully a third of its length tapers very little, so as to appear nearly cylindrical; this basal portion ends by a transverse marking, and is distinct from the terminal by the change in appearance and arrangement. The external chitinous investment is meagre, and it seems almost entirely composed of the cellulo-granular central portion. At the termination of this part there is a distinct narrowing of the entire breadth of the hair, yet the external portion becomes essentially thicker than before on each side by encroaching on the central space, which now rapidly narrows to a fine extremity, and terminates only with the end of the hair. The structure of this central portion seems to be the same as the basal, only it is less distinct and yellower, from the thicker nature of the investing chitine (*vide* Pl. XIX. fig. 12). Along the curved margin of the limb are many long serrated hairs, while on the concave side there are few. Some short, serrate and smooth hairs also occur on the general surface.

The limb, *b*, has its broad extremity covered with stout, smooth spikes, of somewhat similar structure to those of the foregoing portion, but shorter. When acted upon by acid, some of the smaller hairs appear to have three portions; the central tunnel containing a granular structure, then on each side a pale border in the smaller (darker in the larger, where it is still indicated), and, lastly, the cortical. The latter is always marked in these hairs by longitudinal lines, which give it a fibrous aspect and a structure akin to that of the shell. Close by these bristles are a number of smaller serrated ones, which cover the cuticle at their base and for some distance on the limb below. The inner corner (just where the dotted line comes off) has some longer and slenderer serrated hairs, which come up from the oral side and rise to a level with the preceding; altogether the arrangement has a very pectinate aspect. Along the oral margin there are some long serrated hairs, but none on the outer.

Fig. 6.



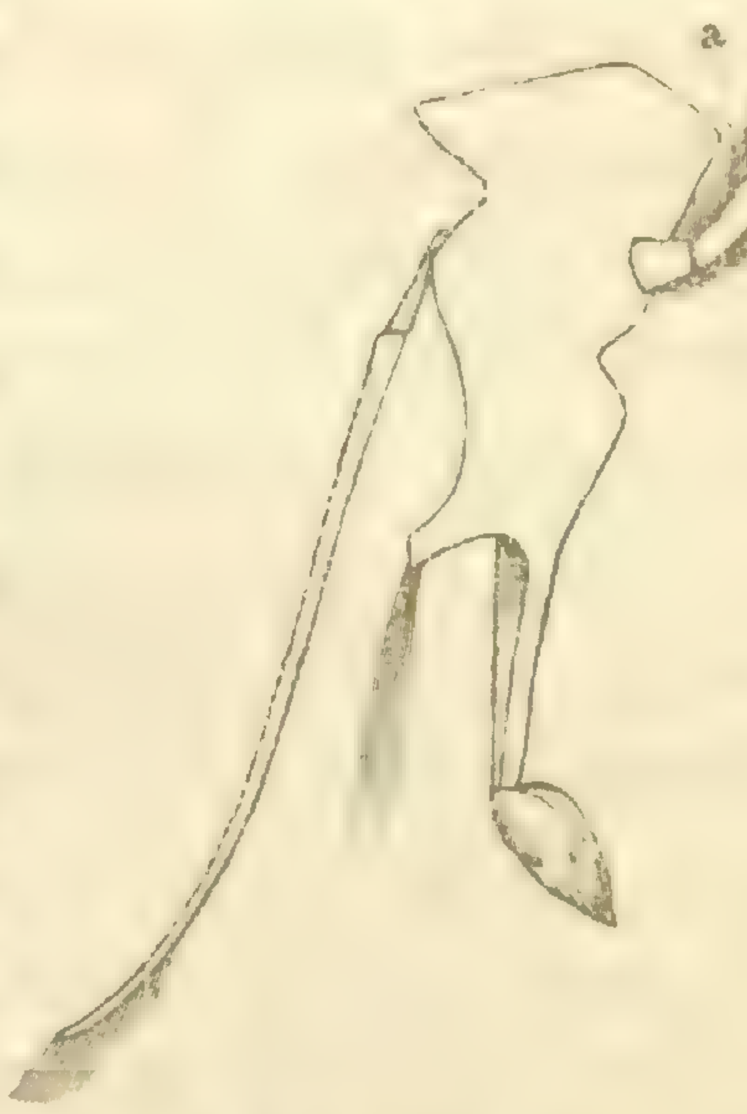
The third limb of this foot-jaw, *c*, has the following hairs:—At the tip there is often found, in the complete state of the Crab, a dense black mass, caused by the total concealment of the hairs in extraneous growths. In the soft and clean Crab there exist on the angle at the tip, and quite separated from all others, two long and peculiarly serrated hairs, which jut from the corner like tusks. The serrations in these hairs are interesting, and may with propriety be termed minute teeth. A little beyond the middle of the hair these blunt teeth commence, following each other to the number of eleven or twelve on each side, and at stated intervals. The terminal fifth of the hair is quite free from them (*vide* Pl. XIX. fig. 11). At the rounded margin opposite this, and along the anterior edge, are some finely bristled or branched hairs, one or two with serrate tips.

The elevation at *d*, and the margin below, have long and beautifully serrated hairs; some having smooth basal portions, others with short and thinly-spread bristles. At *f* there are some branched hairs, but along the rest of this outer or concave margin there are no hairs.

A little to the outer side of the limb here described is a tuft, *e*, of exceedingly long serrated hairs, about half an inch in length, which spring from the slender basal portion of the foot-jaw and taper to an extremely delicate point. In the soft Crab they are best studied to advantage. When torn out, they often show a transverse rupture of the cortical portion, from which protrudes backwards a pale mass of the central substance. The latter appears to occupy the bulk of the hair at the lower part, and, in the largest hairs, proceeding forward, this portion is widened rather than narrowed in proportion to the diminished diameter of the hair; in fact, the cortical portion is so insignificant that the former appears to occupy nearly the whole breadth of the hair. The marginal portion is translucent and structureless, the central granular. In the largest hairs the serrations extend only a comparatively short distance behind the tip, and in several there are large recurved fangs of the form previously described*.

Mandibles, fig. 7.—Attached to each powerful mandible is a short jointed limb, which bears numerous hairs on its sides. They are often so coated with parasitic structures in the usual state of the Crab that it is a somewhat difficult task to make out the exact nature of the hair. In the soft Crab it is found that both the concave and convex sides have a series of thickly branched hairs, which, like many others in a like condition of the animal, curve exquisitely in all directions. Towards the tip on the concave side, *a*, fig. 7, the branched hairs become serrated at the extremities, then follow some only serrated, and finally the tip and part of the anterior (convex) margin of the last segment is covered with strong bristles, some of which exhibit slight serrations. The same rotation follows on the convex side, *b*, viz. strong hairs merging into more slender, then serrate-branched, and finally branched. The general surfaces of the segments have strong smooth spikes and feathered hairs, with the exception of a portion of the terminal one, which is bare.

Fig. 7.



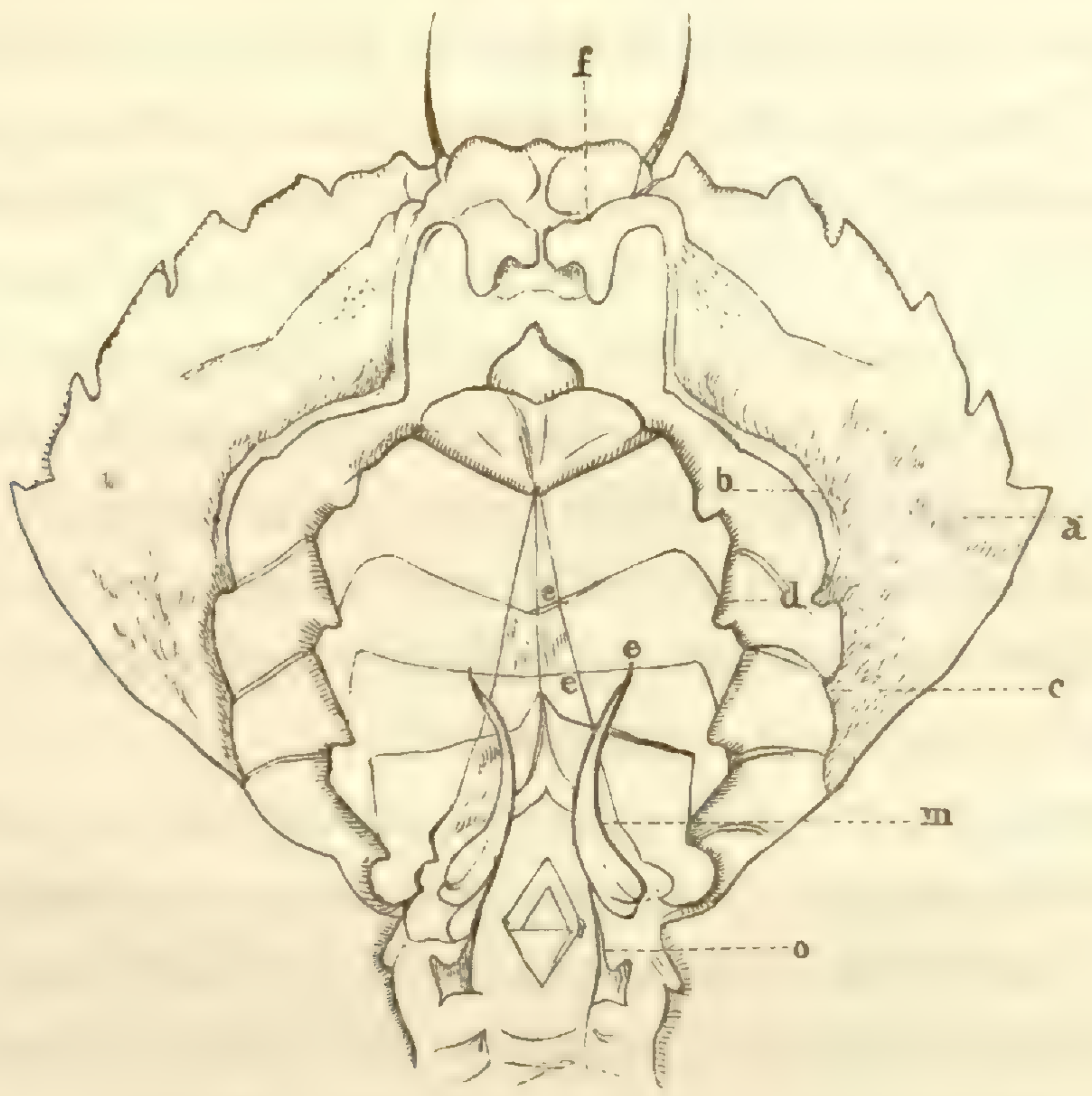
Hairs of the Cephalothorax, &c.—On the under surface, at *a*, fig. 8, and in that neighbourhood, the hairs are pale, elongated, and mostly spiked with long bristles (Pl. XIX. fig. 15). At the ridge, *b*, they have the same aspect, and are often quite covered with extraneous growths. Along the border at *c*, and continued round behind the last limb, are many long, branched hairs arranged in a row. The hairs on all these places are alike, longer, more translucent and flexible than usual in the perfect condition of the animal. Fringing the scalloped margin, *d*, of the central islet are strong feathered hairs, whose tips occasionally show sharp serrations, like minute bristles. Rows of the same, *e*, *e*, *e*, are found in well-marked specimens, extending inwards along

* *Vide* p. 87.

the lines of the shell to the central depression. Hairs of the same structure are found round the abdomen of the males, though they are frequently short and abraded.

Around the basal segment of the external antennæ are numerous branched hairs; and at the triangular surface, and two flat ridges at *f*, many serrated ones.

Fig. 8.



Hairs of the Eye-sockets.—These fringe the cavity entirely around, a short distance within its margin. They are of two kinds, simple and branched; and none are more subject to parasitic growths. A somewhat unusual specimen of the latter sometimes attracts attention by its beauty and the novelty of its position. It is a little Alga, which spreads its tiny filaments from the trunk of the hair, and whose knotted aspect and fresh green colour stand in contrast with the surrounding masses. These hairs overlap the compound eye when retracted within its socket, and give the whole, but more especially the delicate corneæ, due protection. By the admirable series of turns and twists which are made by the eye-cone in its withdrawal, most of the corneæ are covered; but yet there remains a little corner (no doubt of great service to the Crab on fitting occasions) unprotected, and for the safety of this the hairs at that portion are eminently adapted. Masses of the acicular (margaric?) crystals so commonly met with in this animal were often seen amongst the hairs of this part. A portion of one of the hairs, with a cluster of algæ attached, is shown in Pl. XX. fig. 4.

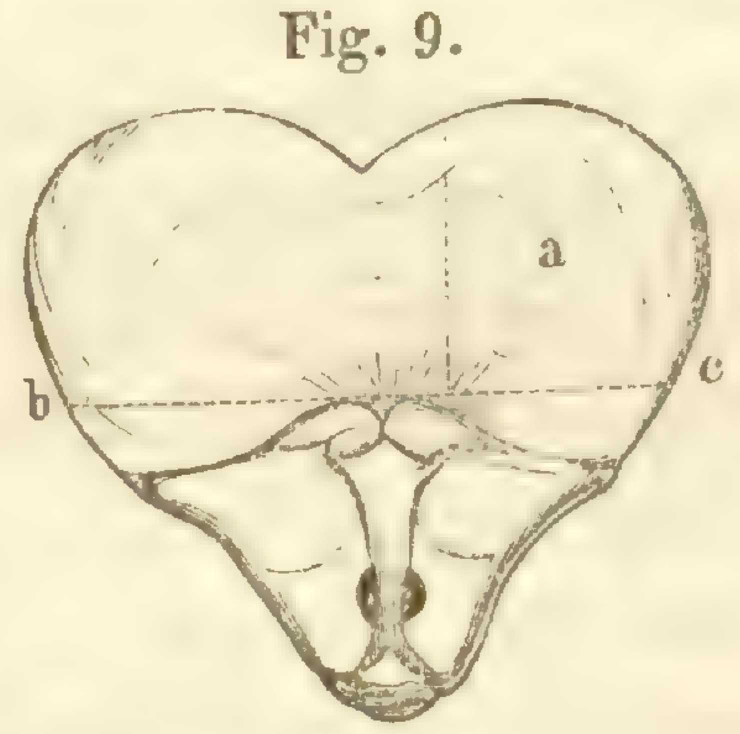
Hairs of the Limbs.—I shall describe *seriatim* those on the various parts of the chelæ, and superadd any peculiarities worthy of mention in regard to the same parts of the other limbs. The *coccopodite* has some short feathered hairs at its anterior and ventral margin, between the projecting articulation with the scalloped margin of the shell and the condyle between it and the basipodite; and a well-marked row of long hairs, some with sharp serrated points, on the posterior surface facing the first small limb. Similar arrangements are met with in the other limbs, only those of the fifth are longer. The *basipodite* is supplied with a fringe of branched hairs at its anterior margin, and towards the inner angle they rise into a longer tuft. Few or none are found in the second limb. On the outer crest of the same structure in the third, fourth, and fifth limbs there is a row of bristled hairs. The *ischiopodite* has chiefly branched hairs on its inner margin, some of the shorter ones being serrated at the tip, and with their lateral spikes scanty and short. Near the inner margin is a row of short serrated hairs which does not quite reach the anterior part of the segment. On the external margin these are feathered only. The third limb has a line of long hairs, like the basipodite of the same extremity. On the convex margin of the fourth limb there is a crest of branched hairs for two-fifths of its basal length. Along the same margin (outer) of the fifth, at the base, is a ridge, first of shorter, then of longer branched hairs. The *meropodite* is three-sided, with one angle below; the two upper angles are covered (the outer mostly at the base) with branched hairs, some of which have serrated tips. The fifth has a row on its outer margin extending a little more than halfway forward, short at first, longer towards its distal extremity. On the *carpopodite* a series of branched hairs occurs along the upper margin of the joint between this and the propodite, beneath the formidable spike which overhangs the hollow. In the second limb this segment is provided with a powerful and thickly-set row on its inner margin for about four-fifths of its extent; and, in the soft Crab, with a series of short hairs in the outer dorsal groove. In structure these hairs are peculiar, being sparsely bristled for their first half, often on one side only, but thickly coated with short setæ throughout the rest of their extent. On the third limb there are some minute brushed hairs in the groove on the upper and outer surface, and on its inner edge and other portions a few more, sometimes in pits. The outer margin of the fifth has a complete mane of hairs, chiefly of the brushed variety, only a few being branched. The two terminal segments of the chelæ (*dactylopodite* and *propodite*) are supplied with a number of small tufts, which stud the pits in the grooves which stretch the entire length of the former and the opposite part of the propodite; they are short and slightly serrated at the tips. Where the last-mentioned segment gives joint to the former are some finely feathered tufts, best seen in the soft Crab. The hairs of the propodite in the second and third limbs more or less resemble in situation and structure those on the carpopodite of the corresponding limbs. The fourth possesses a short row of brushed hairs on its inner groove at the base, while the outer groove on its upper surface has a row of similar hairs halfway down from its proximal end. On the outer margin of the fifth is a row, chiefly of brushed hairs, except at the base, extending nearly to the tip. It will be observed that the hairs differ in a regular manner from one segment to another along the outer margin of these parts. The basal portion of this limb has branched hairs; but they alter their character towards the tip, and assume most markedly the brushed form.

With regard to the branched hairs in general, transverse markings are readily observed in many of those described, joining as it were the roots of two opposite secondaries. Each of the latter marks its origin from the parent trunk by indenting it with a little circular depression, which is usually conspicuous enough. Parasitic growths of very various forms abound on the hairs of the limbs, often to such an extent as to darken the entire field of the microscope.

Hairs of Branchiæ.—Along the tough membrane forming the boundary of the inferior canal of each branchial tuft is a double row of short simple hairs. They present what appears to be a large rounded bulb, with a strong, slightly curved shaft. In the soft Crab there are occasionally some small ones at the beginning or base of the rows, but generally they diminish in size towards the tip. In Pl. XX. fig. 15 is sketched a hair from this region, with the brownish bulb, which has apparently been ruptured. The cellular or areolar nature of the cutis gives this the fictitious aspect of being filled with nucleated cells. Upon the hairs are several parasitic structures, algæ, fungi, &c. In Pl. XX. fig. 14 is shown the tip of a hair from the branchial row of a Crab (kept for nine days in a vasculum), with a parasitic tuft attached. On the bases of the hairs and the surrounding textures a curious parasite presented itself in the shape of a pale zoophyte, which spread its stems from hair to hair after the manner of a creeping rhizome, and shooting up beautiful branches ever and anon, with their living freight. Floating about, too, were many loose bodies of an ovoid or flask shape, which were probably stages in the development of the animal, and which appeared to be furnished with cilia. The outline of one, highly magnified, is given in Pl. XX. fig. 17. In some specimens of the zoophyte there were fine hairs connected with the terminal portion of each bud, as shown in that sketched on the hair in Pl. XX. fig. 15. An enlarged view of a portion of the animal is given in Pl. XX. fig. 16. It occurred in numerous specimens of the Crab, and lived with it in captivity for many days.

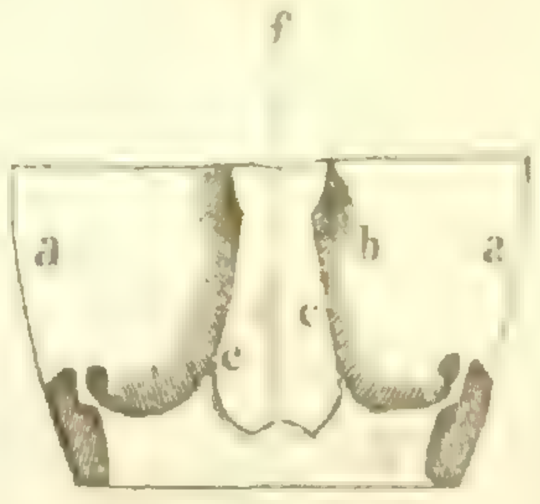
Œsophagus and Stomach.—There may be said to be no hairs in the œsophagus; for although there are some just at its termination, these may be regarded rather as hairs of the stomach than of the œsophagus. The membrane throughout is granular, more so at some parts than others, and a few cells are scattered here and there. The presence of hairs in the stomachs of these animals shows of how much importance these structures are in Crustacean economy, as well as demonstrates the homology between the lining membrane of the stomach and the external investment. A portion (*a*, fig. 9, enclosed within the dotted lines) taken from the upper wall of the stomach was found to be covered, on its internal surface, with minute translucent hairs with slight serrations; a few of the larger ones are sketched in Pl. XX. fig. 1. Some are of considerable length, and others quite short, broken off near their insertion. Generally speaking, the surface in front of the transverse dotted line, *b c*, has hairs on the anterior and lateral curvatures, with a few in the centre. At the bend in front of the œsophagus are a number of the same kind of hairs. On the under surface of the stomach, at the anterior portion, the hairs are scant on the outer parts, *a a*, fig. 10, but increase in number towards the middle line. A portion cut from *b* showed the hairs greatly increased in number, and having scattered amongst them, on the wall of the stomach, a great number of little cellular bodies, which, with the hairs, are seen in Pl. XX. fig. 6. These bodies were generally of an irregular shape, somewhat resembling starch-granules in aspect; but nuclei or analogous internal markings were distinct in most. The ridges, *c c*, which overlap the central smooth depression are fringed with closely-set hairs (Pl. XX. fig. 2).

Fig. 9.



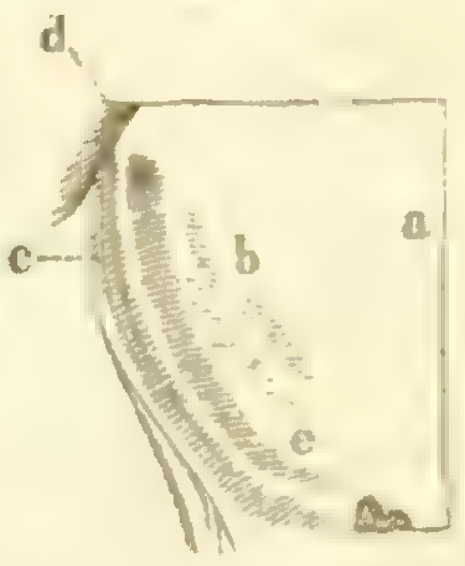
Out of the horny insertion a range of strong palisades arises, and from the extremities of these proceed the minutely-bristled hairs. The posterior part of the ridges (Pl. XX. fig. 11) presents areas of finely dotted cells or areolæ, above which in the figure there is a curious portion with small groups of processes or spikes covering it in a somewhat regular manner. In this figure the origin of the hairs from the firm base of the horny ridge appears to the right; the dark stripe below is the calcareo-horny matrix from which the latter springs.

Fig. 10.



From behind forwards, the general arrangement of the hairs of the region to the outer side of the ridges, *c c*, in fig. 10, and the right one of which is indicated in fig. 11, is as follows:—The strongly-bristled internal ridge, *c*, runs pretty evenly to its anterior termination, where the bristles diminish in size and disappear. Sometimes before they do so, however, a blank occurs; and this occasionally presents a short pale tooth or two, as if the regenerating process had commenced. Slightly exterior to the anterior termination of the row is a dark isolated tuft, *d*, which, when carefully examined, is found to consist of a peculiar pointed process, of the hardness of the teeth, springing from a dense group of the ordinary hairs, and bearing in addition many of the same on its sides (Pl. XIX. fig. 17). In the soft Crab it is generally coated with hairs to the tip, but in the ordinary condition it is as figured. The surface of the membrane in front of this is left bare for some distance.

Fig. 11.

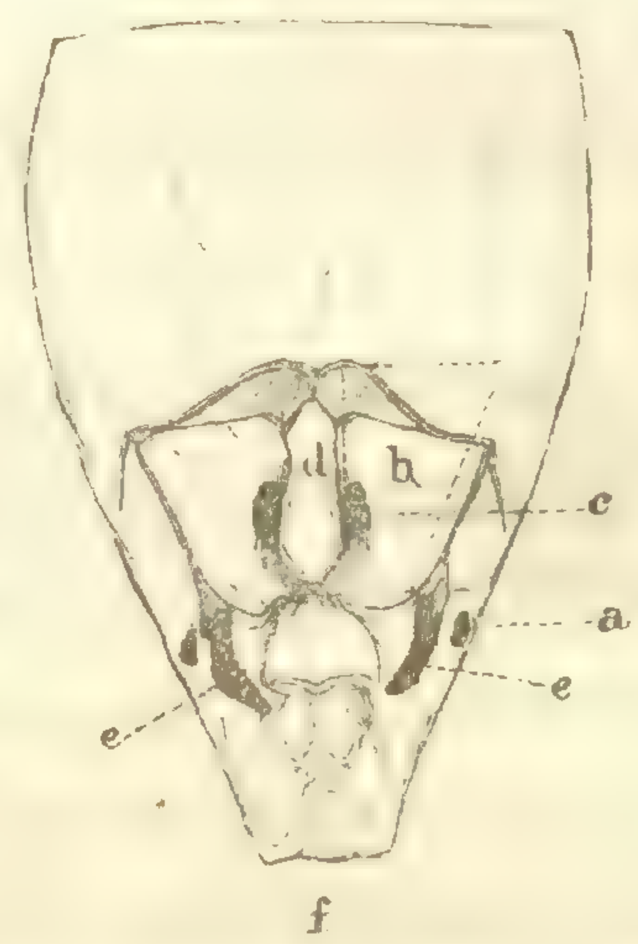


From within outwards in the same portion are, first, the inner edge of the horny ridge which by-and-by bears hairs; secondly, to the exterior of this comes another row of hairs, *e*, fig. 11, which, however, are neither so long nor so regularly set as those of the internal one; they seem rather a closer matting of the numerous hairs which now thickly cover the membrane; thirdly, external to both of the foregoing is a tolerably abundant supply of hairs of the same calibre, but shorter and frequently broken, and whose roots end in a cell-like bulb; lastly, the membrane from which the latter spring becomes paler, and hairs are met with having the gland-like cells mingled with them, as shown in Pl. XX. fig. 6, and which extend over a considerable area both amidst and beyond the hairs. The hairs, dwindling into small points, cease.

The central portion, *f*, fig. 10, between the ridges, is composed alike of horny and membranous texture, and seems to have the following arrangement:—In front and laterally it is covered by an immense number of those gland-like bodies, which appear, in those whose structure is best discernible, to consist of a minute tuft of processes or microscopic spikes, springing from the membrane by a dense, granular root, often in a brush-like fashion (Pl. XX. fig. 8). They form a gradational series on each side of the mesial line, the latter drawing representing the external appearance; then they become closer and closer, till the whole membrane assumes a streaked, granular aspect, and, finally, in the centre, a granular only. Anteriorly there are some longer tufts on each side, as seen in Pl. XX. fig. 9. The horny external portion is dotted by minuter specks. At the anterior margin the cells become larger and have distinct nuclei; and as the deep brown tinge of the harder texture merges into the faint yellowish tint of the softer membrane in front, short, truncated, and then perfect hairs become plentiful. This membranous portion is apt to bend under the harder part when placed beneath the microscope, and thus to escape observation. In structure the hairs last mentioned are very beautiful; they are simple, delicate, have a bluish opalescence in the water, and taper to a fine point. A little granular marking of the central portion, at the base and for a short way up, breaks the sameness of structure; and along their exterior, for fully the terminal half, are slight serrations, best marked in the soft Crab, or in hairs subjected to nitric acid. In the perfect or hard state of the Crab it was noticed that numerous granules and cells always clung to the hairs, which led to a more minute examination for the fine serrations. These rough points in the hairs may detain certain minute alimentary matters in the stomach, which would otherwise have escaped between smooth hair-fibres without impediment. The basement-membrane is for the most part granular, with an occasional faint cellular or areolar marking.

In the neighbourhood and attached to the base of the small tooth at *a*, fig. 12, which represents the inner aspect of the superior wall of the stomach, a little to the outside of the posterior termination of each horny ridge, there are many hairs of delicate structure, similar to those mentioned previously. On the membrane are found many minute cells and granules, some of the former like those already described, but generally much smaller. A portion from the upper wall, enclosed in dotted lines, and marked *b*, presented the following aspect:—All the membrane anterior to the little black tooth, *c*, was quite uncovered by hairs, its surface being only varied by wrinkles, cells, and granules. The hairs commence a little behind this tooth, at first short and sparse, then longer and in greater numbers, although at no part are they very closely placed; on the outer side they scatter and soon disappear. The surface of the central horny piece, *d*, is for the most part smooth throughout, only a few of the ordinary hairs appearing at its sides. On the inner sides of the great lateral teeth, *e e*, the hairs are of like aspect and structure.

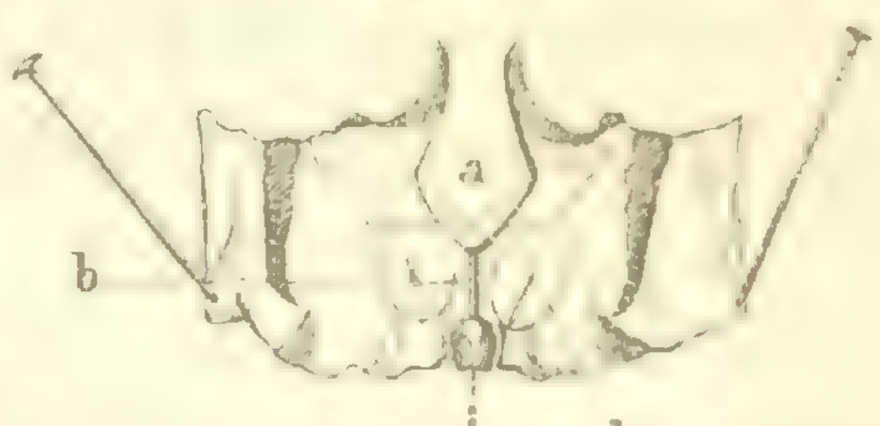
Fig. 12.



An incision, represented by the dotted line *f*, running up the mesial line, divides what remains behind the long horny centre piece into two halves. From before backwards the surface of each is roughened and hardened by numerous calcareo-horny masses. Anteriorly, the usual hairs surround the bases of the latter, while the translucent portions are left bare. The first that occur in the mesial line anteriorly are long and rather closely set; and the general surface of the cavity is studded, sometimes with stronger bristles on the horny portions, as before, sometimes with more delicate hairs on the translucent parts, which are bare in front. Towards the posterior edge they become slenderer and finally shorter (Pl. XX. fig. 7). Near the mesial line, however, posteriorly, some long hairs are found over a considerable area, and placed mostly in one direction in the neighbourhood of a dark horny mass; their structure is the same as that formerly described. The greater part of the membrane is dotted over with distinct granules, which in some places merit the name of cells. In this region some of the hairs arise in a peculiar manner, so as to be grouped in companies of three or four (Pl. XX. fig. 10).

On the projecting ledge, *a*, fig. 13, at the under surface and posterior part of the stomach are many serrated hairs of comparatively large size, and some shorter smooth ones with roundish points. The surface is much dotted with groups of minute points (*tubuli*). Just where the stomach merges into the intestine behind the projecting portion, there is a remarkable arrangement of parts. Immediately behind the projecting portion (*a*, fig. 13), a ridge, *b*, runs straight backwards on the floor of the canal, and having at its termination a tongue-like process, *c*. The ridge is composed of a double layer of horny processes arranged in an antero-posterior direction, and consisting of a dense interwoven series of fine pectinations or hairs. The crest of the ridge is entirely made up of these minute hairs, and they fringe its anterior curvature. The parallel lines seem to be caused by the crossing of the minute fibres which pass between the alternate spaces (like two combs stuck through each other), and forming a line of junction which is well marked; this also corresponds to the bases of the spikes (Pl. XX. fig. 12). If the lines are not formed by the foregoing, there certainly do not appear to be any extraneous lines or fibres which run at right angles to the short perpendicular spikes; at least, none are visible. The tongue-like process, *c*, posteriorly, is composed of a dense series of slightly serrated hairs, which slant backwards from a horny matrix. They taper to a fine point, and present a granular central space. Immense numbers of cells and granules are always entangled amongst these hairs in the normal state of the Crab.

Fig 13.



On the exterior of this portion of the canal two rounded prominences exist, having externally an investment of parallel bands of horny tissue, running from before backwards, or corresponding with the long axis of the swelling; they are smooth on the outer surface, but give off from the inner a vast series of tooth-like processes or pectinations. Six or eight of these teeth often converge so as to leave a wider interval between the ends and the succeeding groups, thus as it were marking off the long pectinate row into a series of shorter combs. The bands or rows, *en masse*, are defined by narrow dark lines and intervening lighter ones, the latter showing the fibrillated structure in virtue of their translucency. At the posterior end the rows terminate in beautiful pectinate structures (Pl. XX. fig. 13), which spring from one edge of a horny bar. These bars decrease in size towards the tip, which ends in the long and gracefully curved crest of processes, continuous with the other pectinations of the row. Some of these terminations are large and boldly marked, others smaller and fainter. The flattened bars of the larger ones are longitudinally striated, and appear to be composed of parallel fibres. Anteriorly the rows end in a smooth border, with their ends tightly bound together and slanted off, the pectinations at the same time becoming indistinct. Some of the divisions present a scalloped arrangement in every alternate row. On the field of the microscope besides these an elongated horny spike is often to be seen, apparently in connexion with this portion.

Below (internal to) the horny parts above mentioned, and corresponding to their curvature, is a soft, white mass composed of one vast series of hair-like fibres of a most beautiful silky aspect, like the finest conceivable asbestos. When put upon a slide and compressed, it breaks into many small masses presenting a somewhat radiated arrangement, and which show the silky aspect even better than before. Under a high power these masses are seen to be made up of a vast multitude of hairs of great delicacy, fusiform and tapering to an almost invisible point at either extremity (Pl. XX. fig. 5). A peculiar feature, however, is that they are almost always bent at a right angle in the middle of the spindle,—an arrangement which, in a bunch, greatly complicates the appearance. There is a slight central marking in the widest or middle portion; and, so far as could be observed, many have no connexion with a basement-membrane. Nitric acid rendered them yellow; and on the addition of caustic potash they became more distinct. Many, from their extreme delicacy, are often much contorted. On the intestinal surface, *d*, is a delicate and transparent membrane, having very minute hairs connected with it. These hairs are shorter than the deeper ones, and appear to be connected with the membrane; yet they are continued beyond it in the shape of pale, delicate processes. At the commencement of the dotted line, *d*, in the same figure, is an oblique red band, which slants across the internal surface of this part. It (the latter) is somewhat of a similar structure with the other portions, and has many of the minute hairs or fibres connected with it; but there are a greater number of minute round granules on its surface, which are easily detached.

It will be seen that the posterior region of the stomach has its channel well guarded. The wedge-shaped ridge, *b*, occupies the floor of the cavity and projects upwards, whilst the flat, tongue-shaped body blocks the way almost entirely behind, reaching with its hairs the superior angle; and, in addition, the canal is further narrowed by the bulging of the portion, *d*, on each side; all which renders the passage of the nutrient matters from the stomach to the intestine a complex process. With such an elaborate and beautiful structure, one cannot but suppose that these parts play an important feature in digestion.

The intestine, from the stomach to the anus, has no hairs. For a considerable extent of its latter portion, it is thrown into longitudinal plaits or folds, the intervening spaces being pale. The folds are variegated with brownish pigment-masses, apparently from an accumulation of basement-structure. The whole membrane has a cellular aspect, like a very faint and delicate repetition of the external investment (areolar or cellular layer) of the animal; this is especially evident at the middle portion and at the anus. Besides these markings, there are groups of boldly-marked cells scattered here and there over its internal surface, many being arranged in longitudinal rows.

Surrounding the anus externally are small hairs with short spikes and serrated tips. Fringing the abdominal margin in the males are many very short, branched hairs, frequently abraded in the hard state of the Crab. On the under surface of the same region are some long, branched hairs. On the great clasper, *m*, fig. 8, feathered hairs occur on the base; further up are a number of short teeth, appearing first on the concave side and then on the other, as well as on the general surface (Pl. XIX. fig. 16). They are continued to the tip, diminishing gradually in size, and slope in a contrary direction to the course of the limb. At the base of the smaller organ, *o*, fig. 8, inserted into this one are many finely-branched hairs. Just before the organ forks at the tip there is a collar of small curved teeth, continued along the shorter limb, chiefly at its inner margin (Pl. XX. fig. 21). The soft organ* (penis) which projects from the opening of the ejaculatory duct at the base of the last limb has numerous branched hairs over its surface and sides, chiefly at the base.

Abdominal Hairs of the Female.—The outer margin of the abdomen is fringed with most beautiful feathered hairs of considerable length, and possessing the double outline and semi-jointed condition so often noticed before.

First pair of Abdominal Feet.—The internal limb is clothed for the most part with long, delicate, silky hairs, which are simple throughout, with the exception of some branched hairs at the base, best seen on the anterior surface of the foremost limb. The former are pale and translucent, and come off in distinct bundles all the way up from their commencement. The tufts above the middle joint arise from the upper part of each of the pseudo-joints that compose the flabellar extremity, being situated, likewise, only on the posterior surface and sides of the limb,—the anterior surface being free. The hairs themselves are very beautiful, presenting externally a brownish or yellow outline, within this a pale streak, and then a more or less granular central portion. Attached to these hairs curious appendages are often found—long, trumpet-shaped, membranous bodies, which are yielding and soft, and somewhat fibrillated. The external limb is covered with branched hairs from base to apex along both outer and inner edges, the hairs on the outer row being rather longer than those on the inner. A few short smooth bristles are distributed over the general surface of the limb. Parasitic structures often cover these hairs, tip, branch and limb; and occasionally they are bound together by the meshes of the byssus of a bearded Mussel.

The same description applies essentially to the hairs of the other limbs, so that it will be unnecessary to repeat it.

The ova, when present, are attached solely to the inner limb of each abdominal appendage. It would seem strange, at first sight, that simple smooth hairs should be selected for the purpose of egg-carrying, while branched or brushed ones, which have more points of contact, are not employed. The examination of an egg-bearing female, however, dispels all doubts. It is found that these curious structures of fibrillated aspect, mentioned previously, which crowd the field of the microscope in many cases where the eggs have been ruptured and disappeared, are the pedicles or cords by which they were attached when present. A peculiar secretion seems to be developed, which coats each hair (often two together) with a tough investment, and bundles of whose fibres every now and then strike off to form the pedicles of ova, yet without diminishing the bulk of the coating on the hair beyond. These pedicles have a fibrillated aspect, and widen out as they touch the ovum; and the fibres, spreading for some little distance around, become lost on the capsule (Pl. XX. fig. 19). The attachment seems to be intimate and strong, since, after rupture of the ovum, this portion of the capsule clings firmly to the pedicle, as if it were a part of itself (Pl. XX. fig. 18).

Development of Hairs.—In *Carcinus mænas* in the act of exuviating, a membranous layer, apparently corresponding to the "uncalcified corium" of Prof. Huxley, is found,

* *Vide* Prof. Owen's Lectures on Comp. Anat., Invertebrata, p. 328.

under the old shell on the surface of the new. It is quite separate from the other layers of the old shell, and soon disappears from the new after the moulting. Microscopically it presents numerous phosphatic crystals and calcareous masses, which evidently are extraneous to its structure, since, when well washed, it is only granular, and the apertures of tubuli are not distinct. Beneath this, the hairs are found everywhere in their peculiar sites; but there is nothing to warrant the supposition of Réaumur that they are pulled from the sheaths of the old textures. Not to speak of the impossibility of this as regards the minute anatomy of the Crustacean shell, the hairs are found lying flatly on the new shell beneath the old, while the hairs of the latter have the same situations and identically the same structure as formerly; but they are often loaded with parasites, both vegetable and animal. Milne-Edwards, on the other hand, states that no hairs are found (in such species as possess them) when the old shell still adheres to the back of the animal,—a view which the above observation negatives in this species. The new hairs are very pale and translucent, the central faintly defined from the outer portion. The surface of the cuticle about the bases of many of these hairs was studded with an immense number of the minute cuticular spikes formerly described, and which seem to follow a certain order in their occurrence, being absent from some portions of the cuticle.

The process of exuviation not only furthers various ends in the growth of the animal, but it also fulfils an important function in regard to the parasitic structures on the hairs; for if the parasites continued to flourish on a Crab which did not periodically undergo this change, its condition can scarcely be imagined. Moreover, since it has almost been proved that the hairs are organs of sensation to the animal, it can readily be conceived that their functions in this respect would be greatly interfered with, if not in some cases destroyed, did not the exuviation at once clear the cuticle and its appendages and thus further the well-being of the Crab.

DESCRIPTION OF THE PLATES*.

Plate XIX.

Fig. 1. Hairs from the inner rows of the long segment of the external foot-jaw: one shows the peculiar marking at some distance above the insertion; a smooth and a bristled tip are also seen.

Fig. 2. Hairs from the inner or dorsal surface of the great or external foot-jaw.

Fig. 3. Two hairs from the anterior margin of the squarish segment of the same foot-jaw.

Fig. 4. Hair from the circlet on the compound eye, loaded with parasitic growths.

Fig. 5. Recurved fangs of a hair from the whip pertaining to the great foot-jaw, and tip of another from the strong rounded segment of the third pair of foot-jaws.

Fig. 6. Bristles from the tip of the strong limb of the second pair of foot-jaws.

Fig. 7. Fragment of areolar layer, with hairs both bristled and serrated, from the long segment of the same part.

Fig. 8. Bristle from the tip of the strong limb of the second pair of foot-jaws, acted on by nitric acid.

Fig. 9. Tip of the delicately jointed organ of the same foot-jaw in an abnormal specimen.

Fig. 10. Extremity of the delicately jointed limb of the third pair of foot-jaws.

Fig. 11. Extremity of the external division of the fifth pair of foot-jaws in the soft Crab.

Fig. 12. Bristle from the broad extremity of the middle segment of the same foot-jaw in the soft animal.

Fig. 13. Brushed hair from a chela.

Fig. 14. Hairs of the larger terminal antennula of the internal antenna.

Fig. 15. Widely-spiked hair from the ventral surface of the carapace.

Fig. 16. Portion of the great clasper near the point, showing the short curved fangs which incline towards the base of the organ; from a soft Crab.

Fig. 17. Pointed horny process at the anterior end of the hairy ridge on the floor of the stomach.

Plate XX.

Fig. 1. Some of the larger hairs from the right side of the anterior portion of the stomach.

Fig. 2. Portion of one of the hairy ridges overlapping the central depression on the floor of the stomach.

Fig. 3. Delicate filmy hairs from the upper portion of the same region on each side of the central horny bar posteriorly.

Fig. 4. Fragment of hair, with cluster of Algæ, from the socket of the eye.

Fig. 5. Fibres from beneath the external brittle calcareous layer of the eminence at the posterior part of the stomach, composing the asbestos-like mass.

Fig. 6. Portion of membrane, with hairs, cells, and granules, from the region to the outside of the hairy ridges on the under surface of the stomach.

Fig. 7. Piece of translucent membrane from the upper and posterior part of the stomach, with hairs attached.

Fig. 8. Square of membrane from the floor of the stomach between the hairy ridges, showing the groups of minute spikes.

Fig. 9. Two longer groups on a fragment of membrane from the anterior portion of the same region.

Fig. 10. Fragment from the posterior part of the stomach, showing the origin of the hairs from the horny matrix in groups of three.

* The powers used in these observations were 80 and 250 diameters.

Fig. 11. View of the posterior part of one of the hairy ridges on the floor of the stomach, exhibiting the origin of the hairs from the horny matrix, together with an area of finely dotted cells and a portion covered with spikes above.

Fig. 12. Pectinate arrangement of the external hard layer of the eminence at the posterior part of the stomach.

Fig. 13. Termination of one of the horny bars of the same posteriorly, in a diverging crest of fibres.

Fig. 14. Tip of one of the branchial hairs, with a fungoid tuft at its extremity.

Fig. 15. Hair from a branchial process, with the parasitic zoophyte attached; the latter is somewhat out of focus.

Fig. 16. A small portion of the parasitic zoophyte (?) from the base of a branchial hair.

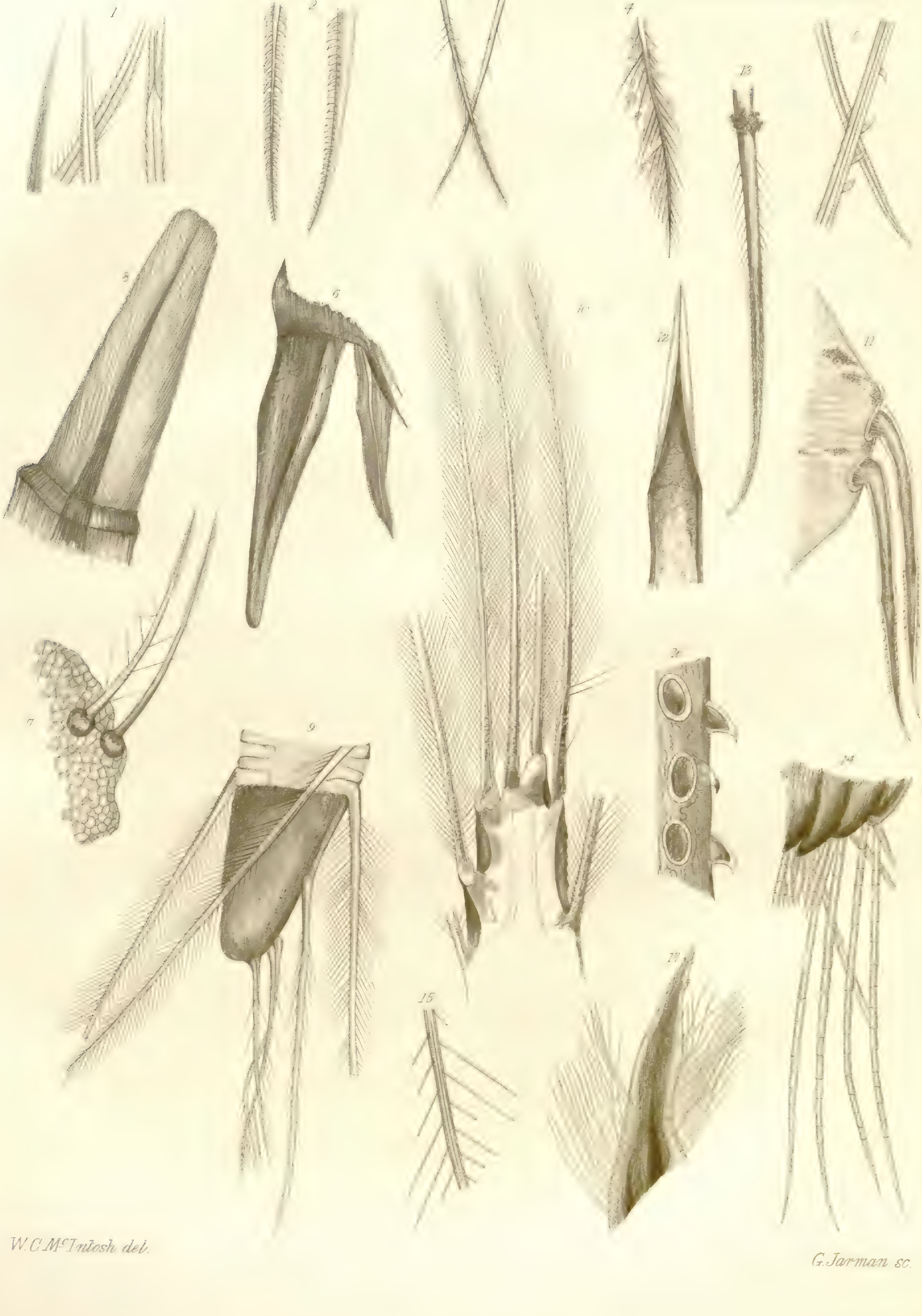
Fig. 17. Outline of one of the free ciliated bodies found in the same region.

Fig. 18. Two hairs, from the internal abdominal foot of an egg-bearing female, imbedded in the tough secretion which forms the pedicles for the eggs. A portion of a ruptured capsule is attached to one of the pedicles.

Fig. 19. An ovum and its pedicle.

Fig. 20. Portion of cuticle from the postero-lateral part of the soft or new carapace, in a specimen with the old shell still adhering.

Fig. 21. Extremity of the posterior clasper; from a soft Crab.



W. C. McIntosh del.

G. Jarman sc.

W. C. McIntosh del.

G. Jarman sc

V. *On the Structure and Nature of the* Dracunculus, *or Guineaworm.* *By* H. Charlton Bastian, *M.A., M.R.C.S., Assistant Conservator of the Anatomical Museum, University College, London.* *Communicated by* George Busk, *Esq., F.R.S., Sec.L.S.*

(Plates XXI. & XXII.)

Read February 19th, 1863.

Among the numerous parasites which infest the human frame, the Guineaworm (*Filaria medinensis*, Gmel.) is one of those which has been known from the most ancient times,—the first undoubted reference to it being made by Agatharchidas*, the philosopher and historian of Cnidus, who lived about 140 b.c., in the time of Ptolemy Alexander. Küchenmeister†, however, discusses the question whether Moses was not the first writer who mentioned the worm, and whether the "fiery serpents" referred to in the Book of Numbers were not in reality *Dracunculi*.

Owing to the tedious and very painful nature of the consequences entailed by the presence of this worm in the human body, more perhaps has been written concerning this parasite than upon any other single Entozoon. The statements regarding its nature have, however, been most conflicting, as may be seen by reference to the works of Küchenmeister, Bremser‡, and Moquin-Tandon§. Up to within comparatively recent times its very animality has been denied, and that too by the distinguished French surgeon Larrey, who might well have acquired a more exact knowledge of its real nature during his residence in Egypt. He held that it was nothing more than a portion of "dead cellular tissue;" Richerand, that it was a "fibrinous concretion;" whilst Ambroise Paré declares that the effects produced by the presence of the worm are due only to a kind of tumour or abscess proceeding from "acidity of the blood." For other views equally novel, as well as for a history of the effects produced by the worm whilst lodged in the subcutaneous tissue of the body, and the medical treatment of the disease, also called *Dracunculus*, I would refer especially to the works before mentioned, as well as to other papers, to which reference will be made, in the Indian journals, as in the present communication I shall confine myself to the natural-history aspect of the question.

Gmelin‖ was the first to assign the Guineaworm its place amongst the true Helminthes, in the order Nematoidea; but a more thorough investigation of its anatomy will, I think, lead us to doubt the propriety of considering it a species of the genus *Filaria*.

It is endemic in the tropical parts of Asia and Africa, in the island of Grenada, with the small neighbouring Grenadine group, and doubtfully so in the island of Curaçoa; but it has not been met with anywhere in the tropical regions of the continent of America.

* Δρακόντια μικρά, Agatharchidas apud Plutarchum, Quæst. conviv. lib. viii. quæst. 9, Op. moral., ed. Düben, Paris, 1841, i. 894.

† Küchenmeister's 'Manual of Parasites,' translated by Dr. Lankester for Syden. Soc., vol. i. p. 390.

‡ Sur les Vers Intestinaux, French edition, by Grundler, p. 198.

§ Eléments de Zoologie Médicale, 1859, p. 333.

‖ Systema Nat., p. 3039.

It is not, however, universally distributed over the countries in which it is endemic, but is confined to certain limited areas, and is much more abundant at some times than at others—both which facts will be seen further on to have their special significance.

In the regions where it is prevalent, this parasite is met with principally in the subcutaneous tissue of persons who have exposed themselves to certain conditions known to be favourable to the production of the disease*. In about four-fifths or more of the whole number of recorded cases, these worms have been situated in the lower extremities, below the knees; and taking into consideration the fact that the people so affected mostly go about with bare legs and feet, and other evidence of a similar nature which will subsequently be alluded to, it is generally admitted at the present day that the worms are contained in some imperfectly known condition in the waters and damp places of these regions, and that they also in some unascertained manner make their way through the integuments of the body, and then acquire extraordinary dimensions in the subcutaneous or intermuscular cellular tissue.

Having once located itself within the body, the worm grows rapidly, without producing any signs of irritation, or attracting much notice, for a period varying from eight to twelve or fourteen months. This has been aptly termed by Mr. Busk the "latent period" of its existence. After a time, however, the head begins to make its way to the surface, and then commences the long category of troubles peculiar to the disease, till the parasite has been completely extracted.

The worms are usually stated to vary in length from six inches to ten or twelve feet, and to be about $\frac{2}{3}$rds of a line in thickness. When fresh, they are of a milk-white colour, and nearly cylindrical. All that have hitherto been examined have been found to be undoubtedly female and viviparous, with the exception of three specimens, to which allusion will again be made further on.

Having had six of these worms placed at my disposal for examination through the liberality and kindness of Professor Harley, of University College, I have availed myself of the opportunity of making a most careful investigation of their structure. But before stating the results of my own observations, I think it will be well to give a brief account of our previous knowledge on the subject. It is really surprising to find the ignorance which prevailed concerning the anatomy of this worm anterior to the writings of Busk and Carter, though this may be accounted for to a great extent by the comparative rarity with which these parasites are met with in Europe, and from many of the observers having had but one, and that an imperfect specimen for examination.

Rudolphi, in his earlier work†, has little to say concerning the anatomy of the Guinea-worm; indeed he confesses, "totius vermis anatome desideratur." The only positive characters he gives are, "Margine oris tumido, caudæ acumine inflexo," whilst in his later work‡ he speaks of the numerous young contained within the parent worm in the following terms:—"Filariæ nostræ prole quasi farctæ sunt, quod si harum longitudinem, illius vero minutiem spectas, fœtuum multa millium millia singulis tribuit. Oviductuum

* The Guineaworm has also been met with in dogs and horses.

† Entozoorum historia naturalis, Amstelodami, 1809, vol. ii. pars 1. p. 55.

‡ Entozoorum Synopsis, Berolini, 1818, p. 205.

indoles quoad particulas tantum examinari potuit, sed ab illa aliarum specierum eo recedere visa, quod tunicæ leves neque fœtuum velamenta fere ulla sisterentur, sed passim tantummodo inter innumeros fœtus grumosi quid adesset." In the body of this work, also, Rudolphi speaks of certain peculiarities in the shape of the anterior and posterior extremities of the worm as characterizing the two sexes, though, in an appendix, he retracts this statement, on finding, after more careful observation, that all the worms examined were female and proliferous.

Dr. Chapotin* gives the following account of the anterior extremity of *Filaria medinensis*:—"Examinée à la loupe, l'extrémité antérieure, légèrement renflée, m'a paru offrir, dans le centre un suçoir, sur les côtés duquel se voient deux petites protubérances arrondies," whilst the posterior extremity, he says, is constantly "terminée assez brusquement par un petit crochet contractile, et dont j'ai vu les mouvements."

M. Jacobson, in a letter to M. de Blainville†, narrates that, in the extraction of one of these worms, he accidentally wounded it with the point of the lancet, and from the opening thus made, he says, "découloit une matière blanche; mais ce que m'étonna le plus, c'est que le ver se vida, et que les parois de son corps s'affaissèrent." On submitting this white matter to microscopical examination, he found, not eggs as he expected, but that it consisted almost entirely of small actively moving worms. He says, "ce qui est presque inconcevable, c'est la quantité innombrable de vermicules dont le corps du dragonneau est rempli, sans que j'ai trouvé aucune trace de viscère qui les renfermeroit. . . . . . Sont-ce bien les petits du dragonneau? . . . . . ou bien, je n'ose presque pas faire cette question, le dragonneau ne seroit-il qu'un tube ou un fourreau rempli de vermicules?" He seems to have made no further observations upon the structure of the parent worm, though he gives figures of seven or eight of its countless progeny, to which I shall have again to refer.

Leblond examined a small fragment of a Guineaworm, one inch and a half in length—being one of the separate portions of the only specimen of the worm contained in the Musée d'Histoire Naturelle at Paris—and seems to have been the first and only observer, before Mr. Carter, who recognized the existence of both a genital and an alimentary tube. He says‡, "Je l'ai fendu longitudinalement, et j'ai trouvé, au sein de l'enveloppe musculo-cutanée, un tube fibrineux gorgé de matière verdâtre, qui était évidemment une portion du canal intestinal; puis un autre tube également fibrineux éraillé, qui renfermait un nombre immense de jeunes filaires. J'ai dû regarder ce tube comme une portion des cavités génitales."

Professor Owen remarks§, "In a recent specimen of small size we have observed that the orbicular mouth was surrounded by three slightly raised swellings, which were continued a little way along the body and gradually lost. . . . . . The caudal extremity of the male is obtuse, and emits a single spiculum; in the female it is acute and suddenly inflected." He also notices two longitudinal muscular bands, and an external elastic

* Bulletin des Sciences Médicales, Mai 1810.

† Nouvelles Annales du Muséum, tom. iii. p. 80, 1834.

‡ Quelques Matériaux pour servir à l'histoire des Filaires et des Strongyles. Précis analyt. des travaux de l'Acad. Roy. de Rouen, 1835, p. 150.

§ Cyclopæd. of Anat. and Physiol., Art. "Entozoa," 1837, pp. 122, 143.

integument, but, after careful examination of three specimens, was quite unable to discover any trace of either generative or digestive organs. After briefly describing the external characters of the minute contained worms, he adds, "What is most remarkable is, that these embryos are not, as in *Strongylus* and the Nematoid genera above mentioned, enveloped in an egg-covering, nor are they included in a special generative tube, but float freely along with a granular substance in the common muscular envelope of the cavity of the body,"—an observation already made, as above cited, by Rudolphi.

In his more recent work*, Professor Owen is altogether silent as to the existence or non-existence of either generative or alimentary organs; but, speaking of the integument of the Nematoid worms, he says, "In the Nematoid parasites of the human subject and in almost all the order, it is more or less smooth: it consists of a thin, compact epidermis, and of a fibrous corium firmly attached to the outer transverse muscular fibres. The corium consists of decussating fibres." It will be seen hereafter that nearly all these statements are at variance with subsequent observations, and that Leblond's description was probably perfectly correct, though Professor Owen doubts its accuracy.

Rudolph Wagner partially examined two specimens of the Guineaworm, and has given a description of them with figures†, as an introduction to a commentary by Birkmeyer‡. He describes the head, with its four papillæ, and the hooked tail, but does not mention any difference in the size of the separate papillæ. He speaks also of an anal aperture at the inner curvature of the tail, serving at the same time as an outlet for the genital organs, and marks its situation in a figure. Seeing a white tube running through the whole extent of the body, he says, "Hoc intestinum pro ovario habui; nam ex incisionibus quas in variis corporis locis institui, fila tenuissima (fig. 5 *a*, *b*, *c*) extrahere potui, quæ quominus pro prole habeamus, nihil obstare videtur." The specimens were not further dissected, as they were destined for the Zoological Museum of Erlangen.

Dujardin§ gives no particulars concerning the anatomy of the Guineaworm, save that the mouth is simple and round, the tail a little acute and recurved, and that all specimens hitherto found have been female and viviparous.

Mr. Busk‖ gives a much fuller and more accurate account of the anatomy of the Guineaworm than any we have yet met with, and is indeed the first writer who has furnished us with anything like a detailed description of this interesting Entozoon. Owing to the great rarity of meeting, in this country, with a worm having its anterior extremity uninjured, he is not very certain about the anatomy of the head, but agrees with other observers as to the acutely inflected tail, and gives figures of different varieties.

He considers the integuments to be composed of two tubes, between which are contained the two longitudinal muscles. The external tube is a transparent, striated, elastic structure, whilst the internal is composed of a soft pulpy substance covered with a deli-

* Lect. on Comp. Anat. and Phys. of Invert., London, 1855.

† Wagner's is the only correct figure of the whole Guineaworm I have met with; but the anterior extremity is more blunt and abrupt, and the lateral papillæ larger, than in the specimens I have examined.

‡ Birkmeyer, De Filar. Medinensi Comment., Onoldi, 1838.

§ Hist. Naturelle des Helminthes, 1845, p. 44.

‖ Transactions of the Microscopical Society, vol. ii. p. 80, 1846.

cate membrane. This pulpy substance forms rounded lobular projections into the cavity of the body, and are considered by Mr. Busk as analogous to somewhat similar processes observed in *Strongylus* and *Ascaris*—the "*appendices nourriciers*" of Cloquet. After speaking of the longitudinal muscles, he says, "On each side of these muscular bands is a thin tract of a peculiar substance, and in the middle of each of these tracts is a more or less transparent line. The substance composing the tracts is minutely granular, and presents no other aspect under the highest power I have been able to employ. The transparent line appears to be a canal excavated in the granular substance, and is without visible walls." These granular tracts and canals I have been unable to discover in the worms examined by myself, and I shall further on have to suggest a possible cause of the difference.

Mr. Busk also describes a straight narrow intestinal canal of uniform calibre, extending from the mouth to near the posterior part of the body, where it has an obscure cæcal ending. He could discover no trace of an anal aperture. Around this narrow alimentary canal, between it and the rounded processes of the inner tube, he states that the *general cavity* of the body is filled with innumerable small worms, all of the same size, with more or less granular matter. He did not detect that these young worms were contained in a genital tube.

Mr. Carter has written three papers* of great interest on the anatomy of the *Dracunculus* and the "microscopic Filaridæ" of the island of Bombay; but it is to his last and longest communication, embodying the results of his most recent investigations, that I shall have principally to refer. The great care which Mr. Carter has taken, and the numerous observations he has made with a view to throw some light upon the early history of the Guineaworm, are most valuable contributions towards a scientific elucidation of this very difficult question; and if followed up by equally zealous attempts by others enjoying the same advantages, the enigma would doubtless soon receive a final solution.

He gives a full description of the anterior extremity, describing the mouth as terminal, punctiform, and surrounded by a smooth-bordered quadrangular space, and four papillæ—two large and two small. Tail presenting the usual hooked appearance, but no anal aperture. The body consists of a firm, cylindrical integument, lined with a coating of muscular fibres, within which again, loosely suspended by delicate filaments of cellular tissue, in the peritoneal cavity, are the alimentary canal and generative organs. The muscular coat, he says, is composed of delicate circular fibres, adhering to the external integument, between it and the two large longitudinal muscles. He also mentions "sarcoid" processes in about the last inch and a half of the anterior and posterior extremities, projecting from the integuments into the cavity of the body. Alimentary canal divided into œsophagus, intestine, and rectum, the two former being contained within a common peritoneal sheath, having a constriction at their point of junction, and of which that surrounding the œsophagus is the wider. The œsophagus, which is about two inches in length, and very narrow, has also a muscular sheath within the peritoneal. The diameter of the intestine itself is about three times as great as that of the œsophagus, with which it is continuous at the constriction in the peritoneal sheath. It is uniform in calibre,

* Trans. of Med. and Phys. Soc. of Bombay, 1853, p. 45; Annals of Nat. Hist., 3rd ser., vol. i. 1858, p. 410; Ibid. vol. iv. 1859, pp. 28, 98.

and the space between it and its containing sheath is occupied by dark-coloured oil-globules, supposed to be hepatic. The rectum is only about one-eighth of an inch long, very narrow, without any sheath, and attached to the ventral muscular band at the inner curvature of the tail. The organs of generation are described as consisting of a large cylindrical ovisac, extending through the body, of uniform calibre to within an inch and a half of either extremity, where it terminates abruptly at each end in a narrow blind tube; but no external communication or vulva could be discovered. The contents of this ovisac were innumerable vermicules, all of the same size, and some granules, which Mr. Carter considers as the remains of ovarian envelopes, though he has never been able to detect anything like a distinct membrane. He has never seen a male worm.

Mr. Carter considers that the structure of the contained young and also of the "microscopic Filaridæ" of the island of Bombay, as observed by him, agrees in all essential particulars (size, of course, excepted) with the account above given, save that the young of the Guineaworm have never any trace of generative organs. Full particulars of their anatomy will be found in the 'Annals of Natural History' for 1859.

I have examined six specimens of *Filaria medinensis*, all of which were taken from the lower extremities of a well-known surgeon of Bombay, by whom they were given to Dr. Harley. The specimens were all of the same age, though of different sizes—four being about thirty inches long, one only eighteen inches, and the other three feet long. All were female and viviparous, and perfect specimens, with the exception of one, in which the head was wanting; and their good preservation was probably owing to the method of their extraction by a native of Bombay, who, after making a minute aperture in the integuments, as nearly as possible opposite the middle of the worm, passed under its exposed body a small hook, and then by gentle traction, at the same time that the skin around was kneaded, each worm was extracted at a single sitting of perhaps an hour or less, instead of by the tedious process of rolling it daily round a small piece of wood.

As the manner in which this gentleman became affected with these parasites is pretty definite, both as to their mode of entrance and their age, I shall quote his account from a Report read to the Pathological Society of London by Dr. Harley.

After stating that he had been many years in Bombay, and never affected with Guineaworm, though accustomed often to be out shooting and drink freely of the water of wells, without being very particular as to quality, he says:—"At last, however, I one day discovered that I had what at first appeared to me to be varicose veins, but which in a day or two I found to be Guineaworms in my legs. At first I was at a loss to account for the presence of a Guineaworm in my body, till I remembered that one day, whilst out shooting, one of my boots burst, and being too impatient to wait till another pair was brought, I took off both boots and stockings and went on shooting barefooted over a piece of swampy stubble; and I believe that the worms entered my feet on this occasion; for after an interval of six or eight months the first worm appeared, and that is about the time generally allowed* for the worms to come to maturity in the human body."

I will now proceed to give the results of my own observations.

* As a rule, the period is certainly longer than this.

External Characters.—Worms varying in length (Pl. XXI. fig. 1) from eighteen inches to three feet, and from $\frac{1}{10}$th to $\frac{1}{15}$th of an inch in diameter, of a milk-white colour (or light straw when kept in spirits), mostly quite smooth, but sometimes slightly annulated by rugose contractions; cylindrical, or more or less flattened laterally, and tapering gradually towards both extremities. About $\frac{1}{20}$th of an inch from the posterior extremity the body becomes more abruptly narrowed, and terminates usually in a sharply curved tail or point. In some cases, however, the tail is straight, and in others, as pointed out by Carter, it is more acutely bent upon itself, and seems connected to the adjacent portion of the body by a delicate membrane (Pl. XXI. figs. 4, 5, 6, 7). On opposite sides of the body are seen, extending along its whole length, two opaque bands, corresponding with the great dorsal and ventral muscles, and two more translucent intermuscular spaces. For a short distance from the anterior extremity, two narrow, white lines may also be seen running along the body, each being midway between the lateral spaces. No vulva discoverable; anal aperture doubtful—if present, situated in the concavity of the tail.

The integuments are so elastic, that the worm may be stretched to nearly twice its natural length.

Examined with a low power of the microscope, the head presents the following characters:—Mouth punctiform, about $\frac{1}{2000}$th of an inch in diameter, situated in the centre of a somewhat flattened terminal disk, and surrounded by a circular eminence or lip* (Pl. XXI. fig. 2) $\frac{1}{270}$th of an inch in diameter. Around the mouth are four papillæ, two of which (much larger than the others, and also nearer the oral aperture) are continuous with the narrow white lines before mentioned, and are therefore situated vertically; whilst the two lateral, more remote from the mouth, not prominent, and scarcely more than opaque spots are situated at the commencement of the gradually widening, lateral, intermuscular spaces. The upper and lower papillæ are prominent, and well seen in outline (Pl. XXI. fig. 3), being about $\frac{1}{1000}$th of an inch in height, $\frac{1}{500}$th of an inch in breadth at the base, and $\frac{1}{200}$th of an inch apart, whilst the small lateral papillæ are $\frac{1}{125}$th of an inch apart. The mouth and papillæ are situated in the midst of an opaque, whitish, quadrangular space, about $\frac{1}{100}$th of an inch from side to side, the papillæ being situated towards the angles, from which also proceed the two opaque-white, gradually widening, lateral spaces and two narrow dorsal and ventral lines, which are only about $\frac{1}{2000}$th of an inch wide†. Between the white lines surrounding the head may be seen longitudinal muscular fibres—the origins of the four longitudinal muscles.

Integuments.—The integuments of the worm are composed of a transparent, almost structureless, chitinous substance, arranged in a number of concentric lamellæ, presenting peculiar linear markings. Altogether it forms a very tough and highly elastic cylindrical investment.

Analogy would point also to a deep cellular layer of integument; and though I have

* The circular rugæ of Carter.

† It will be seen afterwards that this opaque quadrangular space and four converging lines correspond to the quadrangular commencement of the sheath of the alimentary canal and its crucial mesenteric process going (Pl. XXI. fig. 13) to the intermuscular spaces.

not been able to discover any trace of it, this may be due to the fact that the worms examined were not recent specimens, but had been preserved in spirits of wine.

The integuments of the Nematoid worms have been described by Von Siebold, Dujardin, Owen, and other writers, as composed of a structureless epidermis, and a corium made up of layers of longitudinal and oblique decussating fibres; but, after a most careful examination, I have been unable to discover that any such distinction can be drawn between the different portions of the integument of the Guineaworm—the whole thickness being almost identical in structure, and apparently composed of successive excreted * epidermic layers. I think it will be possible to show also that what appear to be layers of decussating fibres, in the Guineaworm and some other Nematoids that I have examined, are not such in reality. A true corium or enderon, as before stated, I have failed to recognise.

The average thickness of the integuments is $\frac{1}{400}$th of an inch, though it is considerably thinner towards either extremity of the body. It may be divided into two principal parts—an external portion with transverse markings, constituting about one-half of the whole thickness, not divisible into lamellæ; and an internal portion, made up of about thirty very delicate lamellæ, having longitudinal or oblique markings.

The *external* portion of the integument is composed of a thick, chitinous layer, tough, elastic, transparent, and perfectly structureless, save that it presents transverse markings at intervals. These lines (Pl. XXI. fig. 8) have an average distance of $\frac{1}{1400}$th of an inch from one another, though near either extremity of the worm they are as little as $\frac{1}{6000}$th of an inch apart, the distance between the lines gradually diminishing up to this point. They are about $\frac{1}{7000}$th of an inch in breadth, and easily recognisable when most of the lamellæ covering them internally have been stripped off. They vary slightly in their distance from one another, are wavy, but do not preserve any parallelism between themselves; and moreover they frequently join one another or bifurcate, so that they by no means form perfect circles round the body.

The external surface of the integument seems perfectly smooth, there being no appreciable depressions corresponding to the annulose markings such as may be seen to a slight extent in *Ascaris lumbricoides* and *A. mystax*; but there is some considerable alteration in the refractive power of the membrane in these situations, as when seen a little beyond the proper focal distance these markings become most distinct, appearing as bright white lines.

The *internal* portion is composed of three different sets of very delicate lamellæ, each being transparent, glass-like, and structureless with the exception of certain faint rectilinear markings at regular intervals, which correspond in breadth to those between the transverse lines of the outer portion of the integument, viz. about $\frac{1}{1400}$th of an inch. These lines also seem due to some variation in structure producing an alteration in the refractive power of the lamellæ.

Each set appears to be composed of about ten superimposed lamellæ, the markings of the external being longitudinal, whilst those of the inner two sets are oblique, in opposite directions. When seen superimposed, the markings of the middle set of lamellæ are found to intersect those of the internal set at an angle of about 85°, or nearly at a

* Huxley, Art. "Tegumentary Organs," Cyclop. of Nat. & Phys. pt. xlvii. 1855, p. 484.

right angle, leaving diamond-shaped spaces between the points of intersection, and constituting a system of spirals in opposite directions round the body of the worm (Pl. XXI. fig. 10).

These linear markings preserve a nearly uniform distance from one another, and pursue a straight course, without dividing or communicating in any way, similar to those of the external portion. And there is this in common with the three sets, that the lines, whether longitudinal or oblique, of the several superimposed lamellæ do not correspond in position; so that when those of the most superficial lamellæ are in focus, there may be seen generally about nine fainter lines of deeper lamellæ shining through, and closely filling, what would otherwise be each clear interlinear space (Pl. XXI. fig. 9).

This appearance is very deceptive, and gives *each set of lamellæ* the aspect of a *single striated or fibrous membrane*, as I, for some time, believed them to be, until on examining one of these supposed membranes with a high power, I discovered that a portion of a very delicate lamella had been torn off from those subjacent, leaving a toothed edge. The linear markings of this superficial lamella could be traced distinctly up to the torn edge; and in this situation also the lines of the uncovered portion of the subjacent layer were plainly visible, corresponding with a portion of the interval between the lines of the lamella above (Pl. XXI. figs. 11, 12). This I have frequently seen since; and the observation evidently affords the key to the arrangement of these markings generally: and the fact is most important, as showing that this anomalous appearance of fibrous membranes in the integuments of these worms is a mere optical delusion, and that the membranes have no real existence, but that instead there exists a series of delicate and successively excreted chitinous lamellæ, having linear markings in definite directions—an arrangement fully in harmony with what we know of other analogous structures.

The two internal sets of lamellæ may be readily isolated by tearing a small piece of integument to pieces with needles; but the external set with the longitudinal markings is very difficult to separate from the outer portion of the integument, to which it is intimately adherent. These longitudinal lines are not so rectilinear as the oblique, and they are all rather difficult of detection, requiring a high power to distinguish those of the superficial lamellæ plainly from those of the lamellæ beneath. In this respect they are very different from the transverse markings of the outer half of the integument,—the greater distinctness of these being apparently due to the fact that the alteration in texture, on which the markings depend, extends through the whole thickness of this outer portion, whereas the lines which have a similar direction in each of the three sets of lamellæ do not correspond in position, and, being produced by an alteration in the texture of one delicate lamella only, are necessarily very faint.

There seems to be some slight difference, too, between the texture of this thick outer portion and the internal lamellæ, since its torn edge is generally even, whilst that of the lamellæ is always sharply jagged and toothed.

The structure of the integuments of *Ascaris lumbricoides* and of *A. mystax* corresponds, in its general nature, with that of the Guineaworm just described, though it differs in several minor and unimportant details. The markings of all the layers are much more rectilinear and distinct in both these worms. They possess an external coat with circular or transverse lines, the same as in *Filaria medinensis*, but, unlike it, they have no series of lamellæ with longitudinal markings, intervening between this outer coat and the lamellæ with oblique markings. When seen superimposed, the oblique lines of these lamellæ are found to intersect each other and the transverse lines of the outer coat at a very acute angle. Internal to this, in *Ascaris lumbricoides*, there is also what appears to be a single delicate lamella, with very faint and close longitudinal markings; but I have not been able to discover anything similar in *A. mystax*. The lamellæ with the oblique markings do not seem so numerous in either of these species as in the Guineaworm, and the external portion constitutes about three-fourths, instead of one-half, of the whole thickness of the integument. The integuments of these worms also are not so favourable for examination as that of the Guineaworm, on account of the extreme difficulty in isolating their component parts.

Muscular System.—This is composed of four powerful longitudinal muscles firmly attached to the inner integumental layer, two of which occupy the dorsal and two the ventral region. They are made up of non-striated muscular tissue. As the longitudinal fibres run along the convexity and the concavity of the tail respectively, and the intestinal tube will afterwards be seen to terminate in the midst of the fibres occupying the concavity, as first pointed out by Mr. Carter, we must look upon these as ventral, and those along the convexity as dorsal, whilst the curve of the tail is thus ascertained to be in the median longitudinal vertical plane of the body, having a direction from above downwards.

Only two longitudinal muscles have been described by other observers; but I think a more careful examination, particularly of the anterior extremity of the worm, will show that there are in reality four of these muscles, as in many other of the Nematoidea, two being dorsal and two ventral. The origins of the four muscles completely surround the head with a thin layer of fibres, the boundaries of each being marked off by the four crucial lines (Pl. XXI. fig. 13). The two dorsal, running close together for two or three inches, one on each side of the middle line, then become fused as it were into one great muscle—though a trace of the original division continues apparent throughout the whole length of the worm, and becomes again rather plainer towards the tail. The two ventral muscles are arranged in just the same manner; so that a broad, lateral, intermuscular interval is left on each side between the dorsal and ventral group, equal in breadth to one-sixth of the circumference of the body. The four muscles are all of nearly the same size, each being of just the same breadth as one of the lateral spaces (Pl. XXI. fig. 19). Each is composed of fasciculi of very fine fibres, about $\frac{1}{40000}$th of an inch in diameter, whilst the breadth of the fasciculi themselves is about $\frac{1}{500}$th of an inch (Pl. XXI. fig. 24). Frequent interchange of fibres takes place between contiguous fasciculi (Pl. XXI. fig. 23).

The arrangement of the muscles and their fasciculi may be well seen in the series of transverse sections shown in Pl. XXI. figs. 13–21.

The four muscles, after leaving the head, soon acquire a perceptible thickness; and it may be seen that the adjacent borders of the two dorsal and two ventral muscles respectively are very thin, whilst each gradually increases in thickness towards its free border bounding the lateral spaces. The irregularity of the inner surface of the muscular bands, owing to the arrangement of the fibres into prominent fasciculi, is very evident for about the first two inches from the head. Further on the fasciculi are less prominent, and, the muscles acquiring a more uniform thickness, each pair becomes fused, apparently, into one great muscle, occupying the dorsal and ventral regions respectively. Where much compressed by the distended ovisac, the muscles seem to undergo partial absorption * (Pl. XXI. fig. 20).

Many contradictory statements have been made both as to the presence and arrangement of transverse muscular fibres in the Nematoid worms; and though Mr. Carter states that they occur in the Guineaworm, I have failed, after most careful search, to discover any trace of them. The transverse markings of the integument, dimly shining through the peritoneal membrane, present a very deceptive appearance.

Nervous System.—The only traces of a nervous system that I have been able to discover are two delicate ganglionated cords, extending the whole length of the worm, one occupying the centre of each lateral intermuscular space. They are situated, with a minute vessel to be afterwards described, in the midst of a pulpy substance, between the peritoneum and inner layer of integument, on which they lie. Some slight change, too, is produced in the texture of the integuments at this place, by which its refractive power is increased; for when quite bared on the inner side, and seen a little beyond the proper focal distance, a bright line is observed, of the same position and breadth as the nervous cord which had lain over it.

I have traced these cords close up to both extremities of the worm, but have not been able to discover any connecting central ganglion anteriorly, or distinct termination posteriorly. The two cords pursue a slightly wavy course, and seem to give off no branches in any part of their length. Each is about $\frac{1}{1400}$th of an inch in diameter, and marked with distinct, elongated swellings, or ganglia, at intervals of about $\frac{1}{13}$th of an inch (Pl. XXI. figs. 22, 25, *c*, *c*, 26). The average breadth of the ganglia, at the widest part, is $\frac{1}{400}$th of an inch, each having an irregularly crenated margin†. The intervals between the swellings are not perfectly equal, neither do the ganglia on opposite sides of the body correspond in longitudinal position.

* The powers of locomotion possessed by this worm whilst still in the body seem considerable; they may sometimes be felt quite superficially beneath the skin, and in a few days have disappeared entirely from their former situation, having either penetrated deeply between the intermuscular planes of cellular tissue or else moved considerably in the subcutaneous tissue, as in the following case related by Dr. Smyttan in the 'Transactions of the Medical and Physical Society of Calcutta,' vol. i. p. 182. He says, in the case of a Lieut. F——, "The worm could be distinctly traced under the skin at the top of the left shoulder. By-and-by it found its way to the elbow, where it was as distinct, and in the course of a few weeks made its way by gradual progress to the wrist, from which place it was extracted." This power of locomotion accounts perhaps most feasibly for the very exceptional case quoted in the same paper, in which two Guineaworms were found alive in the cavity of the abdomen—one attached to the peritoneum, on the surface of the liver, and the other to that of the kidney, but otherwise floating freely amongst the coils of intestine. This is the only recorded case I have met with of these worms being found within any of the great cavities of the body.

† A bright, highly refracting body, about $\frac{1}{2000}$th of an inch in diameter, is seen in the centre of nearly all the ganglia; but careful examination shows that the dot is in no way connected with the ganglion, but belongs to a faintly outlined gland-cell, to be afterwards described, lying on its surface.

Much doubt and uncertainty prevails amongst anatomists concerning the nervous system of the Nematoid worms; so that little or nothing definite can be said with regard to its arrangement in the order generally.

Walter's* elaborate and precise observations on the anatomy of *Oxyuris ornata* seem to show that this animal possesses a most complex and highly organized nervous system, consisting of cerebral and caudal ganglia, from which, and from the cords connecting them, numerous branches are supplied to all parts of the body. But it would be desirable that such observations should be confirmed by other anatomists, since in another species of the same genus, a common human parasite, *Oxyuris vermicularis*, no nervous system has as yet been discovered.

Blanchard†, following Cloquet‡, in his description of *Ascaris lumbricoides* considers it to possess a dorsal and a ventral, median, longitudinal, nervous trunk, and, moreover, considers this to be the typical arrangement of the nervous system in the Nematoidea. This opinion is shared by many other anatomists; but, when speaking of the circulatory system of the Guineaworm, I shall presently point out why it appears to be untenable.

What I have just described as existing in *Filaria medinensis* agrees with the distribution of the principal nervous trunks in the Nemertidæ and some of the Trematode worms; and a careful examination of recent specimens of the Guineaworm may perhaps hereafter show some central connecting ganglia anteriorly, and thus render the resemblance more complete.

Organs of Circulation.—The representatives of this system met with in the Guineaworm belong, doubtless, as in its allies the Tæniadæ and the Trematoda, rather to the "water-vascular system" and the function of respiration than to the propulsion of true blood; yet still, in the present imperfect state of our knowledge, I have thought it better to describe them under the above head.

Four equidistant longitudinal vessels extend through the whole length of the body, situated, like the nervous cords, in the midst of a pulpy substance beneath the peritoneal membrane. The two which occupy the median line of the dorsal and ventral regions respectively are much larger than the two lateral vessels. All four extend from one extremity of the body to the other; but how they terminate in either direction I have been unable to determine, neither have I succeeded in finding any external aperture with which they communicate, such as is generally met with in connexion with the water-vascular system of the Annuloidea.

The dorsal and ventral vessels are in all respects similar, occupying the median intermuscular interval in each situation (Pl. XXI. fig. 22, *e*, *f*). They have an opake-white colour when seen with a powerful lens; but when examined under the microscope by transmitted light, they are found to be very delicate thin-walled tubes (Pl. XXI. fig. 28). They pursue a very undulating course, and are by no means of one uniform calibre, being frequently bulged at intervals. Throughout the greater part of their extent they are

* Zeitsch. für wissen. Zoologie, vol. viii. 1857, p. 163.

† Ann. des Sciences Naturelles, 3ième série, tom. xi. 1849, p. 138.

‡ Anatomie des Vers intestinaux, Paris, 1824, p. 38.

about $\frac{1}{666}$th of an inch in diameter, but anteriorly and posteriorly are reduced to $\frac{1}{1000}$th of an inch.

The lateral vessels are very much smaller, being only about $\frac{1}{6000}$th of an inch in diameter, and near the extremities of the body not more than $\frac{1}{10000}$th of an inch. They are situated outside the nervous cords, and may be seen through their substance pursuing a gently undulating course and having a uniform double contour (Pl. XXI. fig. 26). These vessels may sometimes be seen lying on the integuments after the nerve has been stripped off, and on one occasion I saw the broken extremity of a vessel distinctly projecting alone from the membrane on which it was lying.

In the specimens of Guineaworm examined by Mr. Busk, he did not discover any vessels in the situations I have described, but alludes to what appear to be four lacunar canals, one on each side of the dorsal and ventral muscular bands, in the middle of peculiar tracts of granular substance. I have met with nothing corresponding to this in the specimens examined by myself.

What I have described as dorsal and ventral vessels in the Guineaworm, correspond in position and general appearance with the dorsal and ventral nerves of Blanchard, Cloquet, and other anatomists, in *Ascaris lumbricoides*; but when portions of these structures are submitted to the microscope and examined by transmitted light, they are found to present important differences.

In *Ascaris* we find a tube with irregular swellings at varying intervals, composed of a delicate investing membrane, closely packed with small, roundish, highly refracting, fatty-looking particles. The well-known lateral cords in the same worm are three or four times as thick as those just described, and present a distinct channel or lacunar passage running through their centre, but in other respects are precisely similar, being made up, like them, of the same bright fatty-looking particles contained within a homogeneous membrane. I think, however, after the most careful examination, that there are also indistinct traces of a lacunar passage in the dorsal and ventral cords.

I have found four bodies essentially similar to these in *Ascaris mystax*; and, according to Blanchard, they are to be met with in most Nematoids*.

Professor Huxley† has described, in an *Oxyuris* of the Plaice, two contractile vessels communicating with the exterior and lodged in lateral cellular bands, which are doubtless homologous structures with those just mentioned as existing in *Ascaris*.

There can be little doubt, then, that these lateral cords are in some way connected with the development of a water-vascular system; and considering that the dorsal and ventral cords have exactly the same histological characters, I see no reason why these latter should be held to belong to the nervous system, even had we not the further evidence before us which the Guineaworm presents. But here, in the precise situation of these

* Walter (*loc. cit.*) describes four such bodies in *Oxyuris ornata*, and terms them "fat-canals" (Fettschläuche). He thinks they are in some way connected with the development of the animal, as these structures are most distinct and densely crowded with fatty particles when the animal is young, but that the latter gradually disappear with advancing age and maturity.

† Lect. on Gen. Nat. Hist., Med. Times and Gaz. 1856, vol. ii. p. 384.

so-called nervous cords, we meet with vessels that do not contain a trace of the characteristic fatty particles met with in *Ascaris**.

Filaria medinensis would seem to present us with a higher type of development, in which lacunar channels in the axis of peculiar "fat-canals" are replaced by distinct walled vessels.

Glandular System.—Lining the whole interior of the body is a bed of pulpy granular matter, containing numerous interspersed gland-cells. This system is most highly developed dorsally and ventrally, especially in the anterior part of the body, where it is situated on the corresponding muscles, and forms distinct circumscribed projections; but in the lateral regions, where it lies on the inner layer of integument, no regular projections can be seen. In both situations its inner boundary, or investing membrane, seems formed by the peritoneum lining the general cavity of the body.

For about two inches from the anterior extremity, over the dorsal and ventral muscles, well-marked glandular processes (Pl. XXII. fig. 29) are met with, projecting into the cavity of the body. They vary much in shape as well as size, being either flask-like, ovoidal, oblong, or quite irregular in form; and whilst those situated in the middle line, next the dorsal and ventral vessels, are very small, they gradually enlarge outwards towards the free borders of the muscles.

To the naked eye and by reflected light these processes are of an opaque milk-white colour; but when examined under the microscope by transmitted light, each is seen to be composed of a very delicate limiting membrane containing fine granular matter and a distinct spherical cell varying from $\frac{1}{1000}$th to $\frac{1}{350}$th of an inch in diameter, more densely crowded with the granular material, and having a central dot or nucleus about $\frac{1}{2000}$th of an inch in diameter (Pl. XXII. fig. 30). These projections are apparently connected at their base with an areolar arrangement of filamentous tissue, lying on the surface of the muscles—the areolæ corresponding in size with the processes with which they are connected.

Sometimes near the posterior extremity distinct projections are also met with; but throughout the greater portion of the body the muscles are lined with a comparatively smooth layer of more equal-sized glands, having a beautiful mosaic-like arrangement (Pl. XXI. fig. 27). Where much pressed upon by the distended genital tube, this layer wholly disappears (Pl. XXI. fig. 20).

Opposite the lateral spaces I have not been able to trace any arrangement into separate glands, the highly granular nucleated cells in that situation seeming to be dispersed, at intervals, through a thin stratum of the pulpy substance†, though, from a figure given by Carter in the Transactions of the Bombay Medical Society, I imagine the tessellated

* There is just a possibility that these dorsal and ventral vessels of the Guineaworm may be collapsed canals from which all the fatty particles have been absorbed, as is stated to occur late in life in *Oxyuris ornata*; but all I can say is, that such absorption does not take place in *Ascaris lumbricoides*, as I have never seen any difference in the quantity of these fatty particles in many specimens that I have examined; neither can they have been dissolved out by spirit, as they may be found as numerous as ever in specimens of *Ascaris* which have been three times as long in spirits of wine as the Guineaworms examined.

† Near the tail and in other parts of some of the specimens examined, the only trace of these cells was a faint oval or circular outline, with one or more bright, highly refracting bodies enclosed.

arrangement into distinct glands must, in recent specimens, prevail in the lateral spaces as well as over the muscles.

These processes are doubtless, as suggested by Busk, analogous to the "appendices nourriciers" of Cloquet, described by him in *Ascaris lumbricoides* and also existing in *Strongylus gigas*. In the Guineaworm, as in *Ascaris*, they are more especially developed over the surface of the muscles, though those of *Ascaris* differ in the fact that they are much more regular in form, and also that the largest processes are situated in the median line of the dorsal and ventral regions, whilst the reverse obtains in *Filaria medinensis*. In intimate structure, too, the processes in *Ascaris* are not so firm and solid, and contain distinct areolæ as well as granules in their interior, whilst neither in the fresh nor preserved specimens examined have I been able to detect the central nucleated cell, which is constant in the Guineaworm.

This extensive glandular system, existing in the simplest and most elementary form, is perhaps concerned with the absorption and elaboration of the nutritive fluid or blood contained in the general cavity of the body, and with which it is brought into contact throughout its whole extent.

Besides this system of glands, I may perhaps mention in this place the collection of fat-cells to be presently described as surrounding the alimentary canal. These, Mr. Carter believes, have an hepatic function; and if so, they would also be subsidiary to the absorption and elaboration of fluids contained in the intestine, and thus be intimately connected in function with the extensive glandular system just described.

Organs of Digestion.—The alimentary canal consists of a very narrow œsophagus and a wider intestine presenting no distinct stomachal dilatation, and throughout its whole extent enclosed in a loose peritoneal sheath, on which distinctly flattened epithelial cells can be recognized. The œsophageal portion is also lined with a distinct layer of muscular tissue. In its course through the body the intestine is for the most part unattached to the parietes, and winds several times round the genital tube before terminating, about $\frac{1}{60}$th of an inch from the posterior extremity, in the concavity of the tail.

The œsophagus is from one and a half to two inches in length, and very narrow, having an average diameter of about $\frac{1}{500}$th of an inch, though it varies somewhat in different parts of its course. Its walls are comparatively very thick, and appear to be muscular—the central canal being only $\frac{1}{2000}$th of an inch wide, though very likely this is narrowed by the action of the spirits of wine.

This narrow œsophagus is contained in a much broader musculo-peritoneal sheath (Pl. XXII. figs. 31 & 33 $_1$), together with a consistent mass of white granular matter*. For about one-sixth of an inch behind the oral aperture the sheath is attached to the parietes of the body by four strong, crucial, mesenteric processes going to the inter-muscular spaces, from the angles of the sheath, which in this situation is quadrilateral (Pl. XXI. fig. 13 *b. d, d, d, d*) instead of being more or less rounded as in the remaining

* This fine granular matter is precisely similar in appearance to that met with in the general cavity of the body; so that I am disposed to regard it merely as the remains of a fluid containing a large quantity of organic matter in solution.

part of its course. A similar arrangement of mesenteric processes is said to be met with in *Strongylus gigas.* For about the first inch the peritoneal sheath is maintained in the centre of the body by means of the glandular processes with which it is in contact on all sides. It varies much in size in different parts of its course, though the average breadth is about $\frac{1}{70}$th of an inch. It is less than this just behind the mouth, and for the last half-inch also tapers to about $\frac{1}{117}$th of an inch in diameter, which is the same size as that surrounding the commencement of the intestine. At the termination of the œsophagus there is a distinct constriction of the sheath (Pl. XXII. fig. 33 $_2$); and although this undergoes no change in size, the contained tube does.

The whole of this œsophageal sheath is lined with a layer of muscular tissue composed of longitudinal intercommunicating fasciculi, the separate fibres of which are about $\frac{1}{15000}$th of an inch in breadth.

The intestine at its commencement is twice or three times as broad as the œsophagus, being $\frac{1}{166}$th of an inch in diameter (Pl. XXII. fig. 33 $_2$); it has much thinner walls, and, as well as its containing sheath, continues of a nearly uniform size throughout its whole extent, only tapering somewhat towards the posterior extremity, where the intestinal tube is $\frac{1}{222}$nd, and its sheath $\frac{1}{188}$th of an inch in diameter.

The whole intestinal canal is surrounded, between it and its sheath, by a collection of various-sized, highly refracting fat-cells, which have been before alluded to, and which may be considered to have an hepatic function*. These cells commence at the constriction between the œsophagus and intestine, and are continued, together with the peritoneal sheath, quite to the termination of the intestine (Pl. XXII. fig. 33 $_4$), though Mr. Carter supposed that both were absent from the terminal portion, judging from what he had seen of the structure of the "microscopic Filaridæ."

I quite agree with Carter, that the intestine terminates in the concavity of the tail, where it is attached to the middle of the ventral muscle (or rather in the median line between the *two* ventral muscles); and though neither of us has succeeded in satisfactorily recognizing an anal aperture in this situation, yet I think there can be little doubt that such a minute aperture does exist, more especially after the independent observation of Wagner†, who, not knowing where the intestinal canal terminated, observed a minute opening precisely in this situation, as shown by his figure.

Organs of Generation.—The genital apparatus consists of a large, highly organized sac or uterus, distended with young *Filariæ* and a little fine granular matter. It occupied the whole of the peritoneal cavity in the specimens examined, except from one to two and a half inches from the anterior extremity and about a quarter of an inch or less from the tail. Both anteriorly and posteriorly, this large sac terminates abruptly in a small tube twisted several times round the intestine (Pl. XXII. figs. 34, 35), or forming a knotted glandular-looking mass. Each tube is about one inch in length, and the two are in every

* May they not also be homologous with the peculiar "*corpus adiposum*" described by Meissner (Zeitsch. für wissen. Zoologie, Bd. v. 1854) in connexion with the alimentary sheath of *Mermis albicans*?

In the portions of the alimentary canal of the specimens examined which had been compressed by the genital tube, only an indistinct trace of these cells could be detected (Pl. XXII. fig. 33 $_3$).

† *Loc. cit.*

way alike. In common with other observers, I have been unable to discover any vulva or vagina; but the symmetrical formation of the two extremities of the genital tube leads me to believe that the genital aperture, if it does exist, must be situated a short distance behind the middle of the body—regarding the two terminal tubes as ovaries, and the large sac as a double oviduct or uterus, which by its enormous development appears to form one great tube, and which has obliterated the vagina*. This point could only be satisfactorily cleared up by the examination of very young specimens, before the genital apparatus had assumed such an unusual development.

Mr. Carter appears, however, to have examined worms of different ages, and is positive that there is no proper outlet to the generative organs. His observations go to prove that the distended genital tube in the mature worm is protruded through a rupture of the integuments near the mouth. If this be the usual case, the specimens I have examined cannot have been full-grown, as in them the termination of the genital tube was at least one inch, and in one specimen $2\frac{1}{2}$ inches, from the anterior extremity.

This process of giving exit to the young or the ova by rupture of the integuments and genital tubes, seems by no means an unusual occurrence in the Nematoid worms, judging from the statement of Rudolphi†, who, speaking of *Cucullanus*, says:—"Ovula, verme quieto, per intervalla ex volva pullulent, quin eodem disrupto, quod sæpe accidit, ovula vel embryones ex ovariis prolapsis pariterque ruptis vi quâdam et undatim protrudantur."

In the specimens I have examined, throughout the greater part of the length of the worm the uterus was distended to such an extent as to have become closely adherent to the parietes of the body, the alimentary canal being pressed flat between the two. This adhesion between the coats of the uterus and the parietes of the body is, throughout nearly its whole extent, so intimate that they cannot be readily separated till after maceration in water for a day or two; and even then the genital membranes can only be scratched off piecemeal by needles after the body of the worm has been slit open. For about one or two inches, however, from either blunt extremity of this large sac it is not adherent to the peritoneum, but is separated by some fine granular matter, and can be removed entire.

Such being the condition of the genital tube, if any portion of the worm not bordering upon either extremity be examined, the observer is liable to entertain most erroneous opinions concerning its anatomy, as, on slitting open the integuments, the adherent uterus is also cut (Pl. XXI. fig. 20), and a consistent cylinder of opaque white matter only is met with, which, on being broken up and submitted to the microscope, is found to consist wholly of young *Filariæ* and a little fine granular matter—not a vestige apparently of a containing tube or alimentary canal being visible. This, I have little doubt, is the explanation of Professor Owen's and M. Jacobson's statement that the worm consisted of a mere sac with contained young, but without any trace of either genital or intestinal

* One cannot but be struck with the extremely abortive condition of the ovarian tubes proper of the Guineaworm, as compared with the development of the uteri or ovarian ducts; and this is the more remarkable when we consider that these are precisely the parts of the female generative organs which are most developed in the Nematoids generally. In *Ascaris lumbricoides* each ovary measures, according to Cloquet, about *four feet*, instead of *one inch*, as in *Filaria medinensis*.

† Entozoor. Hist. Nat. i. p. 310; *vide* also *ib.* ii. pt. 1, p. 105.

tubes. Mr. Busk, too, did not recognize the genital tube, and hence his assumption (most probable in such a case) that the Guineaworm was one of the intermediate or "nursing" forms of a worm, similar to the parent of *Cercariæ* amongst the Trematoda. I was also much deceived at first by this peculiar arrangement, and unable to recognize any genital or intestinal tube, owing to the usual situation of the latter alongside one of the longitudinal muscles (Pl. XXI. fig. 22 *d*), where it for some time escaped observation, appearing only as a faint band of granular matter; and it was not till on one occasion I observed this tube twisted on itself, and crossing one of the lateral spaces, that I saw what it really was, and obtained an insight into the correct anatomy of the worm. I have nowhere met with any reference to this great development of the genital tube, and its close adherence to the parietes of the body.

I will now describe the structure of the uterus and ovarian tubes.

The uterus is a powerful and highly organized sac, made up of four distinct coats—an external or peritoneal investment, a transverse or circular layer of elastic tissue, a layer of longitudinal muscular fibres, and a simple internal membrane. The peritoneal coat is a delicate membrane, having roundish or oval, nucleated, flattened epithelial cells scattered over its surface, varying from $\frac{1}{3000}$th to $\frac{1}{600}$th of an inch in diameter (Pl. XXII. fig. 36). The next coat is composed of a beautiful fibrous reticulated network of elastic tissue, as perfect as that met with in the middle coat of an artery, the fibres of which vary from $\frac{1}{2000}$th to $\frac{1}{1000}$th of an inch in diameter (Pl. XXII. fig. 37). The fibres have a circular arrangement, and form a continuous investment of the whole uterine sac, stopping short abruptly at the ovarian tubes. This coat is not easy to isolate, as the fibres mostly break off in the same line as the membranes on either side of it; occasionally, however, a portion may be seen projecting alone beyond the membranes. The network can be seen indistinctly through the external or internal coats. The third layer is an investment of very delicate longitudinal muscular fibres, lying close together, the individual fibres not being more than about $\frac{1}{30000}$th of an inch in diameter (Pl. XXII. fig. 38). The internal coat is a delicate, homogeneous structure, serving the purpose of a mucous membrane.

The small terminal ovarian tubes are rather less than an inch in length, and about $\frac{1}{90}$th of an inch in diameter. They are pretty constant in size throughout their extent, tapering only slightly towards either extremity (Pl. XXII. figs. 34, 35). The free extremity is blunt and rounded or imperfectly lobed. Their structure is totally different from that of the large uterine sac, and seems closely to resemble that of the intestine, with which it agrees also in general aspect. There seems to be an inner homogeneous membrane, which is closely invested by a peritoneal covering prolonged from the uterus, but no intervening muscular or elastic coats. Amongst the granular contents of these tubes may be detected multitudes of nuclei and cell-germs, and in one or two instances I have seen one or even two of the full-sized young contained within them, but they are never distended in the same way as the large uterine sac is.

This structure of the genital organs seems to agree closely with what Meissner * has described in *Mermis albicans*, if we omit the absence of a recognized vulva and vagina in *Filaria medinensis*.

* *Loc. cit.*

Young Filariæ.—The whole uterus is distended with a dense mass of young of pretty nearly the same size, whilst intermingled with them in every part are crowds of germs, or "pseudova"*, and all intermediate grades between these and the most perfect form of the young worm met with within the body of the parent. Mixed up with these young, in the various stages of their development, are the remnants of the membranes which at first enveloped them, and some fine granular matter.

The pseudova are doubtless formed in part in the small terminal ovarian tubes; but, from the totally irregular manner in which they are distributed amongst the more mature young, there can be little doubt that they are, during the whole period of the growth of the parasite, produced with great activity everywhere throughout the length and breadth of the uterus†. At Mr. Busk's suggestion, I employed some of the Magenta-solution in the examination of the uterine contents, and, from the fact of its colouring all the youngest tissues most vividly, it brings into sight at once crowds of young in all stages of development, which, without its aid, are liable to escape observation. Different-sized masses of germs, of a blood-red colour, may then be seen everywhere intermixed with the more mature and lightly coloured young; but, owing to their having been in spirits so long, they were not in so favourable a condition as could have been desired for examination.

The smallest germ discoverable is about $\frac{1}{5000}$th of an inch in diameter, but the most common size is about $\frac{1}{3334}$th of an inch. From the frequency with which two or four of these bodies are met with closely in contact, I am induced to think that they multiply also by fissiparous division, though this may be merely an accidental collocation. The size of the germs met with gradually increases; and when they are about $\frac{1}{1500}$th of an inch in diameter, they appear to be made up of a spherical mass of pretty large cells enclosed within a delicate envelope. This mass soon begins to increase in one direction more than another, becoming elongated and more or less irregularly twisted; and about this time its investing membrane becomes ruptured (Pl. XXII. fig. 44), and the almost shapeless germ is thus early found to possess a distinct tail. From this stage onwards the young worm, often twisted like a corkscrew, becomes narrower and longer, assumes a more regular outline, and a fine granular instead of a cellular appearance (Pl. XXII. figs. 51–58). At last rugæ begin to form on its body; and by degrees an alimentary canal becomes visible, and distinct parietes to the body bounding an abdominal cavity. The anterior part of the alimentary canal is the most distinct and the first to be differentiated.

The young seem to go on growing until they attain a size of about $\frac{1}{42}$nd of an inch long by $\frac{1}{1428}$th broad ‡, and then development, rather than growth, seems to become the

* The term proposed by Prof. Huxley for ova which have been produced by a process of "parthenogenesis," which will be shown hereafter to be the most probable mode of production of young in the Guineaworm.

† The size and rapidity of growth of these worms seem to depend, principally, upon the formative energy of their generative organs, and the rapidity with which fresh pseudova are continually being produced, as much as to the *growth* of those already formed, since this appears soon to reach a limit; and accordingly in the smallest of the specimens that I examined, measuring only 18 inches, there were not nearly as many developing germs as in those (of the same age) which measured from 30 to 36 inches.

‡ This is pretty nearly the size given by all observers who have measured the young, with the exception of

more active process; and this would account for the great majority of the young being so nearly of the same size.

In five of the specimens of Guineaworm examined the young were more or less coiled, usually two or three times, with the tail either projecting as a tangent or curved also; but in the remaining specimen nearly all the young were straight * (Pl. XXII. fig. 56).

The full-sized young are unequally spindle-shaped, tapering slightly towards the anterior extremity, which is rounded, presenting no trace of papillæ, but a small central depression leading to the mouth, whilst at the commencement of the posterior two-fifths of its length the body begins to taper, and for the last fifth of its extent is narrow and linear, measuring only about $\frac{1}{20000}$th of an inch in diameter †. Its body is marked with circular rugæ, at intervals of $\frac{1}{10000}$th of an inch, which are not visible, however, on the narrow tail. The young worm being translucent, an intestinal canal can be most distinctly recognized in some specimens, running in part through the central cavity of the body, which also contains a number of bright, highly refracting particles. At the junction of the anterior three-fifths with the posterior two-fifths of the length of the worm, where the body begins to diminish in size, two different appearances are presented by different individuals, which will be presently described and explained. No trace of distinct muscular tissue can be recognized.

The intestinal tube is about $\frac{1}{87}$th of an inch in length, and appears to consist of a simple ‡ canal of varying calibre, pursuing a nearly straight course, and terminating cæcally at about the middle in length of the worm (Pl. XXII. figs. 57, 58). It does not fill the cavity of the body, but leaves a distinct space on either side of it, and, from the observations of Robin and Moquin-Tandon § on the living young, appears moveable and unattached to the parietes. The œsophagus, just behind the mouth, is $\frac{1}{10000}$th of an inch in diameter, and gradually widens to $\frac{1}{3300}$th of an inch, of which size it continues for nearly the whole of the latter half of its course—till, in fact, it becomes narrowed again to $\frac{1}{5000}$th of an inch at its junction with the stomach. The œsophagus forms nearly one-half of the whole intestinal canal. The commencement of the stomach is the widest part of the tube, measuring $\frac{1}{2000}$th of an inch in diameter. It is about $\frac{1}{450}$th of an inch in length, and either forms one dilated cavity or is divided by slight constrictions into two or three smaller ones. Its junction with the intestine, from the gradual nar-

Mr. Carter, who says their usual length is $\frac{1}{33}$rd of an inch long by $\frac{1}{833}$rd of an inch broad; but as this would make their breadth rather more than twice as much as those ordinarily met with, I think it probable there may have been some mistake about these measurements.

* Duncan (in Trans. of Med. & Phys. Soc. of Calcutta, vol. vii. 1855) says, from observations made on the young of the Guineaworm, that the straight or coiled condition depends upon the manner of death. They are straight when this has been slow and gradual, and more or less coiled when they have died more suddenly.

† Duncan (*loc. cit.*) speaks of a form of young which seems rather incredible: he says, "Out of, I think, two Nharoos (the Bombay name for Guineaworm) the young ones had *double tails,* which they separated and reunited with great rapidity; in the latter state it appeared exactly as one: these were rather thicker in the body than the others."

‡ I have not been able to detect in the young worm, as Mr. Carter has described it, the intestinal tube proper and its peritoneal sheath, but possibly this may be due to my not having examined living or recent specimens,—though I also differ from him as to the termination of the canal, which certainly cannot depend upon the cause just stated.

§ Zoologie Médicale, Paris, 1859, p. 135.

rowing, is frequently imperceptible. This latter portion of the tube is about $\frac{1}{285}$th of an inch in length by $\frac{1}{5000}$th broad, and continues of much the same size till it terminates in a blunt cæcal extremity. In a few specimens I have observed the terminal portion of the intestine reflected on itself (Pl. XXII. fig. 58).

Behind the extremity of the intestinal canal, for some little distance, the abdominal cavity seems occupied only by bright particles, of irregular size and shape; but then we come to the bodies which present a different appearance in different specimens, as before mentioned.

In the form by far the most frequently met with, at the point where the young animal begins to decrease in size, a central rounded body may be observed, about $\frac{1}{2200}$th of an inch in diameter, with a dark or light spot in the centre, according to the varying focal distance, and which seems to represent a central aperture (Pl. XXII. fig. 57 *e*). Sometimes above this traces of two or three large cells may be recognized, whilst behind nothing definite can be made out, save that the cavity of the body is visible for about $\frac{1}{400}$th of an inch.

In other specimens of the young worm the central body and spot are wanting, but in its stead two lateral sacculi are met with (Pl. XXII. fig. 59 *e*, *e*), about $\frac{1}{3300}$th of an inch in diameter, that communicate with the exterior by a minute channel through the integuments, which can sometimes be distinctly recognized. At other times the channel is obscured by a protrusion, which appears to have taken place through it, of a minute bilobed papilla, projecting $\frac{1}{10000}$th of an inch from the side of the body. When the projections are seen, the sacculi are indistinct (Pl. XXII. fig. 60). The parts above and below are just the same as in the other variety.

From the extreme rarity with which worms were met with presenting the two lateral sacculi, as compared with the multitudes presenting the single central body, I was at first disposed to regard the difference as in some way characteristic of different sexes, till convinced by Mr. Busk that the difference was due only to the position in which the young worms were looked at—the central body being one of the lateral sacculi, and the central dot its aperture, the former appearing larger in this position than when seen laterally. When convinced that this was the correct interpretation, I was at once enabled to explain the reason why the double sacculi were so rarely seen; for out of the five specimens of the Guineaworm in which the young were more or less coiled, it was the rarest thing possible to meet with this form, whilst in the sixth specimen, in which the young were nearly all straight, it occurred very frequently. All this is explicable by the supposition that the sacculi are situated on the sides of the body, and that the young are constantly coiled in one definite direction in the median vertical longitudinal plane of the body, so that when lying flat they would present one or other side uppermost, showing a single central body in the situation mentioned; whilst those which were straight, being at the same time cylindrical, would lie indifferently on any part of their circumference, and thus sometimes appear with one sacculus only, sometimes with two; and all intermediate positions can be recognized, if carefully sought for.

What the nature of these sacculi may be is not very clear. Mr. Busk suggests that they may be the rudiments of the water-vascular system; but the protrusions from them are difficult to reconcile with this view. At all events, they appear hitherto to have escaped observation, as the only writer who has noticed anything different from the ordinary kind of worm with the single central body is M. Jacobson*, who mentions and figures young with "deux petits mamelons" in this situation, and, curiously enough, alludes to no other form†, and apparently did not recognize the internal sacculi at all.

The young, in this stage of their development, are asexual, though the rudiments of some organ appear to exist just above the sacculi, which may ultimately develope into a genital apparatus (Pl. XXII. figs. 57, 58, 59, 60, *f*).

The description I have given of the mode of termination of the alimentary canal does not agree either with that of Mr. Carter‡ or of M. Charles Robin§; but I have noticed the cæcal termination so plainly, and in such a large number of specimens, that I have the less hesitation in advancing anything in opposition to such skilful observers. According to Carter, the central body at the root of the tail is a gland, and the very narrow termination of the intestinal tube opens near it. Robin, on the contrary, says the intestinal canal terminates at the central spot of the cellular body, which he regards as a prominent anus.

The accounts given by different writers of the vitality of the young worms are rather contradictory: Carter regards them as very delicate, and but slightly tenacious of life, whereas the positive observations of Busk, Robin, Deville, and others go to prove that they may remain in a torpid state, when *not perfectly* dry, for even twelve or more hours, and then be restored to their usual life and activity by the addition of a little fresh water. They seldom live more than five or six days in pure fresh water; but then, as has been very reasonably suggested, it is scarcely to be expected that they should, seeing that *pure* water is not the natural habitat of the microscopic Filaridæ, which they so closely resemble. Forbes‖ has found that they lived longest (about twenty days) in fine impalpable clay but slightly covered with water and exposed to the sun's rays.

General Observations on the Nature and History of the Guineaworm.

Having investigated the anatomy of *Filaria medinensis*, several interesting questions have to be considered as to the real nature of the parasite, its early history, and the mode of production and ultimate fate of its young; and on these several points I will now make a few brief observations.

Several years ago, before so much was known of its anatomy, Mr. Busk, in the very interesting paper before alluded to, suggested that the Guineaworm was an *intermediate stage* in the development of a nematoid worm, and analogous to one of the so-called "nurses" of *Cercariæ*, described by Steenstrup and other anatomists as a transition form in the development of the Trematoda. This opinion he based upon the facts, that no well-authenticated case of a male parasitic Guineaworm existed—all that had hitherto

* *Loc. cit.*

† In the figures which he gives, the young are also represented as being straight.

‡ Ann. of Nat. Hist. 1859, vol. iv. p. 32.

§ Gaz. Méd. de Paris, 1855, p. 363.

‖ Madras Quart. Journ. of Med. Science, 1837.

been carefully examined having proved to be female and viviparous—and that there was no trace of distinct genital organs, the young being apparently produced in the general cavity of the body. The existence of a blind intestinal canal, as demonstrated by Mr. Busk, was not incompatible with this theory, as it has been shown by M. Filippi* that some of the "nurses" (*rediæ*) are characterized by the possession of a rudimentary alimentary canal, whilst others (*sporocystes*) are simple sacs containing young, without viscera of any kind. But the discovery in the Guineaworm of distinct genital organs, with a vascular and nervous apparatus, fairly entitles us, I think, to look upon this worm as a *fully developed specimen* of one of the highest types of the order Nematoidea, and more particularly so as the remaining special grounds which induced Mr. Busk to advance his hypothesis can be explained in other ways.

The common opinion prevailing in India amongst the natives is, that the ova or young of some aquatic worm enter the body with the water that is drunk, and in some unexplained way get to the subcutaneous tissue, and there become developed into Guineaworms. But the opinion of most naturalists and scientific men is opposed to this, and more in accordance with the general nature of the evidence bearing on the question. They agree so far with the popular belief, that in the early stage this parasite is a microscopic animalcule, having its habitat in water and damp places, but that it makes its entrance into the human body by being brought into direct contact with the naked integuments, which it perforates in some unascertained manner. I should not have thought it necessary to bring forward evidence in support of this latter view, had it not been that the former hypothesis has been maintained by many medical men in India, and even as late as 1856 has been again strongly advocated by Dr. Greenhow†.

Granting that the ova or young are capable of resisting the action of the gastric juice‡, the former view altogether fails to account for the overwhelming frequency with which the parasite is found in the lower extremities rather than equally diffused throughout the cellular tissue of the body generally, in the same way as we find *Trichina spiralis* universally distributed through all the muscles of the body.

But in support of the opinion that the Guineaworm enters directly from without, we have the positive evidence that the parasites are met with most frequently in just those parts of the body that are oftenest brought in contact with water or damp marshy places. From some statistics collected from the Indian journals by Professor Aitken, and kindly placed at my disposal, I find that, out of 930 recorded cases of *Dracunculus*, 98·85 per cent. occurred in some part of the lower extremities, and the great majority of them about the feet and ankles. A similar distribution is observed

* "Mémoire pour servir à l'histoire génétique des Trématodes," Ann. des Sciences Naturelles, 1854.

† Indian Annals of Medical Science, vol. iii., 1856.

‡ I do not lay any stress upon the experiments of Forbes (Trans. of Med. & Phys. Soc. of Calcutta, vol. i.), who tested the action of the gastric juice upon the young of the Guineaworm, by giving some, suspended in water, fresh from a Sepoy's leg, to two young puppy dogs, one of which was killed four hours and the other twenty-four hours after, and in both cases all the young worms were found "dead in the mucus of the stomach and duodenum," because it is not fair to draw inferences from the effects of experiments upon the young of the parasitic Guineaworm which have been produced and reared in such an unusual situation, and then apply them to the young of an aquatic animalcule subject to such totally different conditions.

where a plurality of worms has occurred in the same subject, as may be seen in a case related by Lorrimer*, where thirteen† of these parasites were thus disposed:—

4 in left foot,	2 in right foot,
2 ,, leg,	1 ,, leg,
1 ,, thigh,	3 ,, forearm.

Accidental circumstances also lend support to this theory, as borne out by a statement of Ninian Bruce‡, who says:—"It has been observed that Bheesties, or water-carriers, in India, who carry the water in a "mushuk," or leathern bag, suspended from their shoulders, over the back and side, are most subject to the Guineaworm in those parts which come in contact with the mushuk." Mr. Busk, too, says it is not even necessary for a person to land or drink any of the water in places where the Guineaworm is endemic, as sailors have become infected merely by the contact of their naked skin with water contained in the boats of the natives that come off to a vessel from infected places.

Dr. Chisholm§, in a long and interesting paper on the Guineaworm as met with in the island of Grenada, brings forward what at first sight appear most incontrovertible arguments to prove that the source of infection is in the water drunk by the negroes from certain wells dug near the sea in a brackish volcanic soil; but Scott‖ has no doubt suggested the real explanation of the facts related by Dr. Chisholm, when he says that the negroes who frequented these wells were really infected by contact with the wet marshy soil of the low situations in which the wells were dug, and that their freedom from this troublesome parasite after they ceased to frequent the wells, and used tank or cistern water instead, was really due to these reservoirs being situated near the habitations on a dry and elevated soil.

Taking all these facts into consideration, as well as the account before given of the manner in which the worms I have examined seemed to have entered the body, and some special observations by Mr. Carter to be presently noticed, we have, in favour of the second hypothesis, an amount of evidence which, if not perfectly satisfactory, it would at least be almost impossible to explain in any other way.

In the papers to which I have made such frequent reference, Mr. Carter has done much to show that a very intimate relationship exists between the Guineaworm and certain "microscopic *Filaridæ*," to which he has given the name of *Tank-worms*, abounding in the gelatinous Algæ of the tanks, ponds, and damp places generally in the neighbourhood of Bombay. His arguments are based upon two principal series of observations:—In the first place, the marked prevalence of *Dracunculus* in those regions where the various species of Tank-worms are common, and where the subjects of the disease have been known to have exposed themselves to the circumstances favourable to

* Madras Quarterly Journal of Medical Science, 1837.

† Poupée Desportes has seen a case where fifty worms were taken from the same patient. *Vide* Kunsemüller, 'Sur les Maladies de Saint-Dominique.'

‡ Edin. Med. and Surg. Journal, vol. ii. (1806) p. 145.

§ *Ib.* vol. xi., 1815.

‖ *Ib.* vol. xvii., 1821.

contagion, as contrasted with the great scarcity of the disease in other situations, where careful observation has failed to discover these microscopic Filaridæ. As an instance of this, he states that, "out of a school of fifty boys bathing and dabbling throughout the day in a small pond in their enclosure, whose muddy sediment swarmed with the so-called 'Tank-worm,' not less than twenty-one in one year had *Dracunculus* in more or less plurality; while such was not only not the case in any of the other schools of the island, but in the school of which I have had medical charge for more than ten years, with an average number of 346 children present, only two or three cases have occurred* during that time; and microscopic Filaridæ do not exist, so far as I have been able to ascertain, in the sedimentary deposit of the tank in their inclosure, from which the children of this school are solely supplied with bathing-water." Secondly, he dwells upon the close similarity he has observed in the anatomy of the parasitic Guineaworm, its young, and of these microscopic Filaridæ, especially one species to which he has given the provisional name of *Urolabes palustris*. But, for these anatomical details and the plates, I must refer to the author's own paper. He has discovered and given descriptions of several distinct species whose young have all the same kind of long, linear tail as that described in the young Guineaworm, by the extremity of which they have a great tendency to attach themselves to external objects, and then by a kind of wriggling motion are enabled to imbed themselves in any soft substance. He thinks that in this way, soon after they have escaped from the ovum, when imperfectly developed and not broader than a human blood-corpuscle, they may insinuate themselves into the ducts of the sudatory glands†, whose average size is nearly three times as broad, viz. about $\frac{1}{1200}$th of an inch‡. From this situation, or perhaps directly, without the intermediation of a perspiratory duct, they may bore their way into the subcutaneous tissue by means of a very small, rigid, exsertile œsophagus which was capable of being protruded in all the species examined.

This supposition of a boring-power possessed by these small animals is fully in harmony with recognized facts long known with regard to species of the order Trematoda. The young and immature forms of many of these species are known to penetrate from

* And these could mostly be accounted for by visits the children had made to other localities.

† In a more recent paper (Trans. of Med. & Phys. Soc. of Bombay, 1861, App. p. 1) Mr. Carter says, "No case, however, has yet occurred where a young *Filaria* of the free species has been found entering or in one of the sudorific ducts; so this is still an assumption; but having met with an instance in which young Filaridæ were found entering a fungus by analogous apertures on the surface, even smaller than those of the sudorific ducts, it seems desirable that the facts should be recorded to show that at least in the vegetable kingdom this kind of entrance takes place."

On examining a large fungus of the genus *Xylaria* growing on the decayed trunk of a tamarind-tree, he says, "Some delicate, glistering, thread-like bodies were seen to project from the summit of the conceptacles," these being "little globe-shaped sacs imbedded in and scattered over the surface of the fungus, upon which they open by minute mouths or ostioles respectively, which, when measured, were found not to exceed the $\frac{1}{1880}$th of an inch in diameter, so that they are smaller than the orifices of the sudorific ducts of the human body; and from each of these ostioles was projecting a single *Filaria*—the head in the conceptacle."

He adds that the specimens were too immature to discover their species, and that he has lately found similar worms in the greatest abundance in all the larger species of fungus in the neighbourhood of Bombay.

‡ The full adult size of *Urolabes palustris* is $\frac{1}{6}$th of an inch long by $\frac{1}{370}$th broad, though some of the other species are much smaller.

without through the skin of fishes and of frogs, into the bodies of snails, and in large numbers into the eyes of freshwater fishes, as discovered by Nordmann*.

Should this supposition of Mr. Carter prove correct, as the very close correspondence between the anatomy of these microscopic Filaridæ and of the Guineaworm renders highly probable, several very interesting questions arise for solution. Did the young worm seek its new habitat before or after impregnation? Why are females only discovered in the body? And is there one species of *Dracunculus* only, or many, corresponding with different species of microscopic Filaridæ?

Mr. Carter thinks it probable that these worms enter the body whilst very young, and when they are not more than $\frac{1}{3200}$th of an inch in diameter, and at this early period of their existence they have only the rudiments of genital organs; so that he thinks they must be unimpregnated when they penetrate the integuments. And seeing that a full-sized Guineaworm measuring eight or ten feet in length is, as it were, a continuous sac fully distended with the very minute young, it must contain a progeny numbering at least two or three millions, and I think it would be difficult to understand how a young worm, containing this number of ova, could be so minute as entirely to escape observation whilst penetrating the skin; it would also be very difficult to conceive how the female of so minute an animal could receive a sufficient quantity of the male fluid to fertilize such an enormous quantity of ova.

It does not seem at all probable, either, that in its new situation beneath the integuments the female could be brought into contact with a male; and therefore when Mr. Carter suggests that the young may have been produced from "buds"† instead of fertilized ova, I think he has suggested the real explanation of their genesis, and that I shall be able to support this position by several pretty conclusive arguments.

Much light has of late been thrown upon this process of "parthenogenesis" by the able investigations of Mr. Lubbock‡ and Professor Huxley§; and we need have the less hesitation to call in the aid of so exceptional a process to explain the history of the Guineaworm, seeing that this method of reproduction has been recognized in so many animals much higher in the scale of organization, as may be seen from the following valuable *résumé*, by Professor Huxley, of the classes and orders in which it has been met with. He says, "Among the Annulosa, the Rotifera and Turbellaria possibly possess it to a small extent; the Nematoidea‖ do not possess it at all. Many Trematoda possess it; others, such as *Aspidogaster*, have nothing of the kind. The Acanthocephala are not known to possess it; the Echinodermata are regarded by Professor Owen as possessing it, but their different families show every gradation from simple metamorphosis to something like agamogenesis. A few Annelida possess this power in a marked degree; in many, nothing of the kind is known. The *Nais* has it; the Earthworm and the Leech have it not. Of the Crustacea, some, such as many Branchiopoda, exhibit it in the highest perfection;

* Steenstrup's 'Alternation of Generations,' Ray Soc. edition, translated by Busk, p. 98.

† Ann. of Nat. Hist., 1859, vol. iv. p. 109.

‡ "On Two Methods of Reproduction in *Daphnia*," Phil. Trans., 1857 and 1859.

§ "On the Agamic Reproduction and Morphology of Aphis," Trans. Linn. Soc., 1858, vol. xxii.

‖ Of course, if subsequent investigation confirms the opinion here adopted, this statement would require alteration.

but no trace of it has yet been found in Copepoda, Cirripedia, Pœcilopoda, Edriophthalmia, or Podophthalmia. In the Myriapoda and Arachnida the process is not known; but we find it in the highest Articulata—the Insecta—and this not, so far as we know at present, in Aptera or Orthoptera, but in a few Hemiptera, Hymenoptera, and Lepidoptera; and there is every reason to believe that it only occurs in isolated, though perhaps in many, genera of these orders. Take the Mollusca again: agamogenesis occurs in the Polyzoa and Ascidioida, not in the Brachiopoda. It is not known to occur in any of the Lamellibranchiata; and among the higher Mollusca, the nearest approach to it is presented by the animal (whatever it is) which gives rise to the 'Synapta-Schnecken' (high Gasteropods) and by the Hectocotyligenous Cephalopoda."

The fact that neither vulva nor vagina is discoverable in the Guineaworm would, if their absence were absolutely proved, throw us back upon this process of agamogenesis, in which the young are produced from pseudova without the influence of a male, as the *only* possible explanation. Such a defective development of the female generative organs in *Dracunculus*, as compared with their observed condition in the microscopic Filaridæ, can be met also by a similar suppression of parts, though to a minor extent, in the viviparous females of the *Aphis*, in which the spermatheca and two colleterial glands have been shown to be wanting, though found in connexion with the vagina of the oviparous female*.

In support of this opinion also we have the probability that, throughout the *whole parasitic stage of the life of this Entozoon*, germs are being actively produced in every part of the genital tube, seeing that in six specimens of the worm, taken from the human body after a residence in it of eight or nine months, this formative process was actually going on up to the very time of their extraction—as proved by the uniform dissemination of crowds of pseudova and young, in the very earliest stages of development. How, unless we resort to the phenomena of agamogenesis, can we account for this amazing fecundity at a time so remote from the only period when union with a male was possible? For even were the worm possessed of the most capacious spermatheca, it must long since have been obliterated by the distention of the genital tube, considering that this has become closely adherent to the parietes of the body; yet, nevertheless, up to the very last does this wholesale production and development of germs continue. What, then, are we to consider as the stimuli so efficacious in the production of pseudova and young in the virgin Guineaworm? Doubtless the two very conditions which have been proved to be so necessary for the continuance of agamic reproduction in the *Aphis*, concerning which Professor Huxley remarks, "The number of successive broods has no certain limit," till "on the setting in of cold weather, or in some cases on the failure of nourishment, the weather being still warm, males and oviparous females are produced." But, located as it is in the body of a warm-blooded animal, the Guineaworm is subjected in the highest degree to the influence of these two very conditions—being constantly maintained at a high and uniform temperature, and supplied by imbibition with nutritive and highly organized fluids.

* Is there any possible connexion between the special direction of the arrested development which has led to the non-formation of the *outlets* of the genital organs only in the Guineaworm, and the fact before stated, that the young or ova of Nematoid worms are frequently discharged by a simultaneous rupture of the integuments and some portion of the containing tube?

The obscurity of this process and our inability to explain its nature should of course be no barrier to our acceptance of it as a fact, if this be in accordance with all the evidence that can be brought to bear upon the subject. And, in reality, what clearer insight do we gain into the essential nature of the process by which new organic beings are generated, by supposing the germ-cells of the female to be subjected to the influence of certain cell-products of the male? By long habit and association, indeed, we are apt to think, when this occurs, we have all that is necessary for the explanation of the process, whereas in truth it is but the throwing in of another unknown term into the problem—an attempt to resolve "*ignotum per ignotius.*" Nor can we expect to be able to solve all the difficult phenomena of reproduction, when other common organic processes of growth, development, and secretion are in themselves so obscure. Professor Huxley aptly remarks on this subject, "When we know why, in a mass of tissue of identical structure throughout, one part becomes a brain, another a heart, and a third a liver—when we can answer these every-day questions of the Sphinx, we may attempt her more difficult riddles without running too great a risk of being devoured."

Should future investigation confirm the opinion that the Guineaworm enters its host at a very early stage of its existence, and before the development of its sexual organs, its remaining in this situation till young are produced and ready to be brought forth, is a phenomenon different from what usually occurs, and also from what is met with in the nearly allied *Gordius* and *Mermis*, with reference to which Von Siebold has established that the immature worms penetrate the bodies of insect larvæ, and after remaining there some time, emerge from the bodies of their hosts, and then only, in the free stage of their existence, develope organs of reproduction, ova, and young. Siebold says*, "Ainsi à raison des faits que je viens d'exposer, on ne rencontre jamais certaines Helminthes hors du corps de leurs hôtes naturels à moins que leur croissance ne soit achevée; et certaines espèces aussi ne se voient dans l'intérieur du corps des animaux dont elles doivent être les parasites que lorsqu'elles sont déjà parvenues à une taille déterminée." This difference in the two groups of Entozoa mentioned depends upon the necessity of the conjunction of the two sexes for the fertilization of ova; but there is a third class, comprehending the *Tæniæ* and other hermaphrodite worms, which, from the absence of such a necessity, are enabled to pass through the whole cycle of their development in one or more different animals; and in a subdivision of this class we must assign a place for the Guineaworm, since, having a power of producing young by an agamic process, it remains in the condition of a parasite through nearly the whole period of its existence.

As before stated, all the specimens of Guineaworm hitherto carefully examined have been found to be female and viviparous; and the only writers who mention male worms (so far as I have been able to discover) are Professor Owen, M. Leblond, and Dr. M'Clelland; but in each case the observations are, as will be seen, incomplete, and scarcely definite enough to turn the overwhelming balance of evidence on the other side.

Professor Owen† gives a figure of what he considered a male Guineaworm, and says, "The caudal extremity of the male is obtuse, and emits a single spiculum; in the female

* "Sur la Production des Helminthes," Ann. des Sciences Nat. tom. v., 1855.

† Art. *Entozoa*, Cycloped. of Anat. & Physiol. part x. (1837) p. 122.

it is acute and suddenly inflected." This is the only observation he makes concerning it; and as not a word is said about its internal anatomy, we may presume that it was assigned to the male sex from its external characters alone. But a comparison of the figure Professor Owen has given with Pl. XXI. fig. 7, will, I think, warrant us in believing, till some more definite statement is made, that his so-called male worm was similar to the one figured by myself, whose rather unusual form appeared due to the circumstance of its being more than ordinarily distended with young up to within a short distance from the extremity of the tail.

M. Leblond* having examined one of the portions of the only specimen of Guineaworm contained in the Musée d'Histoire Naturelle at Paris, and found it to be part of a female worm, containing young, then *squeezed* another portion and expressed some white matter, which, when broken up by the aid of needles, and submitted to a high power of the microscope, he says, "m'a paru constituée de corpuscules irréguliers diversiformes. Peut-être ces corpuscules étaient-ils spermatiques. Dans cette hypothèse le fragment indiqué eût fait partie d'un autre individu." But can we admit this hypothesis? To say the least, it is very improbable; and then M. Leblond could not have been certain even that the matter examined came from the genital tube rather than the intestinal canal or general cavity of the body.

Dr. M'Clelland† gives a plate of two or three different forms of the caudal extremity, one of which, pl. 10. fig. 1, he *suspects* only may be characteristic of a male worm, though Küchenmeister‡ alludes to it, on the authority of Diesing, as the actual representation of such a worm§.

I think, then, we are fairly entitled to consider that no satisfactory evidence has yet been brought forward of the detection of a male parasitic Guineaworm; and such being the case, the reason why females only are met with is a very interesting question.

This may be explained, it appears to me, in one of two ways: either both male and female representatives of the species, of which the Guineaworm is an after-development, make their way through the integuments of persons exposing themselves to the conditions favourable for their penetration, but that the males in their new situation never attain any great size, and consequently, producing no inconvenience, do not attract attention, whilst the females, by the enormous development of their genital organs and contents, under the stimulus of high temperature and abundance of nutriment, soon attain such a size as to be palpable in superficial situations. It seems very probable that the male, if it penetrated, would never attain any considerable magnitude; and that it might remain in its new habitat without producing irritation is rendered very likely, seeing

* "Quelques Matériaux pour servir à l'histoire des Filaires et des Strongyles," Précis Analyt. des Travaux de l'Acad. Roy. de Rouen, 1835, p. 150.

† Calcutta Journal of Nat. History, vol. i. p. 359.

‡ *Loc. cit.* p. 390.

§ The only other reference to a male worm that I have met with seems too improbable to require further notice. It occurs in a paper by Dr. Greenhow, before alluded to, in which he says:—"I have not been fortunate enough to meet with a male worm; but the before-named native doctor tells me that he has seen several. He describes them as twice as long and four times as thick as the female, that is, about four feet long and *nearly half an inch in diameter*."

that during the whole period of the growth of the female*, till the maturity of its young, it does not cause any inconvenience, and but rarely attracts attention; and this has in consequence been termed by Mr. Busk the "latent period" of its existence.

Or it may be that females only penetrate the integuments, impelled, as is frequently the case with the females of other animals, by a sort of instinct to seek a new habitat for the production of their young. But if, as we have supposed, the young worms penetrate before the genital organs are completely formed, this latter explanation would be rather improbable, as the sexual instincts could not then be reasonably supposed to come into operation.

But however this may be, whether both males and females penetrate, or females only, I think there can be little doubt that this occurrence (at all events as far as warm-blooded animals are concerned) must be regarded as an exceptional rather than an invariable event in the history and development of these microscopic worms, when we consider the vast number in which these creatures, low in the scale of organization, are found in situations favourable to their existence†. So that these worms may be considered to have an *ordinary* existence in the waters and damp places which they naturally frequent, having then their sexual organs fully developed and capable of producing true ova in the usual manner, as well as an exceptional or *extraordinary* existence as parasites of certain warm-blooded creatures, in which condition females only have been met with, that seem to have the outlets of their sexual organs undeveloped, and to contain young which have been formed from internal buds or pseudova by a process of zooid development.

Whether or not the young so produced are capable of existing externally, in their natural medium, there does not seem at present sufficient evidence to enable us to decide. But there are no real grounds for the belief, on the other hand, that the disease is contagious, as it has been sometimes stated to be. There is, indeed, no evidence to show that the young can or do continue their existence beneath the integuments, where they have been reared, although they are frequently liberated in this situation by the rupture of the parent worm. In these cases the young die and are discharged with the pus and other inflammatory products which are the invariable sequence of such an accident.

We now come to the consideration of the last question to which I shall allude, viz. as to whether there be one species of *Dracunculus* only in the various countries in which the Guineaworm is endemic, or several different species corresponding to one or more genera of worms. This question was mooted long ago by Dr. M'Clelland‡, but does not seem to have received much attention since. He says, "It appears to us probable, however, that we have many kinds of *Dracunculus* even in India; should this be the case, some may

* This must be very rapid: it has been calculated by Mr. Busk that the rate of increase is frequently about an inch per week.

† Of course it is highly probable that these aquatic worms may inhabit ponds and places wholly unfrequented by man, and rarely so by quadrupeds; so that it does not seem at all likely that more than the smallest fraction of their whole number would ever have an opportunity of becoming parasites, if such a state were a necessary stage in their existence.

‡ Calcutta Journ. of Nat. History, vol. i., 1841.

be endemic in the hot season in dry arid tracts, some during the rains in low moist situations, and some peculiar to the cold or winter months. We have hardly a reason for concluding, as appears to have been taken for granted by Dr. Chisholm and all subsequent writers, that the disease of Grenada, which appears there during the winter, is the same as that which appears in the East Indies during the rains, however the general form of the animals that occasion the disease in both cases may correspond." We have, unfortunately, but little evidence bearing upon this opinion*, but what little we have seems to lend it support. How else can we account for the great difference in size usually attained by mature individuals in different countries? Thus, the average length of specimens of *Dracunculus* in Bombay and India generally, seems to be from twenty-six to thirty inches, or even less. Mr. Carter, who has had so much experience, says he has never measured one exceeding thirty-two inches in length. In Egypt, according to Clot Bey, they vary from six inches up to four feet in length, whilst, as far as I have been able to ascertain, all the very long worms, from eight to twelve feet, have been African†.

In all probability, the specimens of Guineaworm examined by Mr. Busk were African, since he says, "In every instance that has come under my notice I have found that the length of the worm has nearly reached, and in some instances has exceeded, six feet." Should this be the case, it may perhaps account for the difference before alluded to in the anatomy of the worms he has described from what I have met with in specimens from Bombay.

Then, again, are the Guineaworms that have been met with in Horses‡ and Dogs§ of the same species as those which infest the human subject?

In conclusion, I would refer to the great difference observed, in various countries, and in different parts of India, in the times of the annual epidemic prevalence of the disease

* I think perhaps it may be well to record here the three statements of difference in the external characters of worms that I have met with in different writers; for although no great stress can be laid upon them, they might, by drawing attention to already observed peculiarities, assist in the determination of this question.

"Respecting the structure of a worm which M. d'Obsonville extracted from his own leg, Bingley quotes that author. The body was not thicker than a strong thread; but when the animal was extracted, it was found to be of the length of two or three ells. Its head was of a chestnut colour, and to the naked eye it appeared to terminate in a small black point. On examining it with a common magnifying-glass, it appeared to be formed of a series of small rings, united to each other by an exceedingly fine membrane; and a single intestine extended through the body."—*Trans. of Calc. Med. & Phys. Soc.*, vol. i. (1825) p. 157.

"The worm was of equal volume till within the last inch, when it became a very *little larger*, was *spirally indented*, and ended in a small hooked point."—*W. Scott, Edin. Med. & Surg. Journ.*, vol. xvii. p. 96.

"The tail is attenuated to a very sharp point, and bent like the point of a cobbler's awl. It is also *armed with a few rough points*. . . . Some, however, are without these points, having the tail smooth."—*M'Clelland, loc. cit.*

† The most trustworthy account I have met with of this great size attained by the Guineaworm is in a "Dissertatio de Dracunculo," by Gallandat (Nova Acta Acad. Nat. Curios., vol. v. (1773) Append. p. 103), who, after stating that he had himself been to the coast of Guinea and seen what he describes, says:—"Hoc animal, quod plerumque octo, novem, decemve, un- et duodecim pedum longitudinem æquat, extrahitur prudentissime volviturque circum laminam ligneam ut facilius exeat."

‡ Forbes, Madras Quart. Journ. of Medical Science, 1839.

§ Dr. Smyttan, Trans. of Med. & Phys. Soc. of Calcutta, vol. i., 1825.

as perhaps having also some slight bearing upon this question*. Thus, at Bombay the disease is most prevalent during the rainy months of June, July, August, and September; whilst, according to the missionary Dubois†, its annual epidemic recurrence in the Carnatic villages is in December, January, and February, "during which time more than half the inhabitants suffer;" and during the same months, as before stated, the disease was found to be most frequent by Dr. Chisholm in Grenada and the small Grenadine group of the West Indian Islands.

I must now bring this long communication to a close, hoping that the subject may be taken up by skilful and patient investigators in the countries where this parasite is endemic, by whom alone can the missing links in the chain of its history be supplied.

EXPLANATION OF THE PLATES.

PLATE XXI.

Fig. 1. Average-sized Bombay Guineaworm, measuring 30 inches in length by $\frac{1}{15}$th of an inch in breadth.

Fig. 2. Head of Guineaworm, magnified about 100 diameters: (*a*) orbicular mouth surrounded by a slight prominent lip; (*b*) one of large papillæ; (*c*) one small lateral papilla; (*d*) lateral intermuscular space; (*e*) dorsal intermuscular space; (*f*) quadrangular or nearly circular opaque space corresponding to sheath of œsophagus.

Fig. 3. Anterior extremity seen in profile: (*a*) upper and lower papillæ; (*b*) one of dorsal muscles; (*c*) lateral intermuscular space; (*d*) one of ventral muscles.

Figs. 4, 5, 6, 7. Different forms of caudal extremity: letters as in fig. 3.

Fig. 8. Irregular transverse markings of the external portion of integument.

Fig. 9. Set of superimposed lamellæ with longitudinal markings: (*a*) the lines of superficial lamellæ; (*b*) lines of lamellæ, seen beneath.

Fig. 10. Two sets of superimposed lamellæ with lines in opposite directions: letters as before.

Fig. 11. A portion of a single glass-like lamella, with its linear markings and jagged torn edges.

(The figures 8–11 are magnified about 600 diameters.)

Fig. 12. Three portions of lamella of unequal length, showing that the markings of the under layers correspond with some portion of the intervals between the lines of the layer above.

Fig. 13. Transverse section of the worm just behind the head: (*a*) section of small thick-walled œsophagus; (*b*) quadrangular œsophageal sheath; (*c*) granular matter within sheath, with œsophagus; (*d, d, d, d*) four strong mesenteric processes; (*e*) thin origin of one of the four longitudinal muscles; (*f*) one of the glandular processes; (*g*) integument.

Figs. 14, 15, 16, 17, 18. Transverse sections at gradually increasing distances from head up to 1½ inch, showing the speedy disappearance of mesenteric processes, the disposition of the four longitudinal muscles and their fasciculi, the varying dimensions of the peritoneal sheath of the

* This difference would appear to depend more upon variations in the breeding-season of the parent aquatic worms than upon differences in the times of incubation or latency of the worm as a parasite.

† Edin. Med. & Surg. Journ. vol. ii., 1806.

œsophagus, the diminution in thickness of the glandular layer, and, in figs. 17 and 18, the sudden encroachment of the blunt end of the dilated oviduct or uterus distended with young upon the peritoneal cavity.

Fig. 19. Section about two inches from the head, showing the great thickness of the longitudinal muscles, of which the two dorsal and two ventral have come so closely in contact as apparently to form a single muscle only in each situation ; (*g*) dilated uterus, occupying nearly the whole of the cavity of the body, and compressing the intestine (*a*) enclosed in its sheath (*b*).

Fig. 20. Appearance of transverse sections through nearly the whole extent of the body of a mature worm, showing great distention of the uterus, whose walls have become adherent to the parietes of the body ; the glandular layer lining the body has been obliterated and absorbed by the pressure, and the muscles diminished in thickness : (*a, b*) intestine enclosed within its sheath, compressed into a flat band along the thin edge of one of the longitudinal muscles.

Fig. 21. Transverse section through the worm, about one inch from the tail ; showing the uterus, near its termination, not so much distended, and the reappearance of the glandular layer lining the peritoneal cavity. (The figures 13–21 are all magnified about 100 diam.)

Fig. 22. Integument slit open through the right lateral intermuscular space, showing, (*a*) two ventral muscles ; (*c*) ganglionated nervous cord in centre of lateral space ; (*d*) intestinal canal lying parallel and in contact with the edge of one of the longitudinal muscles ; (*e*) median ventral vessel ; (*f*) median dorsal vessel. (× 5 diam.)

Fig. 23. Communications of the muscular fasciculi with one another. (× 100 diam.)

Fig. 24. Portion of one of the muscular fasciculi made up of exceedingly slender fibrillæ. (× 500 diam.)

Fig. 25. Portion of the parietes slit open through the left longitudinal dorsal muscle : (*a*) two ventral muscles ; (*b*) two dorsal muscles ; (*c*) ganglionated nervous cord ; (*e, e*) median, dorsal, and ventral vessels ; (*f*) tessellated arrangement of glands on surface of muscles, each including a nucleated gland-cell ; (*g*) one of similar gland-cells situated in a pulpy stratum over lateral space ; (*h*) appearance of gland-cells when much altered from some cause, as noticed in some specimens.

Fig. 26. A nerve-ganglion and adjacent portion of nervous cord, highly magnified, with appearance of the lateral vessel as seen through it : (*a*) irregular crenated margin of the ganglion ; (*b*) lateral vessel. (× about 600 diam.)

Fig. 27. Mosaic-like collection of glands with longitudinal vessel, scraped from the surface of the two dorsal muscles : (*a, a*) included spherical, light, granular, nucleated gland-cells ; (*b*) median vessel.

Fig. 28. Portion of median dorsal vessel, highly magnified, showing its sinuous course and irregular calibre.

Plate XXII.

Fig. 29. Glandular projections on the surface of one of the muscles near the head, as seen by reflected light : (*a, a*) large processes near the lateral borders of the muscles ; (*b, b*) very small processes over contiguous median borders ; (*c*) median vessel running through this pulpy matter. (× about 100 diam.)

Fig. 30. Three of the projections as they appear by transmitted light : (*a*) enclosed spherical gland-cell ; (*b*) dot or nucleus.

Fig. 31. Anterior part of worm (twice the natural size) slit open through mid-dorsal region : (*a*) œsophageal sheath ; (*b*) unction of œsophagus with intestine ; (*c*) anterior ovarian tube ; (*d*) anterior portion of uterus.

Fig. 32. Posterior extremity of worm (twice the natural size): (*a*) intestinal canal; (*b*) posterior portion of uterus; (*c*) posterior ovarian tube; (*d*) termination of intestine in concavity of tail, mid-ventral region.

Fig. 33. Different portions of alimentary canal and its peritoneal sheath.

1. Small portion of sheath of œsophagus: (*b*) showing epithelial cells on its surface; and (*a*) the small included œsophagus.
2. (*b*) constriction in peritoneal sheath at junction of œsophagus with intestine; (*d*) fat-cells surrounding intestine.
3. Portion of middle part of intestine, which has been compressed by the distended uterus, showing obliteration of the fatty liver(?)-cells, and presence of epithelial cells on the peritoneal sheath.
4. Terminal portion of intestine, with sheath and liver-cells surrounding it up to the extremity. (× about 150 diam.)

Fig. 34. Anterior termination of uterus, with ovarian tube attached: (*a*) abrupt termination of uterus; (*b*) ovary; (*c*, *c*) young accidentally found in ovary.

Fig. 35. Precisely similar posterior termination of uterus, with ovarian tube attached. (× about 80 diam.)

Fig. 36. Portion of peritoneal covering of genital tubes, with scattered various-sized epithelium-cells on its surface.

Fig. 37. Reticulated fibrous network of elastic tissue from the second coat of the uterus.

Fig. 38. Very fine longitudinal muscular fibres, composing the third coat of the uterus. (Figs. 36, 37 & 38 × about 400 diam.)

Figs. 39–55. Showing various stages in the development of the young, from the smallest pseudovum recognizable to nearly the full size attained by the young, in which, however, only the rudiments of the anterior part of the alimentary canal can be detected.

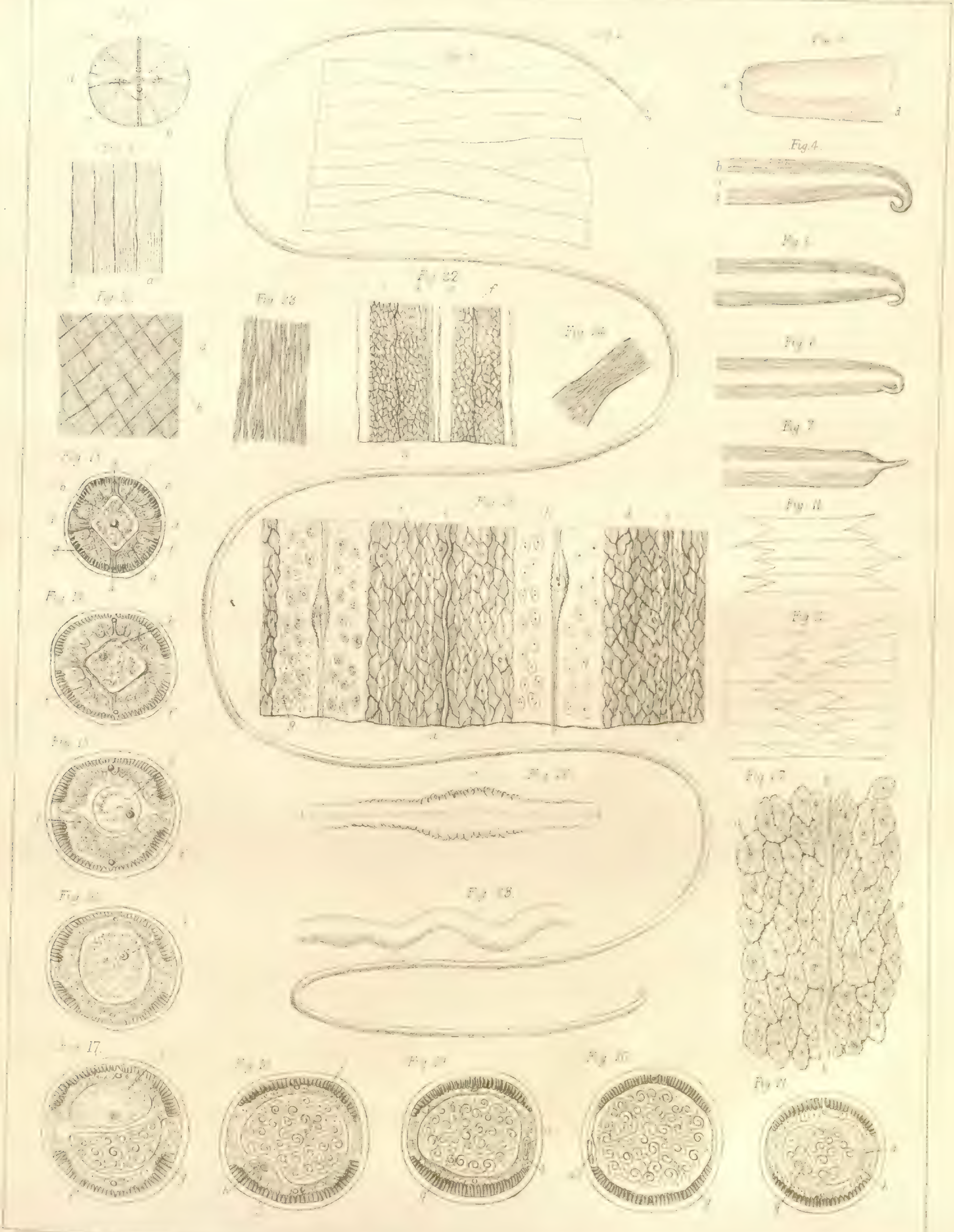
Fig. 56. The various forms of young worms, magnified about 100 diam.: (*a*) granular débris mixed with young; (*b*) peculiar and regular corrugations produced in some of the young, perhaps by the action of the spirit in which they were preserved.

Fig. 57. One of young, seen sideways, showing, (*a*) circular rugæ; (*b*) œsophagus; (*c*) stomach; (*d*) cæcal termination of intestine; (*e*) single sacculus, with central aperture; (*f*) rudiments of some organ, perhaps genital? (*g*) termination of abdominal cavity and circular rugæ; (*h*) linear tail.

Fig. 58. Worm seen in same position, showing reflection of terminal portion of intestine.

Fig. 59. Worm showing both lateral sacculi.

Fig. 60. Worm in same position as last, showing minute bilobed projections from the lateral sacculi. (Last four figures all × 500 diam.)



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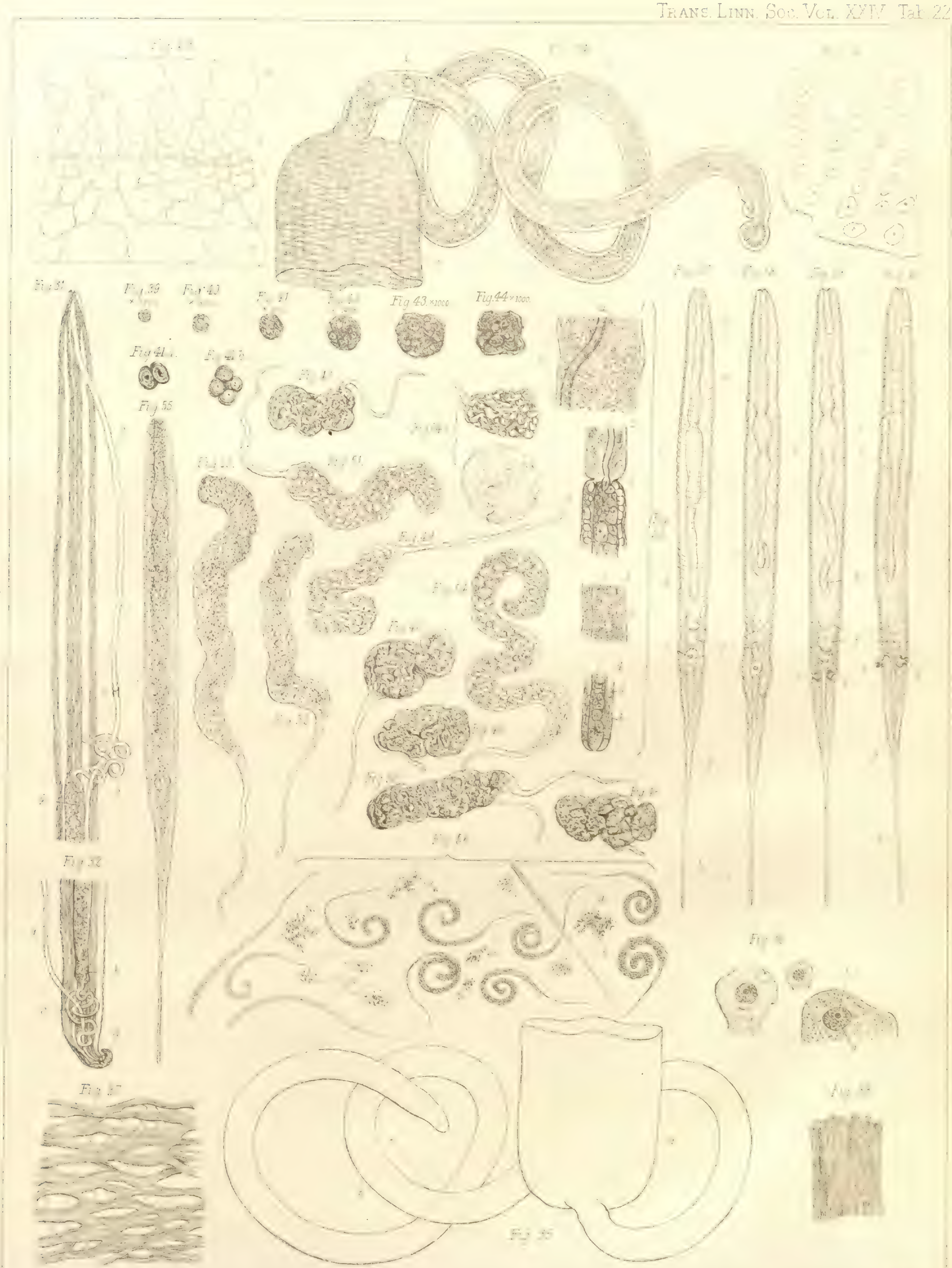


H. C. Bastian ad nat. E. M. Williams lith.

VI. *On two Aquatic* Hymenoptera, *one of which uses its Wings in Swimming.*

By John Lubbock, *Esq., F.R.S., F.L.S., F.G.S.*

(Plate XXIII.)

Read May 7th, 1863.

On one of the early days in August I was enjoying myself by watching the animals in a basin of pond-water. It is customary to regard the inhabitants of fresh water as less beautiful and varied than those of the sea. But though our inland lakes and rivers can boast no Sea-anemones, no Starfishes, Medusæ, Shrimps, nor Sea-urchins, they still are full of beauty and variety. Without counting the rarer forms, almost every weedy pool contains specimens of *Daphnia*, *Cyclops*, *Diaptomus*, and *Asellus* among Crustacea, the *Hydra* among Polypes, the lovely green *Volvox*, and many other Algæ, besides numerous Desmidiæ and Diatomaceæ, with Insects almost innumerable. Besides the perfect insects, such as Water-beetles, *Notonecta*, *Nepa*, and other Hemiptera, there are larvæ of Dragon-flies, Beetles, Phryganeas and Ephemeras, the beautifully transparent larvæ of *Corethra* and many other species of Diptera. But though most of the great orders are more or less richly represented, no aquatic species of Hymenoptera* or Orthoptera† had, till now, been discovered. The species of Hymenoptera have been estimated at about 30,000 in number, and Mr. F. Smith (than whom there is no better authority) informs me that about 12,000 have been already described, 3500 of which live in Great Britain. From the interest attaching in many cases to their habits, from their marvellous instincts, and their curious relations to other animals (no order presenting more parasites and victims of parasites), the peculiarities of Hymenoptera have received more attention than those of almost any other group of Invertebrata.

Great therefore was my astonishment, on the occasion to which I allude, when I saw in the water a small Hymenopterous insect, evidently quite at its ease, and actually *swimming* by means of its wings. At first I could hardly believe my eyes; but having found several specimens, and shown them to some of my friends, there can be no doubt about the fact. Moreover, the same insect was again observed, *within a week*, by another entomologist, Mr. Duchess, of Stepney. This gentleman mentioned it to Dr. Sclater, and, from his description and sketch, there can be no doubt that the insect observed

* The female of *Agriotypus armatus*, indeed, has been observed to descend the sides of rocks in the Clyde to a considerable depth, and to remain there several minutes. Even this species, however, cannot be considered as truly aquatic, or as being entirely at home in the water, since there is no evidence that it knows how to swim.

Mr. Smith also reminds me that *Smiera* (*Chalcis*) *femorata* and *S. sispes* are said to be parasitic on the aquatic larvæ of *Stratiomys*, in which case the perfect insect probably seeks its prey under water; but I am not aware that it has been actually observed to do so.

† A "Grillon aquatique" is indeed described by Stoll; but Westwood, in his excellent 'Introduction to the Modern Classification of Insects,' expresses some doubt as to the accuracy of this statement.

by him belongs to the same species. It is a very curious coincidence that, after remaining so long unnoticed, this little insect should thus be found, almost simultaneously, by two independent observers.

Perhaps this may, in part at least, be accounted for by supposing that the insect was unusually abundant this summer. Yet Mr. Duchess appears to have met with only one specimen. Mine were altogether twenty-one in number, and the females were more than twice as numerous as the males.

Specimens which I forwarded to my friend Mr. Walker, to whose ready kindness and valuable assistance I am much indebted, were at first considered by him to be the *Polynema fuscipes* of Haliday, and under this name I exhibited them at the September Meeting of the Entomological Society.

Subsequent examination, however, has shown that my insect, although allied to *Polynema fuscipes*, cannot be referred to that species. The males not only differ in colour, but also in the number of segments of the antennæ, which, in my specimens, as in *Anaphes* (the abdomen of which last is, however, subsessile), are twelve in number, while the males of *Polynema fuscipes*, and, indeed, of all the hitherto described species of that genus, have thirteen.

Polynema ovulorum has been bred from the eggs of the common Cabbage Butterfly, and the whole group is, in its larval state, parasitic. My specimens were no doubt in quest of some aquatic victim; but this can hardly have been their only object, for the males enter the water as readily as do the females.

The second species to which I am anxious to call your attention is also very interesting, but, although apparently forming a new genus, it is in some respects less remarkable than the first. I found them in the same pond; but whereas *Polynema natans* swims with its wings, and uses its legs apparently only for walking, the present species, when under water, holds its wings motionless, and uses its legs as oars. Though they are neither flattened nor provided with any well-developed fringe of setæ, still they seem to serve their purpose pretty well, and the motion of this species is more rapid than that of the former.

Both species are fond of creeping along the sides of the vessel in which they are kept, or on the leaves and stems of aquatic plants; but very frequently they quit their support, and swim boldly out into the open water.

As the motion in *Polynema natans* is caused by the wings, it might almost be called a flight; owing, however, to the density of the medium, and partly perhaps to the direction in which the wings act, the movement, though not inelegant, is slow, and is rather a succession of jerks than a continuous progression.

The insect is provided with tracheæ, and respiration appears to take place through spiracles in the usual manner. Most of those insect-larvæ which spend much of their time under water are either provided with gills, or carry down with them a supply of air attached to their body, and from which the tracheæ can be replenished. Our insect possesses neither of these advantages; nor can much respiration take place through the skin, which is thick and chitinous.

Moreover, it has some difficulty in passing from air to water, or *vice versâ*: a bubble of air would quite destroy its equilibrium when under water, and a drop of water would equally prevent free motion in the air. The difficulty is, however, mitigated by the fact that the air in the tracheæ requires changing only at considerable intervals. A common house-fly placed under water ceased to move in half an hour. My specimens, however, of *Polynema natans* lived under water several hours without suffering any apparent inconvenience. One, which I put in a bottle full of water at 7 o'clock in the morning, was quite lively at 7 o'clock in the evening, after having therefore been no less than twelve hours at least under water. I say at least, because I had no means of knowing how long it had been there before my experiment began. Probably, however, this was about the limit of its endurance; for four other specimens which I treated in the same manner at about 6 o'clock in the evening were apparently dead at the same hour on the following morning, and the individual above mentioned was itself motionless at 9 o'clock, or after fourteen hours of submersion. I then, however, put it in a dry bottle, and next morning it was as lively as ever. Wishing to see whether it retained any unpleasant recollections of its drowning, I gave it the opportunity of again entering the water, which it immediately proceeded to do.

I was unfortunately unable to ascertain whether they could fly: taking my opportunity when they were out of the water, I teased several specimens of *P. natans* with the point of a needle, but never succeeded in making one take to its wings, at least not in air. When walking on the water, however, they sometimes started off suddenly, but always kept close to the surface, so that it rather seemed as if they were carried by some tiny gust of air.

We might almost wonder how an animal like this, with no apparent weapons of defence, and no great powers of speed, could maintain itself in this world of competition. Protected, however, in its early stages by the victim which it is destroying, it is exposed to its enemies but for a short period of its life; and if, like many of its allies, the eggs of other insects are the prey which it seeks, speed may be of comparatively little importance.

However this may be, we find in the two insects now under consideration no peculiarities indicative of an aquatic life. Many water-insects are more or less boat-shaped, and, both in form and position, the legs are admirably adapted to serve as oars; others, again, use the hinder part of the body as a fish does its tail. Here we find no such arrangements. In both cases the head is broad; in *Prestwichia* the hind legs have, indeed, some scattered hairs, but not more so than its terrestrial allies; nor in *Polynema* do the wings appear in any way modified to adapt them to their new function.

Emerson somewhere says, that the population of the world is "not the best, but the best that could live now." Mr. Emerson is no naturalist, or he would surely know that the population of the world at any given time is not the best that can live, but the worst, since it is not the best and strongest, but the worst and weakest which, in the struggle for existence, habitually go to the wall. Thus our two amphibious Hymenoptera, though not so fleet or well armed as they might be, not so long able to respire under water as some other insects, still maintain their existence, because their enemies are unable to destroy them, and they have the field to themselves.

We have heard much lately about the "imperfection of the Geological Record;" and all geologists admit the fact, though they may differ as to the degree. But what shall we say for the Zoological Record? What terms shall we find strong enough to express our ignorance of existing animals? I speak not now only of foreign species; even in our own country how imperfect is our knowledge even of the Vertebrata! During the last year, two new reptiles and two new fishes have been added to the catalogue; descending to the Invertebrata, however, the case becomes far more striking. Many groups, indeed, have been almost entirely neglected by our naturalists; but, even of those which have been comparatively popular, how little is known! For instance, the Hymenoptera have many admirers, and are carefully studied. Any entomologist happening to see a Hymenopterous insect in the act of swimming would have been well aware that he had a novelty before him; yet the fact that such a creature exists has until now escaped observation. Does not this show how imperfect is our knowledge?

As I have referred to palæontology, permit me to say, in conclusion, that if *Polynema natans* and *Prestwichia aquatica* had been extinct species, no palæontologist would have suspected that they were aquatic; in the present state of our knowledge, there is nothing in their structure which would have suggested such an idea.

Mr. Darwin ('Origin of Species,' p. 184) has brought together several instances of the same fact, but not one, I venture to think, which is more remarkable.

Polynema natans, n. s.

Male black.

Female black; legs, eight basal segments of antennæ, posterior part of thorax, and peduncle ferruginous.

Length of female ·038 of an inch; of male ·042.

In a weedy pond; from the beginning of August to the end of September.

The antennæ are in the male as long as the body, and consist of twelve segments; the basal segment is about twice as large as the others, which do not differ much in size; the second is somewhat pear-shaped; the nine following are cylindrical, abruptly truncated at the apex, tapering at the base; the terminal segment tapers slightly to the apex, which is rounded. They are clothed by short, black hairs, which have somewhat the appearance of being in whorls.

The antennæ of the female are shorter, being only ·022 in length. They consist of nine segments; the first two are like those of the male; the following six are smaller and more pear-shaped; the last is rather smaller at the end, and club-shaped. The arrangement of the hairs is the same as in the male.

The anterior legs are of moderate size, and consist of the usual parts. The coxa is broad at its base, and gradually diminishes to the apex; the trochanter is cylindrical; the femur is elongated, and somewhat swollen in the middle; the tibia is long, cylindrical, and increases slightly towards the apex; the tarsus is four-jointed, the two middle segments being somewhat smaller than the first and last. The foot consists of two claws and a central membranous expansion. The hairs on the leg are short, black, and arranged as in other allied species.

The legs of the second pair are somewhat more elongated, but otherwise very similar; and those of the third pair are decidedly longer, an increase which is not owing to any particular segment.

The legs are not flattened into oars, nor are they provided with fringes as in so many aquatic insects. In fact, this is not to be wondered at, as they are used in walking, and never (as far as my observations went) in swimming.

The wings, though very peculiar, closely resemble those of the other allied species. The anterior pair are as long as the body, and consequently rather longer in the male than in the female; they are between three and four times as long as broad, narrow at the base, gradually expanding for about two-thirds of their length, and rounded off at the apex. They are almost veinless; but at the base, along one margin, there is a thickened portion which is considered to represent the subcostal nerve.

The whole wing is covered by short, simple hairs; and the margin is fringed by long setæ, those in front being, however, shorter than those on the hinder margin, where their length is almost equal to the breadth of the wing.

Through the kindness of Mr. Walker, I have been able to compare my specimens with *Polynema pusillus*, *P. fuscipes*, *P. flavipes*, *P. similis*, *P. atratus*, and *P. euchariformis*, as well as with *Mymar longicornis* and the very curious *M. pulchellus*.

In the latter species the wing is small, oval, and seated on a long process (see Westwood's Introd. to Modern Classification of Insects, pl. 78. fig. 16). In a specimen which I measured, the wing was ·005 of an inch in breadth, and the long setæ were as much as ·0125 of an inch in length.

The Polynemas generally have the wings broader, and the setæ rather shorter; thus in *Polynema fuscipes*, which in many respects has a close resemblance to our species, the length of the wing is ·05, the breadth ·0125, and the length of the setæ ·0075; in other species they are still shorter: but in one labelled "*Mymar longicornis*," which, however, can hardly, I should think, belong to this genus, the length of the wing is ·0375, the breadth ·00625, and the length of the setæ almost exactly the same. The general structure of the wing is similar also in *Oöctonus*, *Anaphes*, and *Anagrus*. Pl. XXIII. figs. 8 & 9 represent the fore and hind wings of *Anaphes fuscipennis*, and it will be seen how closely they resemble those of *P. natans*.

The hind wings (Pl. XXIII. fig. 5) are linear, narrow, and situated on a long, slender, chitinous peduncle.

The peduncle has a length of ·014 of an inch, the wing itself ·026; together ·04 of an inch. The wing is attached to the peduncle, not only at the extremity, but also by a narrow strip of membrane, for nearly half its length. It is very narrow, being only ·0015 in width; on the surface are one or two small hairs, and the margins are fringed with long setæ.

Similar hind wings occur in *Polynema*, *Anagrus*, *Anaphes*, *Oöctonus*, and other allied genera. In *Litus* all four wings are narrow and linear.

Peculiar, therefore, as are the form and structure of the wings, they closely resemble those of other allied species, among which, perhaps, I may particularly mention *Anaphes fuscipennis* and *Anagrus atomus*.

According to the characters which have been regarded by Mr. Walker as of generic value in this group, *P. natans* would form the type of a new genus. I am, however, unwilling to multiply divisions which perhaps have already been carried too far.

For my second species, however, it seems quite necessary to found a new genus, which I propose to call *Prestwichia,* after my friend Mr. Prestwich, one of our most eminent geologists. When this paper was read, I proposed for this species the name of *Valkeria.* Mr. Busk, however, has pointed out to me that the name was already applied to a genus of Polyzoa*. The generic description, for which I am indebted to Mr. Walker, will stand as follows:—

Genus Prestwichia, n. g.

Fœm. Corpus angustum. Caput transversum. Antennæ graciles, subclavatæ, inarticulatæ; clava longi-fusiformis. Thorax brevis. Abdomen sessile, longi-conicum, subcompressum, thorace plus duplo longius. Oviductus vagina lanceolata, abdominis dimidio longior. Pedes longi, graciles; tarsi 4-articulati; alæ longæ, fimbria longissima; anticæ angustæ, posticæ setiformes.

Female. Body narrow; head transverse, as broad as the thorax. Antennæ slender, subclavate, 10-jointed, as long as the head and the thorax; 1st joint or scape nearly as long as the flagellum; 2nd, 3rd, 4th, 5th, and 6th joints equal in thickness, successively decreasing in length; 7th fusiform; 8th, 9th, and 10th forming an elongate-fusiform club. Thorax short. Abdomen sessile, elongate-conical, slightly compressed, more than twice longer than the thorax. Sheaths of the oviduct lanceolate, more than half the length of the abdomen, proceeding from the tip of the latter. Legs long, slender; tarsi 4-jointed, joints successively decreasing in length; middle legs longer than the fore legs; hind legs stouter and much longer than the middle legs. Fore wings long, narrow, without veins, fringed with hairs which are more than twice longer than the breadth of the wing. Hind wings represented by a filament whose hairs are nearly as long as those of the fore wings.

Prestwichia aquatica, n. sp.

Fœm. Nigra; antennis, thorace postico, oviductu pedibusque pallide testaceis; alis anticis cinereis.

Female. Black. Antennæ, hind part of the thorax, sheaths of the oviduct, and legs pale testaceous. Fore wings cinereous, hairs black. Length of the body ·05 of an inch; the wings a little longer.

The antennæ are short, being only $\frac{1}{60}$th of an inch in length. They consist of six or seven segments; the first is long, and near the apex shows a trace of a division. Assuming, from the analogy of *Trichogramma evanescens*, that this is a true joint, the second segment is short and round. The third is longer, and increases somewhat in size towards the apex; the fourth is similar in shape, but smaller. The rest of the organ

* While this would have been some slight acknowledgment of the numerous ways in which Mr. Walker has put his great knowledge at my disposal, it was certainly no more than a just compliment to one who has so much increased our acquaintance with this department of entomology.

forms a club-like mass, which appears to be composed of three segments; the last joint, however, is very indistinctly marked.

The legs are much like those of the preceding species; but the fourth segment of the tarsus (Pl. XXIII. fig. 15) is, in all the legs, very small. Mr. Westwood*, indeed, describes the tarsus of his species as being only three-jointed, and in this he is confirmed by Mr. Haliday†. Mr. Westwood's figure, however (fig. 9), shows a fourth segment, which, though small, is even larger in proportion than that of my species. I am disposed, therefore, to consider that the tarsus of *Trichogramma* is in reality four-jointed, and that Westwood's and Haliday's descriptions must be amended.

The legs are not compressed, nor have they any fringe of hairs. They show, therefore, no trace of adaptation to their new function.

The anterior wings (Pl. XXIII. fig. 13) are club-shaped, narrow at the base, expanding almost to the apex, with elegantly curved margins. The single nervure extends for about half the length of the wing, and at the apical extremity turns inwards, and ends abruptly. The margin of the wing is fringed by long setæ, which are largest along the club-shaped extremity of the wing, from which they gradually decrease in length in each direction. The insertion of the setæ is somewhat peculiar (Pl. XXIII. fig. 13 *a*), and makes a pretty border to the wing. Near and parallel to the front and hinder margins are two rows of small spines, and others are scattered about the expanded portion.

The hind wings are narrow, linear, ciliated, situated on a long pedestal, and, in fact, so closely resemble those of *Polynema* that they need not be separately described.

Remarkable and peculiar as is undoubtedly this conformation of the wings, still, as already observed, it is the same as that which occurs in many allied species, and is not therefore to be regarded as in any way connected with the aquatic habits.

Moreover, we must remember that though the wings of *Polynema natans* so closely resemble those of *Prestwichia*, and though both insects are essentially aquatic in their habits, yet the one swims only with its wings, the other with its legs.

While the abdomen of *Polynema* is petiolated, that of *Prestwichia* is sessile, and tapers almost from its base to the insertion of the ovipositor; so that the whole body is almost boat-shaped. This latter organ is about as long as the abdomen, very stout in proportion, and bears a few scattered hairs.

My specimens were found in the same pond as *P. natans*, from the beginning of August to the middle of September. It appears, however, to be rarer; and I only found six specimens, all of which were females. Possibly the male is not aquatic in his habits.

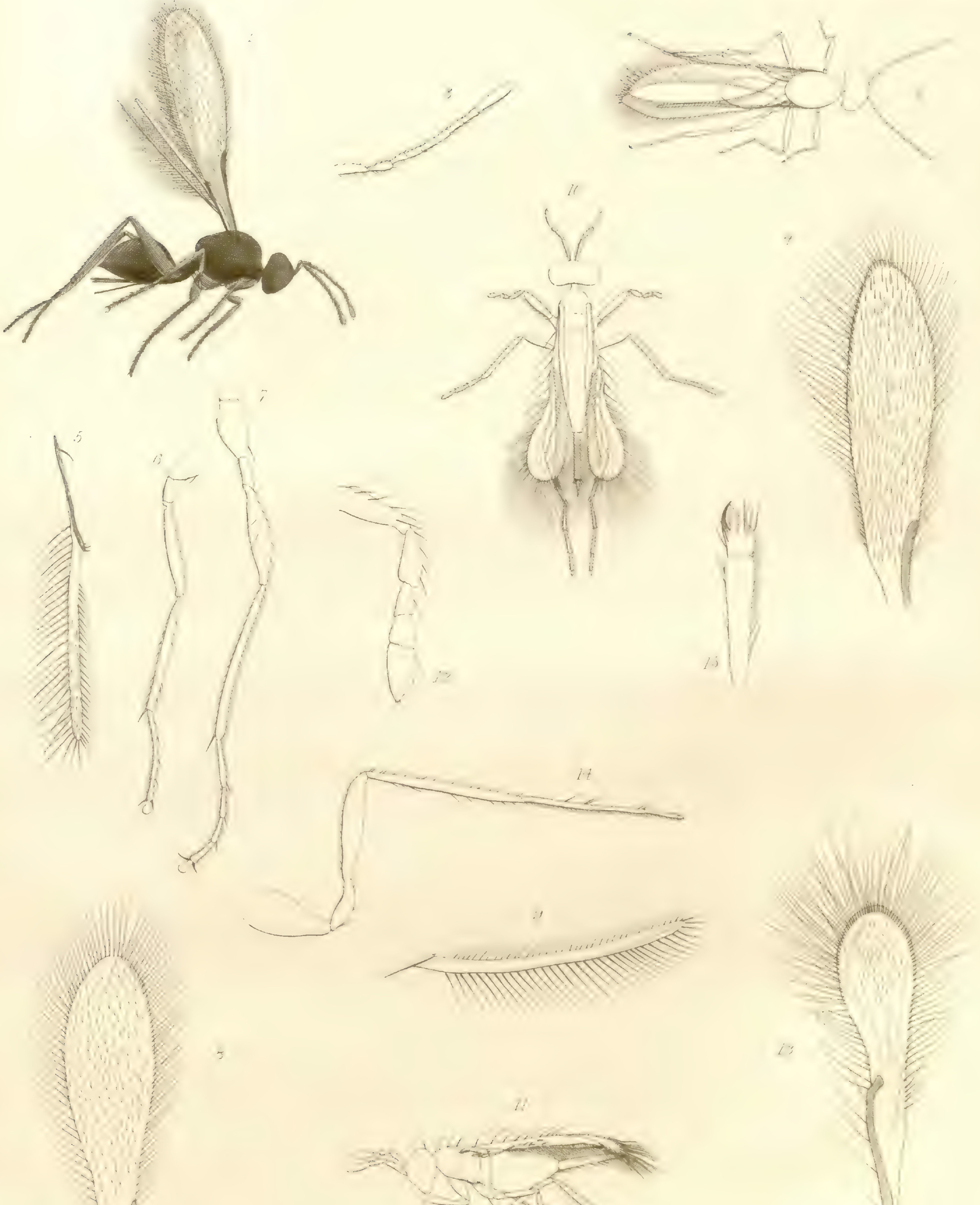
* Lond. and Edin. Phil. Mag. 1833, p. 444.

† Ent. Mag. vol. i. p. 341.

DESCRIPTION OF THE PLATE.

Plate XXIII.

Fig. 1. *Polynema natans*. Side view of female, × 30.
Fig. 2. „ „ Female, seen from above, × 30.
Fig. 3. „ „ Antenna of female, × 60.
Fig. 4. „ „ Anterior wing, × 60.
Fig. 5. „ „ Posterior wing, × 60.
Fig. 6. „ „ Anterior leg, × 60.
Fig. 7. „ „ Posterior leg, × 60.
Fig. 8. *Anaphes fuscipennis*. Anterior wing, × 60.
Fig. 9. „ „ Posterior wing, × 60.
Fig. 10. *Prestwichia aquatica*. Female, seen from above, × 30.
Fig. 11. „ „ „ side view, × 30.
Fig. 12. „ „ Antenna, × 30.
Fig. 13. „ „ Anterior wing, × 60.
Fig. 14. „ „ Posterior leg, × 60.
Fig. 15. „ „ Tarsus of ditto, × 250.



J. Lubbock del.

G. Jarman sc.

VII. *On a Sexual Monstrosity, consisting in the Development of Polleniferous Ovules, in two Species of* Passiflora. *By* S. JAMES A. SALTER, *M.B., F.R.S., F.L.S., F.G.S.*

(Plate XXIV.)

Read June 4th, 1863.

IN the summer of 1860 Dr. Dresser gave me several specimens of a curious monstrosity in the ovaries of Passionflowers which had bloomed in his garden at Hammersmith, the plant producing these being the common *Passiflora cærulea*. A few weeks afterwards I found monstrosities of a precisely similar kind on another species of Passionflower (*P. palmata*), growing in a greenhouse at Selborne in Hampshire. Unfortunately Dr. Dresser's plant died in the winter of 1860–61, and no more specimens could be obtained from that source. In the summer of 1861 I had no opportunity of examining the plant at Selborne, but in 1862 I collected from thence great numbers of these malformations. The specimens were essentially the same in both species, though they differed a good deal as to the degree in which the ovaries were malformed and the sex perverted. I may mention that the examples upon which, in this paper, my descriptions are founded, and from which the illustrations have been drawn, were obtained from the Selborne plant.

The monstrosities in question consisted in a partial and persistent separation of the carpels, thus opening the cavity of the ovary; in the development of anther-like bodies along the free edges of the separated carpels; and, further, in the conversion of certain of the ovules themselves into sacs of pollen,—these ovules being for the most part malformed, but in a few exceptional cases of perfect anatomy, barring the presence in them of the pollen.

Before describing the particulars of my specimens, I would remark that monstrosities of a somewhat similar kind have been found in a few instances in other plants, with this important difference, however, that there is no recorded example in which the ovules themselves have been polleniferous.

Moquin-Tandon, in his comprehensive work on Vegetable Teratology*, enumerates some examples in which the pistil has been converted into an anther or anthers, or in which antheroid organs have been developed within the substance of the carpels; but he remarks that such monstrosities are uncommon, and that from their rarity doubtless it is that many authors, among others Gmelin and Schultz, have denied their existence.

M. Rœper has observed this phenomenon in *Euphorbia palustris* and in *Gentiana campestris*: in these examples one of the carpels seemed to be wanting, and was found in the form of an anther. The same observer has seen a flower of *Impatiens* in which a supernumerary stamen exactly occupied the place of a wanting carpel.

* Eléments de Tératologie Végétale, par Moquin-Tandon. Paris, 1841.

M. Agardh has noticed a similar transformation in the Oriental Hyacinth (*Hyacinthus orientalis*): he affirms that he saw, in a half-blown flower of this plant, the placentas metamorphosed into stamens; one half of the fruit enclosed seeds, and the other half anthers.

M. Schimper has found in the Weeping Willow (*Salix Babylonica*) the most varied instances of the changing of pistils into stamens. In *Primula acaulis* the same observer has seen anther-cells on the internal walls of the ovaries.

According to Engelmann, both *Campanula persicifolia* and *C. rapunculoides* sometimes exhibit their pistils surmounted by organs resembling an anther: the same author has observed in *Cheiranthus Cheiri* the half of an ovary metamorphosed into a staminal mass.

M. Gay has recognized this kind of transformation in *Colchicum autumnale*: one of the styles was much elongated and of regular conformation; the two others appeared shortened and changed into antheriferous filaments.

Moquin-Tandon himself speaks of having found pistils of *Zea Mays* converted, some wholly and some partially, into antheral organs.

Mohl has demonstrated an analogous monstrosity developed in *Chamærops humilis*: the three carpels were found of normal conformation in each flower; they presented their habitual form and size; each contained an ovule perfectly organized; they did not deviate from ovaries of an entirely normal structure, except that a yellow pad existed along the length of the two sides of the ventral suture, which yellow pad was displayed, by a section of the ovary, as an antheral mass full of pollen, and divided by a septum into two loculi.

In some general remarks upon these monstrosities Moquin-Tandon observes, "that the vegetables affected by the metamorphosis of pistils into stamens may be divided into two series, those in which the ovary is formed by a single carpellary leaf, and those which are furnished with many carpellary leaves. The metamorphosis is perhaps less decided in the second case than the first: when the ovary of many carpels is transformed, the foliaceous elements which compose it show constantly a tendency to separate one from another." And he continues, in accordance with opinions expressed by Mohl, "it seems evident that, in this transformation, the lobes of the anther and the production of the pollen have no relation to the formation of the ovules: the fecund matter is developed in the very interior of the ovarian leaf and in the neighbourhood of its edges." I would direct particular attention to this passage, because the conclusion here expressed by such high authority is directly contravened by the specimens I am about to describe.

Some curious observations on the weeping willow, bearing on this subject, have been recorded by Professor Braun of Berlin, in a paper on the "Individuality of Plants in relation to Species," &c., published in the 'Transactions of the Royal Academy of Sciences of Berlin' in 1853*.

All weeping willows appear to have been derived from one individual plant, and to have been propagated by cuttings: that plant was a female. And yet many of the trees thus produced have borne polleniferous catkins. The weeping willow by the tomb of

* "Das Individuum der Pflanze in seinem Verhältniss zur Species," &c., in Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin vom Jahr 1853.

Napoleon at St. Helena was, as its original stock, a female plant: many cuttings have been brought to England which have produced plants more or less male. A similar instance has also occurred in Germany. In the garden of the Grand-Ducal Palace at Schwetzingen is a weeping willow, which, although from the very same origin as all the rest, has in a great degree changed its sex, so that it not only shows the most manifold transitional grades of female into male flowers, but also bears on many twigs purely male catkins.

Gärtner* refers to many instances in which he has observed polleniferous organs developed in female diœcious plants—in *Cannabis sativa, Spinacia oleracea, Mercurialis annua, Cucumis sativa,* and other plants; but his account is given with incomplete anatomical details.

And, lastly, Henry and Macquart have described and figured a series of structures in *Salix cinerea*, in which the ovary was opened first by a slit and then expanded into a cup; next, anther-cells were developed on the margin of the cup with stigmas alternating with them, the ovules at the same time vanishing from the interior; lastly, the margin divided and bore three perfect anthers, and in fully metamorphosed examples these three anthers rose to the edge of the cup on free filaments†.

These are all the recorded examples I have met with in which pollen and pollen-bearing organs have been developed upon the female parts of flowering plants; and it should be noted that in none of these has the pollen been found in the *ovules*.

The monstrosities in the flowers of *Passiflora*, which I now proceed to describe, were entirely confined to the pistil; and they affected all its parts—stigmata, styles, ovaries, and ovules.

The stigmata and styles were generally either deficient in number or stunted in size, and crooked and distorted in shape; rarely they were more numerous than normal, being four or five in number. I did not observe in them any peculiarity of structure.

The malformed ovaries were all about a normal size, but they were more or less split open, generally at their distal end, so as to open the cavity (Pl. XXIV. figs. 1 & 2). This opening in almost all cases commenced at the distal extremity of the ovary, and in very many instances consisted only in an orifice between the attachment of the styles, from which orifice projected various foliar and antheroid organs. In other instances there was a lateral split passing backwards from the apex of the ovary to one-third, one-half, or sometimes two-thirds of its length, but never quite reaching its basal attachment: this split has usually been single; sometimes, however, it has been double, and occasionally triple, thus separating all three of the component carpels of the ovary along a certain portion of their ventral sutures. The free edges of the carpellary leaves, thus separate, have usually been of a yellow colour, thickened and variously modified into lobes and oval processes, sometimes everted, sometimes inverted, and occasionally

* Beiträge zur Kenntniss der Befruchtung der vollkommeneren Gewächse von Carl Friedrich Gärtner. Stuttgart, 1844.

† Referred to by Henfrey in 'Botanical Gazette,' vol. iii. p. 12, the literary reference in a foot-note being, "Erst. Jahresb. des bot. Vereines, am M. & N. Rhein. 1837."

extended into foliaceous prolongations. Rarely the imperfection in the ventral sutures has occurred in the centre of the ovary, and not at its extremity: in such cases the ends of the ovary have been closed, and one, two, or three small openings have occurred in the middle, according as two or more of the carpels were separated on one side or on both (Pl. XXIV. fig. 3). In these instances the everted edges bore cellular processes containing pollen. All the polleniferous organs connected with these monstrous ovaries were either attached to the edges of the carpellary leaves where they were divided, or sprung from the placentas. The position which they occupied was that of ovules, and both in structure and form they passed by degrees from organs identical with anthers to others which were identical with ovules. I incline very strongly, therefore, to the opinion that in all instances they were modified ovules, and that in their earliest condition—in their incipient development—they commenced as such.

The forms of these pollen-bearing bodies have been very diverse, but for convenience of description, rather than for any other reason, I may mention four different varieties in which I have found them.

First, that of a *bilobed anther*. This in many instances has been a tolerably perfect imitation of the genuine anther of the same flower. Such specimens are figured in Pl. XXIV. figs. 1 & 2. In all cases these anthers were sessile upon the free edges of the carpellary leaves, and placed towards the distal end of the ovary. In structure they were essentially the same as true anthers. The external coat consisted of epidermis, or *exothecium*: the internal coat was composed of spiral cells and free spiral fibres, constituting a true *endothecium*. Within the latter was a mass of pollen. Sometimes these antheroid organs have been more or less expanded and foliaceous, but essentially of the same structure.

There is nothing in the form or ultimate anatomy of these bodies to indicate an *ovular nature*, and the opinion that they are modified ovules is merely inferential.

The *second* form consists of globular or oval bodies attached within the ovarian cavity to the placenta by a pedicle more or less constricted. The general contour of these bodies suggests a modified ovule, and their position is in keeping with that idea. Their structure, however, I have found entirely antheroid, and destitute of the particular arrangement of parts constituting an ovule. They have consisted of a chamber filled with pollen surrounded by inenchyma (*endothecium*), and clothed by epidermis (*exothecium*). The stalk has been usually destitute of vascular tissue, and composed of parenchyma with some spiral cells. These bodies vary a good deal in form and size, being occasionally very large and oval. One of these polleniferous processes I have carefully mounted as a microscopical object, and the accompanying figure (Pl. XXIV. fig. 4) is a faithful illustration of the specimen magnified about 35 diameters. I could not make a section of the little polleniferous body from its minuteness; it was therefore necessary to compress it so as to render it sufficiently thin for viewing with transmitted light, otherwise the nature of the opake pollen-mass in its centre would not have been clearly apparent. This compression has modified the form by pressing out the soft stalk and rendering it much broader in proportion to the rest of the organ than it was originally.

A *third* form was usually found fairly within the cavity of the ovary, and below the free split edges of the carpels. This organ *undoubtedly was* a modified ovule. It was of oval form; the external covering having the same crenulated surface as the neighbouring perfect ovules, and attached to the placenta by a constricted pedicle, up the axis of which passed a bundle of vascular tissue,—in fact, attached by a true funiculus. Such a specimen is exhibited in Pl. XXIV. figs. 5 & 6, and is intelligible enough, though somewhat distorted in fig. 5 by the compression necessary to render it sufficiently diaphanous for contemplation with transmitted light.

In the centre is a large mass of pollen, surrounded by a more transparent area of cellular tissue. Whether this latter represents the ovular coats I am not prepared positively to say; but, from the absence of a micropyle, I presume that it does not. The funiculus attaching this body to the placenta is traversed by vascular tissue; the spiral vessels, however, instead of remaining through their course an unbroken fasciculus, as in the case of a normal podosperm, and then expanding into the chalaza, are a good deal branched in their progress. There appears to me to be no question that the organ I have just described is a modified ovule: the erect position of its stalk and the apparent absence of coats would, however, seem to indicate that the sexual aberration which it had undergone in its early development (as manifested by the formation of pollen) had arrested the elaboration of its normal ovular anatomy,—that, instead of becoming, in the progress of its growth, anatropous and clothed with coats, the nucleus had remained orthotropous and naked. At least, that is the interpretation I should be disposed to give to these appearances.

The *fourth* form is that in which the ovule is only modified by the presence of a very few pollen-grains in its substance, in other respects being natural. Such specimens are found deep in the cavity of these malformed ovaries, either among or very near those ovules which display no departure from a perfectly normal anatomy. Examples of this very slight amount of male element within the ovule I have found to be extremely rare: as a rule, in the polleniferous ovules the pollen has been very abundant, and in that case the form and relation of the ovule has been a good deal modified. One of these exceptional instances of a very minute development of pollen within an ovule is figured in the accompanying drawing, Pl. XXIV. fig. 7.

When first examined, a dark spot appeared in the nucleus, about one-fourth of the length of the ovule from the foramen. From the examination of previous specimens I was aware that this was pollen, but, imbedded in the substance of the ovule, its structure was obscured by the opacity of the tissues surrounding it. To demonstrate the nature of this little opaque mass it was necessary to burst the ovule, and this was without difficulty accomplished by compressing it between glass slides under the microscope. By this means the pollen was freed from its endothecium, and emerging from the interior of the ovule occupied the position indicated in the accompanying illustration, and now, freed from any covering, its nature as true pollen can be seen by high magnifying powers.

I may here mention that in perfectly formed anatropous ovules I have never found many grains of pollen; six or eight have been the extreme numbers, and in three several instances two, three, and four grains: but from the rarity of meeting with anatropous well-formed ovules bearing pollen, I have only had opportunities of viewing eight or ten examples in many dozens of malformed ovaries whose contents I have examined with careful scrutiny. The ovule, figured in Pl. XXIV. fig. 7, was one of several which I removed from a slightly malformed ovary, and this was the only one in it which I found containing pollen. There was in this ovule, surrounding the pollen, a true endothecium, an aggregation of spiral cells and some free spiral fibres. I have always found this to be the case in every instance, without exception, where pollen was present.

As regards the pollen itself obtained from these several abnormal situations, it was quite characteristic of Passionflower pollen; that from the antheroid carpels, the ovules, and the true anthers was all alike. In some of the pollen-bearing ovule-like bodies I traced the pollen in different stages of development: in one instance I found perfectly matured pollen in an aggregated condition—three grains adherent as though the septation of the *parent cells of the pollen* had been incomplete, leaving the *special parent pollen-cells* connected, with a common cavity, so that their contents, the forming pollen, became and remained confluent.

From the foregoing descriptions it is seen that, in these monstrous ovaries, a number of organs are developed on the same placenta, commencing at the distal extremity of the carpel with a *bilobed anther*, and passing in series to the base of the ovary, an *antheroid body* of ovule-like form, a *modified ovule* containing pollen, an *ovule* departing from a perfectly natural condition only in the development of a few grains of pollen in its nucleus, and, finally, a *perfect, normal ovule*.

Now, in contrasting these several organs together, it seems to me that their probable relation to one another may be best expressed thus:—That they were by intent one set of organs, originally incipient ovules, but developing different sexual tendencies: in those furthest from the axis, and where the carpels were most divided, the male sex influence has been paramount; and the formation of an anther-like body, with a large amount of pollen, has been the result. Where the organ has been near the base of the ovary (in which part the structure of the ovary has been normal), the female sex influence has been paramount, and the ovules were altogether natural in form and structure: and that the intermediate forms were determined by the predominant force of one or other sex.

The splitting of the ovary and the development of polleniferous organs on the carpels were always concurrent, and to a great extent proportional in degree. This circumstance suggests the questions:—

Is the want of union of the ventral sutures the result of an antheroid development, and with the object of permitting the pollen to escape? Or,

Does the splitting of the ovary, by exposing the ovules, supply a physical condition which tends to convert incipient ovules into polleniferous organs?

As regards the particular part of the ovule which developes the pollen, the situation in which it takes place suggests the idea that the embryo-sac may be the seat of this change when it occurs in ovules otherwise perfectly formed. I cannot imagine that, in those other polleniferous organs in which the ovular anatomy has been entirely lost or much perverted, an embryo-sac could have had an existence, or that there had been any tendency towards its formation. It does seem probable, however, from position, where anatropous ovules have contained pollen, either that the cells of the embryo-sac, or, if they have not been as yet specialized, that that part of the nucleus about to furnish the embryo-sac, had constituted the *parent cells* of this misplaced pollen. The question, however, as to whether the embryo-sac had existed prior to the pollen appears to me simply of interest in reference to the stage of development which the ovule may have attained when the sexual divergence took place. It does not affect the main point—the fact of such sexual divergence, nor the further fact that pollen was formed at the expense of the tissues of the ovule at some stage of its development.

The monstrosities I have now described to the Society are of much curious interest as examples of *perverted anatomy*, and they may possibly have some not unimportant bearing on points of homology; but I conceive that their paramount interest is *physiological*, both in the abstract in reference to the question of sex, and in their consequences as to the influence which such facts must have on the interpretation of cases, or supposed cases, of parthenogenesis in phanerogamic plants.

For an ovule to develope pollen within its interior is equivalent to an ovum in an animal being converted into a capsule of spermatozoa. It is a conversion of germ into sperm, the most complete violation of the individuality and unity of sex; and it involves the idea of a mutation of gender.

The occurrence of an antheroid ovule and a normal ovule on the same carpellary leaf realizes the simplest and the most absolute form of hermaphroditism.

The bearing of these facts is of real *practical* importance in reference to the question of virgin-reproduction in flowering plants. The circumstance that an ovule within an ovary *may* contain pollen in juxtaposition with another ovule normally formed, and capable of ripening into a mature seed, appears to me to cast a grave suspicion on many of the cases of reputed parthenogenesis in phanerogamic plants. It must surely be conceded (upon the facts which I believe I have now established) that no supposed case of parthenogenesis can be considered proved unless the ovules have been subjected to microscopical examination: I am not aware if such scrutiny has been made in any of the reputed cases.

Gärtner, who disbelieved in the agamic reproduction of flowering plants, and who laboured to disprove the idea, applied the term "crypto-hermaphroditism" to those abnormal combinations of the two sexes where, in a plant supposed to be female and unisexual, pollen has been developed in some unnatural and hidden situation. He fully understood how such fallacies were likely to occur and to mislead in a supposed case of virgin-reproduction. But he instanced none in which the term "crypto-hermaphrodite" is so applicable as to a case of polleniferous ovules. In my malformed Passionflower ovaries, the alteration in structure was in many instances so very slight and so little apparent that they would have been altogether overlooked but for the fact that other more distorted specimens had attracted attention; and yet these slightly altered ovaries contained ovules and other organs laden with pollen enough to impregnate an immense number of seeds.

What shall be said, therefore, of those supposed cases of virgin-reproduction in which the observer was not even conscious of the possibility of this fallacy?

I would not, however, have it supposed that I deny parthenogenesis in phanerogamic plants; I have not alluded to the question with that object. Some of the recorded examples are perhaps too well founded upon the evidence of unquestionable authority to admit of doubt. I merely wish to urge what the teachings of the curious and unexpected facts I have now detailed in this paper seem to me to enforce—that the possible fallacies in supposed cases of parthenogenesis are likely to be very subtle, that every such source of error should be eliminated in an attempt to prove so flagrant an exception to that which is (in flowering plants, at least) an almost universal physiological rule, and that the evidence should be complete, as well on negative as on positive grounds, before the reputed fact can be considered as established.

DESCRIPTION OF THE PLATE.

Plate XXIV.

Fig. 1. The sexual parts of *Passiflora palmata* exhibiting malformed ovary. (Enlarged 3 diameters.) The extremity of the ovary is open, and from its interior project some large polleniferous ovules: a sessile anther is attached to the free edge of one of the carpels.

Fig. 2. A specimen similar to that represented in fig. 1, cut vertically, and displaying the interior of the ovary. (Enlarged 3 diameters.)

Fig. 3. Sexual parts of *Passiflora palmata* in which, in the ovary, the carpels are split from each other at the centre of the fruit, the everted edges being developed into antheroid bodies. (Enlarged 3 diameters.)

Fig. 4. Modified ovule (?) from the interior of a malformed ovary, containing a mass of pollen. The specimen has been compressed so as to be seen by transmitted light. (Magnified about 35 diameters.)

Fig. 5. Modified ovule, compressed, exhibiting pollen in the nucleus, and the funiculus with vascular bundles. (Magnified about 35 diameters.)

Fig. 6. Diagrammatic outline of the same, previous to compression.

Fig. 7. Anatropous ovule, broken by compression, and freeing a small mass of coherent pollen-grains. (Magnified about 60 diameters.)

VIII. *Notes on British Fungi.* By Frederick Currey, *M.A., F.R.S., F.L.S.*

(Plate XXV.)

Read June 18th, 1863.

THE object of the present paper is to give a description of some new Fungi, and to note the occurrence in this country of certain species not hitherto recorded as British. I have added also some observations upon a few of our indigenous species, which I think may be of interest to mycologists. Should the present communication prove acceptable to the Society, I shall hope to be able to follow it up from time to time with others of a similar nature.

Amanita spissa, Fr.

A fine *Amanite* occurred last autumn in the woods adjoining Combe Place, near Lewes. It is apparently identical with *A. spissa*, Fr. (Epicrisis, p. 9), but I feel somewhat uncertain about it. The following is a full description:—

Pileus 3 inches broad, umber, with a greyish tinge, dry when I found it, but evidently had been viscid, as it had dead leaves firmly adhering to it, smooth, with a few patches of the volva adhering, not in the form of warts, but irregular; epidermis tough and clammy, easily peeling off, margin not striate. Gills very broad, more than ½ inch, ventricose and adnexed. Stem 3 inches high, 1 inch being buried in the ground, swollen and bulbous at the surface of the ground, narrower above and below. Ring deflexed and striate, as in *A. rubescens*. Sporidia white, irregularly pear-shaped or balloon-shaped, with a short stalk, colourless, about 0·0005 inch long.

The nearest figure which I can find is Krombholz, pl. 1. fig. 7 (*Ag. cinereus*), but my plant is larger and not so dark in colour. Fries's *Amanita spissa* is Krombholz's *Ag. cinereus*.

Lentinus fimbriatus, n. s.

Pileus subdimidiate, subcoriaceous, thin (not fleshy), depressed, sometimes very much so, and almost cyathiform, ½ to 1 inch wide, fawn-coloured, covered with floccose scales of a darker brown; margin slightly involute, almost strigose; stem lateral, from ⅛ to ¼ inch long, rough with somewhat reflexed scales of the same colour as the gills, or rather paler; gills pale brown, irregularly serrate and lacerated at the margin, descending, but not decurrent. In young specimens a delicate white fimbriate collar or fringe (the remains of the ruptured veil) separates the gills from the stem. Pilei two or three together, one above another in an imbricated manner. Some of the pilei were tinged here and there with pink stains, but whether accidental or not I cannot say.

On a stump, standing in water, in a pond in the field adjoining the first turnpike-gate out of Lewes, on the Uckfield road, September 19, 1862. Nearly allied to *L. vulpinus.*

Plate XXV. fig. 2 represents the fungus of the natural size.

NIDULARIA PISIFORMIS, Tulasne, Ann. d. Sc. Nat. 3 sér. vol. i. p. 100.

Granularia pisiformis, Roth, in Usteri's Ann. der Bot., Band i. S. 6, tab. 1. f. 1.

Peridium subrotund, slightly flattened, varying in different specimens from $\frac{1}{12}$th to $\frac{1}{4}$th of an inch across, brown or brownish white, woolly, tuberculate when ripe from the pressure outwards of the sporangia; indehiscent, opening by irregular fissures; sporangia enveloped in jelly, subrotund or disc-shaped, their outline forming a broad ellipse (almost a circle) with a major axis of about $\frac{1}{20}$th of an inch, shining, of a rich dark brown colour, sometimes hollowed inwards on one side, but not umbilicate, and showing no trace of any elastic cord, such as exists in *Cyathus*. Sporidia colourless, slightly varying in shape, globose, pear-shaped or elliptical, produced on sterigmata, 0·0002 to 0·0003 inch across.

On pine-chips, St. George's Hill, Weybridge, May and October 1862.

I was at first inclined to consider this a new species; but after discussing it with Mr. Berkeley, we came to the conclusion that it could not be separated from *Nidularia pisiformis*, Tul. *N. pisiformis* is described as gregarious, and is said to have grown on clayey ground mixed with wood shavings. Tulasne does not figure *N. pisiformis*, not having seen it, but only adopts Usteri's account, who describes and figures it in his 'Annalen der Botanik,' vol. i. tab. 1. f. 1, under the name of *Granularia pisiformis*. Usteri's description does not very well accord with his figure, but the latter is so rough and imperfect as to be hardly intelligible. All the specimens of the plant above described were solitary, and they grew only on fir-chips and fir-leaves, not on the ground. When the sporangia and the enveloping jelly are dispersed, a hollow skinny cup remains attached to the place of growth. The number of the sterigmata appears to vary from one to four. Upon the basidium which is figured I could only make out two. The species does not appear to have been noticed since Usteri's publication of it, now a great many years ago.

Plate XXV. figs. 5 & 6, and fig. 22, represent specimens of the fungus considerably magnified; fig. 4 represents the sporangia detached, and also magnified; fig. 21 represents a basidium, with two sterigmata and spores attached, highly magnified.

HELVELLA GIGAS, Krombholz (Naturgetreue Abbildungen und Beschreibungen der essbaren, schädlichen, und verdächtigen Schwämme, Heft iii. s. 28. Taf. xx. Bild 1, bis 5).

This fine species has occurred once only, in a garden in Blackheath Park. It would seem from Krombholz's figures to vary a good deal in colour. My specimen was brownish yellow.

Plate XXV. fig. 25 represents the fruit × 220 diameters.

Peziza fibrillosa, n. s. (Ser. *Aleuria.* Tr. *Helvelloideæ.* Sect. *Cochleatæ.*)

Cup 1 inch broad, nearly sessile, irregular, orange, clothed externally with dingy-white downy fibrillæ, which form a rather dense tomentose edging to the cup. Spores quite smooth, elliptical, without nuclei, 0·0006 to 0·0007 inch in length. Paraphyses filiform, enlarged spherically at the apex. Hanham Wood, near Bristol, October 1861. C. E. Broome, Esq. This species is allied to *P. aurantia*, from which it differs in the woolly external covering and smooth sporidia. In some of the asci I noticed a cupulate depression at the summit.

Peziza diplocarpa, n. s. (Ser. *Lachnea.* Tr. *Dasyscyphæ.*)

Cups rather flat, $\frac{1}{8}$th of an inch wide, stipitate, externally of a rich vinous brown, clothed (as well as the stem) with dense short hairs. Margin of the cup slightly inflexed and surrounded by a ring of hairs of a pale umber, forming a marked contrast in colour with the reddish-brown outer hairs. Disc waxy, somewhat glaucous, of a greenish-olive colour. Sporidia elliptical, with a nucleus at each extremity, usually slightly narrowed at each end, 0·0003 inch long. Paraphyses filiform, terminating in spore-like bodies, the latter 2–4-septate, acuminate at the apex, and tapering to the junction with the filament, varying much in length, from 0·0008 to 0·0018 inch.

Plate XXV. fig. 30 represents the plant magnified; fig. 32, the paraphyses and spore-like bodies; and fig. 33, the sporidia.

Found by Mr. Broome at Joyden's Wood, near Dartford, November 8, 1862. Allied to *P. rufo-olivacea*, A. & S.

Peziza Theleboloides, A. & S. Consp. Fung. p. 321, t. 12; Fries, Syst. Myc. vol. ii. p. 88. (Ser. *Lachnea.* Tr. *Sarcoscyphæ.* Sect. *Ciliares.*)

This beautiful *Peziza*, not hitherto recorded as a British species, has been found by Mr. Broome and also by Mr. W. Wilson Saunders, in both instances growing upon spent hops.

Peziza lacustris, Fr. Syst. Myc. vol. ii. p. 143. (Ser. *Phialea.* Tr. *Mollisia.* Sect. *Udæ.*)

I have found this species (one of the very few really aquatic fungi) in a pond at Kilbrooke Manor Farm, near Blackheath, upon dead submerged stems of *Alisma plantago.*

The following is the description of the fruit, taken from my specimens:—Sporidia colourless, crowded at the apex of the ascus, pellucid, elliptical, rounded at both ends, often slightly curved, sometimes (? always) with an indistinct minute nucleus at each extremity, 0·0005 to 0·0006 inch in length. Paraphyses filiform or subclavate.

Fries, in his 'Summa Vegetabilium Scandinaviæ,' makes this plant the type of a new genus, which he calls *Niptera*, and places in the order Bulgariacei, near *Ascobolus.*

Helotium luteolum, n. s.

Cæspitose, pale straw-colour; stem about $\frac{1}{5}$th of an inch long; disc 1 line wide, at first hollow, ultimately expanded and convex, the edge covered with very minute parallel white hairs, giving a somewhat ribbed or channeled appearance. Sporidia straight or slightly curved, colourless, 0·0004 to 0·0005 inch long; paraphyses clavato-elongate, acuminate, septate.

On a gorse-stick, the end of which was sunk in the mud of a pool of water, on Paul's Cray Common, Kent, May 31, 1862.

Plate XXV. fig. 18 represents the plant considerably magnified. One of the stems, as will be seen, has thrown out a branch, at the end of which a minute disc is formed. Fig. 11 represents the sporidia, and fig. 12 the paraphyses, highly magnified.

This plant is remarkable in its densely cæspitose and apparently branching habit, and the paraphyses are very peculiar. The aquatic habitat of this and the following species is also an unusual character.

HELOTIUM AQUATICUM, n. s.

Solitary; stem about $\frac{1}{6}$th of an inch long; disc minute, very little wider than the apex of the delicate, almost filiform stem. Sporidia colourless hyaline, 0·0007 inch long, with granules accumulated at each end. On a fragment of stick, in water, Paul's Cray Common, Kent, May 31, 1862.

Plate XXV. fig. 19 represents an ascus with sporidia, × 430 diameters.

The fruit is large for the size of the plant. I cannot remember the colour of the disc, having unfortunately omitted to make a note of it; and the specimens, having been kept in spirits, have turned quite black. The specimens of the preceding species (*H. luteolum*) have been kept in glycerine, and have retained their characters admirably.

ASCOBOLUS VIRIDIS, n. s.

On clay ground; sessile, $\frac{1}{3}$rd of an inch wide, plane or very slightly concave, of a dark dingy yellowish-green colour, externally very furfuraceous, almost tomentose; spores elliptic-acuminate, rugoso-striate, amethyst-purple. Hanham Woods, near Bristol, Oct. 15, 1861.

The above characters may seem at first sight to differ but little from those of the common *A. furfuraceus*; but the very large size, dark colour, and peculiar habitat of the plant seem sufficient to separate it from that species.

ASCOBOLUS FURFURACEUS, P.

In this well-known species I have observed that the inner membrane of the ascus is capable of being entirely detached from the outer one. There are several fungi in which this inner membrane (the existence of which was first noticed by Mr. Berkeley*) has been seen to become partially detached from the outer one, but I do not know of any instance in which the inner membrane has emerged entire. In examining the asci of some specimens of *A. furfuraceus* which occurred at Malling, near Lewes, in September 1862, I noticed that the inner membrane had become entirely free from the outer one, carrying with it the included sporidia.

Plate XXV. fig. 9 represents an ascus with its inner membrane and sporidia complete, and fig. 10 shows the free inner membrane containing the sporidia.

* Mag. of Zool. & Bot. vol. ii. p. 222.

The cases in which a partial escape of the inner membrane has been observed are to be found in Pringsheim's 'Jahrbücher für wiss. Bot.' vol. i. p. 189; 'Quart. Journ. Micr. Science,' vol. vii. pl. 11. fig. 18; and in Tulasne's 'Selecta Fungorum Carpologia,' pp. 43, 44.

Patellaria atro-vinosa, Blox. MS.

Gregarious; disc minute, round or of irregular outline, almost black, distinctly margined; margin of a vinous-purple colour. Sporidia almost colourless, but with a greenish tinge, narrowly almond-shaped or curved, with the endochrome tripartite, 0·0009 inch long. Gopsal, near Twycross. The Rev. A. Bloxam.

The above description is from the dried plant. The specimens grow in a densely crowded manner, and the difference in colour (in the dried specimens, at least) between the disc and the margin is very striking.

Plate XXV. fig. 31 represents the sporidia highly magnified.

Patellaria aquatica, n. s.

Disc minute, scarcely a line wide, of a brownish tinge, distinctly margined, usually quite round and compact. Sporidia colourless, 1–3-septate, 0·0009 to 0·0011 inch long. The shape of the sporidia varies from (*a*) (Pl. XXV. fig. 23) when young, to (*d*) when perfect. The excipulum is formed of small distinct brown cells. On dead rushes in water. Pond at St. George's Hill, Weybridge, May 1862. I found it also a few days afterwards at Paul's Cray Common.

Plate XXV. fig. 23, (*a–d*) sporidia in different stages of growth, highly magnified.

Patellaria palustris, n. s.

Disc very dark bluish grey, almost black, margined, round or irregular, not a line wide. Excipulum composed of small, distinctly outlined cells, as in the last species. Sporidia colourless, narrowly turbinate, elliptical or curved 0·0004 to 0·0005 inch long. On dead rushes in water. Paul's Cray Common, May 31, 1862.

Plate XXV. fig. 35, sporidia highly magnified.

Phacidium pini, A. & S.

I have been much struck by the beauty of the fruit of this well-known species of *Phacidium*; and as I am not aware that it has been drawn, I have given a figure of it. The sporidia are colourless, very long, multiseptate, often tapering more at one end than the other, each extremity being extended into a filiform prolongation.

Plate XXV. fig. 36 represents a sporidium, × 430; fig. 13 represents the fruit of *Phacidium lacerum*, Fr., × 220; and fig. 7 that of *P. coronatum*, × 430.

I think it not improbable that in both these latter species the fruit, when more advanced, may become septate; possibly after the escape of the sporidia from the ascus.

Actidium hysterioides, Fr.

This species, not hitherto observed in England, occurred upon chips of wood, under fir-trees, at St. George's Hill, Weybridge, May 5, 1861.

At the same place I have found a single specimen of a plant strongly resembling in the shape of its perithecium *Ostreichnion Americanum*, Duby. The sporidia are represented in Plate XXV. fig. 20, × 430 diameters. The latter were in asci, eight in number, pale yellowish brown, 7–10-septate, 0·0016 to 0·0020 inch long. The fruit hardly accords with that of Duby's plant.

Cribraria intricata, Schrad.

This plant was first published as a British species in the Addenda to Mr. Berkeley's 'Outlines of British Fungology.' I refer to it here for the purpose of noticing the mode of germination of its spores. It is well known to mycologists that Dr. de Bary has attempted to prove that the Myxogastric Fungi ought to be transferred from the vegetable to the animal kingdom, and his views are partly founded upon the fact that the spores of the Myxogasteres do not germinate like those of other fungi. The production of zoospores instead of the emission of germ-filaments is no doubt a remarkable fact; but the former have been observed by De Bary himself in *Peronospora*, and, if I understand rightly, it is the absence of the latter which he considers to be of service to his argument. In his recent paper in the 'Regensburg Flora'* (No. 17, May 22, 1862), he seems to admit that the production of germ-filaments, if proved, would, to some extent at least, invalidate his theory. In Pringsheim's 'Jahrbücher für wiss. Bot.' vol. ii. pl. 31. fig. 32, Hoffmann figures the sporidia of *Stemonitis typhoides* germinating in the usual manner; but as he adds the remark, "ihre Keimung mit Fäden ist zweifelhaft," it would seem that he had some doubt about his facts. In *Cribraria intricata* I have seen the spores germinate by filaments in the manner represented in Plate XXV. figs. 27, 28, & 29, and I have no reason to suspect any error of observation. The amalgamation of the filaments proceeding from one spore with those from two others may be seen in fig. 29. I have observed a similar amalgamation in the germ-filaments of *Sphæria herbarum*, and it is, I believe, of common occurrence. In opposition to De Bary's views, there is also the fact that in *Badhamia* the spores are produced in sacs similar to the asci of the ascigerous fungi. In his original paper in Siebold and Kölliker's 'Zeitschrift' (vol. x.), De Bary questions the existence of these sacs; but they have been noticed by the late Dr. Badham, by Mr. Berkeley, and by myself, so that there is really no reasonable ground for De Bary's doubts†.

Badhamia inaurata, n. s.

Gregarious; peridia sessile, globose or nearly so, bright yellow, barely $\frac{1}{24}$th of an inch across, covered with floccose yellow scales, and opening by irregular fissures; sporidia subglobose, very minutely punctate, 0·0004 to 0·0006 inch across, enclosed at first (as in other *Badhamiæ*) in hyaline sacs. On *Jungermannia*, Petts Wood, Paul's Cray Common, October 1859.

Plate XXV. fig. 8 represents the fungus magnified.

* Die neuesten Arbeiten über die Schleimpilze und ihre Stellung im System besprochen von A. de Bary.

† Tulasne, in the 'Selecta Fungorum Carpologia' (p. 5, note 2), speaks of De Bary's theory as follows:—"Experimentis observationibusque novis gravissimi momenti nititur clar. Antonius a Bary, francofurtanus, qui, præter omnem ferme verisimilitudinem, Myxomycetes inter animalia deinceps recensendos fore contendit."

LYCOGALA EPIDENDRUM, L.

The nature of the capillitium in several of the Myxogastric Fungi has been the subject of much discussion. I lately had an opportunity of observing that of *Lycogala epidendrum* at a very early stage of growth, and drew a thread of it, which is shown in Pl. XXV. fig. 14. At this period the thread consisted of a rugose membrane (the wrinkles forming little depressed areolæ), surrounded by a broad gelatinous envelope.

XYLARIA VAPORARIA, Berk., n. s.

Stroma sclerotioid, corky, rugose, irregular, terminating at the apex in short prominences, which are possibly abortive receptacles. Receptacles conical, stipitate, bearing perithecia only on the lower half; the upper half attenuated, subpulverulent, of a light reddish-brown colour, the lower half darker. Perithecia rather scattered and slightly prominent. Nucleus black and glutinous. Sporidia eight, almond-shaped, biseriate, black, 0·0018 to 0·0022 inch long.

Plate XXV. fig. 26 represents the plant of the natural size. Fig. 17 is an ascus with sporidia, $\times$ 220.

This plant was sent in a sclerotioid condition to Mr. Berkeley. It was found in a mushroom-bed in Cornwall. Mr. Berkeley forwarded the sclerotium to me, with a request that I would endeavour to cultivate it. In December 1862 I planted it in damp sand, covered it with a bell-glass, and kept it moist in a warm room in a window facing the south. The fertile branches or receptacle soon made their appearance above the surface of the sand, and by the end of March ripe fruit was produced.

VALSA LAGENIFORMIS, Curr.

Sphæria lageniformis, Sollman, Botanische Zeitung, Nov. 1862, vol. xx. p. 380.

Perithecia solitary or circinating, buried in the wood, $\frac{1}{8}$th of an inch long, or nearly so, procumbent, the short ostiolum bending upwards and piercing the bark. A minute dark circle usually surrounds the ostiolum. Nucleus white and glutinous when moist, consisting of a mass of enormously long linear asci, each containing from six to eight filiform sporidia of the same length as the ascus. It is difficult to assign this plant its proper place, as the perithecia are mostly solitary; but their occasional occurrence in twos, threes, or even more together, and their procumbent position, point to the genus *Valsa*. I know of no *Valsa*, however, in which the perithecia are immersed without conceptaculum or stroma in the hard wood; so that the present species is, to some extent, anomalous.

I found this plant, last autumn (September 1862), upon dead branches of ash in the woods adjoining Combe Place, near Lewes. At that time there was no described species, to my knowledge, at all resembling it. Mr. Broome has since called my attention to a new *Sphæria*, described by Sollman under the name of *Sphæria lageniformis**, which I have no doubt is the same as the *Valsa* above described. The extraordinary length of the asci is the most remarkable feature. Sollman gives $\frac{1}{4}$th of a Paris line ($\frac{1}{44}$th of an English inch very nearly) as the result of his measurement, and the asci in my specimens

* See 'Botanische Zeitung' for Nov. 7, 1862, vol. xx. p. 380.

considerably exceed this. The length of the ascus figured in Pl. XXV. fig. 16 (*a*) is as much as $\frac{1}{30}$th of an inch.

Sollman is, I think, in error in placing it in the division Pertusæ. Although of somewhat irregular growth, its characters are almost those of a *Valsa*. If it were retained in the genus *Sphæria*, its proper place would be with the Endoxylæ.

Plate XXV. fig. 16 (*a*) represents an ascus with the tips of the sporidia escaped from the ruptured end, × 220; (*b*) represents the perithecia *in situ*, × 2 diameters; (*c*) the ostiolum and dark circle, seen from above, slightly magnified; (*d*) a detached perithecium, magnified.

Nectria hirta, Blox., n. s.

Perithecia minute, subglobose, with a slightly prominent ostiolum, of a pinkish salmon-colour, covered with prominent white hairs. Sporidia biseriate, curved, colourless, tapering slightly at each end, multiseptate, attaining 0·003 inch in length. On decaying rails, Twycross, Leicestershire. The Rev. A. Bloxam. A small but beautiful species, remarkable for its hairy perithecia and the great size of its sporidia, which differ entirely from the ordinary form of fruit in *Nectria*.

Plate XXV. fig. 24, sporidia highly magnified.

Sphæria fraxinicola, n. s. (*Endophleæ.*)

Perithecia sublageniform, with a pointed or nipple-like ostiolum, having the base sometimes adnate to the wood, and leaving a circular depression in the wood when detached; piercing through the inner bark and just through the outer bark. Sporidia elliptical, 0·0005 to 0·0006 inch long, uniseriate, biseptate, trinucleate, colourless, the outer membrane and septa sometimes invisible, in which case the sporidia appear composed of three detached endochromes, as at (*a*) Pl. XXV. fig. 34. The ostiola of the perithecia fall off with a circumscissile fissure as in the division Pertusæ. Sometimes the perithecia may be stripped off with a fragment of the inner bark, showing an approach to the Obtectæ.

On dead ash-branches, intermixed with *Hysterium Fraxini* and with some *Valsa* of the division Circumscriptæ. Combe Place, near Lewes, September 1862.

Plate XXV. fig. 34, sporidia × 430.

Sphæria verecunda, n. s. (*Endophleæ.*)

Perithecia subglobose or conical, very small, with a pointed or nipple-shaped ostiolum which just penetrates the outer bark. Sporidia eight, pale brown, with five (rarely six) transverse septa and from one to three longitudinal septa, constricted at each septum, mostly uniseriate and overlapping, occasionally biseriate, 0·0008 to 0·0010 inch long. Batheaston, October 12th, 1861.

Plate XXV. fig. 3, ascus with sporidia, × 430.

Sphæria Triglochinicola, n. s. (*Caulicolæ.*)

Perithecia minute, subglobose, situated beneath the epidermis, which is pierced by the papillate ostiolum. Sporidia biseriate, triseptate, oblong in a front view, curved in a side view, constricted at the septa, yellow, about 0·0015 inch long, but varying slightly in length. On carpels and stems of *Triglochin palustre*. Near Ringmer, Sussex, Oct. 1862.

Plate XXV. fig. 15, sporidia × 430.

CONIOTHECIUM AMENTACEARUM, Corda.

Some specimens of this fungus which I met with in May of last year (1862) gave me a good opportunity of observing its structure. It has been represented by Corda ('Icones Fungorum,' vol. i. fig. 26) as forming an amorphous mass of sooty spores; and this is, no doubt, the condition in which it is frequently if not most commonly seen, either owing to the plant being past its prime or from want of sufficient care in manipulation. If examined before the cells become separated from one another, it will be seen to consist of stiff continuous threads, formed of rows of cells of very irregular shape. Fig. 1 represents a portion (hardly more than one-half) of one of the threads, which, as is usually the case, was attached, with crowds of others, to the apex of the perithecium of some *Sphæria*. The lower half of the thread, although traceable to a certain extent, was not sufficiently clearly visible to enable me to draw it with the camera lucida; but it did not, I think, materially differ from the upper half. I made some remarks on *Coniothecium Amentacearum* in the 'Philosophical Transactions' for 1857 (p. 548), and figured the sporidia of a *Sphæria* to which I had then found it attached, and which I called *S. salicina*, Pers. The sporidia were identical with those of a plant marked *S. salicina*, Pers., in Sir W. Hooker's herbarium. I have since had an opportunity of examining an authentic specimen of *S. salicina* in Mr. Berkeley's herbarium, and found the fruit in this latter specimen to be simple and sausage-shaped. The fruit of *S. salicella*, Fr., according to an authentic specimen in Desmazière's 'Plantes Cryptogames de France,' No. 838, is the same as that which I have figured in the 'Philosophical Transactions,' 1857, pl. 25. fig. 19, and in the 'Transactions of the Linnean Society,' vol. xxii. pl. 48. fig. 149, under the name of *S. salicina*.

Plate XXV. fig. 1, portion of a thread of *Coniothecium Amentacearum*, Corda, × 430.

DESCRIPTION OF THE PLATE.

PLATE XXV.

Fig. 1. A portion of a thread of *Coniothecium Amentacearum*, Corda, × 430.
Fig. 2. *Lentinus fimbriatus*, Curr., the natural size.
Fig. 3. Ascus with sporidia of *Sphæria verecunda*, Curr., × 430.
Fig. 4. Sporangia of *Nidularia pisiformis*, Tul., magnified.
Figs. 5 & 6. *Nidularia pisiformis*, Tul., magnified.
Fig. 7. Fruit of *Phacidium coronatum*, Fr., × 430.
Fig. 8. *Badhamia inaurata*, Curr. The plant magnified.

Figs. 9 & 10. *Ascobolus furfuraceus*. Fig. 9, the ascus with sporidia; fig. 10, the inner membrane set free, and enclosing the sporidia, highly magnified.

Figs. 11 & 12. *Helotium luteolum*, Curr. Fig. 11, sporidia; fig. 12, paraphyses, highly magnified.

Fig. 13. Fruit of *Phacidium lacerum*, Fr., × 220.

Fig. 14. Thread of the capillitium of *Lycogala epidendrum*, L., in the young state, highly magnified.

Fig. 15. Sporidia of *Sphæria Triglochinicola*, Curr., × 430.

Fig. 16. (*a*) Ascus and sporidia of *Valsa lageniformis*, Curr., × 220 (the tips of the sporidia free); (*b*) perithecia *in situ*, × 2; (*c*) ostiolum and dark circle, seen from above, slightly magnified; (*d*) detached perithecium, magnified.

Fig. 17. Ascus and sporidia of *Xylaria vaporaria*, Berk., × 220.

Fig. 18. *Helotium luteolum*, Curr. The plant magnified.

Fig. 19. Ascus and sporidia of *Helotium aquaticum*, Curr., × 430.

Fig. 20. Sporidia of a species of *Ostreichnion*, × 430.

Fig. 21. Basidium and spores of *Nidularia pisiformis*, Tul., highly magnified.

Fig. 22. *Nidularia pisiformis*, Tul. The plant magnified.

Fig. 23. *a–d*. Sporidia of *Patellaria aquatica*, Curr., in different stages, highly magnified.

Fig. 24. Sporidia of *Nectria hirta*, Blox., highly magnified.

Fig. 25. Fruit of *Helvella gigas*, Kromb., × 220.

Fig. 26. *Xylaria vaporaria*, Berk. The plant, natural size.

Figs. 27–29. Sporidia of *Cribraria intricata*, Schrad., in different stages of germination.

Fig. 30. *Peziza diplocarpa*, Curr. The plant magnified.

Fig. 31. Sporidia of *Patellaria atro-vinosa*, Blox., highly magnified.

Figs. 32 & 33. Fruit of *Peziza diplocarpa*, Curr. Fig. 32, paraphyses with spore-like bodies; fig. 33, sporidia, highly magnified.

Fig. 34. Sporidia of *Sphæria fraxinicola*, Curr., × 430.

Fig. 35. Sporidia of *Patellaria palustris*, Curr., highly magnified.

Fig. 36. A sporidium of *Phacidium pini*, A. & S., × 430.

G. Jarman

IX. *Note on* Cassia moschata, *H., B., K.* *By* DANIEL HANBURY, *Esq., F.L.S.*

(Plate XXVI.)

Read June 18th, 1863.

THE genus *Cassia* as constituted by Linnæus furnishes to medicine, as is well known, two drugs of some importance, namely, *Senna leaves* and the pods called *Cassia fistula*, in connexion with the second of which I beg leave to submit to the Linnean Society the following observations.

Although the name *Cassia fistula*, which is the common commercial designation of the drug, is properly applied to the ripe legumes of *Cassia Fistula*, L., only, it sometimes designates those of *C. brasiliana*, Lam., and, as I shall presently show, those also of a third species of *Cassia*. The legumes of the first-named, which, on account of the laxative saccharine pulp contained between their transverse septa, find a place in many of the pharmacopœias of Europe, are familiar to most botanists; they are straight or slightly curved, cylindrical, smooth, indehiscent woody legumes, $1\frac{1}{2}$ to 2 feet long by $\frac{3}{4}$ to 1 inch in diameter, and of a deep chocolate-colour. The legumes of *C. brasiliana*, which are seen in commerce but rarely, differ from those of *C. Fistula* in being compressed and thicker, and in having two prominent ridges marking their ventral suture and one similar ridge their dorsal; from each suture ramify prominent nerves, giving a rough surface to the legume, which is increased by a cracking and exfoliation of the epidermis. The third form of the drug was distinguished several years ago by Professor Guibourt, of Paris, who described it under the name of *Petite Casse de l'Amérique*, observing that it differs from ordinary *Cassia fistula* in being of smaller size, in containing a pulp of pale colour and austere, astringent, yet saccharine taste, in the seeds being separated by thinner septa, and in the extremities of the legumes being apiculate instead of rounded. M. Guibourt regarded these pods as derived from a variety of *Cassia Fistula*, L., or possibly from a different species. My friend Mr. Morson has also observed some *Cassia*-pods of unusually small size imported into the London market from New Granada, and which were apparently identical with M. Guibourt's drug. In some of them, which he was kind enough to give me, I could detect no differences which appeared sufficient to distinguish them from the legumes of *Cassia Fistula*, L., to which plant I referred them, attributing their slight variation to want of culture or a poor soil. A few months ago, however, Mr. Sutton Hayes, of Panama (to whose kindness I am indebted for many interesting communications), sent me several pods marked *Cañafistola de purgar*, which I recognized as the small variety of *Cassia* of Messrs. Guibourt and Morson. In reply to my remark that they were derived from *Cassia Fistula*, L., Mr. Hayes observed, "I think you are wrong as to the tree which produces the pods I sent you being a form of the true *C. Fistula*. I have often seen both trees; and the true *C. Fistula* is much less like the *Cañafistola* *de purgar* than many other species of *Cassia*. The flowers of *C. Fistula*, L., are of light yellow and in very long racemes, and the leaflets are different in shape and much larger. The flowers of the *Cañafistola de purgar* are yellow, becoming brick-red with age; the racemes are much shorter than those of *Cassia Fistula*; and the leaflets are altogether different, being much smaller and quite like those of *C. brasiliana*; in fact, the *Cañafistola de purgar* is much nearer *C. brasiliana* than it is to *C. Fistula*. The wood of the tree is very dark-coloured, heavy, and compact, and is considered one of the best on the Isthmus: it makes excellent fuel. The tree is very common in open woods on hills, and is perfectly indigenous; whereas *C. Fistula* is to be found only about towns and in old cleared places, as if introduced. I have never seen *C. Fistula* in the virgin forests. *C. brasiliana* is very common about Panama."

Upon examining Mr. Hayes's plant and comparing it with the species of *Cassia* already described, I have found it to agree with the *Cassia moschata* of Humboldt, Bonpland, and Kunth, so far as the characters of that plant have been recorded; and M. Triana, who is now engaged on the Flora of New Granada, and has compared Mr. Hayes's specimens with the type specimens in Paris, has arrived at the same conclusion. As the notices of this plant hitherto published are quoted entirely from the 'Nova Genera et Species,' the authors of which had not seen the flowers, I have thought it desirable to draw up a complete description, which, with a drawing, I have now the honour of laying before the Society.

CASSIA. Sect. *Fistula*, DC. Subsect. *Ebracteatæ*.

C. MOSCHATA (H., B., K., Nova Genera et Species, vi. 338); arborea; foliolis multijugis, oblongis, apice rotundatis, utrinque pubescentibus deinde supra glabrescentibus, antheris glabris, leguminibus cylindricis.

DC. Prod. ii. 489; Vogel, Synopsis Generis Cassiæ, 11; Walp. Rep. i. 812; *Cathartocarpus moschatus*, Don, Syst. of Gard. and Bot. ii. 453.

Hab. Ad isthmum Panama, ubi ab incolis *Cañafistola de purgar* vocatur (*Sutton Hayes*, No. 58); ad fluvium Magdalena (*Humboldt et Bonpland*, *Triana*); ad ripam fluminis Casiquiare paulo infra ostium superius, arbor unicus ab Orinoco, ubi abundare dicitur, allatus (*Spruce*, No. 3300); ad pagum Villavicencio prope Bogota (*Triana*, No. 4376).

Arbor 30–40-pedalis, ramulis novellis flavescenti-pubescentibus. *Folia* alterna, abrupte pinnata, petiolo communi 4–10 poll. longo, pubescente, supra pubescentia ampliore flavescente. *Foliola* 10–18-juga, subopposita vel alterna, oblonga, inæquilatera, basi utrinque rotundata, apice obtusa, interdum mucronulata, reticulato-venosa, 1½–2 poll. longa, 6–7 lineas lata, margine integerrimo, pubescente, nervo medio subtus prominente, pubescente, pagina foliolorum superiore nitida parce et breviter pilosa vel glabrescente, inferiore fuscescenti-pilosa vel puberula. *Stipulæ* triangulares, caducæ. *Racemi* laterales, 6–10-pollicares, simplices, graciles, puberuli. *Flores* flavi, mox rubescentes. *Pedicelli* ad 5 lineas longi, gracillimi, minute pubescentes. *Calyx* quinquesepalus, puberulus vel glabrescens, sepalis rotundatis, obtusis, concavis, reflexis. *Petala* quinque, concava, reticulato-venosa, flava, glabra, subæqualia, semipollicaria; superius ovale, longe unguiculatum, altera suborbiculata, breviter unguiculata. *Stamina* decem, inæqualia, glabra; quatuor inter se æqualia, corolla parum breviora; tria his triplo vel quadruplo longiora, curvata, basi geniculata; tria brevissima, quorum lateralia incurva, medium filamento crasso, dilatato. *Antheræ* staminum quatuor breviorum ellipticæ, bilobæ, basi et apice biporosæ, dorso medium versus affixæ; antheræ staminum trium longiorum late ellipticæ, birimosæ, introrsum dehiscentes, basi affixæ; antheræ staminum trium brevissimorum birimosæ, tribus supradescriptis haud dissimiles sed valde minores. *Ovarium* longe stipitatum, lineare, adscendens, falciforme, margine superiore basin versus parce pilosum, aliter glabrum. *Stigma* oblique truncatum. *Legumen* cylindricum, rectum, 1–1½-pedale, lignosum, durum, læve, corticatum, breviter apiculatum vel obtusum, septis transversis numerosis ut in *Cassiæ Fistulæ* L. legumine (cui simillimum) instructum. *Semina* ovato-rotundata, compressa, nitida, durissima, 3 lineas longa, coloris cinnamomei, in succo saccharino adstringente immersa.

Cassia moschata, as remarked by the authors of the 'Nova Genera et Species,' as well as by Mr. Sutton Hayes, is nearly allied to *C. brasiliana*, Lam., but it is easily distinguished from that plant by its comparatively glabrous yellow flowers and its totally different legumes. These legumes are stated by both Mr. Hayes and M. Triana to be used in medicine in New Granada instead of those of *C. Fistula*, L.; so that their occasional appearance in European commerce is not surprising. They differ from the latter by their smaller size, less regularly straight and cylindrical form, and especially by their paler and less saccharine pulp, which, when fresh, is stated to have a slightly musky odour. These characters are of but little value botanically; the leaves, however, of *C. moschata*, its shorter racemes and nearly glabrous ovary, amply suffice to distinguish it from *C. Fistula*, L.

DESCRIPTION OF THE PLATE.

Plate XXVI.

A, B, C. Flowers, legume, and leafy branch of *Cassia moschata*, H., B., K. (natural size).

Fig. 1. Flower, the petals and sepals having been removed.

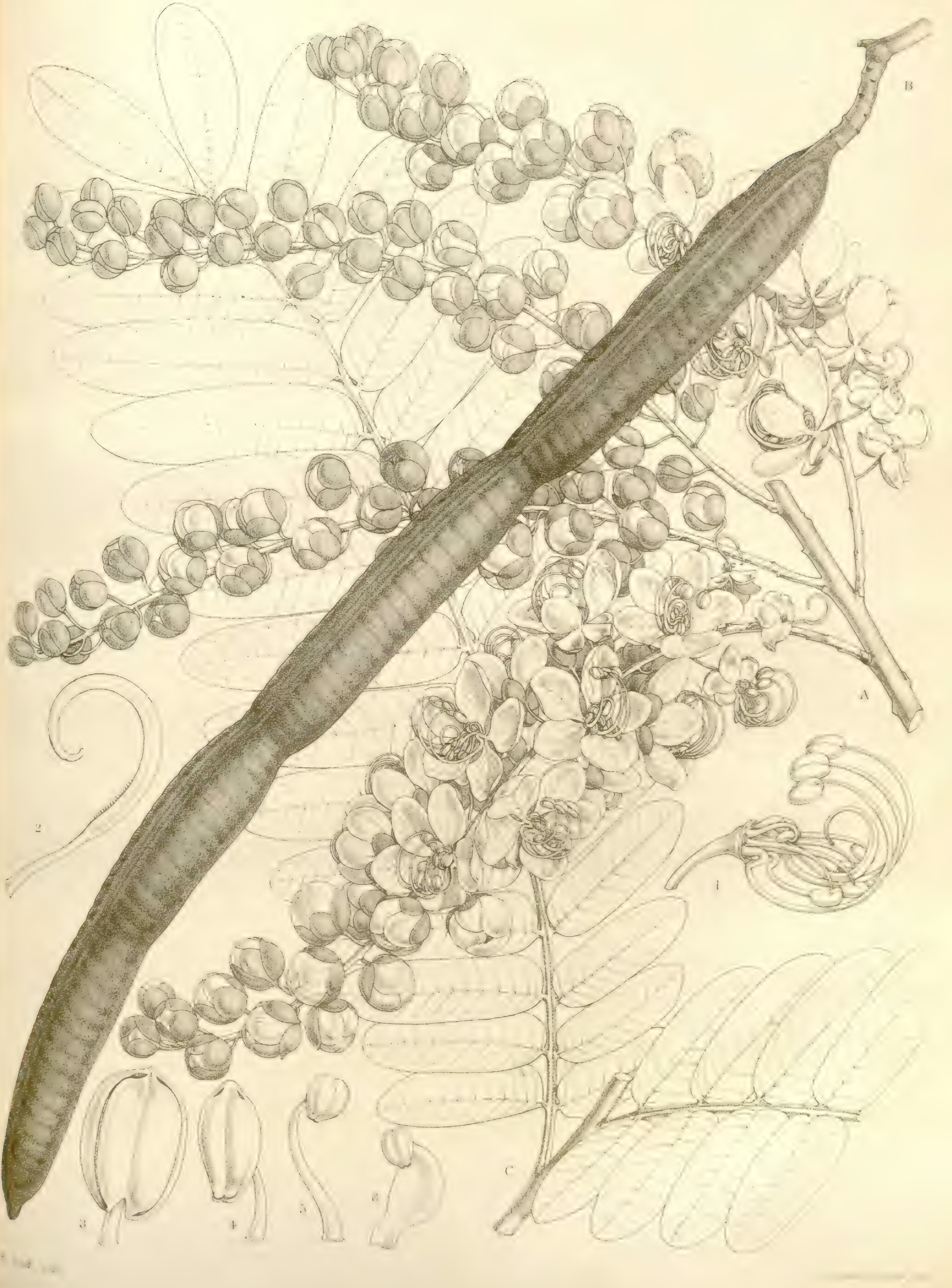
Fig. 2. The stipitate ovary.

Fig. 3. Anther of one of the three long stamens.

Fig. 4. ,, of one of the four medium-sized stamens.

Fig. 5. One of the two lateral short stamens.

Fig. 6. Central short stamen with inflated filament (all magnified).



Cassia moschata, H.B.K.

X. *On the Relations of* Tanalia, Philopotamis, *and* Paludomus; *with a review of the Cingalese Species of the latter Genera. By* H. F. Blanford, *F.G.S. Communicated by* Dr. J. D. Hooker, *F.R.S., F.L.S., &c.*

(Plate XXVII.)

Read June 18th, 1863.

In a paper read at the meeting of this Society in June last, I expressed an opinion that the Cingalese genera *Tanalia* and *Philopotamis** are more closely related to *Melania* than has been held by several recent writers, and that in fact they should be regarded rather as sections of that genus than as distinct genera. The object of the first part of the present paper is to substantiate that view by showing that the opercula of *Philopotamis* and *Tanalia*, upon the structure of which generic distinction has been based, so far from being distinct in type, really present modifications of the subspiral operculum of *Melania*, from which the digression is serial and gradated in the different forms (species and varieties) included under those genera. While, however, insisting on the facts of affinity, I should at the outset so far modify the above general assertion as to admit that the question of genus and subgenus is to a great extent one of opinion, depending upon what amount of difference be held to constitute a family, genus, or subgenus. By those who regard such a form as *Melania variabilis*, Bens., with its largely spiral operculum, as a true *Melania*, *Philopotamis* and *Tanalia* should be treated as subgenera, their aberration in one direction from the type not being greater than that of *M. variabilis* in another direction. To those, on the contrary, who, with Messrs. Gray and Adams, regard most of the Lamarckian genera as families, *Philopotamis*, &c., will rank with the typical Melanias as nearly allied genera of one family.

In the second part of the paper I shall review the Cingalese species of *Paludomus* and *Philopotamis*; the latter genus is, so far as we know at present, restricted to Ceylon.

Part I.

It is unnecessary to review in detail the various opinions that have been expressed with regard to the affinities of *Tanalia*, *Philopotamis*, and *Paludomus*. The last-mentioned genus was distinguished from *Melania* by Swainson on account of the concentric structure of the operculum, and *Tanalia* and *Philopotamis* were subsequently separated therefrom by Gray and Layard, the former genus having a trigonal operculum with a marginal nucleus, the latter a subspiral operculum with a submarginal nucleus. *Paludomus*

* *Paludomus* was also included in this remark, but reconsideration leads me to regard it as more distinct than either of the above. See *posteà*.

conicus, Gray, *Tanalia aculeata*, Chemn., and *Philopotamis sulcata*, Reeve, sp., are quoted as the respective types of the genera.

Two other genera have been formed from the species herein included, viz. *Rivulina*, Lea, and *Ganga*, Layard; but there appears to be no distinction between the former genus and *Paludomus*, the two species quoted under it being, so far as I can judge from Mr. Cuming's authentic specimens, mere varieties of *Paludomus chilinoides*, Reeve, and *P. Tanjoriensis*, Chemn., while the latter is, as I have shown in my former communication, founded upon certain monstrous forms of *Tanalia aculeata*.

In the June Number of the 'Ann. & Mag. Nat. Hist.' for 1856, Mr. Benson pointed out that although the adult operculum of *Paludomus* has, as stated, a concentric structure, much resembling that of *Paludina*, with which the genus had consequently been classed by Dr. Gray, and subsequently by Mr. A. Adams, the embryonic operculum or the nucleus of the adult is spiral, resembling that of a *Melania*. He also remarked that the subspiral structure of the operculum of *Philopotamis* indicated an affinity with *Melania*, but expressed a doubt whether *Tanalia*, with its unguiculate operculum, should be referred to the Paludomidæ at all.

Now remembering that no essential difference of structure has been noticed in the animals of these genera, and that, with the exception of certain differences of habit, upon which I shall remark presently, the only assigned generic characters held to distinguish them from each other and from *Melania* are those of the operculum, let us see what these really amount to. Pl. XXVII. fig. 8 represents, on an enlarged scale, the operculum of a Ceylonese specimen of *Melania spinulosa*, Lamk., a common Eastern species, and, on the point in question, a fair representative of the genus. The structure is paucispiral, and the nucleus subbasal. Fig. 9 is the operculum of *M. lirata*, Bens., also enlarged: in this the structure is less distinctly spiral, and the nucleus is almost marginal and basal. In fig. 13, the operculum of *Tanalia violacea*, Layard, a subspiral structure is still apparent, but the nucleus is marginal and dextrally subbasal. The operculum of *Philopotamis decussata*, Reeve, fig. 10, only differs from this last in having the spiral structure more distinctly developed. And, finally, from *T. violacea* we pass to *T. aculeata*, fig. 14, in which a trace of a subspiral structure is only perceptible towards the nucleus; while from *Ph. decussata* we proceed through *Ph. sulcata*, fig. 11, to *Ph. globulosa*, figs. 12 *a* & *b*, which is the most aberrant form presented in the genus. We have thus tolerably perfect series from the typical *Melania* operculum to the extreme forms of *Philopotamis* and *Tanalia*. The operculum of *Ph. nigricans*, Reeve, is more nearly related to that of *Melania* than any of the above, and indeed some forms are scarcely distinguishable generically: fig. 15 *a* affords an instance of this; but in others again the *Philopotamis* structure is more developed (fig. 15 *b*).

It might seem at first sight that the operculum of *Paludomus* is, in an abstract morphological point of view, merely that of a *Philopotamis* with the nucleus pushed over towards the other side; but it is, I think, essentially different, or rather, the digression from the *Melania* type of structure has taken place in a different direction. The passage from *Melania spinulosa* to *Tanalia aculeata* may be regarded as a gradual unrolling of the opercular spiral, which becomes nearly obsolete by successive gradations, while in

Philopotamis a similar modification obtains to a less extent, accompanied in *Ph. globulosa* with an incipient concentric growth. In *Paludomus*, on the other hand, the growth of the operculum is, up to a certain point, that of a typical *Melania*: after the formation of one and a half or two whorls it suddenly takes a different direction, and is superseded by a strictly concentric growth, in which the chief addition is in the direction of the outer or dextral margin instead of the inner as in *Melania*, *Philopotamis*, and *Tanalia*. It would be arguing in a circle, and on an unproved generalization, to adduce the comparatively wide range of *Paludomus*, as contrasted with that of *Philopotamis* and *Tanalia*, in support of their generic diversity, on the supposition that successive gradations of structural character argue successive appearance in time, and that the earlier forms have the wider range; but if the structural argument appear valid, the facts of range will have much significance to those who admit the possibility of generic derivation from preexisting types.

The solid structure and depressed form of the shells of *Paludomus*, *Tanalia*, and *Philopotamis* may be held to indicate a closer relationship between these genera than exists between any one of them and *Melania*. In these respects, however, the true Melanias exhibit much variety. *Paludomus brevis*, D'Orb., is a *Melania* as regards its operculum, although the shell has, on account of its form, been erroneously referred to *Paludomus*; and the *Melania Hugelii** of S. India is almost as thick and depressed as certain *Paludomi.* The genus *Gyrotoma* also, with the operculum of *Melania*, has the solid, depressed form of *Paludomus*, yet would scarcely be classed therewith.

With respect to habit, no marked line can be drawn between the different genera in question. *Tanalia aculeata* is indeed never found in still water, nor, I believe, elsewhere than in mountain streams; but it is met with in the smallest perennial streamlets as well as in the largest torrents: it is generally found adhering to rocks, but also frequently crawling over sandy bottoms. *Philopotamis globulosa* has a similar range of habit, but is apparently more restricted in geographical range. I have myself only met with it in the Mahavelli Ganga and tributaries, and in the stream of the Balcadua Pass, nor have I seen any specimens from the southern or eastern watershed of the hills. *Ph. sulcata* occurs chiefly in the smaller streams on and among the hills, extending from an elevation but little above the sea to a height of 3000 feet. Mr. Layard records that this species sometimes climbs far out of the water; but, though I do not question his accuracy, I do not remember ever to have met with it myself in such a situation. The species of *Paludomus* are, as their name imports, the most marsh-loving in their habits; but *P. chilinoides* and *P. Tanjoriensis*, the only species I have myself collected, though occurring in marshes and tanks, are at least equally or even more common in streams and rivers, of both slow and rapid flow, on the hills and in the low country.

* This species is from the upper waters of the Cauvery, where it has been rediscovered by Dr. Jerdon. The quoted habitat, New Holland, is probably erroneous.

Part II.

Genus Melania, Lamk.

Subgenus Philopotamis, Layard.

Five species of this genus are known to me, one of which, *P. regalis*, Layard, is doubtful, and may hereafter prove to be merely a variety of *P. sulcata*: of another, *P. decussata*, Reeve, I have only seen the three specimens in Mr. Cuming's collection, and, in a genus exhibiting so much specific variation as the present, a much larger series is necessary to convince me of specific distinction. The other three species are more distinct from each other than is usual in the case of the allied subgenera, and differ to some extent in their opercular structure, as well as in the form, &c. of their shells. Each of these species is variable, and one includes several forms which have been described as distinct. The following is a list of the species provisionally admitted by me:—

P. sulcata, Reeve.
P. regalis, Layard.
P. globulosa, Gray.
P. nigricans, Reeve.
P. decussata, Reeve.

Philopotamis sulcata, Reeve. (Pl. XXVII. figs. 5 *a–c*, 11.)

Shell ovately conic or conic, more or less strongly sulcate; sulcations regular, frequently minutely decussated by transverse striæ, sometimes nearly obsolete. Epidermis citrine to dark brown or reddish brown, concealing the proper colouring of the shell, which consists sometimes of irregular zigzags, more or less interrupted, and tending towards a spiral arrangement; more frequently of spiral bands, interrupted or continuous. Spire elevated, varying in height, always eroded. Upper whorls (rarely more than three remaining) variable in convexity, rounded or flattened. Last whorl globose or (rarely) conoidal. Aperture gibbous to obliquely pyriform. Outer lip denticulated. Inner lip thinly callous: columella flattened, arcuated, and somewhat everted, sometimes tinted with brown. Operculum ovately pyriform, varying in width, obsoletely spiral: nucleus very near the dextral margin, somewhat variable in position.

This species is the type of the genus. The shell is always Paludiniform, but varies in globosity even in a series of specimens from the same spot. Pl. XXVII. figs. 5 *a* & *b* are two specimens from the same stream at Avisavella, the first being the most tumid form I have seen. Fig. 5 *c* is a very conical form, from Hautanne, a hill in the neighbourhood of Kandy. In fig. 5 *a* it will be seen that the sutures are deep, the upper part of the whorl sloping off much less obtusely than in fig. 5 *b*. Other specimens in my collection present intermediate gradations, so that it is impossible to regard these differences as other than specific variations. The spiral sulcation, from which the species derives its name, is usually fine and regular, and in some specimens is seen under the lens to be regularly decussated with striæ of growth. In other specimens these last are obsolete, as is occasionally the spiral sulcation also to a great extent, at least on the last portion of the body-whorl. The upper whorls are always more or less eroded.

The painting of the shell varies greatly. In a specimen from Avisavella the whole is covered with a zigzag marbling, but more frequently this is broken up into interrupted spiral bands, and in other specimens, again, the bands are continuous, resembling those which characterize *P. bicincta*, but narrower and more numerous. The colouring is only visible in the interior, and, in old specimens, is concealed beneath a white callous deposit of the mantle. The edge of the peristome is generally, but not always, tinted with brown.

The operculum is normally as figured in Plate XXVII. fig. 11, but, as in the case of *Tanalia*, is not unfrequently destroyed, and replaced by one having a concentric structure. If this takes place at an early age, the nuclear portion of the operculum is alone so formed, the later-formed layers having the usual arrangement. I found that, in a stream at Hautanne, more than half the specimens had lost portions of their opercula, and one or two full-grown shells were totally divested of this appendage. The shells of these specimens were also eroded in holes in a manner difficult to account for.

PHILOPOTAMIS REGALIS, Layard.

This appears to be a rare shell. I saw no specimens of it in Major Skinner's collection, nor have I met with it myself in Ceylon. The only specimens I have seen were those in Mr. Hugh Cuming's collection, obtained, I believe, by Mr. Thwaites. I am thus unable to add anything to Mr. Layard's description from my own observations; but I may remark that it appears to differ in no respect from *P. sulcata*, except in possessing a row of small scale-like spines round the upper edge of the whorl. I cannot but think that it may eventually prove to be a variety of *P. sulcata*.

PHILOPOTAMIS GLOBULOSA, Gray. (Pl. XXVII. figs. 1 *a–c*, 12 *a*, *b*.)

***P. abbreviata*, Reeve; *P. bicincta*, Reeve; *P. clavata*, Reeve.**

Shell globose or ovate, solid, smooth, rarely bearing faint traces of spiral sulci. Epidermis yellowish brown. Shell colourless, or ornamented with two or three spiral bands, only visible in the interior of *adult* shells. Spire depressly conical, variable in height; apex usually eroded. Whorls flattened, the last more or less elongated, depressly flattened above, produced below. Aperture semi-ovate to obliquely pyriform, subcanaliculate behind, lined interiorly with a callus, sometimes tinted yellow towards the exterior margin. Outer lip sharp. Columella callous, arcuated towards the front. The callus continuous to the junction of the outer lip. Operculum obliquely pyriform, obsoletely spiral, subconcentric: nucleus rather variable in position near the dextral margin, and from $\frac{1}{5}$th to $\frac{2}{5}$ths the height of the operculum.

The shell of this species is always yellowish brown (the colour of the epidermis), and shows less tendency to variation than most of its allies. The chief points of variation observable are—the form, which is sometimes globose, sometimes elongate (but exhibiting all intermediate gradations); and the painting, which is sometimes developed, more frequently not, and in the former case only in the interior of the adult shell. Two extreme forms have been described as *P. globulosa* and *P. bicincta*, but the comparison of even a moderate series from Kandy, Ambegammoa, and the Balcadua Pass is sufficient, I think, to convince any one that they are specifically identical. In some small specimens from Peradinia, near Kandy, the upper whorls are in certain of the specimens somewhat exserted, but only to a slight degree. In the more elongate forms the slight flattening and angulation of the upper part of the whorls which characterize the more globose specimens tend to become obsolete.

Coloured specimens, which are almost always young shells, have sometimes two, sometimes three bands.

The operculum of this species is characterized by its more pyriform shape than that of *Philopotamis sulcata*, and by the nucleus being further from the margin. The position of the latter is somewhat variable (see fig. 12 *a*, *b*).

Paludomus olivaceus, Reeve, from Sumatra, bears much resemblance to this species; but, in the absence of its operculum, no safe conclusion can be drawn.

PHILOPOTAMIS NIGRICANS, Reeve. (Pl. XXVII. figs. 3 *a–e*, 15 *a*, *b*.)

Shell of type-form, thick, elevately conical (apical whorls almost invariably eroded), ornamented with close-set granular striæ, those near the suture more developed than the rest. Colour of epidermis dark citrine to black. The shell painted with numerous wavy brown bands, generally visible only in the interior, and sometimes obsolete near the aperture. Spire, when perfect, acutely conical; whorls about six, rarely more than three remaining in eroded shells, flattened, with shallow sutures. Last whorl more or less angulate at the periphery, obliquely flattened beneath. Aperture obliquely ovate, pointed above. Peristome white or greyish white, callous: outer lip sharp, even: columella slightly arcuated anteriorly. Operculum paucispiral: nucleus rather large, transversely central, and at from $\frac{1}{4}$th to $\frac{2}{5}$ths of the height.

Var. *α*. (The only specimens found, not fully grown.) Shell in form as above, uneroded, smooth, with one or two strong striæ only near the suture. Epidermis transparent, citrine, with the markings of the shell distinctly visible through it.

? Var. *β*. Form of shell as above, but more elongate. Shell smooth, colourless or with the bands broken up into a series of square dots. Last whorl elongate, the angulation nearly or quite obsolete (Pl. XXVII. fig. 3 *e*).

This species is more nearly allied to *Melania*, both in form and in the structure of the operculum, than any of its allies. From *P. decussata*, the only congener to which it bears any near resemblance, it is distinguished by its more conical form, the angularity of the last whorl, and the character of the marking, as well as, in the majority of specimens, by the granular surface, which, so far as I have seen, is peculiar to this species.

The type-forms and the var. *α*. were collected by myself in large numbers (associated with *Tanalia violacea*) in some small mountain streams near Huckgalle, at an elevation of 5000 feet. With regard to var. *β*, I am in some doubt whether it really belongs to this species, notwithstanding that var. *α*, and a single colourless specimen of the normal form given me by Mr. Cuming, seem to link it with the type. The only specimens I have seen were in Mr. Cuming's collection, where they were erroneously referred to *Paludomus palustris*, and none of the specimens contained opercula. In the absence, however, of any adverse evidence, I provisionally regard this as a variety of *P. nigricans*.

P. nigricans has been collected by Mr. Gardner near Adams Peak, at an elevation of 6000 feet, by Mr. Thwaites in the Black Pool at Nuora Ellia (7000 feet), and by M. Humbert* in the Paudel Oya Valley. The specimens quoted by Mr. Layard, from the Balcadua Pass, do not belong to this species. Its range appears to be restricted to the higher parts of the hills.

PHILOPOTAMIS DECUSSATA, Reeve. (Pl. XXVII. figs. 6, 10.)

Shell ovate-conical, smooth (or decussate?). Epidermis citrine; shell ornamented with two broad spiral bands of colour, with a narrow interspace on the periphery. Spire rather small, acute, elevately conical. Whorls 5, the upper somewhat flattened, the last large, somewhat cylindrical. Aperture ovate, pointed above, equal to $\frac{4}{5}$ths the height of the shell. Peristome white. Operculum obliquely pyriform: nucleus small, spiral, close to the outer margin, subbasal.

The only specimens I have seen of this shell are those in Mr. Cuming's collection, which I take to be authentic, notwithstanding the absence of decussate sculpture; and I am unable to say how far, and in what direction, the form, &c., of the species varies. It appears to be distinct, but it must be admitted that, seeing the great variability of most of its congeners, it would be premature to separate it otherwise than provisionally until a much larger series has been examined. Pl. XXVII. figs. 6 & 10 represent one of Mr. Cuming's specimens, and its operculum enlarged.

Genus PALUDOMUS, Swainson.

This genus, as restricted by the separation of *Philopotamis* and *Tanalia*, is characterized by the concentric structure of the adult operculum, and a spiral nucleus situated about the middle of its height, and nearest to the left margin. The geographical range of *Paludomus* is much greater than that of either *Philopotamis* or *Tanalia*, including not only Ceylon, India, and Birma, but also extending in one direction to Egypt, Cape Guardafui, the Mauritius, and the Seychelles, in the other to Java, Sumatra, and the Island of Timor. It is remarkable, too, as contrasted with the above genera, that the species have in some cases a very extensive range, following in this respect certain of the low-country species of *Melania*, whose habit is similar, and that throughout the genus the form and structure of the operculum are, so far as I have observed them, very constant.

The species of true *Paludomus* enumerated from Ceylon are pretty numerous, but a careful comparison of the types in Mr. Cuming's cabinet, aided by those specimens which I have myself collected, or examined in Major Skinner's and Mr. F. Layard's collections, has convinced me that they are all reducible to two species, viz.,

P. chilinoides, Reeve.

P. Tanjoriensis† (scil. *Tanschauriensis*), Gmelin.

* These specimens are stated by Dr. Brot (Cat. d. Melaniens) to be in part smooth, in part granulated, but identical in form.

† I have taken the liberty of altering the orthography of this name to a form more in accordance with the modern spelling of the place after which it is named.

PALUDOMUS CHILINOIDES, Reeve. (Pl. XXVII. figs. 4 *a–f.*)

P. constrictus, Reeve; *P. phasianinus,* Layard (not Reeve); *P. lævis,* Layard; *P.* (*Rivulina*) *Zeylanica,* Lea; *P. fulguratus,* Dohrn; *P. nasutus,* Dohrn.

Shell thick, ovate or ovate-conic, smooth (rarely having traces of spiral sulci on the upper part of the whorls). Colour of epidermis citrine or citrine yellow. Shell ornamented with spiral bands of brown crow's-feet markings, which sometimes coalesce into transverse zigzags (*P. fulguratus*), sometimes, but very rarely, into longitudinal (spiral) bands. Spire always exserted, sometimes elevated. Whorls 5, all rounded, obliquely flattened above; upper whorls more or less eroded; last whorl ventricose. Sutures impressed. Aperture ovate, flattened on the columellar side, angulate above. Outer lip sharp: inner lip callous, usually white, rarely citrine-tinted on the edge. Interior of aperture lined with white callus in old shells. Operculum with small spiral nucleus, about central on the longitudinal axis, at about $\frac{1}{3}$rd of the transverse axis from the sinistral margin.

In the above description I have briefly indicated the chief points in which *P. chilinoides* is variable. The most striking of these are the elevation of the spire and the markings of the shell; but the differences observable in the latter are not so great as to lead to any doubt of the specific identity of the specimens in question. To illustrate the variation of form I give a selected series, Pl. XXVII. figs. 4 *a–f*, of which fig. 4 *a* is from an unknown locality in Ceylon, figs. 4 *b* and 4 *c* from Peradinia near Kandy, and the remainder from a stream at Ballepane, on the Colombo and Kandy road. From these it will be seen that, as in the case of *Tanalia aculeata*, specimens from the same locality vary somewhat in form, but in order to ascertain the full extent of variation a wider selection is necessary. This series also exhibits a certain amount of variation in point of size, but not to the full extent actually observed. I have not, indeed, met with any much larger specimens, but smaller shells than fig. 4 *a* are occasionally to be met with, though rare.

I distinguish this species from *P. Tanjoriensis* chiefly by the smoothness of the upper whorls, and by the inferior height and the obtuseness of the spire, which is generally eroded. The whorls in all varieties of *P. chilinoides* are smooth; and though sometimes subangulate, owing to the flattening of the upper surface, they never have anything like the sharp keel which distinguishes the apical whorls of most varieties of *P. Tanjoriensis.* Moreover, *P. chilinoides* never exhibits that distinct margination of the sutures which is almost invariable in the other species. I have never noticed more than five whorls in *P. chilinoides,* while *P. Tanjoriensis* has sometimes as many as eight. Varieties occur upon which it is difficult to pronounce satisfactorily, but the great majority of the specimens are so well marked that I have little or no doubt of their specific distinctness.

The range of *P. chilinoides* appears to be confined to the southern provinces of the island—at least I have met with no specimens among the shells received from the northern plains. This species is found in streams of all sizes, generally on sand and mud, and is frequent in small sluggish brooks as well as in those of more rapid flow.

The animal is of a dark slate-colour, nearly black on the sides of the foot, muzzle, and tentacles. The foot is lyre-shaped, broadest in front, with a round anterior margin, and very obtuse behind. In creeping, the muzzle, which is slightly notched, is pushed in front of the foot, the extremity only and the tentacles being protruded beyond the shell. The eyes are small, and placed externally at the base of the tentacles. The dorsal fold of the mantle is ornamented with a fringe of black filaments.

PALUDOMUS TANJORIENSIS, Gmelin, sp. (Pl. XXVII. figs. 2 *a–e.*)

P. acutus, Reeve; *P.* (*Rivulina*) *modicella,* Lea; *P. spiralis,* Reeve; *P. spurcus,* Souleyet; *P. lutosus,* Souleyet; *P. parvus,* Dohrn; *P. palustris,* Layard; *P. obesus,* Layard.

Shell elevately conical, smooth with obsolete sulci on the lower whorls, grooved and generally carinated on the upper whorls, which are perfect or but slightly eroded. Epidermis citrine. Shell colourless, or marked with spiral rows of brown dots, which sometimes on the lower whorls, and nearly always on the upper, coalesce into irregular transverse bands of colour. Spire variable in height, sometimes concave, acute, consisting of seven or eight whorls when perfect, of which two or three are sometimes eroded. Sutures deep, those of the last whorl, or whorls, marginate. Upper whorls angular: last whorl ventricose, flattened above towards the mouth, usually marked with two to five linear sulci on the periphery. Aperture gibbous ovate, pointed above. Peristome white, continuous: outer lip sharp, even: columella callous.

Like most of the *Paludomi, P. Tanjoriensis* varies considerably in the elevation of the spire, as is shown by the series of specimens (all from Ceylon) figured. Another series from a small stream near Tindevanum in S. Arcot exhibit almost as great a range of variation, although all collected within the space of a few yards. The development of the spiral grooving of the upper whorls is very different in different specimens, and only the first two or three whorls are distinctly carinated. These characters, however, together with the acuteness of the spire, the deep sutures, and the dotted typical marking, well characterize the species, and distinguish it from *P. chilinoides.*

The range of *P. Tanjoriensis* is very wide. It commences on the northern limit of that of *P. chilinoides* at some miles from the hills, and ranges over the low country of Northern Ceylon. It is common in the plains of the Carnatic, and I have found it in the neighbourhood of Madras in paddy-fields, and in irrigation-channels at Poonamallee. It is not yet recorded from the northern part of the Madras Presidency, but is found in Central India and Bombay (*P. obesus, P. parvus*). The *P. lutosus* of Souleyet, which, as I am informed by Mr. Benson, was taken in the Hoogly, is absolutely undistinguishable from the typical form; and in Mr. Cuming's collection are some specimens of the same form, the history of which I do not know, but which are labelled as from Cashmere.

Of all the species with which I am acquainted, *P. Tanjoriensis* most resembles such Melanias as *M. fasciolata,* Oliv., in habit, and it is essentially a species of the plains. It is common on the sandy beds of rivers and in small perennial streams, and I have above noticed its occurrence in the irrigation-channels of paddy-fields. I have also received from Major Skinner specimens from a tank in Northern Ceylon. To this peculiarity of habit it is probably owing that its range is so much wider than that of most *Paludomi*, for it is a general rule that low-country species of Mollusca have a wider geographical range than those which are peculiar to the hills*.

The animal of the Hoogly form has been figured by M. Souleyet ('Voyage de la Bonite') and copied by Mr. Adams in his 'Genera of the Mollusca.' Unfortunately I omitted to notice the characters of the South Indian form (*P. acutus*, Reeve, and type of Gmelin), the only one I have myself collected, and I am unable therefore to add anything from my own observations.

DESCRIPTION OF THE PLATE.

Plate XXVII.

Fig. 1 *a–e*. Series of *Philopotamis globulosa*, Gray: *a, b*, from Ambegammoa; *c, d, e*, from Peradinia.

Fig. 2 *a–e*. Series of *Paludomus Tanjoriensis*, Gmelin, sp., from the Northern Province, Ceylon.

Fig. 3 *a–e*. Series of *Philopotamis nigricans*, Reeve: *a, b*, from Huckgalle; *c*, from Mr. Benson's collection; *d, e*, from Mr. Cuming's collection.

Fig. 4 *a–f*. Series of *Paludomus chilinoides*, Reeve: *a*, from Major Skinner's collection; *b, c*, from Peradinia, Kandy; *d, e, f*, from Ballepane.

Fig. 5 *a–c*. Series of *Philopotamis sulcata*, Reeve: *a, b*, from Avisavella; *c*, from Hautanne, Kandy.

Fig. 6. *Philopotamis decussata*, Reeve, sp., from Mr. Cuming's collection.

Fig. 7. Operculum of *Melania variabilis*, Benson: from Birma. (Enlarged 2 diameters.)

Fig. 8. Operculum of *M. spinulosa*, Lamarck: from Kandy. (Enlarged 2 diameters.)

Fig. 9. Operculum of *M. lirata*, Benson: from Calcutta. (Enlarged 2 diameters.)

Fig. 10. Operculum of *Philopotamis decussata*, Reeve, sp.: from Mr. Cuming's collection. (Enlarged 3 diameters.)

Fig. 11. Operculum of *Ph. sulcata*, Reeve, sp.: from Major Skinner. (Enlarged 3 diameters.)

Fig. 12 *a, b*. Opercula of *Ph. globulosa*, sp.: from Ambegammoa. (Enlarged 2 diameters.)

Fig. 13. Operculum of *Tanalia violacea*, Layard, sp.: from Huckgalle. (Enlarged 3 diameters.)

Fig. 14. Operculum of *T. aculeata*, Gmelin, sp.: from Ambegammoa. (Enlarged 1½ diameter.)

Fig. 15 *a, b*. Opercula of *Philopotamis nigricans*, Reeve, sp.: *a*, from Huckgalle; *b*, from Mr. Benson's collection. (Enlarged 4 and 3 diameters respectively.)

Fig. 16. Operculum of *Paludomus regulatus*, Benson: from Ava. (Enlarged 2 diameters.)

N.B. The form being the chief object of illustration, the colouring of the shells has been omitted in those few specimens which exhibit markings. The shells are all of the natural size.

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* Mr. Darwin's suggestion as to the mode of dispersion of freshwater Mollusca, plants, &c., will probably apply here. The stations occupied by *P. Tanjoriensis* are precisely those most frequented by water-fowl.

H F Blanford, del

W West, imp

XI. *On the Parasitism of the Mistletoe* (Viscum album). *By* John Harley, *M.D., M.R.C.P., &c.* *Communicated by* J. D. Hooker, *M.D., F.R.S., F.L.S.*

(Plates XXVIII., XXIX., XXX.)

Read March 5th, 1863.

Some three years ago I turned my attention to small Vegetable Parasites, hoping that they would throw some light on the cause of cancer and analogous diseases in the human subject, or that, at least, they would direct my investigations into the nature of these obscure growths. But on referring to the literature of our great vegetable parasite, the Mistletoe, I was surprised to find that, although the structure and development of the wood, the ovules, and the pollen of this plant, and the anatomy and germination of its seed, have been very fully and carefully investigated*, our knowledge of the anatomical and physiological relations of the parasite to the plants upon which it grows was still imperfect. The observations of our own authors in particular are most fragmentary and superficial; and the English student, if he wanted definite information respecting the nature of the parasitism of the Mistletoe, would seek in vain for that information in our own language; and, what is still more remarkable, the subject has never been illustrated by our own botanists. Our fellow-labourers in Germany have, however, advanced our knowledge of the subject very considerably, but yet their observations are incomplete and sometimes contradictory; and as I have found them in some essential particulars at variance with my own observations, I have thought it desirable that a subject so important to vegetable physiology as the nature of the parasitism of the Mistletoe should be more fully considered. The present paper professes to be an investigation into the anatomical relations of the Mistletoe to the plants upon which it grows, and a deduction therefrom of the general physiological relations existing between them.

The Mistletoe attaches itself to the nourishing plants by roots, some of which are horizontal and confined to the bark, the others are contained within the wood.

* Decaisne, M.: Mémoire sur le Développement du Pollen, de l'Ovule, et sur la Structure des Tiges du Gui (Acad. Roy. Bruxelles, 1839, vol. xiii.). Développement du Pollen dans le Gui (Académie des Sciences, vol. viii. p. 201). De la Structure ligneuse du Gui (Comptes Rendus, 1839, p. 204).

Kieser: Mém. sur l'Organisation des Plantes, 1814, p. 305, tab. 22.

Bischoff: Lehrbuch, vol. ii. p. 62.

Link, H. F.: Icones selectæ Anat. Bot. 1842, fascic. iv. tab. 8, all the seven figs. Icones Anat. Bot. fascic. ii. tab. x. 7, 8.

Richard: in Jussieu's Mémoire (Ann. Mus. vol. xii.).

Griffith, W.: On the Development of the Ovules of *Loranthus* and *Viscum* (Trans. Linn. Soc. vol. xviii.).

Loudon, J. C.: On the Germination of *Viscum album* (Arboretum et Fruticetum, vol. ii. p. 1024).

Henslow*, Griffith†, Unger‡, Schacht§, and Pitra‖ all agree, so far as their individual statements extend, in the following particulars:—The young plant first sends into the bark of the nourishing plant a single root, sucker, or *senker*, which, pressing inwards, comes into perpendicular relation to the wood of the nourishing plant, in the cambial layer of which the point rests, and there ceases to grow. In its passage towards the wood it gives off several horizontal or side roots, which run along the branch in the bark or upon the surface of the wood. These side roots give origin to perpendicular suckers (*senker*), which come into contact, like the original root, with the surface of the wood. "The wood and bark of the mother plant, in their periodical increase, form layers around the suckers, which grow in exactly the same manner in the cambial stratum" (Pitra, p. 61), and thus the hardened suckers come to be imbedded in the body of the wood.

I will now proceed to detail the result of my own observation, introducing as occasion requires such particular statements of these several authors as are not mentioned here.

First, as to the general characters and structure, and the arrangement and direction of that part of the Mistletoe which lies within the nourishing plant.

The base of the Mistletoe gradually diminishes in size from the surface of the supporting branch inwards, that being the thickest part of the entire plant which corresponds in position to the outer surface of the last-formed layer of the wood. From this situation the base of the parasite, in its simplest condition, tapers as it passes towards the centre of the branch—gradually in the case of a young plant, so as to form a long tapering root (Pl. XXVIII. figs. 1, 5 *c*, &c.), suddenly in an old plant, forming a short, conical, woody plug, which, however, invariably ends in a slender cellular process (Pl. XXVIII. figs. 1 *b*, 2 *b*, 3 *a*; Pl. XXIX. figs. 8, 10, & 11).

But more commonly the base of the Mistletoe terminates in three or four, and sometimes in five or six, such tapering roots.

When the base of the parasite does not exceed at its thickest part $\frac{4}{10}$ths of an inch in diameter, itself and all its ramifications are composed of a delicate yellowish-green soft cellular tissue, which, shortly after making sections of a green branch charged with Mistletoe, shrinks below the level of the wood to the same extent as its younger layers of bark. When moistened, however, the young roots immediately swell up and project considerably above the surface of the wood.

The young roots, and the equally soft cellular terminations of the older ones, are chiefly composed of delicate tubular cells, the $\frac{1}{200}$th of an inch long and the $\frac{1}{1000}$th of an inch wide, joined end to end, and arranged parallel to each other and to the long axis of the root (Pl. XXX. fig. 17 *b*). In cross sections of the root they have the appearance represented in figs. 14, 15. This parenchyma is pervaded by a few (the number depending upon the age and size of the root) straggling plates of young prosenchyma, each composed of one or two layers of small thick-walled elongated cells destitute of markings.

* Magazine of Natural History, vol. iv. p. 500, 1833.

† On the Parasitism of *Loranthus* and *Viscum*, by W. Griffith, Esq. (Trans. Linn. Soc. vol. xviii. p. 78, 1841).

‡ Beiträge zur Kenntniss der parasitischen Pflanzen, Annalen des Wiener Museums der Naturgeschichte. Wien, 1840.

§ Lehrbuch der Anatomie und Physiologie der Gewächse, vol. ii. p. 465, 1860.

‖ Botanische Zeitung, von Hugo von Mohl, 1861. Leipzig, 4to, p. 61.

Arranged in the same radiate manner as the plates of prosenchyma, and in the larger roots associated with it, but in the younger occurring alone, are narrow bundles of vessels, formed of one, two, or three rows of very delicate reticulated ducts composed of elongated cells, $\frac{1}{200}$th of an inch long and $\frac{1}{500}$th of an inch wide, joined to each other by their oblique ends. The woody fibres and ducts take the same direction as the root.

The extremities of the young roots are altogether destitute of prosenchyma, but here the ducts are very numerous. The parenchymatous cells which form the surface of the root, and connect it with the tissues of the nourishing plant, are narrower than those lying more internally, and measure only the $\frac{1}{1500}$th of an inch wide. A similar contraction is observed to occur in the reticulated ducts as they approach the surface of the root, and before they come into connexion with the surrounding wood they become reduced to half their original width (Pl. XXX. figs. 15, 17).

In order to understand the structure of the woody portions of the roots of *Viscum*, it will be necessary to describe briefly that of the stem.

Structure of the Stem and woody Base of Viscum album.—The medullary rays of the stem of the Mistletoe are large and numerous; they are, however, very irregular, and each varies in size several times in its passage from within outwards. They average about the $\frac{1}{25}$th of an inch in depth and the $\frac{1}{300}$th of an inch in width, and are composed of large tubular cells, which also vary in size, and average the $\frac{1}{900}$th of an inch wide: the majority of these cells have thick walls, marked by a few scattered transversely elliptical dots. The rays are often confluent longitudinally, and so form wide plates of parenchyma: they are separated laterally by intervals of about the $\frac{1}{250}$th of an inch. One-third of this interval is occupied by the prosenchyma, the remaining two-thirds by slit-marked vessels. The prosenchyma, or wood-fibres proper, is composed of long plain fibres, the $\frac{1}{1250}$th of an inch wide, and so much thickened that their original cavities are reduced to mere canaliculi: this tissue immediately surrounds the medullary rays, forming a thin layer two cells wide. The slitted vessels form wide bundles composed of three or four rows of cells, lying between the prosenchymatous fibres which on either hand bound the medullary rays: the constituent cells have thick walls, and the reticulated deposits are broad and close, converting the intervals between them into short and very narrow slits; they measure the $\frac{1}{1100}$th of an inch wide, and are joined together by almost straight extremities.

The porous wood of the Mistletoe is, therefore, chiefly composed of coarse parenchyma and thick-walled ducts, the prosenchyma being very scanty, and forming a thin, wide-meshed network surrounding the medullary rays.

The woody base of the Mistletoe, contained within the nourishing plant, has a still looser texture: the prosenchyma forms a wider network of narrower strands, while the medullary rays become proportionately enlarged; by far the greater number of the cells composing the latter have walls as thick as the slitted vessels, and present elliptical dots which hardly distinguish them from the vessels; the deposits, however, are very soft and are readily coloured. The rest of the parenchymatous cells preserve their original delicate condition. The prosenchyma gradually thins away, and ultimately disappears at a little distance from the line of junction between the two plants. And here is noticed a modification of the vascular tissue which is not observed in any other part of the wood of *Viscum*, viz. reticulated or "scalariform" ducts, identical with those described as constituents of the cellular roots. The reticulated ducts are modifications of the thick-walled slitted vessels, and may be traced into direct continuity with them. Thus at the distance of the $\frac{1}{4}$th of an inch from the line of junction between the woods of the two plants the vessels composing the vascular bundles become less numerous, while the constituent cells of the remainder gradually enlarge, their walls become thinner, the deposits forming more delicate reticulations, and the slits consequently elongating into linear chinks, which extend uninterruptedly over a considerable portion of the cell-wall. At the distance of about the $\frac{1}{8}$th of an inch from the wood of the nourishing plant the conversion is complete, and the enlarged bundles subdivide into single or double rows of delicate, reticulated, branching cells, which come into contact with the wood of the nourishing plant at intervals varying from the $\frac{1}{250}$th to the $\frac{1}{125}$th of an inch, and form the smooth undulating lines which grain the wood of the parasite in its vicinity. Just where the ducts appear to terminate, however, they change their original direction, and instead of continuing at right angles to the medullary rays, they first become oblique and then run parallel to them. It is further to be observed, that the cells composing them contract at the line of contact to about the width of the slitted vessels or dotted parenchymatous cells.

This description of the wood of *Viscum* differs considerably from that given by Decaisne. He states "that the ligneous bundles are composed of short fibres having thickened and punctured walls, described by Kieser under the name of *porous cells*" (which, I presume, correspond to what I have called slitted vessels); "between these there are other tubes, much longer and more or less regularly attenuated, with very thick walls destitute of dots or reticulations" (these are the prosenchymatous cells proper). "The medullary rays of the Mistletoe are extremely numerous and small, and divide the vascular bundles into very thin plates, so as to render it extremely difficult to distinguish each of the elements of a wood bundle."*

The great discrepancy between our descriptions appears to be due to M. Decaisne's misapprehension of the homology of the "porous cells" with those composing the medullary rays, and of that of the slitted vessels with vessels proper.

In oblique sections of the wood of the Mistletoe there is considerable difficulty in distinguishing between the thickened parenchymatous cells and the slitted vessels, and this may be another source of disagreement. That the above homologies are correct is clearly demonstrated by examination of the woody base and roots of the *Viscum* at their junction with the wood of the nourishing plant; they may be more readily understood by a reference to Pl. XXX. figs. 18 & 19.

The peculiarity of the wood of *Viscum* is due, first, to the irregularity of the medullary rays producing a corresponding irregularity of the prosenchyma immediately surrounding them, so that in transverse sections it is not very easy to trace a given ray from centre to circumference; and, secondly, to the thickening of the walls of great numbers of the parenchymatous cells and of the whole of the vessels.

* *Op. cit.*

With regard to the direction and arrangement of the roots of *Viscum* which lie within the wood, this is determined by the arrangement of the medullary system of the nourishing plant, the roots always lying strictly parallel to the medullary rays. The examination of the specimens figured in the plates led me, more than two years ago, to this conclusion; more recently, however, Professor Oliver kindly referred me to the writings of the German botanists who have worked at the subject, and I then discovered that Dr. Hermann Schacht, in his 'Lehrbuch der Anatomie und Physiologie der Gewächse' (vol. ii. pp. 156 & 465), had come to the same conclusion. He states that "the root of the Mistletoe developes, on the side of the wood, branches which occupy the position intended for the medullary rays of the wood." Adolphe Pitra (Botanische Zeitung, von Hugo von Mohl, 1861, p. 61), however, refutes this statement. He says, "Dr. Schacht's statement may be true with regard to certain definite stocks, such as firs and pines, but I cannot establish this fact, as I have not had opportunity of investigating such stocks; but it certainly does not hold for all. With limes, willows, and other trees I have found the rule uniformly not established. The place where the sucker (*senker*) meets the wood is quite accidental, and is usually not that of a medullary ray; besides, the sucker is from the first much too strong and too broad (in the section of a yearling shoot) for it to correspond to a medullary ray."

Since Dr. Schacht has not offered any arguments or observations in favour of the above-mentioned assertion, I will proceed to detail the facts which led me independently to the same conclusion.

1. The base of the Mistletoe is always attached at right angles to that particular part of the branch upon which it grows, and this relation is maintained with regard to the roots of the parasite contained within the nourishing plant; the two plants, in fact, grow at right angles to each other.

2. On making a transverse section of a branch infested with young roots of Mistletoe (Pl. XXVIII. figs. 1, 2, 3; Pl. XXIX. figs. 8, 10, 11), we find that the latter are divided longitudinally, and that they are arranged like radii from the circumference of the stem towards its centre, if this be occupied by the medullary canal; if not, then the points of the roots are directed towards the excentrical pith (Pl. XXIX. figs. 8, 10, 11). Each root lies in the same horizontal plane, and terminates, by a very fine point, at a variable distance from the central pith; occasionally it terminates in it (Pl. XXIX. fig. 8). The roots vary in length; some attain to 2 or even 3 inches.

On examining such sections more closely with the help of a pocket lens, the medullary rays of the wood are observed to lie strictly parallel with the sides of the roots throughout their entire course. The intrusion of roots of various size and length throws the rays into simple curves or undulations, and no matter how tortuous soever these may be, the contiguous roots are correspondingly bent in the horizontal plane. The wide conical roots produce a great divergence of the rays and consequent curving of the younger roots in their neighbourhood (Pl. XXVIII. figs. 1, 2; Pl. XXIX. fig. 8 *a*).

When thin sections are examined under the microscope, the wood-cells and ducts of the nourishing plant are seen transversely divided and arranged in linear series, parallel with the sides of the young roots (Pl. XXX. fig. 17), which simply interrupt the concentric layers of the wood without disturbing them.

When the root of the parasite begins to increase in diameter by the formation of woody layers, the fibres and ducts of the nourishing plant, leaving their strictly vertical direction, incline outwards towards the base of the Mistletoe, and the woody layers of the two plants ultimately become coincident, and have the same relation to each other as have the woody layers of the trunk of a tree to its horizontal branches, but with this difference, the woody layers of the nourishing plant are not simply coincident with those of the Mistletoe, but, at their junction with them, are pushed outwards on all sides of the growing base of the parasite; so that, in transverse or in longitudinal sections parallel to the medullary rays (Pl. XXIX. fig. 12), the fibres and ducts in the immediate vicinity of the parasite are divided more or less obliquely. This explains the appearances seen in Pl. XXX. fig. 19, where the wood-cells and ducts of the Poplar are represented, not only divided a little obliquely near and at the line of junction with the base of the parasite, but also laterally divergent. This divergence of the woody layers is effected in a very regular way in the Maple: they are not bent bodily outwards in a simple curve from around the root, but each layer is separately bent away from it at the lines where the wood-rings encircle the sloping surface of the woody base of the parasite, and so suddenly as to cause ridge-like elevations corresponding in number and position to the concentric rings of the wood of the nourishing plant. These successive outward bendings of the woody layers commence at that part of the root which first begins to enlarge, and progressively increase as they affect the outer layers. Thus is explained the formation of the circular ridge-like elevations occurring on the walls of the conical cavities occupied by the roots of the parasite, to be described hereafter.

The roots of the Mistletoe are very perishable, and after the death of the stock they soon crumble down in the hard woody cavities which contained them, giving to the surface of the decorticated branch an alveolated appearance. The alveoli are arranged in linear series along the branch, but when crowded the rows become confused. They have a superficial resemblance to the alveoli of the human jaws, and, like those which receive the double teeth, they sometimes present partitions below. These branched alveoli result from the confluence of the roots at their bases, while the extremities have remained distinct, and therefore contained in separate cavities. The cavities which correspond to the larger woody roots are almost always branched towards their apices, each one dividing into two or more separate canals.

In the Maple the sloping walls of the cavities which contained the older roots are striated longitudinally by fine linear elevations of the wood, and marked transversely at pretty regular intervals by circular ridges corresponding in number and position with the concentric rings of the wood. Dr. Hooker has noticed the same appearance in the conical cavities left in the wood of *Fagus* after the falling away of the parasitic Myzodendron. He says ('Flor. Ant.' pt. ii. p. 301), "The parasite falls away, and leaves a cup still terminating the branch of Beech, whose inner surface is channelled with radiating fissures, and these again crossed by the concentric rings of the wood." I have already explained how these circular elevations are produced in the Maple.

The longitudinal striations are best seen at the bases of the cavities: they are not visible at the apices of any.

Bearing in mind the appearances presented by the sections above described, the modified appearances of the larger roots when seen in vertical sections of the nourishing branch, made *parallel* to its medullary rays, will be readily understood. In such sections the base of the Mistletoe often appears to terminate in a "sucker-like expansion" furnished next the wood with little nipple-shaped processes, or coarse fibres dipping into its substance (Pl. XXIX. fig. 12).

The young taper roots also appear wider and shorter (Pl. XXVIII. fig. 5; Pl. XXIX. fig. 6) than in sections made in the other directions. These are the appearances which doubtless led Mr. Griffith to the conclusion that the Mistletoe is attached to the stock by sucker-like processes. If we could make a longitudinal section of the entire root parallel to the medullary rays, it would have an appearance similar to that seen in cross sections of the branch, but modified in most cases by the greater dimensions of the root in the vertical direction. It is difficult, however, to make a complete section of the root in this direction, first, because many are narrow-elliptical wedges terminated by two or three tail-like cellular processes, of which altogether it is much more difficult to make a longitudinal section in this direction than in cross sections of the branch; and secondly, owing to the undulations or simple curvings of the taper roots in the horizontal plane, we are unable to make complete longitudinal sections of them in the vertical. And thus it is that in ordinary longitudinal sections of the parasite and the branch supporting it we make such oblique, or partial, sections of that part of the former which is contained within the latter, as resemble "sucker-like expansions" or gibbous processes imbedded in the wood of the stock (Pl. XXIX. fig. 12). When the modifying conditions are absent, or nearly so, we may make a more complete section of the root (Pl. XXVIII. fig. 5 *c*; Pl. XXIX. fig. 6).

When longitudinal sections of the Mistletoe-bearing branch are made at right angles to the medullary rays, the roots will be seen in transverse section as represented in Pl. XXIX. fig. 7, and also in Pl. XXX. figs. 13, 14, 16, which are magnified sections. They have a circular or elliptical form, the long diameter of the ellipse corresponding to the long axis of the branch; and they manifest a greater tendency to increase in this direction than in any other, the section occasionally presenting a depth many times greater than its width. Confluence of two or more roots is observed to have often occurred, and this is most common in the longitudinal direction. The roots being taper, their size varies according to their distance from the surface of the wood; and since the conical roots of the larger and older plants taper so suddenly as to be, at the depth of an inch within the wood, but little thicker than their cellular prolongations, sections made at this distance from the bark rarely expose roots of a greater diameter than the $\frac{1}{4}$th of an inch, while some measure only the $\frac{1}{70}$th of an inch. Their greatest dimensions are of course at the surface of the wood, where they commence, and where, as may be seen in a decorticated branch, the cellular roots have a mean diameter of an eighth of an inch, but even here there are numbers which measure no more than the $\frac{1}{60}$th of an inch across.

These young cellular roots are in some cases exceedingly numerous. On the decorticated surface of a branch of Maple, a foot long and 15 inches mean circumference, I have estimated several thousands, a single square inch of by no means the most crowded part of the surface containing ninety such roots, varying in diameter from the $\frac{1}{5}$th to the $\frac{1}{60}$th of an inch.

The size of the woody roots varies according to the age of the plant. Owing to the tendency of the roots to increase more in the longitudinal than in the transverse direction, and also on account of their more frequent confluence in this direction, the greater number of the woody bases of the Mistletoe have an elliptical form in transverse section, but few of them preserving a regular conical shape.

The ultimate anatomical relation existing between the Mistletoe and its nourishing plants may be very well studied in sections which cut the roots of the former and the medullary rays of the latter at right angles to their length. The nourishing plant best suited for examination is the Maple (*Acer campestre*). Before proceeding therefore to describe the appearances presented in such sections, I will, for the sake of greater exactness, briefly describe the wood of the Maple. The tissues are arranged as is seen in Pl. XXX. fig. 14, which represents a vertical section of the wood across the medullary rays. The woody fibres diverge at intervals of about the $\frac{1}{100}$th of an inch, and enclose the bundles of cellular tissue composing the medullary rays, which measure, on the average, the $\frac{1}{80}$th of an inch deep and the $\frac{1}{350}$th of an inch wide, the long diameter of the ellipse taking, of course, the same direction as the long axis of the branch. In this view the parenchymatous cells appear small and round; they are tubular, measuring the $\frac{1}{2000}$th of an inch wide and the $\frac{1}{250}$th of an inch long, and are joined end to end and collected into bundles. The medullary rays thus constituted pass in straight lines from centre to circumference. Pitted ducts, the $\frac{1}{830}$th of an inch wide, run amongst the wood-fibres at regular intervals. If now we examine the tissues in relation to the young cellular roots of *Viscum*, we shall find that, where the woody fibres and ducts of the Maple meet with the root of the parasite, they suddenly diverge, and, sweeping round it, as suddenly converge above it, and having thus enclosed the root, resume their original direction. In fact, the woody fibres and ducts are arranged about the root just in the same way as they are about the medullary rays of the plant to which they belong; and the smaller roots are often separated by only single fibro-vascular bundles of the nourishing plant, and thus resemble contiguous but greatly hypertrophied medullary rays, save that the cells composing them are larger and some of them delicately reticulated (Pl. XXX. figs. 14, 16). Occasionally we see the section of a root which has scarcely attained twice the size of an average medullary ray, and which, like the latter, possesses a narrow elliptical form.

Agreeable with their regular distribution, the medullary rays of the nourishing plant lie against the surface of the root, somewhere separated from it by a few woody fibres, otherwhere by the intervention of a pitted duct, while, at several parts of its circumference, the woody fibres bounding the rays disappear in places, and the constituent cells of the latter thus become confluent with those composing the root (Pl. XXX. figs. 14 & 15); and as the latter are here of intermediate size, and in other respects similar to the parenchymatous cells of the medullary rays of the nourishing plant, which, on the other hand, are invariably increased in size in the immediate vicinity of the root, one cannot say positively whether the cells which form the surface of the *Viscum*-

root, and connect it with the tissues of the nourishing plant, belong to the medullary system of the latter or to that of the former.

The young cellular root of *Viscum* may be regarded generally as a prolongation of the central pith of the parasite, and the contiguous medullary rays of the nourishing plant are successively confluent with its surface, which sometimes presents deep crenatures resulting from its lateral extension into the positions occupied by the medullary rays. This assimilation and confluence of the medullary systems of the two plants is perhaps best seen at the angles formed by the divergence of the woody fibres; but, in many roots, it may be traced continuously around them for the greater part of their circumference, the growing roots evidently producing absorption of the woody fibres interposed between them and the adjacent medullary rays, which thus become, one after another, confluent with them. At the same time great distortion and distention of all the tissues of the wood is effected. These points are well seen in such sections as is represented in Pl. XXX. fig. 13. Five young roots are here seen in transverse section, bounded by sharp undulations of the woody tissue, each of which is terminated by a rugged, sometimes bifurcated, spicular process projecting into the root.

Pl. XXX. fig. 15 represents an oblique section, and the line of demarcation between the tissues of the two plants is irregular and ill-defined.

The appearances here described are seen in sections made at some distance within the heart-wood. In the younger layers the divergence of the woody fibres around the roots is less complete, and the cells of the latter occasionally lie against the jagged free extremities of the fibro-vascular bundles, indicating clearly enough that absorption of the woody tissues of the nourishing plant has been taking place. This effect is also best observed where the fibres first begin to diverge.

The few small reticulated ducts of the parasite which come to the surface of the root appear in these cross sections to be attached indifferently to the parenchymatous cells, fibres, and ducts of the nourishing plant.

The *woody fibres* of the two plants never, as far as my observations go, come into actual contact: the plain, thick-walled prosenchyma of *Viscum* gradually thins away, and disappears towards the attached surface of the parasite, where it is entirely absent.

With regard to the relation of the *vascular tissues* of the parasite and its nourishing plants, Unger (Beiträge zur Kenntniss der parasitischen Pflanzen*) considers their inosculation to be an essential condition of all cases of parasitism. In fig. 17, tab. iii., he has represented "the scalariform ducts of the extremity of the root-substance of *Viscum*, regularly apposed to," and directly inosculating with, "the dotted vessels of *Cratægus*," and opposed to none other of its tissues. Adolphe Pitra ('Botanische Zeitung,' Hugo von Mohl, 1861, Leipzig, 4to) appears to have adopted the same view. He says, "In a transverse section of the root (sucker or senker) of *Viscum*, which also cuts the mother branch tangentially (fig. 5), we observe not only that the wood-tissue runs round the sucker, but also that the vessels of the wood attach themselves to the short vessels of the sucker which radiate from the centre of it in all directions to the contiguous wood. From this position of the elements of the wood, it may be concluded that here occurs a

* Annalen des Wiener Museums der Naturgeschichte. Wien, 1840.

streaming of the sap, first of all, out of the wood-layers which are in process of formation, and certainly also out of those which are already formed." In the figure the fibro-vascular bundles of the nourishing plant are represented curving towards the sides of the root, against which their extremities abut at various angles. This appearance is occasionally seen, but I believe that it is produced by the absorption of the fibro-vascular bundles about the angles of convergence or of divergence, in the extension of the root in these directions, and therefore to be independent of any tendency to inosculation of the ducts.

That the vessels of the two plants do not, however, directly inosculate, as is represented by Unger, and that their inosculation is probably accidental and contingent upon the relation of the parenchymatous systems of the two plants, will, I presume, be evident from the following facts:—

1. The reticulated ducts of *Viscum album* invariably run parallel to the surface of the part in which they are contained. It has been shown that the vertical roots of *Viscum* run horizontally inwards parallel to the medullary rays, and therefore at right angles to the fibro-vascular bundles which regularly diverge around them. In longitudinal sections of these roots it is readily and uniformly observed that the reticulated ducts run parallel with the long axis of the root, and rows of the long reticulated cells which compose them frequently occupy the surface of the root, and come into contact with a wall formed of wood-fibres and ducts in transverse section (Pl. XXX. fig. 17). Here, then, it is clear that the vascular tissues of the two plants are arranged at right angles to each other.

2. If, now, we take a section of the conjoined tissues from the edge of a vertical plane which would bisect the woody base of the parasite (Pl. XXX. figs. 20 & 18), and where the ducts of the two plants would be supposed to run in the same linear directions, we shall find that they actually do so to within a short distance of the line of junction, but that here the ducts of *Viscum*, having changed their direction, as above described, appear in transverse section, in which condition they abut against the abrupt ends of the fibro-vascular bundles of the nourishing plant, which are here, even near the median plane, a little inclined in their divergence about the base of the parasite, to the right or to the left. Again, in sections at right angles to that just described (Pl. XXX. fig. 19), it is observed that the ducts of the Mistletoe, having run parallel to the surface of the base of the parasite to within a very short distance of the line of junction with the nourishing plant, suddenly bend inwards in order to become parallel with the surface of the tapering root, in which they all in like manner converge. In the position therefore which is of all most favourable for the direct inosculation of the vascular bundles, we find that they are still arranged at right angles to each other. That they do frequently inosculate, however, is quite certain; but the circumstance of their doing so appears, as I have stated, to be a necessary consequence of the confluence of the medullary systems of the two plants. Thus, in the former of the two sections (Pl. XXX. figs. 18 & 20) just described, it is observed that the base of the parasite near the line of junction is chiefly composed of parenchymatous tissue (in part thick-walled and dotted cells, and in part of thin-walled unchanged cells) (Pl. XXX. fig. 19) subdivided into large medul-

lary rays by the reticulated ducts, which are here the only representatives of the woody bundles. These large medullary rays become confluent with two or more of the medullary rays of the nourishing plant, the intervening fibro-vascular bundles of the latter also abutting against the parenchyma of the parasite. And, since the medullary systems of the two plants thus compass each other, it necessarily follows that the reticulated ducts of the parasite are opposed to the remaining fibro-vascular bundles of the nourishing plant, and hence, at first sight, the appearance of direct inosculation between the vessels of the two plants; but, in reality, the ducts of the parasite as often abut against the woody fibres of the fibro-vascular bundle as against its ducts.

The relation of the fibro-vascular bundles of the two plants may be best made out in *Populus nigra*, the large ducts of which correspond in size with those of *Viscum*.

The *horizontal ramifications* (side roots) of the base of the Mistletoe have precisely the same structure as the young perpendicular roots. I have been unable to distinguish in them a root-sheath (Wurzel-haube) and a bark, mentioned by Schacht (*op. cit.*). They pervade the bark of the nourishing plant freely, which they can of course only do by effecting its absorption simultaneously with their advance; some pass transversely and partially encircle the branch (Pl. XXIX. fig. 11), but by far the greater number, running parallel to each other and to the branch, traverse it lengthwise (Pl. XXVIII. fig. 5, & Pl. XXIX. fig. 6). Whichever direction they take, they produce at frequent and pretty regular intervals other tapering cellular roots, which, guided doubtless by the medullary rays of the bark, pass towards the surface of the wood, and are thus brought into contact with the ends of its medullary rays. They are subsequently found imbedded at various depths in the hard wood of the nourishing plant, like the primary roots. These lateral roots also give origin to bud-like processes, which, deepening in colour, grow up obliquely through the bark, and appear as little shoots in its chinks, or, if the bark be young and smooth, they first greatly distend it,—the tense, shining cuticle becoming so thin that the already green buds of the parasite may be seen beneath it,—and subsequently rupturing it, develope leaves and stems.

The horizontal roots are cylindrical, and are wholly contained in the bark; and such being the case, they are each year removed further outwards from the surface of the wood of the nourishing plant by the endogenous growth of its bark; and when the more external layers in which they lie have become cracked and dead and fall away, they are discovered (Pl. XXVIII. fig. 1 *a*, & Pl. XXIX. fig. 6 *a*). Meantime these roots increase in size and harden in texture by the formation of woody layers.

Such being the relation of the horizontal roots to the bark of the nourishing plant, I cannot agree with Dr. Unger that they become imbedded in the wood by the growth of the branch; and I have never seen them lying indifferently in the bark or on the surface of the wood, as he (tab. iii. fig. 15, *op. cit.*) and Schacht (fig. 9, vol. ii. *op. cit.*) have represented. When, however, they are tied down at short intervals by the perpendicular roots, that portion of the bark which is included between them and the surface of the wood is often killed by the pressure resulting from the growth of the latter. It follows, of course, that the corresponding portion of the wood is arrested in its growth, and the horizontal roots are, in after-years, found lodged in vertical or horizontal grooves in the wood, but always separated from it by a layer of dead compressed bark (Pl. XXIX. fig. 11 *a'*, *a*).

The young roots of the Mistletoe and the bark of the nourishing plant live contiguously in organic union with each other, the delicate green larger cells of the former being intimately connected with the brownish smaller cells which constitute the mesophlœum of the latter, in which the roots are immediately imbedded. The boundary-line between the tissues of the two plants is very distinct, but often uneven.

With regard to the relation between the *cortical systems* of the two plants, I find myself at variance with the statements of DeCandolle. In his 'Physiologie Végétale,' p. 790, he says, "The bark of the Apple-tree, although juxtaposed against that of the Mistletoe, does not appear to be joined to it. In fact, every part of the bark which touches the Mistletoe is dead, and especially below the Mistletoe, where the necrosis is seen to extend for nearly an inch." Again, at page 1412, "The Mistletoe, therefore, communicates with the tree only by the soldering together of its base with the wood, and not by the bark." Since this eminent botanist has drawn some important physiological deductions, involving the relative growth of the two plants, from these statements, I have thought it necessary to examine this matter. The growth of the Mistletoe causes great thickening of the bark in its vicinity, and its older layers are pushed outwards and cracked by the distending base of the parasite, and thus a superficial appearance of necrosis is produced; but, on closer examination, it is found that the younger layers of the bark are in intimate living contact with the corresponding layers of the bark of *Viscum*. The contiguous margins of the barks are mutually bevelled, that of the Mistletoe at the expense of its outer surface, that of the nourishing plant at the expense of its inner surface; and the bark of the parasite is received within, and thus shortly invaginated by the bark of the nourishing plant (Pl. XXIX. figs. 8, 10, 12). At the surface, and for some little distance inwards, the barks are often separated by a little chink; there is, in fact, no union between the dead outer layers of the barks; but more internally they form a continuous living stratum covering over the smooth line of junction between the woods of the two plants, and thus the uninterrupted circulation of the sap through both is secured.

The foregoing observations were made upon the Maple, Hawthorn, Apple, Willow, and Oak; and from more superficial examination of the attachment of the parasite to other trees upon which it grows, I conclude that they are strictly applicable to all. The conclusion to which they lead is, that a confluence of the cellular system of the Mistletoe with that of the plants which support it is the essential condition of its parasitism. Whether the roots of the parasite are implanted in the medullary system of the plant upon which it grows by any invasive action of their own is not the object of this paper to determine, but I cannot pass by the question without specifying the principal anatomical facts which support this view. They are, *first*, the evidence of repeated absorption of the fibro-vascular bundles, allowing the extension of the roots into the exposed medullary rays; and *second*, the confluence of the extremity of the roots with the central pith, which could only result from invasive growth of the roots; for, although a branch may be very early affected with the parasite, we can hardly suppose that this would occur simultaneously with its original development: the branch must be preformed, which implies the existence of at least one ring of wood between the point of the root of the parasite and the medullary centre of the nourishing plant.

Mutual growth of the Parasite and its nourishing Plant.—When the roots of *Viscum album* have become fairly infixed into the medullary system of the nourishing plant, their outer portions become gradually thickened by the formation of woody layers upon their surfaces. This increase in the lateral dimensions of the root takes place *pari passu* with that of the branch upon which it grows; for every layer of wood deposited upon the branch, a corresponding one is deposited upon the Mistletoe; and the growth of the two plants proceeding thus uniformly, the concentric rings of the stock pass uninterruptedly into those of the Mistletoe, and the woody layers become coincident. While the roots thus undergo increase and lignification about their outer portions, their inner extremities, which now lie deeply in the hard wood of the nourishing plant, constantly retain their original soft cellular condition. And, as far as my own observations go, the life of the parasite depends upon these delicate cellular processes; they are, in fact, to *Viscum*, what the cellular rootlets of terrestrial plants are to them. When through accident or old age they die, secondary ones are thrown out from the soft outer layer of the woody base, which, after traversing the bark for a shorter or longer distance, come into relation with the medullary rays of the nourishing plant.

Guided by the above conclusion respecting the nature of the parasitic connexion of the Mistletoe, I was led to suppose that a difference in the size, number, and arrangement of the medullary rays might explain the reason why, apart from any natural affinity, which certainly does not exist, the Mistletoe is so frequently attached to certain trees, but rarely to some, and never to others. With a view of testing the truth of this supposition, I have examined the wood of those of our indigenous trees and shrubs which, from their size, distribution, and aggregation, are liable to the attacks of the parasite, and also that of some exotic plants to which it is naturally attached, or upon which it may be made to grow. The sections were made at right angles to the medullary rays, at the surface of the wood where the roots of the parasite would first come in contact with the rays; generally speaking, however, the rays have the same dimensions in the heart-wood as they have at the surface. The following are the results:—

PINUS SYLVESTRIS and ABIES LARIX.

Ray composed of a single row of about six wide cells, forming a narrow ellipse, the $\frac{1}{200}$th of an inch deep and the $\frac{1}{1200}$th wide. Rays discrete, separated by intervals equal, in one direction, to twice their width, in the other to half their depth.

ALNUS GLUTINOSA.

Ray $\frac{1}{100}$th of an inch deep and $\frac{1}{2500}$th wide, composed of a single row of about sixteen cells. Rays distinct, distant about thrice their width. Some are plates the $\frac{1}{35}$th of an inch deep.

Betula alba.

Ray $\frac{1}{100}$th of an inch deep and $\frac{1}{1250}$th wide, composed of two rows of cells about thirty-nine in number. Rays distinct, distant about thrice their width.

Populus nigra and Salix alba.

Ray a thin plate, the $\frac{1}{100}$th of an inch deep and the $\frac{1}{1250}$th of an inch wide, composed of a single row of about eighteen cylindrical cells, row sometimes double. Rays almost contiguous longitudinally, separated by intervals equal to about twice their width laterally.

Corylus avellana.

Ray $\frac{1}{120}$th of an inch deep and the $\frac{1}{2600}$th of an inch wide, composed of a single row of about twenty small cells. Rays discrete, distant about thrice their breadth.

Fagus sylvatica, Quercus Robur, and Castanea vesca.

Ray the $\frac{1}{120}$th of an inch deep and the $\frac{1}{2500}$th of an inch wide, composed of a single row of about fourteen cylindrical cells. Rays discrete, arranged linearly, without overlapping by their edges, distant about twice their width.

Juglans regia.

Ray a broad elliptical fasciculus, the $\frac{1}{80}$th of an inch deep and the $\frac{1}{350}$th of an inch wide, composed at widest part of five rows of large cells, the $\frac{1}{1500}$th of an inch broad. Rays discrete, but overlapping by their edges, distant laterally about one and a half their width.

Ulmus campestris.

Ray a narrow elliptical fasiculus, the $\frac{1}{100}$th of an inch deep and the $\frac{1}{1250}$th of an inch greatest width, composed of a double row of about twenty cells. Rays wide apart, distant four times their width in transverse direction, and their width in the longitudinal.

Æsculus hippocastanum.

Ray $\frac{1}{150}$th of an inch deep and the $\frac{1}{2500}$th of an inch greatest width, composed of a single row of about six small cells, forming a narrow ellipse. Rays discrete, distant transversely about twice their width.

Tilia europæa.

Rays vary much in size; they form deep plates, some measuring the $\frac{1}{10}$th of an inch deep and $\frac{1}{1100}$th of an inch wide, and composed of two, at widest part of three rows of cells; others are but the $\frac{1}{30}$th of an inch deep and the $\frac{1}{2500}$th of an inch wide, being composed of one long row of oblong cells. Rays distant about three times their width.

Acer campestre.

Ray very large, an elliptical fasciculus, the $\frac{1}{80}$th of an inch deep and the $\frac{1}{400}$th of an inch wide, composed of five or six rows of cells. Rays overlapping each other above and below, distant transversely about half their width.

Ilex aquifolium.

Ray very large, average size same as that of Maple, an elliptical fasciculus, composed at the widest part of four rows of cells, the cells being very large. Rays arranged linearly and a little overlapping each other above and below, but separated laterally by wide intervals equal to three or four times the width of ray.

Sambucus nigra.

Ray a broad elliptical fasciculus, $\frac{1}{65}$th of an inch deep and $\frac{1}{500}$th of an inch wide, composed of three rows of large cylindrical cells. The rays overlap, and are distant about their width; they closely resemble those of the Maple, differing only in forming narrower ellipses, in having the constituent cells larger, and in being a little further apart.

Fraxinus excelsior.

Ray an elliptical fasciculus, the $\frac{1}{200}$th of an inch deep and the $\frac{1}{1000}$th of an inch wide, composed of about fifteen large cylindrical cells arranged in two rows. The rays do not overlap, and are distant laterally about once or twice their breadth.

Olea europæa.

Ray an elliptical fasciculus, $\frac{1}{125}$th of an inch deep and $\frac{1}{830}$th of an inch wide, composed of twenty cylindrical cells, some of which are very large, arranged in two rows. The rays a little overlap, and are distant laterally scarcely their width. The wood only differs from that of Ash in the larger size and closer approximation of rays.

Syringa vulgaris.—Ligustrum vulgare.

Ray a very narrow elliptical fasciculus, $\frac{1}{120}$th of an inch deep and $\frac{1}{1500}$th of an inch wide, composed of about sixteen small cells arranged in one or two rows. Rays distant about thrice their width.

Cratægus oxyacantha.—Pyrus malus.

Rays elliptical fasciculi, $\frac{1}{100}$th of an inch deep and $\frac{1}{800}$th of an inch wide, composed of two or three rows of cylindrical cells. Rays crowded, often contiguous longitudinally, distant laterally about their width.

Cerasus Laurocerasus.

Rays narrow elliptical fasciculi, or plates, varying much in size, average $\frac{1}{40}$th of an inch deep and $\frac{1}{800}$th of an inch wide, composed of one or two rows of cells. Rays once or twice their width apart.

Cerasus lusitanica.

Rays very large, long elliptical fasciculi, some measuring $\frac{1}{100}$th of an inch $\times$ $\frac{1}{1250}$th, others as much as $\frac{1}{25}$th $\times$ $\frac{1}{500}$th of an inch. Rays crowded.

Robinia pseudacacia.

Rays very large elliptical fasciculi of cylindrical cells, $\frac{1}{40}$th of an inch deep and $\frac{1}{800}$th of an inch wide; cells arranged in two or three rows. Rays overlapping above and below, distant laterally twice their width.

Amygdalus communis.

The rays vary much in size, elliptical fasciculi $\frac{1}{70}$th of an inch deep and $\frac{1}{1000}$th of an inch wide, composed of two rows of largish cells, or plates the $\frac{1}{35}$th of an inch deep and $\frac{1}{1000}$th or $\frac{1}{800}$th of an inch wide, composed of two or three rows of cells. Rays very numerous, ellipses often continuous into plates, separated by about their width.

Prunus domestica.

Ray an elliptical fasciculus, $\frac{1}{60}$th of an inch deep and $\frac{1}{625}$th of an inch wide, composed of three rows of large cylindrical cells. Rays often continuous by their ends, separated by once or twice their width.

Pyrus communis.

Ray lamelliform, the $\frac{1}{70}$th of an inch deep and the $\frac{1}{2000}$th of an inch wide, composed of a single row of about twenty-seven cells. Rays separated by intervals equal to about three times their width.

Mespilus germanica.

Ray an elliptical fasciculus, $\frac{1}{100}$th of an inch deep and $\frac{1}{1250}$th of an inch wide, composed of two rows of cylindrical cells. Rays distant from each other once or twice their width, often confluent into long plates the $\frac{1}{20}$th of an inch long.

Vitis vinifera.

Ray a long ellipse, the $\frac{1}{20}$th of an inch deep, and the $\frac{1}{250}$th of an inch wide, composed of about eight rows of cells. Rays closely overlapping, and separated by intervals equal to their width, and less.

With reference to the size and number of their medullary rays, these plants may be arranged in the following order:—

Vine	rays average	$\frac{1}{20}$th of an inch	×	$\frac{1}{250}$,	crowded.
*Maple *Walnut . . .	„	$\frac{1}{80}$	„	$\frac{1}{400}$,	crowded, more so in Maple.
Elder	„	$\frac{1}{65}$	„	$\frac{1}{500}$.	
Holly	„	$\frac{1}{80}$	„	$\frac{1}{400}$,	large, but wide apart.
*Plum	„	$\frac{1}{60}$	„	$\frac{1}{600}$.	
*False Acacia *Cherry Laurel *Portugal Laurel	„	$\frac{1}{40}$	„	$\frac{1}{800}$.	
Plum	„	$\frac{1}{60}$	„	$\frac{1}{625}$.	
*Hawthorn *Apple and Crab	„	$\frac{1}{100}$	„	$\frac{1}{800}$,	numerous.
*Almond	„	$\frac{1}{50}$	„	$\frac{1}{900}$,	numerous.
Medlar	„	$\frac{1}{100}$	„	$\frac{1}{900}$.	
*Lime	„	$\frac{1}{20}$	„	$\frac{1}{1800}$,	wide apart.
*Olive	„	$\frac{1}{125}$	„	$\frac{1}{830}$,	close.
*Ash	„	$\frac{1}{200}$	„	$\frac{1}{1000}$.	
*Poplar *Willow . . . Alder	„	$\frac{1}{100}$	„	$\frac{1}{1250}$.	
*Pear	„	$\frac{1}{70}$	„	$\frac{1}{2000}$.	
*Elm and Birch .	„	$\frac{1}{100}$	„	$\frac{1}{1250}$,	wide apart.
*Fir *Larch	„	$\frac{1}{200}$	„	$\frac{1}{1200}$.	
Lilac	„	$\frac{1}{120}$	„	$\frac{1}{1500}$.	
*Oak *Beech Spanish Chestnut	„	$\frac{1}{120}$	„	$\frac{1}{2500}$	
Hazel Horse Chestnut	„	$\frac{1}{150}$	„	$\frac{1}{2500}$.	

The order in which the Mistletoe-bearing trees occur in the above series corresponds closely to the relative frequency of the attachment of the parasite to them. The apparent exceptions are due to two circumstances: 1st, the precariousness of the dissemination of *Viscum*, the only means for effecting the process being extrinsical and accidental. The more closely, therefore, a tree is approximated to a fertile plant, the more certainly will it be affected, and *vice versâ*. The greater frequency with which the Mistletoe attacks Apple- and Hawthorn-trees, as compared with Maple- and Walnut-trees, which upon the

* Plants upon which the Mistletoe spontaneously grows, or upon which it may be grafted.

theory are much more liable, is thus accounted for. There is perhaps no tree in the series more liable to the attacks of the parasite than the Maple, nor one that suffers so much from its ravages. 2nd, the nature of the bark, but especially of its periderm. The immunity of the Holly, Birch, and Alder is doubtless due to the condition of this outer portion of their barks, forming, as it does in them, dry, smooth, unbroken surfaces.

The Elder rarely grows to a sufficient size to bear the Mistletoe.

The Poplar, which, as far as my own observations extend, is more liable than either the Lime or Ash, appears to be the only exception to the theory; but in this tree there are greater predisposing conditions: thus, the nature of the bark is most favourable for the attachment and germination of the seed, and the wood is very soft and, from the number, size, and arrangement of the ducts, is easily separable in the direction of the medullary rays. The cells composing the medullary rays of the Poplar are almost as large as those forming the parenchyma of *Viscum*; and it may be, that, in plants whose medullary rays are small, that one is most liable to the encroachments of parasites whose parenchymatous cells approach most nearly in size to those constituting the parenchyma of the parasite.

The Mistletoe is but rarely found on Elms and Oaks, and never, I believe, on the Horse Chestnut; yet these trees, except as regards their medullary system, appear in all other respects, viz. of number, size, aggregation, and condition of bark, to be even more exposed to the attacks of the Mistletoe than the Apple and Hawthorn.

The Hazel and Spanish Chestnut have both a very fine medullary system, and also a smooth, unbroken periderm; and neither of these plants, as far as I am aware, spontaneously nourish the Mistletoe.

From these considerations I think we may conclude, generally, that, other conditions being equally favourable, the size and number of the medullary rays is the chief cause which determines in any given case the attachment of the Mistletoe; and this is probably true of all other cases of parasitism. Thus Balanophoraceæ are found on the roots of Maples, Vines, Oaks, Araliaceæ*. Cytinaceæ occur on *Cistus* and succulent Euphorbias; Rafflesiaceæ on *Cissus* and branches of leguminous plants. *Adesmia*, nourishing *Pilostyles*, is represented† as having very large medullary rays.

The positions of the Elder, Holly, Plum, Lilac, &c., in the series probably indicate their relative fitness for Mistletoe-grafting.

The fibrous structure and deciduous nature of the bark of some trees, *e. g.* the Vine, no doubt prevent the attachment of parasites to them.

Effects of Mistletoe on the supporting Branch.—The invariable result of the attachment of the Mistletoe to a branch is the increased development of its tissues, which form a swelling around the base of the parasite. It is remarkable that there should be any obscurity or difference of opinion as to the mode of the formation of this swelling, since its explanation requires little more than a superficial examination. Yet Unger seems to have a notion that *Viscum* exercises some obscure diffusive influence in producing it. He says (*op. cit.* p. 32), "I observed that the germinating seed, as soon as ever it is implanted into the nourishing branch, causes already so important a reaction in it, that

* Dr. J. D. Hooker in Lindley's 'Vegetable Kingdom,' 3rd edit. p. 90.

† Unger, *op. cit.* tab. ii. fig. 3.

thereby an observable swelling of the part ensues;" and in tab. iii. fig. 13, he has represented the germination of *Viscum* upon a small branch of *Tilia Europæa*, and shows that in the act of germination, and before the young plant has put forth a leaf! it causes the young branch to swell out pretty uniformly to about twice its diameter.

DeCandolle (Phys. Végét. p. 1411), speaking of the effect of the Mistletoe upon the bark of the supporting branch, says, "It results from this mortification of the bark, that the Mistletoe produces upon the supporting branch an effect analogous to that produced by a section or ligature of the bark, and a swelling is formed above the Mistletoe which is greater in proportion as the trunk of the Mistletoe approaches the thickness of the branch which supports it."

Griffiths also supports the theory of the downward circulation of the sap, and the effect of the Mistletoe in arresting it, in stating (Trans. Linn. Soc. vol. xviii.) that "the upper bourrelet surrounding the suckers is always the larger." I find that this swelling is due to the regular hypertrophy of the woody layers of the nourishing plant around the base of the parasite, and, discordantly with these statements, that as long as it does not interfere with the vitality of the branch beyond it, the hypertrophy takes place equally around it.

Dr. Hooker (Flor. Ant. vol. ii.) states that "the *Fagus*-branch dilates around *Myzodendron* into the form of a cup, and is formed of as many layers of wood as years have elapsed since the germination of the parasite;" and he represents the cup as being equally developed in all directions. Now the difference between the swelling around the base of *Myzodendron* and that of *Viscum* is only one of degree and regularity. The hypertrophy is in both cases produced by the uniform and uninterrupted growth of the parasite and its supporting branch. In the one case, owing to the simple condition of the base of *Myzodendron*, a regular cup-shaped expansion is formed; but in the other, on account of the ramified condition of the base of *Viscum*, and a more or less complete confluence of its roots, the swelling around the base is generally irregular, though not more developed actually in any particular direction, if the whole branch bearing it be alive. If, however, the base of *Viscum* be simple, then the woody layers, being regularly raised up and everted, often form a cup-shaped swelling around it, which is sometimes very well developed.

When, however, the parasite has killed or very much atrophied the branch beyond it, then, for the obvious reason that the lower part of the base of the parasite is situated in the midcurrent of the nutrient fluid, while its upper part is but just within its limits, the hypertrophy takes place to a greater extent around the *lower* part of the base than the upper (Pl. XXIX. fig. 12). I have never, in any case, seen the swelling greater above the base of the parasite than below it.

If we examine more closely into the mode in which the hypertrophy is produced, we observe that the thickening is effected by the gradual widening out of the woody layers from the side of the branch opposite to the Mistletoe to their junction with it; and when the parasite is seated on one side only of the branch, that side in the neighbourhood of the Mistletoe is increased to twice, thrice, or even four times its natural thickness, the medullary canal becoming excentrical (Pl. XXIX. figs. 9, 10, 11, 12).

In some specimens the concentric layers of the wood appear to be more numerous in the hypertrophied portion of the branch than below, where it is of normal size; but it is doubtful whether they really be so, for it is very difficult to count the obscure and crowded rings of a young branch.

It appears from the facts just mentioned that the roots of the Mistletoe stand to the nourishing plant in the relation of an hypertrophied medullary system, and one which induces an excessive flow of the sap of the branch, resulting at first in the local hypertrophy of its tissues, but subsequently, the supply of sap, or the power of transmitting it, failing, the central portion of the wood becomes exhausted and dies, involving in its death that of its destroyer also; for the dark-coloured sapless wood extends from the centre in irregular wavy processes, and enshrouds the dead roots of the parasite. The branch, however, still maintains its vigour, and slowly buries the inveterate intruder,—the roots and woody bases of the Mistletoe, some full three inches in circumference, becoming imbedded in the centre of the stem by its subsequent growth (Pl. XXVIII. figs. 1 *a*, 2 *a*, 3 *a*). But other roots are meanwhile penetrating the newly formed layers of the wood, and its whole circumference is in time more thickly beset with parasites than ever; the branch is heaved out into a spindle-shaped swelling, and the outer layers of the bark are rent into wide breaches favourable to the continued encroachments of the invading parasite, while its inner layers become immensely thickened and form a suitable nidus for its increase. After a while the second crop of roots spread destruction still further outwards, and, like the former crop, implicate themselves in it; the branch still struggles vigorously with its enemy, but as fast as one generation of roots are dying, a later and more numerous progeny attack it. Many of the medullary rays are destroyed, and, the development of the wood being interrupted in the direction of the dead roots, deep fissures filled with dead bark, and resembling involutions of the stem, are formed and extend sometimes to the very centre of the branch, which, in this condition, resembles in section that of a *Malpighia* (Pl. XXIX. fig. 9). The infected branch, moreover, assumes various contortions, being twisted sometimes in one direction and sometimes in another: it is frequently found bent at right angles to itself. But it wrestles in vain with a veritable Hydra, which, having killed its centre, spoiled and occupied its bark, and invaded anew the little living wood that remains, now gradually completes the work of destruction.

While the Mistletoe is thus affecting the branch in its immediate neighbourhood, it is producing, by interception of its juices, atrophy of that portion beyond it. With the increase of the parasite this interception becomes complete, and the atrophied portion of the branch dies.

The death of the supporting branch thus precedes that of the Mistletoe; but decay first affects the softer wood of the parasite, and its roots quickly crumble down and leave corresponding cavities in the wood, by which the branch is laid open, and thus fully exposed to the inroads of decay; and if the atrophied portion have not already dropped away, it now rots off at the infested part.

Such are the effects produced by the Mistletoe on large branches of the Maple; and I would here record my obligations to my friend, Mr. Frederick Nash, of Ludlow, for having kindly furnished me with most of the material upon which the foregoing observations have been made, and for having pointed out to me, in Oakley Park, near that town, a clump of fine Maples affected in the way I have described. As we were walking, in the spring of the present year, through this wild and beautiful park, we came to the stump of a Maple, six feet high, and between two and three feet in circumference. To one side of it was still attached one of its large primary branches, but it was withered and nearly dead. The cause of the destruction of this tree was sufficiently apparent: round about were strewn portions of its dead decorticated branches, here and there swollen and perforated by roots of the Mistletoe. The solitary attached branch, enormously swollen near its base, and thickly beset with Mistletoe, was fast rotting away, while the parasite still flourished in the little living bark that remained about its junction with the trunk.

EXPLANATION OF THE PLATES.

Plate XXVIII.

Figs. 1, 2, 3. Cross sections of branches of Maple (*Acer campestre*) infested with Mistletoe (*Viscum album*). The branches are hypertrophied to thrice their natural size, and the bark is proportionately thickened, the outer layers being dead and deeply fissured. The taper cellular roots of the parasite are seen converging inwards from all parts of the circumference. The centre parts of the wood are dead. *b, b, b,* woody roots with soft taper prolongations; *a, a, a,* dead roots. Fig. 1 *a,* fig. 2 *a,* completely buried in the wood. Fig. 3 *a,* a large woody root in process of being buried.

Figs. 4, 5, & Pl. XXIX. fig. 6. Longitudinal sections of a branch of Maple, made in a direction parallel, or nearly so, to the medullary rays. Fig. 4 represents a young plant situated in the hypertrophied bark, and sending down vertical roots towards the wood, and horizontal ones between the layers of the bark, illustrating the way in which the outer layers of the bark are separated from the living layers beneath them. Figs. 5 & 6 show the longitudinal course of the lateral roots in the bark, and the production of secondary roots and stems from them. The vertical roots in this section are observed to be parallel to each other, and to be wider than when seen in cross sections of the nourishing branch.

Plate XXIX.

Fig. 7. Section of a similar branch of Maple made at right angles to the medullary rays, showing the roots of the parasite in transverse section. Those about the centre of the figure are seen to be enveloped by dead wood. Some have crumbled away and left channels.

Fig. 8. Cross section of a branch of Hawthorn (*Cratægus oxyacantha*) hypertrophied to about three times its natural thickness. The conical woody base of the Mistletoe is prolonged into a cellular root, which terminates at the central pith. The divergence of the woody fibres of *Cratægus*, and the coincidence of the woody layers of the two plants, are well seen: *a,* two roots curving in correspondence with the medullary rays.

Fig. 9. Cross section of a dead branch of *Cratægus oxyacantha,* which has been much infested with Mistletoe: *a, Viscum album.* The extreme divergence of the woody fibres, and the grooving of the stem by the arrest of its development in the direction of the dead roots and its hypertrophy in connexion with those which have lived subsequently, are here shown. The dark radiating lines indicate the position formerly occupied by roots of the parasite.

Fig. 10. Transverse section of a branch of Crab (*Pyrus malus*), bearing *Viscum album* (*c*). The hypertrophy of that side of the branch upon which the Mistletoe is situated is well shown.

Fig. 11. Transverse section of a branch of Hawthorn, and longitudinal section of the roots of *Viscum album* contained in it. Their convergence, the opening out of the woody layers towards the roots of the Mistletoe, and the transverse rhizomata and their effect in destroying the bark and arresting the development of the wood are seen in this section.

Fig. 12. Longitudinal section of *Populus nigra*, bearing *Viscum album*. The nipple-shaped processes towards the wood are the oblique sections of the cellular roots in which the base of the parasite terminates. The branch is atrophied and dead above (*a*).

Plate XXX.

Fig. 13. Section of the wood of Maple (*Acer campestre*) and of five young roots of the Mistletoe perforating it, taken at the distance of about $1\frac{1}{2}$ inch beneath the bark ($\times 5\frac{1}{2}$). The tissues of the wood are divergent around the roots, and are otherwise much distorted by their proximity. Each root appears to be enlarging itself by absorbing and distending the tissues around it. Towards *a*, two of these roots have become confluent.

Fig. 14. Section of wood of Maple and a young root of *Viscum album*, made at right angles to the medullary rays ($\times 60$): *a, a,* medullary rays of Maple; *b, b,* pitted ducts diverging with the woody fibres around the root. Contiguous to the lower part of the root the tissues of the wood are partly absorbed, and at several parts of its circumference the medullary rays are seen to be confluent with the root. *c,* radiating plates of prosenchyma and slitted vessels: the latter become larger and more delicately reticulated externally, and form the reticulated ducts. Some of the parenchymatous tissue between the young woody plates is not represented.

Fig. 15. Upper part of fig. 14, $\times$ 250: *a, a,* medullary rays; *b,* pitted ducts of Maple; *c,* reticulated ducts of *Viscum,* cut across.

Fig. 16. Wood of Maple, and *Viscum*-root, seen in oblique section: *a, a, a,* medullary rays of Maple; *b,* wood-fibres and ducts of Maple; *c,* cells composing *Viscum*-root.

Fig. 17. Section of wood of Maple and cellular root of *Viscum,* at right angles to the woody fibres and ducts of the former, and horizontally parallel with the long axis of the latter, $\times$ 250: *a,* woody fibres and ducts of Maple cut across; *b,* parenchymatous cells and reticulated ducts of *Viscum*-root, the long axes of both at right angles to the prosenchymatous cells and ducts of Maple.

Fig. 18. Vertical section of *Populus nigra* and *Viscum album* ($\times 100$), taken from the surface and made at right angles to the medullary rays: *a, a, a,* reticulated ducts of *Viscum,* between which lies the parenchymatous tissue composing the hypertrophied medullary rays (the ducts at their junction with *Populus* are cut across); *b, b,* pitted ducts of *Populus,* with medullary rays and wood-fibres intervening.

Fig. 19. Transverse section of the coincident woody layers of the same: *a, a,* thin-walled parenchymatous cells of medullary rays; *b, b,* thick-walled dotted cells of the same; *c,* reticulated ducts of *Viscum,* seen first in oblique section, and then at their junction with *Populus* in longitudinal section; *d, d,* medullary rays of *Populus* parallel with those (*a, b*) of *Viscum*; *c,* ducts of *Populus* cut across obliquely, as are the woody fibres also.

Fig. 20. Vertical section of *Cratægus oxyacantha* and woody base of *Viscum album,* taken from the surface and at right angles to the medullary rays: *a,* ducts of *Viscum,* with medullary rays in transverse section intervening; *b,* medullary rays of *Cratægus,* in transverse section, with ducts and fibres intervening. The ducts of *Viscum* are cut across at their junction with *Cratægus.*

All the figures, except 13, 14, 15, 16, 17, 18, 19, & 20, are of natural size, and were taken while the specimens were moist with sap.

Vincent Brooks, Imp.

J. Harley del. Fitch lith.

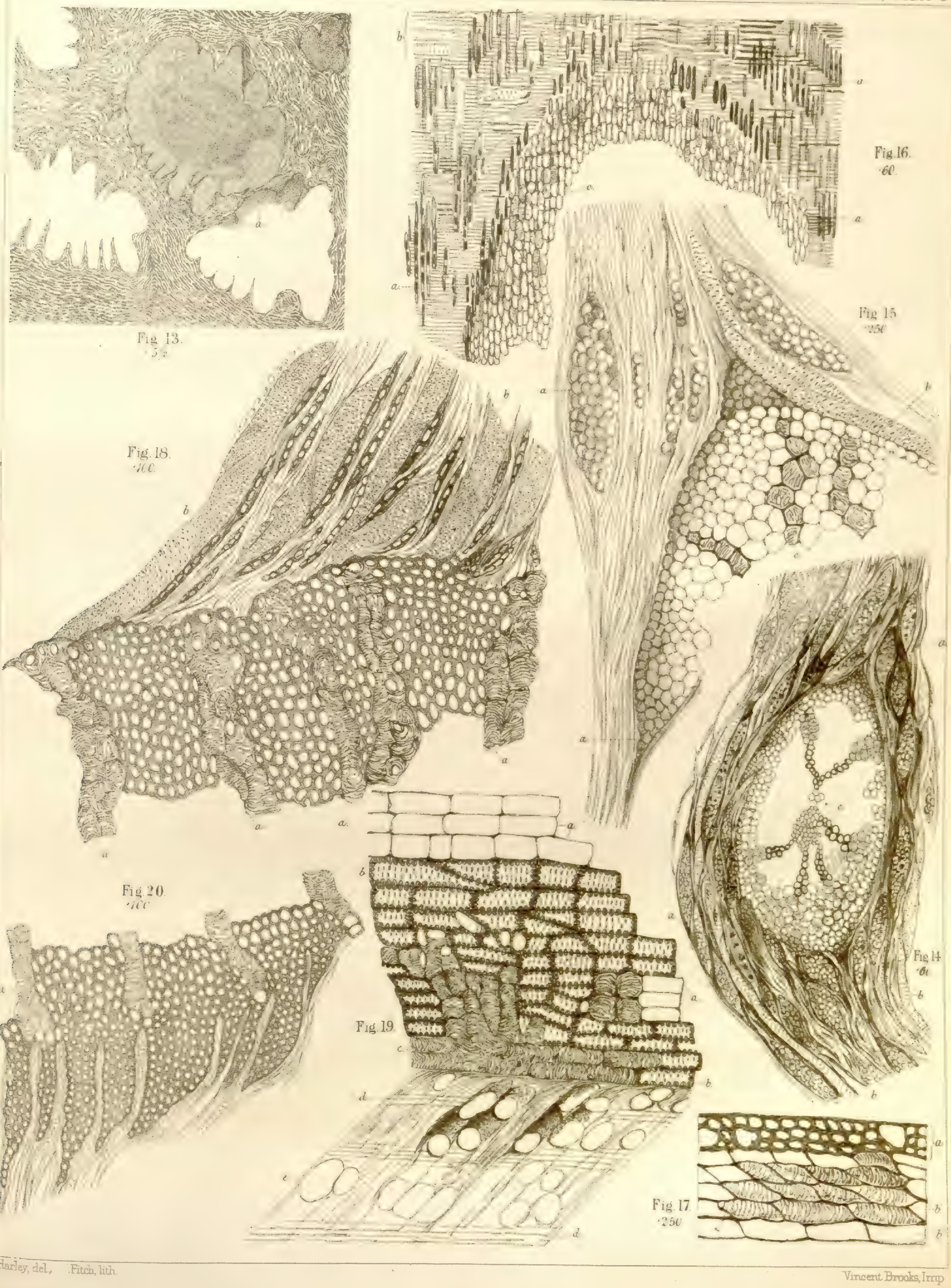
Fig. 13.
Fig. 16.
·60.
Fig. 15.
·250
Fig. 18.
Fig. 14.
Fig. 20.
Fig. 19.
Fig. 17.
·250

XII. *Notes on some new or little-known Species of Freshwater* Entomostraca. *By* John Lubbock, *Esq., F.R.S., F.L.S., &c.*

(Plate XXXI.)

Read June 18th, 1863.

CYCLOPIDÆ.

Cyclops.

At the time when Dr. Baird published his excellent work on the British Entomostraca*, although many species of *Cyclops* had been described, principally by Koch, yet the characters used by that author were not those upon which new species could in that group be properly established, and accordingly Dr. Baird exercised a wise discretion in uniting them under a single head. Since the appearance of his work, Continental naturalists have carefully studied the genus, and have ascertained certain differences which may be satisfactorily used as specific characters, and which, as I have already observed in the 'Transactions' of this Society (vol. xxiii. p. 176), are found principally in those organs which exhibit secondary sexual differences.

Considering that they are among the commonest inhabitants of our fresh waters, that probably there is not a weedy pond in the country which does not contain two or three species, it is somewhat remarkable that the genus should have been so completely neglected by our English zoologists; and yet I am not aware that any one has written on the Freshwater Cyclopidæ of Great Britain since the appearance of Dr. Baird's work, or has attempted to compare our English forms with those described by the foreign carcinologists, and especially by Claus and Fischer.

I have now to record seven species which occur in our Kentish ponds; six of which, namely, *C. serrulatus*, *C. coronatus*, *C. tenuicornis*, *C. brevicaudatus*, *C. canthocarpoides*, and *C. brevicornis*, have been met with on the Continent; but the seventh appears to be new, and I have much pleasure in dedicating it to Professor Claus, who has contributed so much to our knowledge of the genus.

Cyclops serrulatus, Fischer, Bull. de la Soc. des Nat. de Moscou, 1851–52.

In this species the antennæ have only twelve segments.

Female. The figures given by Fischer and Claus of the anterior antennæ are not altogether correct. The hairs are not, as might be inferred from the figure given by Claus, inserted on both sides of the antenna, but, as usual, are, with the exception of the three apical segments, confined to the anterior side. The hairs on the basal segments are in the figures neither sufficiently numerous nor unequal. For instance, the basal segment has at least eight hairs of different lengths, the one at the apex being the longest. Again,

* 'Natural History of the British Entomostraca,' by W. Baird. Printed for the Ray Society, 1840.

the fourth segment, counting always from the base, has several more hairs than in Claus's figure. Besides the long seta at the middle of the segment, is another at the apex, which is quite as long, and had probably been accidentally broken off from Claus and Fischer's specimens. The three terminal segments increase respectively in length, and decrease in breadth. In the centre of the apical segment, on the posterior side, is a small notch and a minute hair. The terminal setæ are six in number, the central one being the longest. The penultimate setæ are correctly figured by Claus, except that he makes them a little too short, the anterior penultimate being in my specimens as long as the apical segment—though upon this point Fischer agrees with Claus. I could see no trace of the ridge described as running along the three terminal segments.

The antennæ of the second pair have, as usual, on the basal segment a long setose hair, which points backwards. The posterior margins of the two apical segments have a row of short hairs. The antepenultimate has some short spines, and the basal segment a row of fine teeth. The apical hairs differ in length more than they do in Claus's figure.

The figures given by Claus of the mouth-parts are very correct.

The posterior legs consist of a single segment terminated by three setæ, which, however, in my specimens, are by no means similar to one another, as they are represented in Claus's figure. On the contrary, the inner hair is flat, lanceolated, and provided with similar flat secondary setæ at the side. The other two hairs are simple setæ, the outer one being rather more than half as long as the other.

The abdomen* is as described by Claus.

The young, when one day old, is rounder than that of *C. brevicornis*; the appendages also are shorter. The anterior pair is inserted so far back that only the apical segment projects beyond the margin of the body.

It seemed to me that the anterior appendages had two equal terminal setæ, that the penultimate segment had one seta at the apex and one in the middle, and the antepenultimate one at the apex. This, also, agrees with the arrangement in *C. brevicornis*. In addition there were a few smaller hairs, none of which, however, appeared to me to be seated at the apex.

The large spine at the base of the second pair of appendages seemed to me to be single, but to give off one or two short and small hairs; in Claus's figure it is double; from which and from other indications I am inclined to think that the specimen figured by Claus was not in its first state. The second segment bears, as in Claus's figure, two short hairs. The lower branch is as in *C. brevicornis*. The larger branch consists of a large basal segment, followed by two or three imperfect divisions, and terminated by a longer, narrower terminal segment. The basal segment has a small hair, the second and third have each a long seta, the fourth again has a short hair, and the apex has a long seta and a shorter hair.

The third pair of appendages are formed on the same type as in *C. brevicornis*. The small branch bears three setæ, the middle one of which is the largest, and the inner

* While adhering to the views I have already expressed (Nat. Hist. Rev., vol. i. p. 29) as to the homologies of the so-called "thorax" and "abdomen" in Crustacea, I use the words here in their usual sense, being reluctant to complicate our nomenclature by any peculiar system of my own.

one the smallest. The shortness, however, of all the appendages in the young of this species makes it rather difficult to ascertain their form and the arrangement of the hairs. Between the caudal setæ is a fringe of short hairs.

This, which is one of the smallest species belonging to the genus *Cyclops*, was described by S. Fischer in the Bull. de la Soc. des Nat. de Moscou, 1851–52, p. 423. It appears to be a hardy species, and lives well in confinement.

Kent.

Podophrya Cyclopum does not appear to be very common in Kent; but I have found specimens of it on this species.

Cyclops coronatus, Claus, Wiegmann's Arch. 1857, p. 29. Antennæ primi paris septendecim-articulatæ, ultimo annulo crista præditæ serrata, corpus anticum (cephalothoracem) minime superantes: antennæ secundi paris magnopere elongatæ; annulus earum secundus brevis, margine inferiore convexus; ciliatus tertius tenuis, cylindricus, quartum longitudine fere superans. Long. fem. (inclusis setis apicalibus quatuor) 3–5 mm.

In the drawing of the anterior antenna, Claus represents the hairs much too uniform in length. Thus the fourth segment bears two long setæ, and the fourteenth one long seta, which are erroneously figured of the same size as the other setæ. The two posterior subapical setæ also are longer than the segments to which they respectively belong. At the centre of the terminal segment is a small seta, which Claus has wholly omitted; and he has also left out a good many of the setæ on the basal segments. The eighth, ninth, tenth, twelfth, thirteenth, and fourteenth segments have a row of spines at their anterior ends, as described by Claus.

The second pair of antennæ is correctly figured by Claus, except that the spine on the posterior side of the basal segment is, as usual, long and setose.

The upper lip has fifteen teeth, counting the two large ones as external, and omitting one or two slight eminences on the outer side of the large teeth. Three or four of the central ones projected very slightly.

The inner maxillary foot is as in Claus's figure, except that the terminal seta is much too small.

The outer maxillary foot also is as in Claus's figure, except that the small setose spine on the finger-like projection of the third segment is inserted on the outer side of the great spine. Both of the great terminal spines of the same segment are spinose on one side; and close to their base is inserted a short hair. The terminal segment has two great spines, one smaller one, and two hairs; but there is no hair at the base of the segment, as in Claus's figure.

The basal segment of the posterior legs bears a long spine, plumose at the free end. The three spines by which the second segment is terminated are in Claus's figure equal and similar to one another. This, however, is not the case in my specimens. The two outer setæ are plumose, and the central one is nearly twice as long as the other. The inner hair is flat, somewhat lanceolate, and provided with short lateral appendages. This hair is as broad at the base as the central seta, but is much shorter.

This segment strongly resembles, nay, is almost identical with the corresponding leg of *C. serrulatus*, which consists only of one segment; and we may therefore conclude that in this species neither the basal segment nor its spine are developed. As the peculiar arrangement and form of the three terminal setæ are the same in these two species, while in other nearly allied forms they are altogether different, we may, I think, conclude that this organ, though minute, still subserves some important function in the economy of the animal, and doubtless one connected with the reproduction, for which its minuteness is one of the necessary conditions, and therefore affords no reason for considering these appendages as truly rudimentary organs.

The abdomen and caudal setæ agree with the description and figures given by Claus.

Chiselhurst. February.

Often of a dark greenish-blue colour.

Cyclops brevicornis, Claus, *l. c.* p. 32. Antennæ primi paris septendecim-articulatæ, breves, primum cephalothoracis segmentum paullulum superantes. Pedes quinti paris rudimentarii, simplices, bisetosi. Abdominis segmenta in postremo margine parvulis dentibus prædita. Long. fem. 3–5 mm.

The figure given by Claus represents the hairs on the antennæ shorter and more uniform than they are in my specimens. For instance, the large hair on the fourth segment, counting as usual from the base, is longer than the six succeeding segments. Again, the seta on the antepenultimate segment is longer than the three terminal segments. The two posterior penultimate setæ, instead of being shorter than the two anterior setæ of the same segments, are at least twice as long. These latter are correctly represented by Claus, but the former are not half long enough. The apex of the antenna is terminated by the usual number of setæ, namely seven, while Claus only gives five.

The second pair of antennæ also is terminated by seven setæ.

The labrum is correctly figured by Claus: one specimen that I examined had eleven teeth, and another only ten.

Maxilliped as in Claus's fig. 4, pl. 3, except that the terminal segment had three spines and two hairs, instead of two spines and three hairs.

The abdomen and caudal setæ are as in the figure given by Claus, but the inner setæ are rather thinner, and the lateral spine is weaker. The lamellæ are $\frac{12}{2000}$ of an inch in length, $\frac{5}{2000}$ in breadth at the base, and $\frac{3}{2000}$ at the apex. The internal seta is $\frac{30}{2000}$ in length; the exterior of the four terminal setæ is $\frac{12}{2000}$ in length.

Common in ponds at Farnborough and Chiselhurst, in Kent, &c.

The egg-sacs are elongated and narrow.

Cyclops brevicaudatus, Claus, *l. c.* p. 34. Antennæ primi paris septendecim-articulatæ, secundum cephalothoracis segmentum superantes. Pedes rudimentarii; secundus annulus bisetosus. Setæ apicales parum ciliatæ, brevissimæ, furcam longitudine paulo antecedentes. Long. fem. 2–4 mm.

This species is principally characterized by the shortness of the caudal setæ, which in the above description are said to be a little longer than the lamellæ, though in Claus's figure, with which also my specimens agree, they are almost exactly twice as long.

Common at Chiselhurst.

Cyclops Clausii, n. sp. (Pl. XXXI. figs. 12, 13, 14.) Antennæ primi paris septendecim-articulatæ, secundum cephalothoracis segmentum non superantes. Pedes quinti paris parvuli, trisetosi. Furca caudalis longa, setis longis.

The first cephalothoracic segment is longer than the four following.

Female. The anterior antennæ are seventeen-jointed, and the segments are of the usual proportions. The terminal segment (Pl. XXXI. fig. 13) has, as usual, seven terminal setæ, one of which is quite short, five out of the six others are long and delicately plumose. At the centre of this segment, and on the posterior side, is the usual notch, with a short hair. The penultimate segment has three setæ at the apex—one at the posterior side considerably longer than the segment, and two at the anterior side somewhat shorter than the segment. They do not differ much in length, but one is stouter than the other, and plumose. The antepenultimate segment has only two hairs, which correspond in form and position to the two larger ones of the following segment. The fourth segment has one long seta, which is not inserted on the posterior side, but is generally bent over in that direction, as so often happens with this hair in the Cyclopidæ. The whole organ reaches about to the end of the second cephalothoracic segment.

The second pair of antennæ offer no special peculiarities. The three terminal segments are ciliated on the posterior side, and the basal segment bears, besides the usual long setose hair, a few very short and stout spines. On the anterior side the basal segment has two setæ, the second one, the third nine, and the fourth seven. The whole organ is stouter than Claus's figure of that belonging to *C. coronatus*.

The inner maxillary foot resembles Claus's figure of that in *C. gigas* (*l. c.* pl. 11. fig. 3). The terminal segment, however, has only three setæ, of which one is very large, one very small, and the third intermediate both in size and position. The third segment is somewhat shorter and stouter than in the figure given by Claus, and has two spines.

The posterior legs of the female (Pl. XXXI. fig. 14) are two-jointed. The basal segment bears one seta; the second has two, one of which is quite short, and has the form of a strong spine. The organ, therefore, most nearly resembles that of *C. furcifer*; but the terminal segment is more quadrangular, and the attachment of the long seta appears to vary slightly: sometimes the end of the segment was truncated, and the seta only occupied a part of the termination, at others it tapered slightly, and the seta occupied the whole extremity.

The shapes and relative sizes of the abdominal segments offer no special peculiarities; the posterior margin of the last is serrated, but the other segments have plain margins.

The caudal lamellæ (Pl. XXXI. fig. 12) are long, ciliated on the inner margin, and their length is between five and six times their breadth. The arrangement and proportions of the setæ resemble those of *C. gigas*, as figured by Claus (*l. c.* pl. 11. fig. 5); but the external seta is situated rather nearer to the end of the lamella, and is attached in a notch, from which a ridge proceeds to the hinder end of the lamella. Of the four terminal setæ, the inner one is about twice as long, but no stouter than the outer. The two great medial setæ do not differ much in length, and are about twice as long as the lamella.

Male. The male is altogether slimmer than the female.

The second pair of antennæ and the parts of the mouth resemble the corresponding organs in the female.

The abdomen is longer and thinner than in the female; it is four-jointed, and the segments diminish progressively in size, the first being but little bigger than the second, while in the female it is as large as the other three put together. The caudal lamellæ also and the setæ resemble those of the female, but that the two larger terminal setæ are more unequal.

The posterior legs are in the form of a simple lobe, bearing three setæ, of which the one on the outside is the largest, and that on the inner side is the smallest.

The egg-bags are at first greenish, but gradually become light pink.

Common in a pond on Farnborough Common in Kent, May 1861; and also in a horse-pond at Reigate, in July; at Chiselhurst Common, in February, March, April, and September.

The male seizes hold of the penultimate legs of the female with his prehensile antennæ.

This species may of course be at once distinguished from all those with less than seventeen segments to the anterior antennæ; from *C. coronatus* and *C. tenuicornis* it may be known by the shortness of the antennæ and the form of the posterior legs; *C. pennatus* differs in the length of the antennæ, and in having the caudal setæ remarkably plumose; *C. viridis*, *C. crassus*, *C. brevicornis*, and *C. Leuckarti* in the shortness of the caudal lamellæ; and the two latter, as well as *C. bicuspidatus* and *C. gigas*, in the form of the posterior legs; *C. strenuus* and *C. vernalis* (if S. Fischer's figures are quite correct) in the setæ of the caudal lamellæ and of the anterior antennæ; *C. furcifer* has narrower and more elongated lamellæ, and the caudal setæ, as well as those of the anterior antennæ, are unlike those of the present species. Finally, *C. brevicaudatus* is described by Claus as having the second segment of the posterior legs bisetose, and the caudal setæ little longer than the lamellæ.

Cyclops tenuicornis, Claus, *l. c.* p. 31. Antennæ primi paris septendecim-articulatæ, elongatæ; ultimi tres annuli tenuissimi, cristam simplicem gerentes. Abdominis segmenta in longitudinem extensa.

Chiselhurst, in June and July.

This species is very nearly allied to *C. coronatus*, if indeed distinct.

Cyclops canthocarpoides, Fischer.

This species may at once be known by its having only ten segments to the anterior antennæ, which are very short, and do not even reach to the end of the first cephalothoracic segment. The arrangement of the caudal setæ gives it the look of a *Canthocarpus*. The fourth abdominal segment is short; one of the two terminal setæ of the abdomen is much longer than the other, and the lateral ones are short.

Chiselhurst.

PONTELLADÆ.

DIAPTOMUS.

The remarks above made with reference to *Cyclops* are to a certain extent applicable also to the genus *Diaptomus*. Müller described three species, under the names *D. cæruleus*, *D. rubeus*, and *D. lacinulatus*; but the characters which he gives have been regarded as unsatisfactory by most of those who have subsequently written on the genus. S. Fischer, however (Bull. de la Soc. des Nat. de Moscou, 1853), has described two very distinct species, which he refers to Müller's *C. cærulea* and *C. lacinulata*. The *Cyclopsina lacinulata* of Fischer is probably our *D. castor*; and his *C. cærulea* resembles in many respects a new species, which I have now to describe, and which I propose to call after Mr. Westwood, the founder of the genus.

DIAPTOMUS WESTWOODII, n. sp.

The *cephalothorax* consists of seven segments, of which the second is the largest, and the last is quite short. Seen from above, the cephalothorax of the male resembles the figure given by Baird, but it ends in a small spine (Pl. XXXI. fig. 5.): in the female the posterior segment is expanded and ends in two spines (Pl. XXXI. fig. 1); it resembles, therefore, the figure given by Liljeborg (*l. c.* pl. 26. fig. 1).

The *anterior antennæ* consist of twenty-six segments, and are in the male as long as, and in the female rather longer than the body. The terminal segment is small. The apical and subapical setæ are subequal in size. The penultimate, antepenultimate, and the preceding segments have each of them a long hair at the posterior side. The hair at the anterior side of the apex of the penultimate segment is large; the corresponding hairs on the two preceding segments are about as long as the segments to which they belong, while that on the twenty-first segment is again much larger. All these hairs, except the usual lanceolate* one at the apex, are plumose. The left antenna of the male resembles that of the female; but the right is swollen and prehensile. The sixteenth, seventeenth, eighteenth, nineteenth, and twentieth segments are specially enlarged for the reception of the powerful flexor muscle; and most of the setæ on them are shortened and thickened.

The bend takes place between the twentieth and twenty-first segments. The twenty-first and twenty-second segments have coalesced so completely, that, but for the arrangement of the setæ and the analogy with *D. castor*, they might have been taken as a single segment. The twenty-third and twenty-fourth have united in a similar manner, and the latter bears a sort of tooth at its apex. On the seventeenth, eighteenth, and nineteenth segments one of the setæ assumes the form of a rod with a hook at the end.

* M. Schultze (Arch. für Naturgeschichte, 1862, p. 356) attributes the observation of these lanceolate hairs to M. de la Valette, in 1857, and Leydig, in 1860. As long ago, however, as the year 1853 (Ann. & Mag. of Nat. Hist. p. 160, &c.) I had called special attention to these peculiar appendages, and pointed out that they held certain definite positions, although I did not hazard an opinion as to their exact function. Again, Mr. Spence Bate, in his "Report on the British Edriophthalma," published in the Journal of the British Association for 1855, p. 29, describes them under the name of "membranaceous or auditory cilia"—a name which sufficiently indicates his views as to their use.

The two terminal segments have undergone no material alteration.

The *second pair of antennæ* closely resembles the figure given by Liljeborg (*l. c.* pl. 13. fig. 7); but the second segment of the branch "a" has four setæ, and the apex of the basal segment of the branch "b" has a row of small spines on the inner side.

The *mandibular palpus* is also well figured by Liljeborg (*l. c.* pl. 13. fig. 10); but the terminal segment of the larger branch has seven large setæ in addition to the smaller one, which does not in reality form part of the series. The mandibular teeth are nine in number.

The *anterior maxilla* is also well figured by Liljeborg, but the plate "*a*" had in my specimen seven large hairs, besides the small one.

The *second pair of maxillæ* offers no special peculiarity.

The *maxillipeds* consist of seven segments. The basal one has ten strong setæ, the second five, the third three, the fourth and fifth two each, the sixth two (one on each side), and, finally, the seventh four.

The *anterior pair of legs* also are correctly figured by Liljeborg; but in my specimens the setæ were longer in proportion to the legs themselves. The outer branch has three, the inner only two segments. In the other legs both branches consist of three segments.

The *fifth pair of legs* can easily be distinguished from that of the other species.

Like the other pairs, they consist of a two-jointed basal portion and two branches. In the *female* (Pl. XXXI. fig. 4 *a*) the inner branch is two-jointed, and is either cylindrical or club-shaped, according to the aspect from which it is regarded. It has two or three rudimentary spines near the apex. The outer branch (Pl. XXXI. fig. 4 *b*) is also two-jointed. The basal segment is rather longer than broad; the terminal segment is short, and ends in two great and two small spines. In the male they are quite unsymmetrical, one being more than twice as long as the other. Both of them, however, consist of the usual parts—namely, a basal two-jointed portion bearing at the apex two branches. The basal portion is in this case normal, and but slightly unsymmetrical. In the longer leg the inner branch is reduced to a simple cylindrical appendage (Pl. XXXI. fig. 3 *a*). The outer branch (Pl. XXXI. fig. 3 *b*) consists of two segments: the basal is cylindrical, and bears a strong spine on the middle of its outer side; the terminal segment is in the form of a long, narrow, sickle-shaped spine.

The shorter leg (Pl. XXXI. fig. 3 *c*) has a small one-jointed inner branch. The outer branch is also small, and bears a setose spine, which probably represents the terminal segment.

The *abdomen* in the female is three-jointed, and the basal segment has a spine on each side. The lamellæ are not longer than the last segment, and bear six plumose setæ, of which the five outermost are very stout. The inner borders of the lamellæ also are plumose. The abdomen of the male consists of five subequal segments. The inner seta is more than half as long as the others, but much narrower and not plumose. Near the base is a portion (Pl. XXXI. fig. 6 *a*) distinguished by the walls being suddenly and conspicuously thinner than elsewhere. At first I looked on this as an accidental variation, but I have since found the same structure in all the specimens I have examined, not only of this species but of *D. castor*.

Common in ponds in Kent.

It is generally colourless, but often red.

The females carry their egg-sac in spring and autumn, and generally float in a more or less perpendicular position.

Length $\frac{1}{15}$ of an inch.

DIAPTOMUS CASTOR, Jurine.

The anterior antennæ are shorter than the body. The apical seta on the anterior side of the twenty-third segment is large (Pl. XXXI. fig. 7 *a*), while in *D. Westwoodii* it is quite small (fig. 1 *a*). The right anterior antenna is very much like that of the preceding species; but a careful comparison of the figures will show several slight differences: for instance, there is in *D. castor* no tooth at the apex of the twenty-fourth segment.

The inner branch (Pl. XXXI. fig. 11 *a*) of the fifth pair of legs is in the female cylindrical, and consists of two well-marked segments. At the apex it bears three spines—one small, one large, and one of middle size. The large one is spinose. The outer branch is much larger. The inner margin of its second segment (*b*) is produced into a great spine; hence it comes to pass that the terminal portion of the branch (*c*) is apparently situated, not at the apex, but on the outer margin and not far from the base of the second segment. Unlike as this branch is to the corresponding organ in the other species, it is easy to see that it is composed of the same parts.

The fifth pair of legs in the male (Pl. XXXI. fig. 10) do not differ so much from those of the other species; they are, however, somewhat longer in proportion. The inner branch (*a*) of the right leg is two-jointed.

The posterior segment of the cephalothorax and the first of the abdomen resemble the figure given by Liljeborg (*l. c.* pl. 13. fig. 6), but the posterior angles of the cephalothorax are less expanded, and the angle *a* was in my specimens rounded off. These parts are somewhat unsymmetrical.

Colour reddish.

With the preceding, in Kent. The females carry their eggs in April.

Length $\frac{1}{10}$th of an inch.

APODIDÆ.

LEPIDURUS PRODUCTUS.

The genus *Lepidurus* was founded by Leach. It differs from *Apus* in having the posterior segment produced into a plate or flap which lies between the caudal filaments, and in the shortness of the anterior legs. The species of this family, though found in large numbers wherever they do occur, are yet but seldom met with, and until last year I had never seen any of them alive.

During a visit to the north of France made last spring with Mr. Prestwich and Mr. Evans, principally in order to compare the river-gravels of the Seine valley with those of the Somme, we fortunately chanced to visit, among many others, a gravel-pit at Pont de l'Arche, near Rouen. After an ineffectual search for flint implements, I went to look at some nearly dried-up pools of stagnant water, when I was delighted to find them occupied by great numbers of this interesting species. Still *Lepidurus productus*, though not often met with, has been so well described that I should perhaps not allude to it, but that among the specimens I collected there are a considerable number of males, while, so far as I am aware, the female sex is the only one which has hitherto been met with. My specimens differ in some points from the descriptions and figures given by preceding authors.

Schäffer ('Abhandlungen von Insecten,' erster Band, p. 182, pl. 7), who was the first to describe this species, had before him, as he expressly says, only young specimens. The form of the caudal lamella, however, changes with age, and consequently the figures given by Schäffer and copied by Latreille (Hist. Nat. des Crust. et Insect. vol. v. p. 28) do not correctly represent the form which is characteristic of mature specimens. The figure given by Milne-Edwards (Hist. Nat. des Crust. pl. 35. fig. 5) represents a full-grown (or nearly full-grown) individual; but the form of the caudal lamella is not quite correct; at least in my specimens it is more regularly oval, the base being narrower, and the extremity sometimes entire, sometimes notched, as in the figure.

Dr. Baird, in his "Monograph of the Apodidæ" (Proc. Zool. Soc. 1852; Ann. & Mag. Nat. Hist. 1854, vol. xiii. p. 221), describes three species of the genus, and uses as one of his specific characters the extent to which the body of the animal is covered by the carapace. My specimens, however, varied a good deal in this respect; in some of them the carapace left the seven posterior segments uncovered, while in others of the same size it extended to the base of the caudal setæ, and in one it even covered a large part of the caudal lamella. The carapace, however, in all my specimens covered a larger portion of the body than appears to be the case in either of the two other species.

I mention these differences because they show that both the form of the median caudal lamella, which changes with age, and the relative size of the carapace, which appears to vary so much in different animals, are characters which, though very useful, must be employed with great caution in the establishment of new species.

Both Schäffer (*l. c.* pl. 2. fig. 5 *i*) and Baird (British Entomostraca, pl. 1. fig. *d*) represent the "triangular" plate of the anterior legs in *Apus* as rounded at the upper end, whereas in my specimens of *Lepidurus* it was pointed. The "rami" have a series of notches on each side, which give an appearance of joints. The longest filament has about twenty notches on each side, the second about fourteen, and the third only eleven, while in *Apus cancriformis* the two longer rami are described as having respectively about sixty and fifty segments.

On the other hand, as if to counterbalance the shortness of the anterior pair, the following legs are decidedly longer and stronger in *Lepidurus productus* than in *Apus cancriformis*. The pseudosegments, however, even of the longest appendage are not more than ten in number. Schäffer and Baird agree in representing the two terminal appendages of *A. cancriformis* as being nearly equal in size. In *L. productus* the outer one is much smaller, unjointed, broad below, and contracted above.

In the following legs the triangular plate and the oval appendage become gradually larger, while the other appendages become shorter and broader, with the exception of the small one at the apex, which, on the contrary, becomes larger and larger, until in the seventh pair it is as long as its companion. It also developes on its inner edge a row of simple conical teeth.

The eleventh pair is in the females developed into an egg-cup, as is the case in *Apus*.

Apus cancriformis is described as having sixty pairs of legs, of which the first eleven correspond to eleven somites, the rest to seventeen or eighteen somites, leaving five or six segments to which no legs are attached. This makes thirty-four postcephalic segments. According to Baird, however, there are only thirty. In one of my largest specimens I found the number of segments to be twenty-eight, exclusive of the head. The pairs of legs were forty-two in number.

Male. After the first notice of the genus *Apus* by Jacob Frisch in the year 1732, more than a century elapsed before the male was discovered. Satisfied that all his specimens were females, and laying it down as an axiom that "aus einem unbefruchteten Eye eben so wenig ein lebendiges Thier werde, als aus gar keinem Eye," Schäffer assumed that the Apodidæ were hermaphrodites, although he was unable to discover any male generative organs. Berthold came to the same conclusion, but, in addition, considered that he had solved the mystery, and that the semen was secreted in certain sacs sometimes found among the legs. This supposition was refuted by Zaddach, who, however, thought that he had found the male orifice in two small eminences on the posterior segment not far from the median line of the back, and surrounded by three or four spines; these, though with some doubt, he considered to be the retracted penes.

At the meeting of the German Naturalists at Breslau in September 1833, Professor Retzius announced that M. Kollar, of Vienna, had at length discovered the male of *Apus*. Neither Baird, however, nor Zaddach has been able to find any further account of this interesting discovery; nor do I find any memoir on *Apus* attributed to Kollar in the useful 'Biblographia Zoologiæ,' published by the Ray Society in 1852.

Under these circumstances the credit of being the first to describe the male of *Apus* appears to belong to Dr. A. Kozubowski, Professor in the University of Cracow, who has published a memoir on the subject in Wiegmann's 'Arch. für Naturgeschichte' for 1857.

The males of *Lepidurus productus* may be distinguished from the females in the same manner as those of *Apus cancriformis*. In general form there is no apparent difference; but the eleventh pair of legs, which in the female is specialized into an egg-holder, remains in the male of the usual type, and is in size and form, as in position, intermediate between the ninth and the eleventh pairs.

Among 160 specimens Kozubowski found only sixteen males. Among mine they were much more numerous. I examined seventy-two specimens, of which thirty-three were males and thirty-nine females. This proportion, however, is probably but little to be depended on, since in my case most of the large individuals were males and almost all of the small ones were females. Though the greater number of my specimens were small, still as it is natural to take the large individuals first, the small ones were doubtless more numerous proportionally than my collection would indicate.

Kozubowski mentions that in *Apus* the male, though livelier and stronger than the female, is about one-third shorter. So far as my observations at present go, this is not the case in *L. productus*. As I have just mentioned, of my largest specimens the great majority were males; on the other hand, it must be admitted that none of them were more than, or even quite so much as an inch and three quarters in length, and, as the species is stated to attain a length of two inches and a half, it is still possible that the full-grown females may be considerably larger than the males.

Homologies.—"The Phyllopoda" (says Prof. Dana) "in which the number of segments exceeds the normal number, offer a difficult problem to science, viz. the determination of the normal relations of the appendages. In *Branchipus* the number of segments is twenty-two, of which *nine* belong to the abdomen, *eleven* to the body posterior to the second pair of maxillæ, *seven* being the normal number for the former, and *eight* for the latter. In *Limnodia* there are eighteen or twenty-seven pairs of thoracic members following a pair of maxillæ and mandibles. In *Apus* there is a pair of mandibles, then two of maxillæ, then a large series of legs, all of which are more or less foliaceous, excepting the anterior. In *Nebalia* the abnormal character is the same, although their members are not as much multiplied."

And he offers the following explanation of the difficulty:—

"The most natural supposition," he says, "in view of the fact that the members of Crustácea consist normally of three parts or branches, a tigellus, a palpus, and a fouet, is that the multiplication consists in these several parts (two of them or the three) becoming separate legs, and at the same time having separate segments in the body, the normal basal portions of each possibly corresponding to these segments; and possibly we see some analogy also in the multiplication of branchiæ, two or three being often appended to a single leg, in the Decapods."

Notwithstanding the ingenuity of this idea and the great weight of Prof. Dana's authority, I cannot bring myself to adopt this hypothesis. If we examine the relation which the legs bear to the segments, we shall find that the anterior eleven legs are each attached to a separate and well-marked somite. Though the position of the posterior appendages as regards their relation to the segments is not quite so easy to determine, still a glance at the animal will show that the size of the dorsal arches does not decrease in proportion to that of the legs; so that while the twelfth segment has only a single pair, the number gradually increases until we find that the last nine pairs correspond to a single dorsal segment.

But it is evident that these legs are all homologous. Much as the extremes differ from one another, they are connected together by so gradual a series that no one who has examined them can have any doubt on this point. There is, indeed, one apparent exception, namely, the eleventh pair in the females; but this is evidently modified for a special purpose, and the corresponding pair in the males is, as we have seen, of the usual form. Moreover, even if we were to admit (for which, however, we have not the slightest reason, and which would indeed be entirely contrary to all evidence and experience) that this pair is of a different nature to the rest, still it would not be any support to Prof. Dana's hypothesis. Nor can it, I think, be maintained that the sternal segments do not really belong to the dorsal arches with which they appear to correspond;

the composition of the six posterior legless segments is a sufficient refutation of any such idea.

Moreover Prof. Milne-Edwards considers that in the branchial feet of the Phyllopods one can distinguish "trois portions principales ou branches qui semblent représenter les trois parties qui chez les Décapodes constituent la tige principale des pattes ou des pattes-mâchoires, le palpe et le fouet; mais ici toutes ces parties sont lamelleuses." Now, if this is true of the anterior legs in *Apus*, it is true of all; for they all consist of the same parts, however much they may be reduced in the posterior pairs.

But even if we were to admit Prof. Dana's theory, it would not remove his difficulty. The appendages of *Apus* are, first, the eyes; secondly, the antennæ; then the mandibles and two pairs of maxillæ, which of course represent five segments, to which we must add one more for the second pair of antennæ. Now, if we divide the sixty pairs of legs by three, we shall still have twenty leg-bearing segments, which, added to the anterior ones, gives a total of twenty-six; and as Prof. Dana has adopted the theory of Milne-Edwards and Audouin, that the body of a Crustacean consists normally of only twenty-one segments, he has still five intruders for which his hypothesis does not account. But why should we be called on to account for the number of segments in certain Branchiopods? The same character occurs in the Crustacea of the earliest geological periods. In fact the Branchiopods hold the same position with reference to the Crustacea as the Myriapods do with reference to Insects. In conjunction with certain special characters of the Crustacea in the one case, of the Insects in the other, they retain the general Annulose characteristic, of a variable and often great number of similar segments.

We see therefore that the two principal divisions of the Articulata, the Insecta and Crustacea, were already differentiated before the number of segments was limited so strictly as we now find it to be; and we are, I think, thereby led to the conclusion that the posterior segments of *Apus* and its allies have no representatives in the higher Articulata. The body of a Lobster, in fact, corresponds not to that of a mature, but of a young *Apus*; and the forces, perhaps, which in the first have produced a high degree of differentiation have in the other spent themselves on an almost irrelative repetition.

DESCRIPTION OF THE PLATE.

Plate XXXI.

Fig. 1. *Diaptomus Westwoodii.* Female, seen from above, × 30.
Fig. 2. „ „ Right antenna of male, × 60.
Fig. 3. „ „ Posterior legs of male, × 125.
Fig. 4. „ „ „ „ female, × 125.
Fig. 5. „ „ Posterior cepalothoracic segments of male, × 60.
Fig. 6. „ „ Inner caudal seta, × 250.
Fig. 7. *Diaptomus castor.* Extemity of antenna, × 60.
Fig. 8. „ „ Extremity of cephalothorax, × 30.
Fig. 9. „ „ Right antenna of male, × 30.
Fig. 10. „ „ Posterior legs of male, × 125.
Fig. 11. „ „ „ „ female, × 125.
Fig. 12. *Cyclops Clausii.* × 30.
Fig. 13. „ „ Extremity of antenna, × 125.
Fig. 14. „ „ Posterior leg of female, × 125.

J. Lubbock del. G. Jarman sc.

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PART III.—1864.

XIII. *Monograph of the Family of* Nitidulariæ. *By* ANDREW MURRAY, *Esq.*, *F.L.S.*

Part I.

(Plates XXXII.–XXXV.)

Read April 2nd, 1863.

INTRODUCTION.

IT is now some years since I agreed, at the request of Dr. Gray of the British Museum, to prepare a catalogue of the *Nitidulariæ* in the Museum, for the purpose of publication as one of the Museum Catalogues.

It was not without hesitation that I undertook the task. The catalogues published by that establishment had been gradually assuming the character of monographs, embracing not only the actual contents of the Museum collection, with descriptions of the new species in it, but also of its desiderata. I therefore felt that, if I undertook the task of arranging and cataloguing the *Nitidulariæ* in the Museum, I was, in fact, undertaking to write a monograph of that family. And this I knew to be no easy task, "no journey of a sabbath day"—loaded especially as I was with numerous other occupations. It implied the microscopic dissection of the parts of many hundred specimens, and the making of careful drawings of these dissections—a work rendered doubly difficult and laborious by the minute size of the insects to be examined. I knew, too, that its results would bear no proportion to the labour bestowed upon it; and what was perhaps more discouraging, I felt that after it was done there were few from whom I could expect an intelligent appreciation of my work.

Still the subject was not without its attractions. It was allied to one (the genus *Catops*) which I had already monographed. It possessed a special interest from its well-defined character, its affinities with other groups, and the variety of form and structure in its genera.

Influenced by such considerations, I accepted Dr. Gray's invitation. I soon found, however, that the mere preparation for the work would take a long time. The collection of *Nitidulariæ* in the British Museum, although large, had great blanks which required to be filled up. The verification of the different types described by previous authors entailed a vast amount of correspondence and the necessity of personally visiting the great museums in the different capitals of Europe. The subsequent examination of the materials begged or borrowed from all quarters took up years. And when at last my work began to assume a shape fitted for the printer, other engagements entered into by the British Museum, which had precedence of mine, prevented its being then sent to press. On my part other duties by-and-by took up the whole of my time and made me look upon the delay, if not with satisfaction, at least without regret; and it was only in the course of the present winter, when I began again to have a little leisure, that, looking to the uncertainty of human life, I thought it would be well if the information I had accumulated were put beyond the reach of casualties.

Finding from my friend Dr. Gray that it was still uncertain when the Museum might be able to publish my manuscript, I, with his approval, resolved to offer to transfer it to this Society, as likely to bring it out more speedily, should it seem to the Council worthy of that honour.

So much for the origin of this paper. The next point which I should wish to advert to is the materials I have had to work with. This is of some importance, as showing the degree of pains bestowed in perfecting it, and the probable proportion of accessible materials which have been embodied in it. In the first place, then, the Monograph contains the results of examinations of the whole of the specimens in the British and Oxford Museums, of those in the Jardin des Plantes (including Blanchard's and D'Orbigny's types), of those in the Copenhagen Museum, in the Berlin Museum (including Erichson's types), and in the Stockholm Museum (including Bohemann's). It contains those in the private collections of Dr. Leconte of Philadelphia (including the types of his species), those in the collections of the Marquis de Laferté-Sénectère (including Dejean's collection), Chevrolat, Marseuil, Javet, Guérin-Méneville, Fairmaire, Brissot, Chabrillac, Sallé, Deyrolle, Bonvouloir, and most of the other Parisian entomologists, of Lacordaire and Candèze in Belgium, of Schiödte and Westermann at Copenhagen, of Förster at Aix-la-Chapelle (including the types of his species of *Meligethes*), of Riel at Cassel, of Haage and Heyden at Frankfort, of Bruck at Crefeld, of Dohrn at Stettin, of Gerstäcker, Kraatz and Schaum at Berlin (including Germar's types), those of Kiesenwetter at Bautzen, of Obert and Motschoulsky at St. Petersburg, of Märkel at Dresden, of Rosenhauer at Erlangen, of Sturm at Nuremberg (including his types), and of our own chief coleopterists in Britain—Westwood, Saunders, Waterhouse, Parry, Hamlet Clark, Pascoe, Fry, &c. The veteran Wm. Sharpe M'Leay has contributed of his stores in Australia; Mr. Nietner made for me an admirable collection of *Nitidulariæ* in Ceylon; Count Castelnau and Dr. Traill at Siam and Singapore, Mr. Bowring in China, Mr. Hepburn in California, Mr. Wedderspoon in Chili, Dr. Jameson at Quito, and the Hudson Bay Company's officers in the north of America, all kindly added to my materials. Mr. Bates's entire collection of *Nitidulariæ* made on the Amazon was secured for the Museum, as was that of Mr. Wallace made in Celebes, Batchian, and the other places he visited; and the chief dealers in insects, Messrs. Stevens, Deyrolle, &c., preserved for me whatever novelties came into their hands. To numerous other less-known entomologists I owe thanks for their liberal contributions. These have enabled me to do much to increase the collection of the British Museum. To fill its blanks I have also sacrificed my own unique specimens wherever they were required for that purpose; so that it has now become the finest and best collection of this family in the world. One chief value which it possesses is due to my having obtained authentic types of described species from the original describers themselves wherever it was possible. To Professors Peters, Gerstäcker, and Schaum I owe types of a large proportion of Erichson's species. Boheman has given me types of most of his Caffrarian described species. Förster and Rosenhauer gave me their species of *Meligethes*, and Leconte has sent me his newly described Californian and other American species. There are thus not very many species to see authentic types of which it would now be necessary for the student to go beyond the walls of the British Museum.

An estimate of the relative strength of the Museum in this family may be made from a comparison of the numbers it possesses with those possessed by the Berlin Museum, which, before I took the monograph in hand, was far ahead of every other collection, and which is now second only to the British Museum. Of the genus *Carpophilus* there have been thirty-five species previously described; the Berlin Museum possesses thirty-five species, while the British Museum has sixty-two species, and I describe ninety-three. Of the genus *Brachypeplus* five species have been described, of which four are in the Berlin Museum; I describe twenty-eight, of which twenty-three are in the British Museum. Of *Colastus* eighteen species have been described; the Berlin Museum contains nineteen, the British Museum twenty-eight, and I describe forty-seven: and other genera in like proportion.

In subdividing this family, I have found it necessary to make the characters of many of the genera, and especially of the subgenera, to a greater or less extent artificial. If genera really did exist in nature, we ought to be able to find positive and defined characters by which to distinguish them. That we do not find any limiting boundaries, goes far to prove that there are no such things as genera in nature, and that what we call so are neither more nor less than artificial aids to memory and classification. In no family which I have studied have I been more struck with this than in the *Nitidulariæ*. The affinities which we find constantly appearing in unexpected places, and the gradual shading off which we see in others, show that the whole group is a perfect network of relationship, and that, with a few exceptional breaks, the boundaries of the genera, or subsections into which for convenience' sake we divide them, have no real existence. It is no part of my present purpose to discuss the question whether genera and species actually do exist or not. It may be that the larger divisions, such as our present families, which were first described as genera by Linnæus and the older naturalists, *have* limits which (subject to the usual exceptions which occur in all systems) are sufficiently well defined and constant to allow of their being regarded as boundaries laid down by nature and not by man; and there is no doubt that the characters of these larger divisions or old genera are much better marked (as, of course, they ought to be) than those of the more numerous smaller subdivisions proposed by modern naturalists; but when we come to the smaller sections I have almost invariably found that some inosculating passage or other links the whole together, not in a chain or series, but in a complete network.

The purpose of this monograph is not antiquarian but practical. I shall therefore not occupy—I must not say waste—time in recapitulating the early notices of the species composing it. Practically they are now of little value, and it will sufficiently answer every useful purpose to give references to them in the body of the monograph wherever they are necessary for the elucidation of the different species. Nor need the more recent literature of the subject, although very different in value, occupy us long: it is as scant in quantity as it is excellent in quality.

The species which now compose the family were originally arranged by De Geer and

Linnæus among the *Silphidæ*. Fabricius threw them, and a number of other species which are now to be sought in distant parts of our systematic arrangements, into one genus under the name of *Nitidula* (a diminutive of *nitidus*)—an appellation not very appropriate considering the obscure colouring and sordid appearance of many of the species, but which has been retained, notwithstanding an early attempt of Laicharting (Verz. Tyrol. Ins., Zür. 1781), in which he was followed by Schönherr, to get it changed (to *Ostoma*).

Latreille, Herbst, Kugellan, Leach, Stephens, Shuckard, Laporte, Fischer, Perty, &c. from time to time broke up the genus, or added new genera to the family, as fresh materials were discovered. To them we owe the genera *Cateretes*, Herbst (*Cercus*, Latreille); *Brachypterus*, Kugellan; *Carpophilus*, Leach and Stephens; *Cillæus*, Laporte; *Psilotus*, Fischer; *Pria*, Stephens (*Cormyphora*, Laporte); *Meligethes*, Stephens; *Lasiodactylus*, Perty; *Strongylus*, Herbst; *Cychramus*, Kugellan; and *Cryptarcha*, Shuckard. But it was not until the year 1843 that it underwent a special examination. In that year Erichson published, in Germar's 'Zeitschrift für die Entomologie,' a monograph of the family, which has been ever since and still remains the standard work on the subject; and perhaps no better proof of its excellence and ability could be given than the fact that during the lapse of nearly twenty years, most fertile in the progress of entomology, which have passed since that publication, no subsequent author has found, nor do I now in my turn (with the added experience of all that time) find, anything to alter in the general principles of his classification. The main divisions which he has laid down seem the best which can be adopted, and I have little more to do than to fortify them by additional characters, correct their boundaries where imperfect information had led Erichson into error, and add to the species contained in them the new discoveries which have accumulated since the publication of his work, and establish new genera for the new forms for which a place cannot be found in the old.

The new "*coupes*" which Erichson made in his monograph were the following genera:—*Mystrops*, *Colastus*, *Brachypeplus*, *Conotelus*, *Ecnomæus*, *Epurea*, *Perilopa*, *Soronia*, *Prometopia*, *Platychora*, *Axyra*, *Ischæna*, *Ipidia*, *Amphotis*, *Lobiopa*, *Omosita*, *Phenolia*, *Stelidota*, *Thalycra*, *Æthina*, *Hebascus*, *Gaulodes*, *Lordites*, *Pocadius*, *Camptodes*, *Cyllodes*, *Amphicrossus*, *Pallodes*, *Oxycnemus*, and *Triacanus*.

The year after (1844), in the fifth volume of Germar's 'Zeitschrift,' he gave an appendix to his previous paper, which is chiefly occupied with the characters of the genera of the *Trogositidæ*, which he regarded as a portion of the family of *Nitidulariæ*. I look upon them as a distinct family, and do not include them in this monograph. He there added also the genus *Cybocephalus* to the *Nitidulariæ*—a step from which I dissent for reasons to be presently given.

In 1844 and 1845 Sturm, adopting Erichson's classification, and adapting it to his 'Deutschlands Fauna,' published a sort of monograph of the family as found in Germany, chiefly valuable for the excellent coloured figures given of the different species. No new divisions or genera are there proposed, although one or two new species, chiefly of *Meligethes*, are described.

In 1848 the volume of Erichson's 'Insekten Deutschlands' (usually known as the third volume), in which the *Nitidulidæ* came in turn to be treated of, appeared. Here he repeated his former views without material alteration, but with the addition of descriptions of the German species of *Meligethes*.

I need not enumerate the authors of local faunas who have adopted Erichson's classification; it would be simply a list of those of every fauna published since his work appeared—Sturm, Stephens, Redtenbacher, Wollaston, Bohemann, Leconte, Thomson, &c. Of these Wollaston, in his 'Insecta Maderensia,' has added the genus *Xenostrongylus* to the group, and Dr. Leconte of Philadelphia *Amartus* (a subgenus of *Carpophilus*) and *Psilopyga* (a well-marked form of the *Strongylinæ*). Redtenbacher, in his 'Fauna Austriaca,' has proposed to place the genus *Sphærites* in this family, and Thomson, in his 'Fauna of Scandinavia,' has made a similar suggestion with regard to the genus *Nosodendron*,—propositions, however, which seem unwarranted. Mr. Westwood, in a separate notice, has added the genus *Paromia* to the *Ipidæ*.

The same estimation of Erichson's system has been shown by the authors of works of a more extended and general nature. M. Lacordaire has followed it implicitly, and without correction, in his 'Histoire des Insectes,' as has M. Jacquelin Duval in his 'Genera des Coléoptères d'Europe,' who, however, has proposed two subgenera of the *Brachypteridæ*.

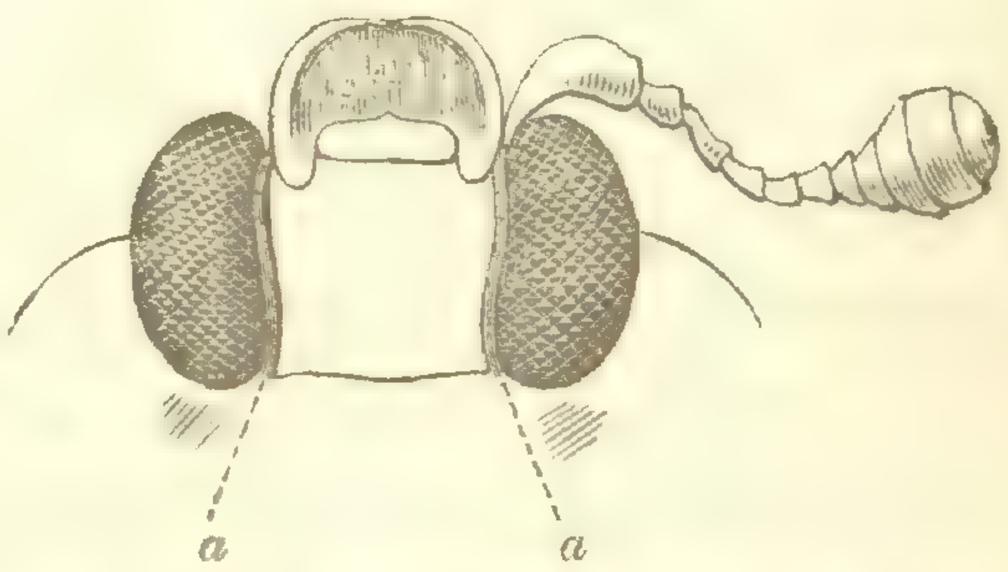
Scarcely anything has been written upon the larvæ of this family. Insufficient notices of one or two by Bouché (Naturg. der Insect.), a description of one species by Curtis, and of two by Erichson (Insekten Deutschlands, vol. iii.), a *résumé* of these by Candèze and Chapuis in their Catalogue of the Larvæ of Coleoptera, and a description of two exotic species by Candèze in his 'Histoire des Métamorphoses de quelques Coléoptères exotiques,' and of one or two by M. Perris in his papers on the Insects of the Maritime Pine (*Pinus maritimus*), are all that has been done on the subject worth mentioning.

Characters of the Family.

Antennæ.—The antennæ characterize the whole family, but do not furnish distinctions of much value for minor sectional division. They are clavate, but not geniculated. They vary in the size, form, and proportion of the articles; and the claviform character passes through all the gradations from an almost circular club of comparatively large dimensions as in *Camptodes* or *Æthina*, to little more than moniliform antennæ somewhat thickened towards the apex as in *Brachypterus* and *Brachyleptus*. The proportions of the articles, moreover, are not always, although generally, constant; in *Mystrops*, for example, no two species have them alike. The majority have the first article thick, the second short, the third longer, the fourth shorter, the fifth, sixth, and seventh small and moniliform and about equal in size; the eighth more or less expanded, forming a transition to the club, which is composed of the ninth, tenth, and eleventh.

Antennal grooves.—In some species there are grooves or hollowed channels under the head, in which the stalks of the antennæ repose when at rest. These usually consist of a narrow groove at the inner and under corner of the eye (fig. 1), extending backwards obliquely, or straight on each side of the mentum. The presence or absence of this channel is a useful character, but its degree of obliquity is of more doubtful value.

Fig. 1.



Underside of head of *Lordites villosus*, showing antennal grooves, *a*, *a*.

Mandibles.—These are too variable to furnish good sectional characters; very generally they are bidentate at the apex, but sometimes they are simple, and frequently they have a number of small teeth following the two larger ones. In *Cillæus* they are multidentate; and in some of the species of *Ipidæ* the left mandible is bidentate, while the right is simple, the apex of the latter being received between the two teeth of the former.

Maxillæ.—The maxillæ furnish useful characters for separating the larger groups of Clavicorns. They are constructed on three separate plans—two of them bilobed, and one with only a single lobe. The *Brachypteridæ* have two lobes to the maxillæ. The remainder of the *Nitidulariæ* have only one; and the Clavicorns which follow them have two lobes. The double lobes of the *Brachypteridæ* are unusual, and differ from those of the *Trogositidæ*, *Colydiidæ*, &c. in this respect—that the exterior lobe is not furnished with hairs, but has a small vesicle near the point, whilst in the latter both lobes are furnished with hairs in the usual way. Fig. 2 shows the form of the maxillæ in the *Brachypteridæ*, fig. 3 in the *Nitidulidæ* proper, fig. 4 in the genus *Rhizophagus*, and fig. 5 in the *Colydiidæ*.

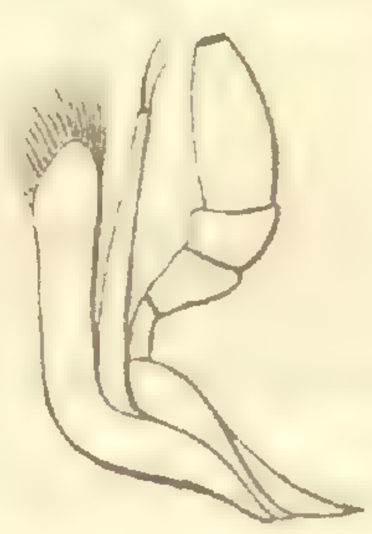
Fig. 2.

Maxillæ and maxillary palpus of *Brachypterus gravidus*.

Fig. 3.

Maxilla and palpus of *Thalycra fervida*.

Fig. 4.



Maxillæ and palpus of *Rhizophagus depressus*.

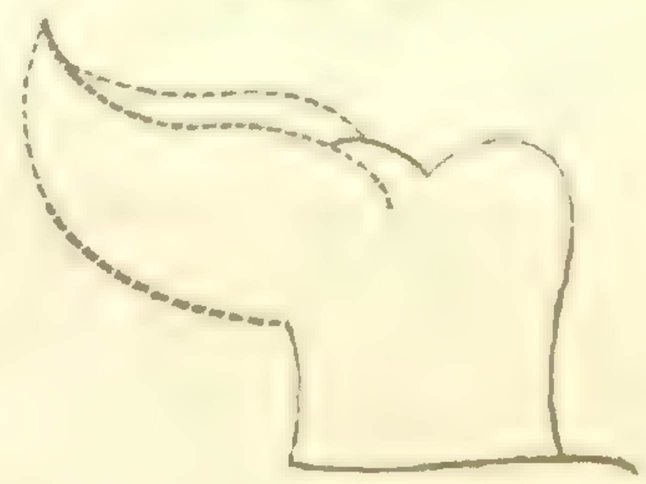
Fig. 5.

Maxillæ and palpus of *Bitoma crenata*.

Ligula and Paraglossæ.—The ligula and paraglossæ of this family have given rise to some discussion and considerable difference of opinion among entomologists, from the fact that they usually have a structure developed which does not exist in other insects. I would refer those who wish to study the relations of these parts to M. Lacordaire's observations on the subject in his 'Histoire des Insectes Coléoptères,' vol. ii. p. 288, and to M. Jacquelin Duval's remarks on the notes to pages 134, 136, and 139 in the 'Genera des Coléoptères d'Europe,' vol. ii. I shall here confine myself to stating the result of my own observations. In the *Nitidulariæ* the ligula is usually a narrow, projecting, oblong, ovate or triangular piece, placed in the mouth, next the mentum: that is, supposing the insect to be walking on the ground, it is nearer the ground than the paraglossæ or their lobes. Behind this lie the true paraglossæ, soldered to it.

The ligula is well seen in its simplest state in *Macrostola straminea*. Figs. 7 *e* & 7 *e*** of Plate XXXV. show the under or, rather, outer side of it—that is, the side next the ground; the two corner pieces at the tip are parts of the paraglossæ, seen behind; suppose these away, the simple ligula remains. If that be turned over, fig. 7 *c** is then seen, which is the united paraglossæ, in this instance allowing no part of the ligula to be seen. From each of the anterior angles of the ligula springs, in most of the species of *Nitidulariæ*, a translucent membranous lobe or wing. How this is attached is a point on which I am not yet satisfied. In some it appears to be merely a continuation of the ligula, as if it were expanded into this lobe, its corneous substance thinning off by imperceptible degrees; in others it seems to invest it to the very base, like a gown folded around it (see Plate XXXIV. fig. 5 *c**); in many, probably in all, it has a certain amount of lateral motion. My idea of the nature of these membranous lobes is that they are composed of a double fold of membrane, attached to the front and back of the ligula somewhat in the manner shown in fig. 5*. In some species the outer edge of this double fold is united, while the inner is open, like the mouth of a bag; in others it is disunited on both edges, as if cut asunder at the fold; and in others, again, and that the most numerous body, both sides appear to be united and soldered together. We see the first of these conditions in the Australian *Brachypepli* (see Pl. XXXIV. figs. 10 *e* & 5 *c**), in *Haptoncus* (Pl. XXXIII. fig. 7 *e**), in *Colastus* (Pl. XXXIV. fig. 1 *e*), and in *Cillæus megacephala*, where it looks like a moveable fringed hood (Pl. XXXV. figs. 4 *e** & 4 *e***); I think we see the second, like double plates, in *Calonecrus* (Pl. XXXII. fig. 9 *e*) and in *Halopeplus* (Pl. XXXV. fig. 1 *e*); and we see the last in *Carpophilus* (Pl. XXXII. fig. 10 *e*), in *Brachypeplus rubidus* (Pl. XXXIV. fig. 6 *e**), in *Carpophilus* (*Stauroglossa*) *terminalis* (Pl. XXXIII. fig. 4 *c*), where it takes the form of a rounded hammer, and in many others. I do not suppose that in the figures which I have given of my dissections of these parts I have never been mistaken, but I claim the credit of having literally put down what I thought I had seen; and I regard as a merit what may by some be attributed to me as a fault, that I have never filled up blanks with details which I did not see, but which, according to the ascertained anatomy in other species, I might have assumed to be there. For systematic arrangement the ligula and paraglossæ afford characters of variable value. In some genera or sections, as *Carpophilus* for instance, they vary considerably without any other feature suffering a corresponding variation. In others they preserve a well-marked uniformity confined to the species of one genus; or the characters reappear in some distant genus in another section, indicating affinities which would not otherwise have been suspected, as in *Colastus* and *Psilotus*, which belong to different sections of the family, look very unlike, and yet both have the same maxillæ, ligula, and paraglossæ, and these of a peculiar and unusual structure.

Fig. 5*.



Epistoma and Labrum.—In all the tribes of the family, except the *Ipidæ*, the labrum is exposed, transverse, and usually bilobed; in the *Ipidæ* the epistome projects over the labrum, concealing it from view.

Mentum.—The mentum is sometimes very much developed, as in *Prometopia*, and when it is so it furnishes a good generic character; but in most of the species there is great uniformity, it being usually bisinuate with a projecting tooth in the middle.

Palpi.—The maxillary palpi vary but little. The terminal article is usually cylindrical, with the apex more or less acuminate; and the trifling variations in it are not sufficient to furnish data for subdividing genera or sections. The labial palpi show greater variation, and occasionally furnish characters which may be used for dividing smaller sections.

Eyes.—The eyes are lateral and rounded. Considerable difference exists in their size and in the degree of coarseness of their granulation,—*Ips*, for example, having them very finely granulated, and most of the *Nitidulidæ* proper, coarsely. As better characters for distinction generally accompany this, it is not of much practical value.

Thorax.—The *Nitidulariæ* comprise within their bounds two styles of form, which at first sight appear as unconnected and as widely separated as can well be imagined—the one an oblong, flat, depressed insect, often scarcely thicker than the piece of paper on which this page is printed, and the other a rounded, semiglobose insect like a *Coccinella* or a *Liodes*. In the parts in which we usually find change of structure explanatory of change of form we here find no difference: antennæ, mandibles, maxillæ, mentum, paraglossæ, cotyloid cavities of the limbs, &c., are all impressed with the same general character, and we have to seek for a defined character in the less seizable arrangements of the body itself. Two characters have been made use of for this purpose—the one the projection or prolongation of the prosternum between the anterior coxæ, and the other the application to or covering of the base of the elytra by the base of the thorax.

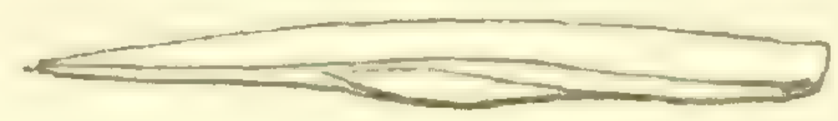
These characters are not very satisfactory. In the first place, the meaning intended to be conveyed is not very clear to one who is not familiar with the subject; and even after we know what is meant, the characters in question are so much matters of degree, that it is often with difficulty that one can say whether they are present or not. Have *Lobiopa*, *Lordites*, and *Gaulodes*, for example, their prosternum prolonged behind between the anterior coxæ? They are, to all ordinary apprehension, alike in this respect; but Erichson says that *Lordites* and *Gaulodes* have, while *Lobiopa* has not. To my eye none of them have it. In *Prometopia* does the prothorax cover the base of the elytra? Erichson and Leconte place it among those in which it does not; perhaps they stretch a point to preserve it in its natural place; but the fact, especially in some newly-discovered species, is undoubtedly the reverse.

An equally good definition could be drawn from the comparative convexity of the body—the *Nitidulidæ* proper being mostly oblong and depressed, and the *Strongylinæ* rounded and convex. Another way of saying the same thing (a way, however, which, like all these characters, leaves a sort of debateable ground between the two sections) is to take the comparative length of the thorax above and below. The true *Nitidulidæ* have the thorax nearly as long below as above; the *Strongylinæ* not nearly so much so, perhaps not more than half (see figs. 6 & 7). This will be easily understood to be a necessary consequence of the more convex form of the body: as the segments of a circle are smaller as they approach the centre, and as the abdomen is usually not shorter than the back, the thorax is the part where the inner diminution must take place. It is owing to the same cause that the prosternum is prolonged in the convex species behind the anterior coxæ. The space in which they are placed is so short that they almost break

Fig. 6 *a*.

Underside of thorax of *Lobiopa decumana.*

Fig. 6 *b*.



Side view of *Prometopia sexmaculata.*

Fig. 7 *a*.

Underside of *Camptodes communis.*

Fig. 7 *b*.

Side view of *Camptodes communis.*

through the wall behind, and a fulcrum is needed on which to rest them; for this purpose the prosternum is prolonged backwards*. The thorax in the *Nitidulidæ* is always thinned at the lateral margins and very generally truncate or sinuate behind, and with the anterior angles more or less projecting in front.

Anterior Coxæ.—Cylindrical, imbedded in the cotyloid cavities, and not projecting as in the *Staphylinidæ* and *Silphidæ.*

Anterior Cotyloid Cavities.—These are always transverse, and form an excellent character for the whole family; they are obtuse at the inner end, and terminate in a point directed obliquely forwards on the outer side. In the *Brachypteridæ* the cavities are so far back that they are open behind, no partition-wall surrounding the back of the coxæ or separating them from the mesothorax.

Scutellum.—Varying in form (triangular, pentagonal, semicircular, or quadrangular).

Mesothorax.—Short: the mesothorax and its epipleura and epimera are usually soldered together, although the suture can be traced. The mesosternum is in some projected in front to meet the prolongation of the prosternum.

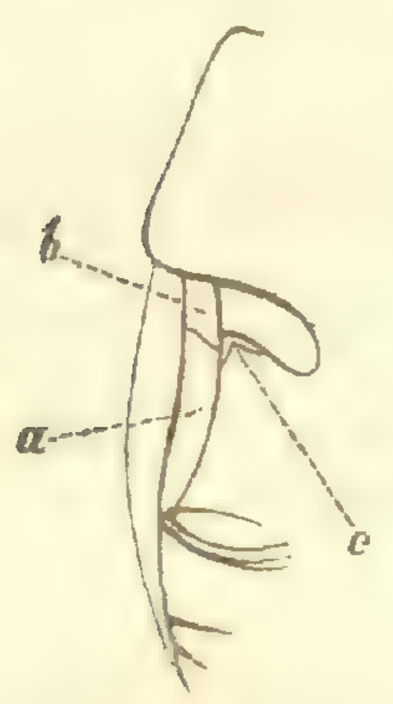
Middle Cotyloid Cavities and Coxæ.—Transverse and slightly oblique. The coxæ imbedded.

Metathorax.—The metathoracic epipleura are generally long and narrow, diminishing

* The phrase "prolonged backwards" or "projecting backwards" is very awkward, and, undoubtedly, bad English; but I do not know any other word to use in its place: *retrolonged* or *retrojected* would, I fear, be condemned as still worse.

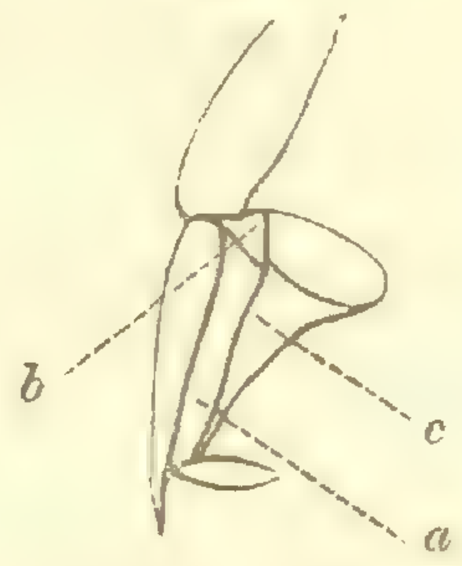
in breadth from before backwards (see letter *a* in figs. 8, 9 & 10). In the *Strongylinæ* they are broader (see fig. 11, letter *a*). The epimera are short and small, sometimes triangular, sometimes oblong, and at others rhomboidal (see letter *b* in figs. 8, 9, 10, & 11).

Fig. 8.



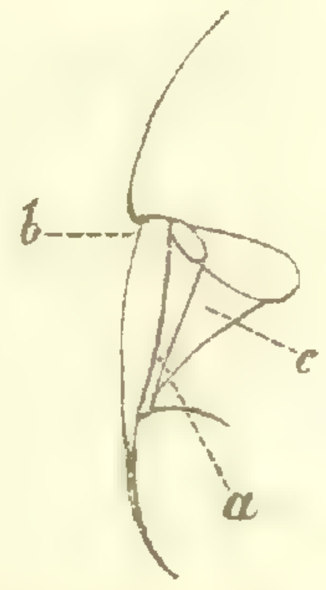
Side of metathorax of *Carpophilus mutilatus.*

Fig. 9.



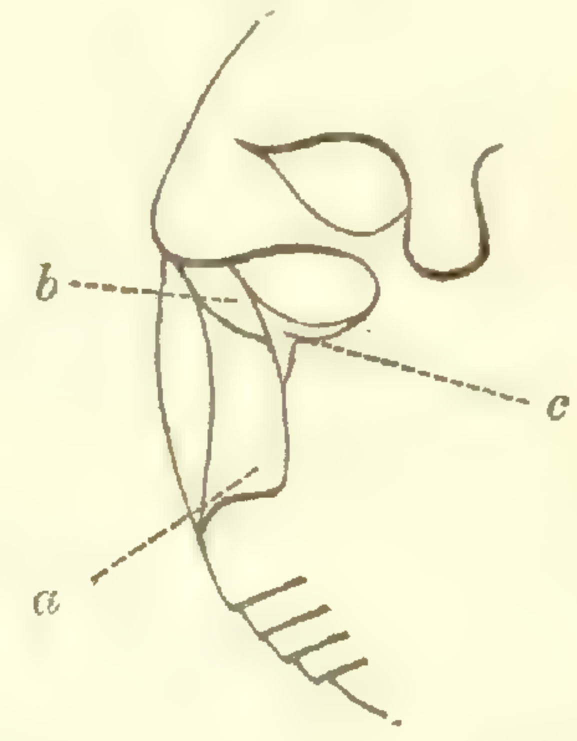
Side of metathorax of *Lasiodactylus brunneus.*

Fig. 10.



Side of metathorax of *Meligethes æneus.*

Fig. 11.



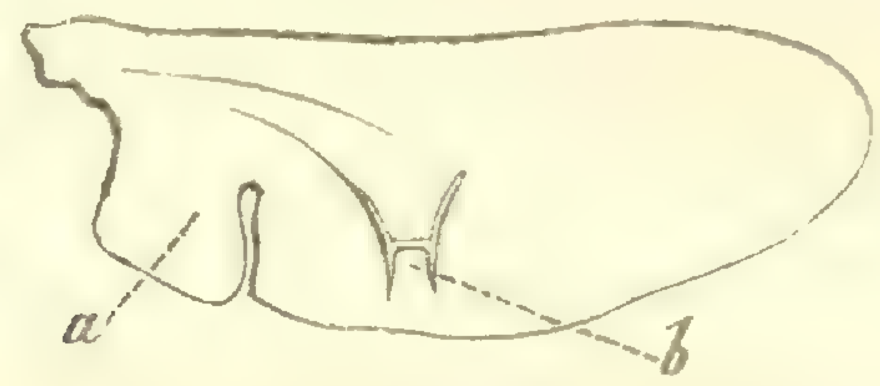
Side of metathorax of *Camptodes communis.*

Axillary pieces.—There is another small character which occurs in the *Strongylinæ* and *Nitidulidæ* proper, which, so far as I am aware, has not been previously observed. It is a small triangular space (see letter *c* in the above figures), marked off in these species by a line or suture, in the angle behind the coxæ of the middle legs and between them and the epimera and epipleura. It is not always clear whether it is a line or a suture. In some it is obviously a mere line; for we can trace it as the mere reflexed margin of the cotyloid cavity in the *Carpophili.* In others, where it is a distinct groove marking off a large corner as in *Lasiodactylus brunneus,* it has doubtless become developed into a suture; but in some others, where, although it still marks off a sufficiently distinct corner, which is differently punctured or sculptured from the neighbouring surfaces, it is not so much developed, and the line is thin and slight, I am inclined to infer that it is a mere line and not a suture. Figs. 8, 9, 10, & 11 show examples of the extent and progressive development of this line: fig. 8 shows it in *Carpophilus,* where it is in its least stage of development and generally wholly absent; fig. 9 in *Lasiodactylus brunneus,* fig. 10 in *Meligethes,* and fig. 11 in *Camptodes communis.* It does not exist at all in the *Brachypteridæ*; it is merely a rudimentary reflexed margin of the middle cotyloid cavities in the *Carpophilidæ,* and is very little developed in that portion of the *Nitidulidæ* proper which are most allied to the *Carpophilidæ.* In many of the species of *Epurea,* for instance, which is most so, it is absent altogether; in the *Nitidulidæ* most akin to the *Strongylinæ,* and in the *Strongylinæ* themselves, it is most developed. I propose to call it the metathoracic axillary piece. It is obviously a natural character, and like all natural characters thins off in species on the one hand, and becomes more developed in those on the other, and occasionally varies in different species of the same genus. In *Prometopia,* for instance, it varies in the amount of development in different species. It therefore cannot be used as a constant character for establishing sectional or generic boundaries, but it will always be found useful as a guide to a correct appreciation of the true position and affinities of puzzling species.

Posterior Cotyloid Cavities and Coxæ.—Always transverse, and showing little variation. The breadth of the middle space between them, however, varies in different genera.

Wings.—The wings are moderately long (about twice the length of the insect) and have very few nervures—one or two at the base, and, in most cases, none towards the apex of the wing. There appear to be two points which may perhaps be useful for classification. One of these is whether the wing is entire or bilobed as it were—that is, the basal part separated by a narrow cut from the rest of the wing. Fig. 12 represents the wing of *Amphotis marginata*, in which this bilobation is present (letter *a*);

Fig. 12.



Wing of *Amphotis marginata*.

Fig. 13.

Wing of *Ipidia 4-notata*.

and fig. 13 that of *Ipidia 4-notata*, where it is absent. The bilobed wing seems to be more frequent in the *Nitidulidæ* proper than in the *Strongylinæ*, but it is not confined to them. Some of the genera of *Nitidulidæ*, notably *Ipidia*, *Lobiopa*, *Lordites*, &c., have the wing entire, *Meligethes* has it bilobed, while in *Pria* it is entire. I have not met with any of the *Brachypteridæ* or *Carpophilidæ* where it is simple; they seem all to have a lobe, usually a small one, at the base of the wing. The other specialty is a distribution of the veins somewhat resembling the letter H, as shown at *b* in these figures. This seems a more constant character than the previous one, being generally absent in the true *Strongylinæ* and present in the *Nitidulidæ*, but, like the other, it is uncertain and not to be depended on.

Elytra.—Varying greatly in size (especially length) and form—sometimes square or oblong, sometimes truncate, sometimes spherically triangular, and sometimes partly rhomboidal; sometimes they cover the whole abdomen, at others only a single segment of it, with all gradations between these extremes. Combined with the relative proportion of the abdomen exposed, they furnish useful characters for classification.

Abdomen.—The characters drawn from the abdomen are valuable from being easily accessible and readily recognizable. It is composed of only five segments (with, in some genera, a small additional appendage in the male). On uncovering the back it appears to be composed of six segments, or six and the lateral portions of a seventh; but the sixth and seventh are soldered to the metathorax, leaving only five free segments. The whole of the five segments are visible on the underside,—a point to be noted, as in some classes of Coleoptera the first segment is covered by the metathorax. The segments vary in length, and their relative length has been found a useful sectional or subgeneric character. The junction of the under with the upper side of the segments is almost always effected on the margin or the dorsal side; the under side is turned up and soldered to the upper, the turned-up margin being usually raised higher than the dorsal portion of the segment: in some genera, as *Carpophilus*, the suture is close to the margin; in others, as *Brachypeplus*, distant from it; in others, as *Colastus*, the last segment or pygidium has the hem broad at the base and the other segments narrow. It is also more or less (in *Brachypeplus* entirely) continued along the anterior margin of each dorsal segment, so that if the separate dorsal part of the segment were removed there would still remain an abdominal ring (fig. 14). I propose to call this hem or turned-over part of the segment the *fimbria*.

Fig. 14.

Part of abdominal ring of *Brachypeplus basalis*.

Legs.—Femora. These are almost always more or less flattened; in some of the species of *Camptodes*, *Amphicrossus*, and *Æthina*, very much so. Where the flattening is not very great, there is a slight depression on the posterior edge of the femur in which the base of the tibia is received. When the legs are very much compressed the inner and posterior side of the femur is thinned to half its thickness, so that the flat tibia folds in upon the flat femur like the blade of a paper-cutting knife. Fig. 15, letter *b*, shows this arrangement. In such cases the side of the tibia and that of the thin portion of the femur are highly polished, although the rest of the leg may be punctate or pubescent.

Fig. 15.

Hind leg of *Camptodes fulvus*.

Tibiæ. Sometimes very broad and thin, at others not flattened. The very broad tibiæ are confined to the *Strongylinæ*. In *Meligethes* the serrations of the anterior tibiæ are found to afford useful specific characters. In some genera (*Brachypeplus* for example) there is a small groove on the outer side of the apex, for the reception of the tarsi (see Plate XXXIV. fig. 10, *c*).

Tarsi. Pentamerous, but the fourth article is very small. The three first are usually broad, and furnished with long brushes of hairs beneath. The small fourth article (fig. 15, *a*) is one of the best characters for distinguishing the family. It is absent in no species belonging to it, if we remove *Cybocephalus* from it, which, I think, ought to be done.

Larva and Metamorphoses.

The remark made by M. Candèze and M. Chapuis upon the larvæ of this family, in their modestly styled "Catalogue des Larves des Coléoptères connues jusqu'à ce jour, avec la description de plusieurs espèces nouvelles," may at this day be repeated with little alteration—"There are few families so considerable as this, of the earlier stages of which so little is known: not more than five or six of these larvæ have been described." Anything further that is known in relation to them proceeds from M. Edouard Perris, in his "Insectes du Pin maritime" (Ann. Soc. Ent. France, 1853), and from M. Candèze himself, who in his 'Histoire des Métamorphoses de quelques Coléoptères exotiques' (1861) has added the descriptions of two or three to the number. But still the number known is even more limited than those mentioned by these entomologists. The five which had been described previous to the publication of their catalogue were *Epurea obsoleta*, *Soronia grisea*, *Pocadius ferrugineus*, *Ips* 4-*pustulata*, and *Rhizophagus depressus*. But of these the descriptions of *Epurea obsoleta* and *Ips* 4-*pustulata* were so little detailed as to be of no use, and a doubt has been suggested by Erichson whether Bouché, who describes *Pocadius ferrugineus*, had not confounded it with a *Lycoperdina*; which is not an improbable supposition from his description, and from the fact that both feed on the *Lycoperdon Bovista*. *Rhizophagus* I do not include in my subject. The larva of one of the species of that genus, *Rh. depressus*, has been described both by Erichson and Perris; but the descriptions of these two authors do not correspond; and Erichson's description must be cancelled or transferred to some other species, for he mentions that he assumed it to be the larva of that species only from finding a number of them in company with the perfect insect; while Perris, on the other hand, carefully and repeatedly bred the insect, and there seems no reason to doubt that perfect dependence may be placed on his observations. I also have received specimens of larvæ supposed, on the same grounds as those relied on by Erichson, to belong to *Rhizophagus depressus*; but these differ both from Perris's and Erichson's descriptions, and of course are useless, and I only mention the circumstance to show the difficulty attending the study of the larvæ of this family. Few can be bred; and unless this be done, we can have no assurance that the larva really does belong to the species to which it is referred. I have received specimens of larvæ referred to different *Nitidulidæ*, which on examination turned out to be the larvæ of Diptera; and I have others given me as belonging to particular species of *Nitidula*, but which I cannot use from want of sufficient evidence that they really do so.

The result of this difficulty in determining the larvæ is that even yet there are not more than about half a dozen species described which can be relied upon—*Carpophilus sexpunctatus* by Perris, *Soronia grisea* by Curtis and Erichson, *Meligethes æneus* by Heeger, *Lordites glabricula* and *Amphicrossus discolor* by Candèze, and *Ips ferruginea* by Perris.

Confined as we are therefore to such imperfect and doubtful materials, any attempt at generalizing is out of the question; all that we can say is that the following characters have been met with in the different species which have been described:—

Head.—Small, depressed, rounded.

Ocelli.—Placed behind the antennæ, varying in number from two to four on each side.

Antennæ.—Usually four-jointed; but Erichson says that in *Soronia grisea* they are only two-jointed; and in another Nitidularian larva which I have received as *Meligethes æneus* they are only three-jointed.

Labrum.—Short, transversal, and sometimes bilobed.

Mandibles.—Lamellar; usually dentate on the inner side and expanded at the base into a broad flat plate.

Maxillæ.—With one lobe only. None of the *Brachypteridæ*, however (which in the perfect state have two lobes), have yet been examined; but it is to be observed that in other Clavicorns which in the perfect state have two lobes to the maxillæ (the *Colydiidæ* for example) there appears to be only one lobe in the larva. It is soldered to or continuous with the mentum.

Maxillary Palpi.—Three- or four-jointed.

Ligula.—Narrow, terminating variably in front.

Labial Palpi.—Two-jointed.

Mentum.—Variable in shape.

Thoracic and Abdominal Segments.—Of the same general form and consistence. The thoracic segments usually longer and larger than the abdominal. The latter have frequently tubercles on the margins, and bristles or small tubercles or depressions regularly disposed across the back. The last segment has a pair of hooks at its termination. In some cases there are two additional hooks on the back of this segment.

Stigmata.—Confined to the nine abdominal segments; borne in some cases on conical projections along the margins, or in front of them near their base.

Legs.—Terminated by a single claw.

I propose to recapitulate what is already known regarding such larvæ as have been described, along with any additional information I may possess on the subject, in a separate chapter at the close of this Monograph.

Classification of the Family.

The essential characters of the family may be anticipated from the foregoing *résumé*; they may be briefly summed up as follows:—

Ventral segments free, five in number, the first visible both at the middle and sides; some of the dorsal segments membranous. Antennæ more or less clavate, but not geniculate. Tarsi five-jointed, in general dilated; fourth article the smallest, usually very minute. Anterior coxæ transverse, not prominent; anterior cotyloid cavities transverse, oblique, more or less open, and tapering towards the outer side.

This diagnosis excludes *Cybocephalus*, the *Rhizophagi*, the *Peltidæ* and *Trogositidæ*, which have by various authors been ranked as members of this family, but which, although all closely allied to it, seem to me either deserving of being raised into distinct families themselves or placed elsewhere. I shall briefly state my reasons for this opinion.

As to *Cybocephalus*, in the first place, although it possesses many of the characters of a *Nitidula*, it does not look like one. This may appear a very childish reason, but it is less so than it looks. Any one who has ever devoted himself to the study of any natural family knows that the members of it have all a sort of family resemblance, which he who has been constantly poring over them recognizes in an instant without examining a single organ. To my eye *Cybocephalus* wants this family resemblance. It has more the appearance of an *Agathidium* than a *Nitidula*, and on examination we find that the characters of some of the parts which are usually considered of first importance differ from those of the *Nitidulariæ*. The thorax and the cotyloid cavities of the anterior coxæ, although transverse, are not formed quite on the same plan. The figures 6 *a* and 6 *b* show their usual form in the *Nitidulariæ*; fig. 16 shows their form in *Cybocephalus*. Then the tarsi differ in the number of articles. *Cybocephalus* has only four articles to the tarsi, the *Nitidulariæ* have five: Erichson thought that there was a fifth article, so extremely small as to be overlooked. Duval says there are only four, and my examination confirms his. Duval's extreme care and marvellous skill in minute dissection warrant me in relying on his conclusions*, the more so that I have had the advantage of seeing him make the dissections and satisfying myself of the accuracy of his observation. Further, it is much smaller in size

Fig. 16.

Under view of thorax of *Cybocephalus festivus*.

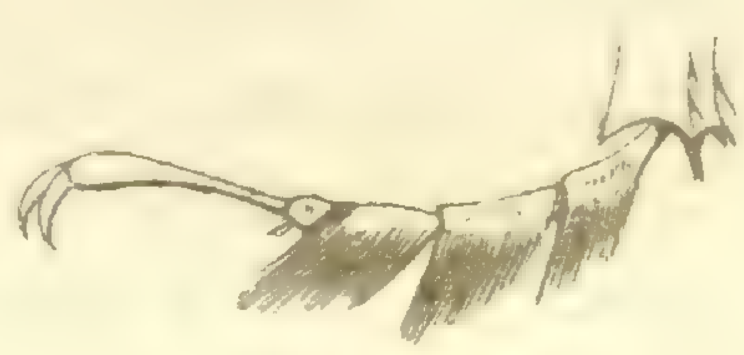
* The following are M. Duval's remarks:—"Erichson, it is true, has thought that the tarsi of *Cybocephalus* consisted of five articles, of which the fourth was extremely small; but he is certainly in error; and it was easy to fall into it with insects so small and so difficult of examination on account of their form. I have assured myself with the greatest care, in three species and in the two sexes, that not even a rudimentary article existed at the base of the latter, and that consequently the tarsi in point of fact consisted only of four articles." . . . "For that verification I have made

than any other genus of the *Nitidulariæ*. I know of no instance in the zoological world where very great differences in size exist in the same family. We should hesitate to class a mouse with an elephant even although it were to possess a trunk and tusks. Some thirty or forty years ago the Foraminifera were classed with the Nautili, but it is long since the totally different nature of the two objects has been recognized. In like manner (although in a less degree) I think the difference in size too great to allow us readily to class *Cybocephalus* with the *Nitidulariæ*. Further, *Cybocephalus* has a peculiarity in habit not possessed by any of the true *Nitidulariæ*. Its body is so constructed that it can roll itself up into a ball.

Next, as regards the *Peltidæ* and *Trogositidæ*, of which I prefer to speak first, as displaying the greater amount of divergence, before discussing the *Rhizophagi*, which form the transition between the *Nitidulariæ* and them, it is to be noticed that, while undoubtedly nearly allied to the *Nitidulariæ*, they differ in two very important points: they have two lobes to the maxillæ, a character found in most of the families of Clavicorns which naturally follow them; they have also the first article of the tarsi smallest, instead of the fourth. The *Trogositidæ*, moreover, have a distinct facies and are considerably larger in size; and although the *Peltidæ* preserve a greater resemblance to the *Nitidulariæ*, they possess similar tarsi and maxillæ to the *Trogositidæ*, and the species naturally arrange themselves with them. If we hold that the *Trogositidæ* form a distinct family, the *Peltidæ* must go with them.

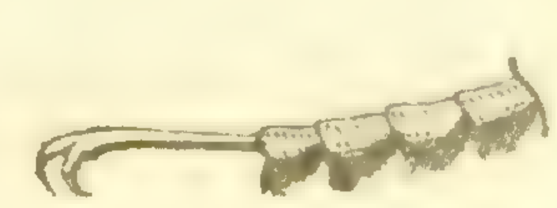
The disposal of the genus *Rhizophagus* is a matter of greater difficulty. It forms the passage between the *Ipidæ* and *Trogositidæ*. *Ips* is the last group of the *Nitidulariæ*. It is well marked by the epistome projecting over the mandibles, but in other respects it does not differ from the rest of the family. It has only one lobe to the maxillæ; it has Nitidularian tarsi, viz. dilated, with five articles, of which the fourth is smallest. Fig. 17 shows the tarsus of *Ips*. *Rhizophagus*, on the other hand, has the tarsi five-jointed in only one of the sexes. In the males there are only four articles, and the tarsi are less dilated than is usually the case in the *Nitidulariæ*. Fig. 18 shows the five-jointed tarsus of the female *Rhizophagus*. Further, *Rhizophagus* has two lobes to the maxillæ, whilst the rest of the *Nitidulariæ* with which it has closest affinities have only one. Contrast fig. 4 (the maxilla of *Rhizophagus*) with fig. 3 (the maxilla of *Thalycra fervida*), which may be taken as a fair example of the normal form of that structure in the *Nitidulariæ*. It may be said that its possessing two lobes is no reason for removing it from them, because the *Brachypteridæ*, a group of *Nitidulariæ* at the other end of the line, have two also. This is true; but

Fig. 17.



Tarsus of *Ips 4-signata*.

Fig. 18.



Tarsus of *Rhizophagus depressus* ♀.

use of extremely high magnifying powers; I have examined the tarsi placed in essences; in fine, I have disarticulated them between two plates of glass, and I have remained convinced that no article existed, as I have said, at the base of the latter. Care must be taken in this examination not to allow one's self to be imposed upon either by the cavity of the third article, in which the fourth is implanted, or by the feeble basal swelling of the articulation of the latter. Erichson was probably deceived by some such illusion." (Duval, Genera des Col. d'Eur. ii. p. 151.)

the second lobe of the maxillæ in the *Brachypteridæ* is peculiar. It is not furnished with hooks or hairs, but has a small vesicle at its termination. Fig. 2 shows the bilobed maxilla of *Brachypterus*, from which it will be seen that the bilobed maxilla of *Rhizophagus* differs in character from it, and belongs to the type of the *Trogositidæ*, *Colydiidæ*, and other Clavicorns of that class. I have added fig. 5 to show the bilobed maxilla of *Bitoma crenata* as an example of their style in these Clavicorns. Another distinction of less importance, but one still further indicating a relationship with them, is that the antennæ have only ten articles, the two terminal articles of the club being soldered into one. Several of the *Colydiidæ* have this peculiarity—notably *Cicones*, *Synchita*, *Sarrotrium*, *Pycnomerus*, *Cerylon*, &c. On the above grounds I exclude *Rhizophagus* from the family of the *Nitidulariæ*.

The first step to the classification of the family thus restricted is to separate it into those whose maxillæ have two lobes and those which have only one. The *Brachypteridæ*, as already mentioned, have two lobes, the external of which is long and slender and terminated by a vesicle (see fig. 2, *suprà*). In this tribe also two of the dorsal segments of the abdomen are exposed.

Fig. 19.

Epistome of *Ips oculata*.

Fig. 20.

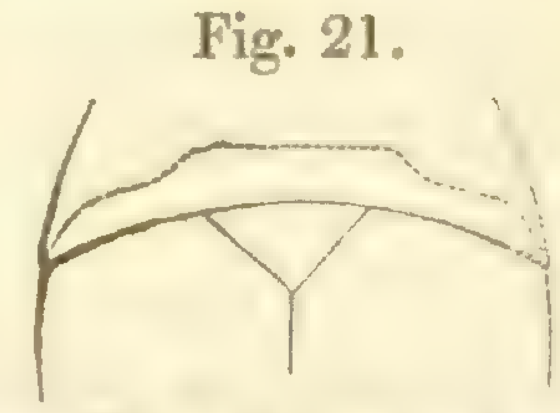
Epistome and labrum of *Ischæna angustata*.

The whole of the remaining species have only one lobe to the maxillæ; and a further dismemberment of them may be made at the other end of the line by setting apart all those which have the epistome prolonged and covering or almost covering the labrum (as in fig. 19), which form the tribe *Ipidæ*, in contradistinction to the species with an exposed labrum as in fig. 20, which represents the form of these parts in the majority of the family.

The species which fall into neither of these sections may next be separated into those which have the pygidium or last dorsal segment of the abdomen alone exposed, and those which have more than it exposed, viz. the last two, three, or four dorsal segments. The latter form the tribe *Carpophilidæ*.

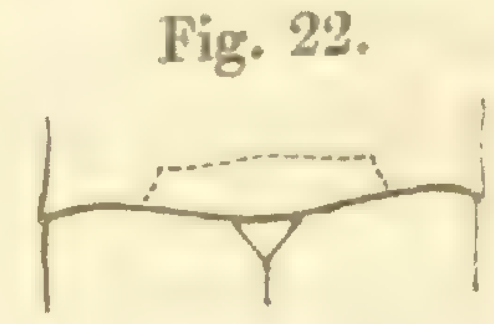
These being withdrawn, there remains a numerous body of insects for the division of which there is more difficulty in finding characters. It comprises two different forms (each of which may again be divided into other sections),—one the *Nitidulidæ* proper, generally of an oblong shape and more or less depressed; the other the *Strongylinæ*, more or less rounded, deep, and globose, reminding one of some of the *Coccinellidæ* or *Chrysomelidæ*. Erichson made the distinctive character of the *Strongylinæ* the extension of the prosternum behind the anterior coxæ, as shown in the foregoing fig. 7 *a* & fig. 7 *b*, which represent the underside of the thorax of *Camptodes communis*. The absence of this extension or prolongation was his distinguishing character of the *Nitidulidæ* as contradistinguished from the *Strongylinæ* (see figs. 6 *a* & 6 *b*). He then divided those which had it into *genuine Strongylinæ*, in which the prothorax covered the base of the elytra, as in fig. 21, and *spurious Strongylinæ*, in which it was only applied to their base, as in fig. 22. Leconte, using the same characters, has only reversed their

Fig. 21.



Base of thorax of *Camptodes communis*.

Fig. 22.



Base of thorax of *Lobiopa decumana*.

application. He includes Erichson's spurious *Strongylinæ* in his *Nitidulinæ*, making the character of the section that the prothorax does not cover the base of the elytra, and dividing it into two groups, the *Nitidulidæ* proper and the *Meligethidæ*, by the prolongation or not of the prosternum behind the anterior coxæ. He then gives the "prothorax covering the base of the elytra" as the character for his *Cychramini*, by which name he designates Erichson's *Strongylinæ genuinæ*.

While I admit that the *Meligethidæ* deserve a subsection to themselves, I think with Erichson that they have more affinity with the *Strongylinæ* than with the *Nitidulidæ* proper, and therefore I have so arranged my characters as to bring them into that section. On the other hand, I think the affinity between *Phenolia*, *Lobiopa*, *Stelidota*, &c., and *Lordites* and *Gaulodes* is so great, that it is impossible to retain the latter among the *Strongylinæ*. They are the most convex of the *Nitidulidæ* proper, and have, of course, thence necessarily acquired a corresponding proportion of those characters which depend upon the convexity of the insect, but all their other characters range with these genera.

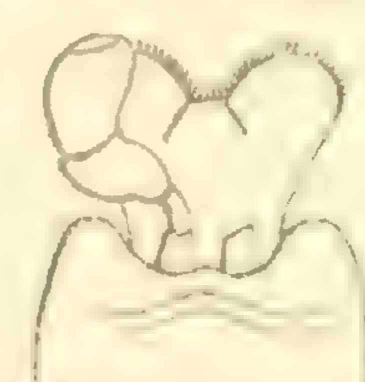
Speaking without precision, the *Nitidulidæ* proper may be distinguished as being oblong and depressed, whilst the *Strongylinæ* are rounded and convex. With more precision, the *Strongylinæ* may be characterized by the under side of the thorax being much shorter (one-half is about the usual proportion) than the upper side (see fig. 7), the *Nitidulidæ* by being only slightly shorter (one-third is about the extreme of the least convex species) (see fig. 6). The prolongation of the prosternum behind the anterior coxæ may, with the qualifications already indicated, be also taken as a character for dividing them—the *Strongylinæ* possessing it, the *Nitidulidæ* not.

To justify the separation of the *Meligethidæ* as a subsection from the rest of the *Strongylinæ*, the form of the paraglossæ seems sufficient. In the former they are horned (fig. 23), and in the latter more or less rounded (fig. 24).

Fig. 23.

Ligula and paraglossæ of *Pria Dulcamaræ*.

Fig. 24.



Ligula and paraglossæ of *Cyllodes ater*.

A subsection of the *Nitidulidæ* may be founded upon those genera which have the metathoracic axillary pieces well developed in contradistinction to those which have not.

Habits and Geographical Distribution.

The chief function of this family is that of scavengers. Their main business is to clear off decaying substances from the face of the earth, especially those minute and neglected portions which have escaped the attention of other scavengers whose operations are conducted on a larger scale. We may characterize them in one point of view as retail scavengers. They are, so to speak, users-up of waste materials. After the beast of prey has satisfied his hunger on the animal he has slain, after the hyæna and the vulture have gorged themselves on its carrion, after the fly with its army of maggots has consumed the soft parts, after the burying-beetle and the Silphidæ have borne their part in the clearing away and when nought but the bones remain, then come the *Nitidulariæ* to go over what they have left, to gnaw off every fragment of ligament or tendon, and to leave the bones as nearly in the state of phosphate of lime as external treatment can. In another point of view, however, their employment is wholesale and wide enough. They conduct their operations all over the world, their branches extend into the most remote districts; the materials with which they have to do, although mere waste, have no other limit to their variety or their number than the organized substances found on the surface of the globe. As in all great establishments, too, the principle of division of labour is carried to a great extent. Each different kind of substance has a different member of the firm told off to take charge of it. One species confines itself to rotten oranges, another to bones, a third to putrid fungi, a fourth to decaying figs. Decaying wood, decaying bark, decaying flowers, decaying leaves, all furnish distinct employment to different species.

They are not all scavengers, however. Many pass their lives in flowers; others feed upon fresh victuals; and Mr. Frederick Smith of the British Museum has, whilst I write, brought to my notice a species of *Brachypeplus* (*B. auritus*) which he has received from Australia, in a wild bee's nest, where it feeds, both in the larva and perfect state, on the wax and honey.

With such extensive functions, it follows that the family is cosmopolitan; so are most of the genera and even a few of the species. The wide distribution of these is no doubt due to the universal presence of their food and to their introduction into distant countries by accidental causes, of which the migrations of man are probably the most prominent; but there are occasional instances of species so nearly alike to others (whose habitat is at great distances) as to be scarcely distinguishable, and yet on close examination certainly distinct, and whose occurrence in such distant localities it is very difficult to account for. Take, for example, the genus *Stelidota*, which is properly an American form, seeing that out of nineteen or twenty species all are from the American continent, except one from Tahiti, one from Celebes, and two from Madagascar. (I do not include here another large species from Celebes, which forms the passage from *Stelidota* to *Lordites*, and which I have constituted a separate genus.) Of the Madagascar species one is so very like the commonest North American species (*St. geminata*), that, if placed among a number of them and passed off as coming from America, it would probably never be detected as different, although when forewarned by the locality, and looking for distinctions, it is rightly viewed as a distinct species. How are we to account for this close resemblance? The transference of a species from Carolina to Madagascar without man's assistance is not easily conceived; and if we imagine that a *Stelidota geminata* has been introduced by ships from North America, the period of introduction must have been comparatively recent—not more than 200 years ago. Can we believe that in that short space of time climatal causes have changed *Stelidota geminata* into *St. didyma*? No introduction, of either plant or animal, from the oldest time to which introduced species have been traced back, has, so far as we know, ever resulted in an alteration in the species, without man's assistance by breeding or cultivation; and if we were to adopt this solution in the case of *Stelidota didyma* we could not refuse to extend it to the other species, *St. orphana*, which again is a little more removed from *St. geminata*. Our explanation would then be that the latter had been introduced from North America into Madagascar, its descendants had under the new conditions changed into *St. didyma* and given off cousins now called *St. orphana*, and that all this had been done within the short space of a couple of centuries, probably much less. A similar explanation would do for the Tahiti species, with this difference, that its parent was probably *Stelidota ruderata* from the West Indies. The variations in these are slight, and very different in degree from the class of phenomena of which the existence of the new genus *Lordyra*, found by Mr. Wallace in Celebes, is an example.

There are other genera which, although almost entirely confined to one country, are also represented in some other distant lands by one or two exceptional species. There is the genus *Lobiopa*, of which there is one species in North America, several in Mexico and the West Indies, a greater number in Brazil, Para, and Columbia, two species in Peru, and one in Senegal. The Peruvian species are obviously outliers from Columbia. The district about Quito embraces many species of plants and animals which are called Peruvian or Columbian according as they are most frequent in Peru or Columbia; and when we see the *same species* thus found on both sides of the Andes, it is natural to expect that different species of the same genus should also be found. But it is different with the Senegal species. I have already, in a paper published in this Society's 'Transactions,' "On the geographical relations of the Coleoptera of Old Calabar," pointed out the occurrence on that part of the west coast of Africa of species belonging to genera of remarkable facies which had up to that time been supposed to be peculiar to the opposite coast of South America, and in that paper I briefly discussed the question whether their presence on the west coast of Africa, and similar instances of the converse where West-African forms are met with in Brazil, could be referred to the proximity or junction of the two continents at some former period of time not so distant as to have allowed great changes in the fauna to be gradually effected. The *Nitidulariæ* furnish a number of instances illustrative of this point. Besides *Lobiopa*, the Brazilian genus *Platychora* has representatives in Africa; there are species of *Perilopa* both in Africa and Brazil; and Old Calabar furnishes at least two species of the American genus *Prometopia*—although this is of less importance, as other species are found in the East Indies and Philippine Isles.

An interesting point in the distribution of genera which are thus widely spread is the fact that they are not found in numbers in these outlying districts: the number in what we may call the metropolis of the genus may be considerable; but we find that of those located elsewhere very limited—one dropped here, and another there, at immense distances. Take *Prometopia*: we find one species of it in North America, one in Mexico, four in Para, &c., two in West Africa, one in the East Indies, and six in the Malayan Archipelago. Others, again, seem equally scarce everywhere. We know of one species of *Æthina* in Madagascar, one in the East Indies, one in Australia, one in Africa, and one in Mexico. With the exception of the genera *Colastus* and *Camptodes*, peculiar to America, I do not remember any genus containing numerous species which is confined to one hemisphere. Of course where a genus has only one species it must be confined to one hemisphere, unless indeed the species is cosmopolitan (and I know of no instance where a genus with only one species has that species widely distributed).

Family NITIDULARIÆ.

Antennæ rectæ, clavatæ. Coxæ anticæ cylindricæ, receptæ. Acetabula transversalia. Abdomen segmentis ventralibus quinque, omnibus liberis. Tarsi articulis quinque, quarto minimo.

Mentum transverse, subquadrate, composed of two pieces closely united together, frequently rounded, sometimes sinuate or emarginate in front. Maxillæ usually exposed, rarely covered at the base; with only one lobe, except in the first Tribe, where there is an outer lobe. Antennæ inserted under the margin of the front, eleven-jointed, terminated by a round or oval club composed of three or, rarely, of two articles. Thorax sometimes closely applied to the elytra, sometimes enclosing their base. Prosternum frequently produced behind; parapleura not distinct; coxal cavities transverse. Mesothorax with the parapleura large, extending to the coxæ. Metathorax short, parapleura narrow. Elytra sometimes truncate, sometimes entire. Abdomen with five free ventral segments, the first a little longer. Anterior coxæ transverse, separated, not prominent; middle and posterior ones transverse, flat, the latter extending almost to the margin of the body. Legs short, somewhat stout, retractile or subretractile; tarsi short, usually dilated, hairy beneath, five-jointed, with the fourth article very small.

Five tribes compose this family, and the species belonging to each may be recognized by the following dichotomous table:—

	Labrum not concealed by the prolonged epistome	1
	Labrum concealed by the prolonged epistome	IPIDÆ.
1	Two or three dorsal segments of the abdomen exposed	2
	The last dorsal segment (pygidium) alone exposed	3
2	Maxillæ with two lobes	BRACHYPTERIDÆ.
	Maxillæ with one lobe	CARPOPHILIDÆ.
3	Prothorax not much shorter below than above	NITIDULIDÆ.
	Prothorax much shorter below than above	STRONGYLINÆ.

Tribe I. BRACHYPTERIDÆ.

Genus *Cateretes*, Erichs. in Germ. Zeitschr. iv. 227 (1843).

Maxillæ malis binis. Labrum distinctum. Antennæ clava haud magna vel abrupta. Sine sulcis antennariis. Acetabula antica transversa, aperta. Abdomen segmentis duobus vel tribus ultimis liberis. Coxæ posticæ valde distantes.

The exposed labrum, the epistome not produced, the two-lobed maxillæ, the absence of antennal grooves, the open transverse anterior cotyloid cavities, and the exposure of more than the last segment of the abdomen, all readily distinguish this tribe.

The absence of antennal grooves is a character by which to distinguish them from the greater number of the *Carpophilidæ*, although not from all, the genus *Mystrops* proving an exception to the general rule in the *Carpophilidæ*. There are no metathoracic axillary pieces. The club of the antennæ is gradually thickened, not suddenly increased into a circular club.

They live upon flowers, and are comparatively few in number.

They may be divided into two genera, according to whether the claws of the tarsi are toothed or not, each of which, again, may be further subdivided.

The following dichotomous table shows some of the characters of the different genera into which they may be classed:—

	Ungues simple	1
	Ungues toothed at the base	*Brachypterus.*
1	Pygidium simple in both sexes	*Cercus.*
	Pygidium with an accessory segment in males	*Amartus.*

Genus Cercus.

Latr. Préc. d. car. gén. d. Ins. 68 (1796). Erichs. in Germ. Zeitschr. iv. 228 (1843). Sturm, Deutschl. Faun. xv. 1. taf. 288 (1844). Erichs. Naturg. Ins. Deutschl. iii. 126 (1848). Redtenb. Faun. Austr. gen. 124. p. 161 (1849). Lacord. Hist. des Coléopt. ii. 291 (1854). Jacq. Duval, Gen. des Coléopt. d'Europe, ii. 135 (1857–59).

Fig. 25.

Unguiculi simplices.

Claw of *Cercus.*

Besides the claws of the tarsi being simple in this genus, the last article of the labial palpi is usually oval. Erichson made this character a point of distinction between *Cercus* and *Brachypterus*, in which it is usually subglobose; but some of the species of the latter from California have the article in question elongate-oval, and therefore it cannot be used to distinguish them. A similar remark applies to a character drawn by Erichson from the pygidium, to which there is, according to him, a small appendage added in the males and not in the females in *Brachypterus*, while it continues simple in both sexes in *Cercus*. Leconte's genus *Amartus*, however, which has the simple claws of *Cercus*, has this supplementary piece added to the pygidium in the males. That character occurring in both, can therefore be used only to distinguish subsections in each genus.

	CARPOPHILUS.	
Position and Affinities.—BRACHYPTERUS.	CERCUS.	MYSTROPS.
	MELIGETHES.	

Different authors have divided the genus *Cercus* into four genera. I do not think they are called for; but as they may be of use in rendering the determination of the species belonging to it more easy, I have given them here as subgenera. They may be thus distinguished:—

	First and second articles of the antennæ simple	1
	First and second articles of the antennæ much dilated in the males	Subg. *Anomœocera.*
1	Pygidium with a supplementary anal piece in the males	*Amartus.*
	Pygidium without a supplementary anal piece in the males	2
2	Pronotum with the posterior angles rounded	Subg. *Cercus.*
	Pronotum with the posterior angles right-angled	Subg. *Heterhelus.*

(Subgenus ANOMŒOCERA.)

Shuckard, Coleopt. Delin. 25. pl. 30. fig. 2 (1840). Jacq. Duval, Gen. des Coléopt. d'Eur. ii. 137 (1857–59).
Anisocera, Steph. Illustr. Brit. Entom. v. 438 (1832).

Antennarum articulus primus et secundus maribus dilatati.

The first and second articles of the antennæ dilated in the males. Considerable variation in the degree of dilatation and size of these articles occurs in different individuals even of the same species, which makes the antennæ themselves look longer in some than in others.

1. CERCUS PEDICULARIUS. (See Plate XXXII. fig. 1.)

Latr. Gen. Crust. et Ins. ii. 16. 4 (1807). (Dej. Cat. 137, ed. 1837.) Erichs. in Germ. Zeitschr. iv. 288. 1 (1843). Sturm, Deutschl. Faun. xv. 5. 1. taf. 288 (1844). Erichs. Naturg. Ins. Deutschl. iii. 126. 1 (1848). Redtenb. Faun. Austr. 161 (1849).
Dermestes pedicularius, Linn., Fabr., Schrank, Payk., Panz.
Cateretes pedicularius, Herbst, Gyll., Duftschm., Steph., Heer, Schönh.
Brachypterus pedicularius, Kugell.
Nitidula truncata, Fabr. Syst. El. i. 354. 37 (1801).
Anisocera Spirææ, Steph. Illustr. Brit. Ent. Mand. v. 438 (1832).
Anomœocera Spireæ, Shuck. Coleopt. Delin. 25. pl. 30. fig. 2 (1840).

Fortiter punctatus, testaceus, sutura elytrorum pectoreque piceis; prothorace lateribus rotundatis; elytris thorace fere duplo longioribus. Long. $\frac{3}{4}$–$1\frac{1}{4}$ lin., lat. $\frac{1}{4}$–$\frac{1}{2}$ lin.

Per totam Europam communis.

Strongly punctate, testaceous, with the suture of the elytra and breast piceous. Head even. Antennæ in both sexes longer than half the body, longest in the males; the first article elliptical, the second three-cornered. Thorax about the breadth of the elytra, half as long as broad, the sides rounded, the anterior angles obtuse, the posterior oblique and rounded, finely pubescent, coarsely but not deeply punctate. Scutellum large, rounded. Elytra almost twice as long as the thorax, convex, and somewhat obese; exterior apical angles rounded, apex truncate somewhat obliquely inwards and forwards. Yellow rust-coloured or light brown, with the breast, the scutellum, and the neighbouring portion of the elytra piceous.

Not rare in Europe; common in England.

2. CERCUS BIPUSTULATUS.

(Dej. Cat. 137, ed. 1837.) Erichs. in Germ. Zeitschr. iv. 229 (1843). Sturm, Deutschl. Faun. xv. 7. 2. taf. 289. fig. A, *a*, *b* (1844). Erichs. Naturg. Ins. Deutschl. iii. 127. 2 (1848). Redtenb. Faun. Austr. 162 (1849).
Dermestes bipustulatus, Payk., Fabr.
Cateretes bipustulatus, Gyll., Duftschm., Steph., Heer.

Fortiter punctatus, niger; ore, antennis, pedibus elytrorumque macula magna discoidali rufo-testaceis; prothorace lateribus rotundatis; elytris thorace sesquiplo longioribus. Long. $\frac{3}{4}$–$1\frac{1}{4}$ lin., lat. $\frac{1}{4}$–$\frac{1}{2}$ lin.

Per totam Europam communis.

In size and form very like the preceding. Black, clothed with fine grey pubescence, rather more deeply punctate. The mouth, the antennæ, the legs, and a patch on each elytron reddish yellow. Sometimes the head, or the head and thorax, or even the whole body is reddish yellow. The elytra are considerably shorter than in *C. pedicularius.*

Common in Europe; not rare in England.

Var. SUTURALIS (Motsch.). Fortiter punctatus, testaceus, elytris dilutioribus, scutello elytrorumque apice et macula triangulari circa scutellum brunneis. Long. $\frac{3}{4}$ lin., lat. $\frac{1}{4}$ lin.

Habitat in Siberia orientali.

Received from Count Motschulsky under the above name; but I do not think it is a distinct species from *C. bipustulatus*. The only differences beyond colour which I can see are that it is somewhat more deeply punctate, and that the thorax is perhaps a little more expanded before the posterior angles. I have placed the specimen in the British Museum.

From Eastern Siberia.

3. CERCUS OCHRACEUS.

(Dej. Cat. 136, ed. 1837.)

C. bipustulato affinis; major, punctatus, flavo pubescens; prothorace transverso, marginibus rotundatis vix explanatis; elytris magis parallelis, thorace plus quam sesquiplo longioribus; flavus. Long. $1\frac{1}{3}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Volhynia.

Distinguished from its allied species by its slightly larger size and more parallel form, as well as by its colour. It corresponds with the description given by M. Fairmaire of his Algerian species *C. flavescens*, except in the length of the elytra, which he states to be shorter than in *C. bipustulatus*, whereas in this species they are rather longer. The colour is bright flavous, the thorax and head a little darker, and a slight obscurity about the scutellum. The punctation is distinct, but not very close.

From Volhynia.

The only example of this species which I have seen is in the Dejean collection, kindly lent to me by the Marquis de Laferté-Sénectère.

4. CERCUS FLAVICANS.

Fairm. Ann. Soc. Ent. de France, sér. 3. viii. 166 (1860).

"Ovato-oblongus, flavus, nitidus, dense punctatus, pygidio sparsim ac tenuiter asperato; antennis sat validis, testaceo-flavis, apice obscurioribus; elytris thorace duplo longioribus, apice parum rotundatis, angulo suturali obtuso. Long. 1 lin."

Habitat in Algeria.

I have not seen this species: M. Fairmaire mentions that it resembles the female of *C. pedicularius*, but the body is much less convex, the thorax is broader, the antennæ shorter and thicker; the elytra are shorter, more parallel, and the punctation not so deep.

From Algeria.

(Subgenus HETERHELUS.)

Jacq. Duval, Gen. des Coléopt. d'Europe, ii. 137.

Fig. 26.

Form of thorax in the subgenus *Heterhelus*.

Pronotum angulis posticis rectis.

The thorax in this subgenus has the posterior angles briefly right-angled at the tip (see fig. 26).

5. CERCUS SAMBUCI.

Erichs. in Germ. Zeitschr. iv. 229. 4 (1843). Sturm, Deutschl. Faun. xv. 9. 3. taf. 289. fig. C (1844). Erichs. Naturg. Ins. Deutschl. iii. 127. 3 (1848).
Cateretes Solani, Heer, Faun. Col. Helv. i. 412. 7 (1841) ♂.
—— *scutellaris*, Heer, Faun. Col. Helv. i. 412. 8 (1841) ♀.
(*Cercus ferrugineus*, Dej. Cat. 137, ed. 1837.)

Fuscus testaceusve, cinereo pubescens, dense subtilius punctatus; prothorace lateribus subangulato. Long. 1–1¼ lin., lat. ½ lin.

Habitat in Europa.

Usually clear rust-colour, but sometimes darker, finely and closely pubescent, moderately densely and finely punctate. Antennæ with the club in the females two-jointed. The thorax with the sides somewhat angularly expanded in the middle. The eyes, breast, and abdomen black. The elytra long, and most convex a little past the middle. Scutellum rounded at the apex.

Distinguished from its allied species by the slightly angular sides of the thorax and the fine punctation.

Found on the flowers of *Sambucus racemosus* in spring in most parts of Europe. Not found in England.

6. CERCUS LONGIPENNIS (Motsch.).

Leviter punctatus, ferrugineo-testaceus, cinereo pubescens, elytris flavis; prothorace transverso, lateribus rotundatis; elytris prothorace fere triplo longioribus. Long. ¾ lin., lat. ¼ lin.

Habitat in Dauria meridionali.

Allied to *C. Sambuci*, but smaller and of finer punctation, and less pubescent. The elytra comparatively a little longer, and the thorax not so angular in the middle. Reddish yellow, with paler elytra. I received a single specimen from Count Motschulsky, from Southern Dauria, which I have placed in the British Museum.

7. CERCUS RUBIGINOSUS.

Cateretes Spireæ, Märkel, Allgem. Naturg. Zeit. iii. 176 (1857).
Cercus Rhenanus, Bach.
Brachypterus rubiginosus, Erichs. in Germ. Zeitschr. iv. 232. 9 (1843). Sturm, Deutschl. Faun. xv. 30. 6. taf. 291. fig. D (1844). Erichs. Naturg. Ins. Deutschl. iii. 133. 6 (1848).

Saturate vel dilute fuscus, subnitidus, cinereo pubescens, dense subtiliterque punctatus;

prothorace lateribus haud angulatim rotundatis; elytris humeris prominentibus. Long. 1–1¼ lin., lat. ⅔ lin.

Habitat in Germania.

Allied to *C. Sambuci*, but distinguished by the colour and by the absence of the angular expansion of the sides of the thorax. It is more shining. The antennæ have the club three-jointed in both sexes. The scutellum is triangular with the apex acute, while in *C. Sambuci* it is rounded. The shoulders of the elytra are very prominent. The profile of *C. Sambuci* is more level than that of *C. Spirææ*, which has a greater declivity between the base of the thorax and the base of the elytra. However, except in very exceptional cases, there is no need to refer to these points to distinguish the species, the colour alone being quite sufficient—dark rich umber in *C. Spirææ*, and pale testaceous in *C. Sambuci*.

This species was first noticed by Erichson, but somehow was mistaken for a *Brachypterus*, and described by him under the name of *Brachypterus rubiginosus*.

Märkel, in ignorance of Erichson's error, described it under the name of *Cateretes Spireæ*; and Herr Bach, of Boppard, having afterwards found specimens which appeared to him different, made it known under the name of *Cercus Rhenanus*; and all three names hold their place in Continental lists *in fide parentum*. A careful examination of the specimens of *B. rubiginosus* preserved in the Berlin Museum shows that they belong to the genus *Cercus*, and that they are the same as Märkel's and Bach's species.

I am informed by Herr von Kiesenwetter that this species may be taken in thousands in the valley of Dresden in the month of July, on the flowers of *Spiræa Ulmaria*.

Herr Bach takes it in profusion near Boppard in the month of March, on the same tree as *Cercus Sambuci*, viz. *Sambucus racemosus*, but always a fortnight before it, it appearing before the buds are open.

The difference in the time of appearance would lead one at first to suppose that Bach's species must be distinct from *C. Spireæ*, Märkel; but I have failed to discover any difference; and as Märkel came to the same conclusion, I have felt constrained to consider them the same, notwithstanding this embarrassing circumstance. The Saxon specimens taken in July may be a second brood.

It is widely distributed, being found in most parts of Europe—and also, probably, throughout Asia, as I have received a specimen from Count Motschulsky, named by him *C. melanocephalus*, which had been taken on the banks of the river Amoor, and which is now in the collection of the British Museum. I can discover no difference between this specimen and those taken in Europe, unless perhaps that it is a trifle less convex.

8. CERCUS PENNATUS.

Query, *Cercus pusillus*, Melsh. Proc. Acad. Philad. ii. 105 (1846)?

Fulvus vel piceo-fulvus, capite, disco thoracis scutelloque parum saturatioribus, punctatus, pubescens; scutello parum punctato, obtuse rotundato; elytris longis, sutura versus scutellum paululo elevata, utrinque linea brevi subdepressa, apice rotundato, truncato. Long. 1¼ lin., lat. ⅗ lin.; long. elytrorum ¾ lin., lat. ⅔ lin.

Habitat in America boreali.

The American representative of *C. Sambuci*; longer and larger, somewhat narrowed in front. Dull fulvous, with the head, the disk of the thorax, the scutellum, the part of the elytra adjacent to it, and the suture, a little darker; finely punctate and pubescent, rather dull. The head with a faint semicircular line impressed between the eyes. Antennæ with the club in the female two-jointed. Thorax with the base subemarginate and the sides rounded; slightly margined, the anterior angles a little inflexed and somewhat obtusely rounded. Scutellum slightly punctate, obtusely rounded at the apex. Elytra long, broadest behind, a little broader than the thorax at their base, with the shoulders slightly prominent; the suture slightly elevated towards the scutellum, bearing on each side a short subdepressed line; sides margined and almost inflexed, with the apex truncate and the angles rounded. The pygidium and projecting angles of the preceding segment alone exposed.

Found in Canada, Pennsylvania, and other parts of North America.

There is a species described by Melsheimer (*Cercus pusillus*) which may possibly be the same as this, or *Cercus crinitus* (see p. 237); but I have been unable to procure authentic specimens of it or to identify it from Melsheimer's description, and have consequently not ventured to adopt his name for it.

9. Cercus abdominalis.

Erichs. in Germ. Zeitschr. iv. 229 (1843).

Viridis, nitidus; antennis, pedibus abdomineque rufo-testaceis. Long. $1\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in America boreali.

A very distinct and well-marked species. Of the size of *C. bipustulatus*, oval, slightly convex, very sparingly and finely cinereo-pubescent. Green, shining, and thickly punctate. Antennæ rufo-testaceous; club three-jointed in both sexes. Mouth rufous. Thorax convex, narrower than the elytra; sides rounded, posterior angles right-angled, but blunter than in other species of the genus. Scutellum sparingly punctate. Elytra broad, convex; shoulders somewhat piceous. Breast black.

The only one of the *Brachypteridæ* with something of a metallic lustre.

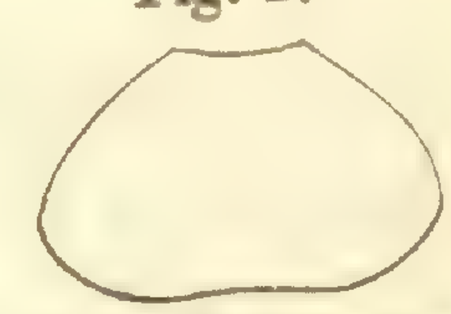
It does not appear to be common.

(Subgenus Cercus proper.)

Jacq. Duval, Gen. des Coléopt. d'Europe, ii. 137.

Pronotum angulis posticis rotundatis.

Fig. 27.



Form of thorax in subgenus *Cercus* proper.

The slightly rectangular termination to the posterior angles of the thorax is not present in this subgenus.

10. Cercus Dalmatinus.

(Dej. Cat. 137, ed. 1837.) Erichs. in Germ. Zeitschr. iv. 229. 5 (1843). Sturm, Deutschl. Faun. xv. 12. 4. taf. 289. fig. *d*, D (1844). Erichs. Naturg. Ins. Deutschl. iii. 128. 4 (1848).

Var. C. testaceus (Dej. Cat. 137, ed. 1837).

Fortiter punctatus, testaceus, cinereo pubescens, scutello, elytrorum sutura, pectore abdomineque piceis; elytris thorace sesquiplo longioribus. Long. 1 lin., lat. $\frac{2}{5}$ lin.

Habitat in Austria, Dalmatia, et Græcia.

Somewhat of the appearance of *C. pedicularius*, but smaller and narrower, punctate, and with longer and closer grey pubescence and much shorter antennæ, which are only as long as a fourth of the length of the body. Testaceous, with the scutellum, the elytra on each side of the suture, and the breast and abdomen piceous. The thorax about the breadth of the elytra, and a half broader than long, narrowed in front and with the sides rounded. Scutellum punctate and apex obtuse. The elytra are a half longer than the thorax. Breast and abdomen finely punctate.

This species is found in the Austrian German provinces, as well as in Dalmatia and Greece. Herr von Kiesenwetter informs me that in Greece it is found on a species of *Carex* growing in the sea marshes.

The specimens standing under the name of *C. testaceus* in Count Dejean's collection are flavous-coloured varieties of *C. Dalmatinus*, and are said also to come from Dalmatia.

11. Cercus crinitus.

Statura *C. Sambuci*, rufo-testaceus, capite et prothorace paulo saturatioribus, leviter punctatus, subnitidus, longe pubescens; elytris thorace magis punctatis, humeris prominentibus, apice truncato, angulis paulo rotundatis. Long. 1 lin., lat. ½ lin.

Habitat in Tennessee in America boreali.

Of the size of *C. Sambuci*. Rufo-testaceous, head and thorax darker, faintly punctate, slightly shining, with a comparatively long, loose, fine pubescence. The head deeply impressed on each side in front. The thorax both before and behind moderately rounded and margined, all the angles rounded. The elytra more deeply punctate than the thorax, moderately long, with prominent shoulders, and sides rounded and almost inflexed; the apex truncate, with the angles, both exterior and sutural, rounded. The pygidium and the projecting angles of the preceding segment alone exposed.

Found in Tennessee. I am indebted to Dr. Schaum for the specimen now in the British Museum.

12. Cercus rufilabris.

Latr. Gen. Crust. et Ins. ii. 16. 3 (1807). Erichs. in Germ. Zeitschr. iv. 229. 6 (1843). Sturm, Deutschl. Faun. xv. 13. 5. taf. 289. fig. E (1844). Erichs. Naturg. Ins. Deutschl. iii. 129. 5 (1848).

(*Cercus rubicundus*, Dej. Cat. 136, ed. 1837.)

Cateretes rufilabris, Steph. Illustr. Brit. Ent. Mand. iii. 54. 2 (1830).

—— *Caricis*, Steph. Illustr. Brit. Ent. Mand. iii. 54. 10 (1830).

—— *rubicundus*, Heer, Faun. Col. Helv. i. 411. 4 (1841).

Brachypterus fulvus, Erichs. in Germ. Zeitschr. iv. 232 (1843).

Profunde punctatus, niger, ore pedibusque rufis; prothorace lateribus rotundato, antrorsum angustato. Long. $\frac{4}{5}$–1 lin., lat. $\frac{1}{3}$ lin.

Var. A. *Cateretes Junci*, Steph. Illustr. Brit. Ent. Mand. iii. 54. 9 (1830).

Rufo-piceus, elytris nigris.

Var. B. *Cateretes pallidus*, Heer, Faun. Col. Helv. i. 411. 5 (1841).

Testaceus, unicolor.

Communis in Europa.

Scarcely half so large as *C. pedicularius*, more elongate and less convex. Black, shining, deeply punctate, with white pubescence. Mouth, antennæ, apex of the elytra, and legs reddish yellowish-brown. Antennæ one-fourth of the body in length, with a rather slender club. Head small, forehead flat. Thorax narrowed in front, nearly of the breadth of the elytra behind, sloping in a gentle curve to the posterior angles, which are obtuse. Scutellum large and rounded. Elytra distinctly and not very closely punctate.

The colour is variable, which has given rise to the above varieties A and B being described as distinct species.

I am unable to see any difference between this species and the specimens of Erichson's *Brachypterus fulvus* preserved in the Berlin Museum. Erichson himself remarks regarding the latter that it is very like the reddish varieties of the former, but can be distinguished, in addition to the generic characters, by its having the last two segments of the abdomen exposed. Now there must be some misapprehension here, because *Cercus rufilabris* likewise has the last two segments exposed. Erichson, however, specially refers, besides, to the generic characters as being those of *Brachypterus*; but as the specimen in the Berlin Museum is unique, and not in a state to allow of these characters being observed without sacrificing the specimen, I am inclined to think that Erichson must have taken them upon trust; and as it is, in every point that we can test, apparently identical with *C. rufilabris*, I have recorded my opinion that it is synonymous with that species. The only difference that I could perceive is that it seemed to be not quite so deeply punctate.

It is found all over the Continent and also in England.

13. CERCUS SERICANS.

Leconte, Proc. Acad. Nat. Sci. Philad. Feb. 1859, p. 69 (1859).

Oblongus, modice convexus, fuscus, punctatus, pube brevi cinerea sericans; capite thoraceque sæpe rufo-testaceis, hoc latitudine plus sesquiplo breviore, lateribus rotundatis marginatis; elytris thorace fere duplo longioribus; antennis pedibusque testaceis, illis articulo nono præcedente vix majore. Long. 1 lin., lat. $\frac{1}{3}$ lin.

Habitat in California, prope Fort Tejon.

Longer and more slender than the preceding species of the genus, and provided with a closer and more silky cinereous short pubescence; punctate; brown, with the head and thorax often rufo-testaceous, and antennæ and legs testaceous. The club of the antennæ biarticulate, the ninth article being scarcely longer than the eighth. Thorax less than two-thirds as long as broad. Elytra about twice as long as the thorax.

Found near Fort Tejon in California. Dr. Leconte has been kind enough to supply me with a specimen, which I have placed in the British Museum.

14. CERCUS EXILIS (Laferté).

Parvus, subcylindricus, flavus, punctatus, pubescens. Long. $\frac{2}{3}$ lin., lat. $\frac{1}{4}$ lin.

Habitat in Cumana.

Small, narrow, cylindrical, not unlike a small *Carpophilus*. Yellow, punctate, and pubescent. Antennæ with the club rather large and the articles moniliform. Head with a deep semicircular depression or canal in front at the base of the epistome, very faintly punctate, pubescent. Eyes large. Thorax subquadrate, the sides rounded, the anterior angles subrectangular, rounded; closely and irregularly punctate, pubescent; the posterior angles rounded; base truncate, margined. Scutellum small, smooth. Elytra subparallel, about a half longer than the thorax; darker at the apex; shoulders prominent, irregularly punctate. Apex truncate, slightly rounded. Exterior apical angles rounded. Abdomen paler; very little of the penultimate segment exposed above; fimbriæ distinct.

By some this has been mistaken for a *Rhizophagus* and named *R. adustus*.

From Cumana and Cuba.

(Subgenus Amartus.)

Leconte, in Proc. Acad. Nat. Sci. Philad. Nov. 1861, p. 343 (1861).

Palpi labiales articulo ultimo elongato-ovali (see Plate XXXII. fig. 4, *e*); unguiculi simplices; *mas* pygidio segmentulo anali aucto.

The outer lobe of the maxillæ is slender, not hooked at the point, but with a long terminal vesicle. Last article of the labial palpi elongate-oval; the maxillary palpi with the last article conical, a little longer than the preceding. The mentum is broad, emarginate in front. The labrum is emarginate; the mandibles flat, scarcely toothed. The club of the antennæ is 3-jointed and elongate. The second and third ventral segments are shorter than the first and fourth, the fifth is the longest; in the males a small but distinct dorsal segment is added. The tarsi are dilated; the claws slender, a little broader at the base, but not toothed.

15. Cercus rufipes.

Amartus rufipes, Leconte, *loc. cit.*

Ovalis, parum convexus, nigro-piceus, helvo pubescens, confertim punctatus; prothorace longitudine fere duplo latiore, antice truncato, lateribus et basi rotundato, angulis posticis parum explanatis; elytris thorace sesqui longioribus, lateribus et apice late indeterminate rufo-testaceis; antennis pedibusque rufo-testaceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{4}{5}$ lin.

Habitat in California.

Compared with the rest of the *Cerci*, this species is large. It is oval and convex, blackish piceous, covered with a close silky griseous pubescence, thickly and equally punctate both above and beneath. The antennæ are as long as the head and thorax united. The thorax is nearly twice as broad as long, the sides and base rounded, and the posterior angles somewhat expanded. Scutellum oblong; angles rounded, truncate at the apex. The elytra a half longer than the thorax, with the shoulders lighter, and the sides and apex broadly margined with an indeterminate rufo-testaceous margin. Below sometimes concolorous and sometimes ferruginous.

Found at Mendocino and in the neighbourhood of San Francisco in California, and probably throughout the whole of California. It does not appear to be rare, as I received many specimens from Mr. Hepburn of San Francisco.

Genus Brachypterus.

Kugellan, in Schneid. Mag. 506 (1792). Erichs. in Germ. Zeitschr. iv. 228 (1843). Sturm, Deutschl. Faun. xv. 16. taf. 290 (1844). Erichs. Naturg. Ins. Deutschl. iii. 130 (1848). Redtenb. Fauna Austriaca, no. 125. p. 162 (1849). Lacord. Hist. des Coléopt. ii. 292 (1854). Jacq. Duv. Gen. des Coléopt. d'Europe, 137 (1857–59).

Ungues dentati (fig. 28). Pygidium maris segmentulo anali auctum (fig. 29).

Fig. 28.

Claw of *Brachypterus.*

Fig. 29.

Pygidium of male *Brachypterus.*

Fig. 30.

Pygidium of female *Brachypterus.*

This genus may be shortly characterized by having the claws toothed, and by the males having an additional anal segment or appendage. It may be further subdivided into two or three subgenera, depending upon the form of the thorax and of the last segment of the labial palpi; thus:—

	Posterior angles not embracing the elytra	1
	Posterior angles embracing the elytra	*Heterostomus.*
1	Elytra much longer than exposed dorsal segments of abdomen	*Brachypterus.*
	Exposed dorsal segments of abdomen nearly as long as elytra	*Brachyleptus.*

Position and Affinities.—Cercus. Brachypterus. Mystrops.

(Subgenus Brachypterus proper.)

Prothorax angulis posticis obtusis vel rotundatis. Elytra abdominis segmentis dorsalibus expositis multo longiora. Palpi labiales articulo ultimo ovato.

Labial palpi with the last article ovate. Thorax with the posterior angles obtuse or rounded, not embracing the base of the elytra. Elytra much longer than the exposed dorsal portion of the abdomen.

1. Brachypterus pubescens.

Erichs. in Germ. Zeitschr. iv. 231. 4 (1843). Sturm, Deutschl. Faun. xv. 24. 4. taf. 191. fig. B (1844). Erichs. Naturg. Ins. Deutschl. iii. 132. 4 (1848).
Cateretes urticæ, var. α, Illig. Käf. Preuss. 395. 2 (1798).
—— ——, var. β, Duftschm. Faun. Austr. iii. 140. 3 (1825).
—— *glaber*, Steph. Illustr. Brit. Ent. Mand. v. p. 407 (1832). Newm. Ent. Mag. ii. p. 200 (1834).
Cercus Urticæ (Dej. Cat. 136, ed. 1837).

Plumbeo-ater, nitidulus, punctatus, parcius albido pubescens, antennis pedibusque piceis vel nigris. Long. 1 lin., lat. $\frac{1}{2}$ lin.

Habitat in Europa, sat frequens.

Black with a slightly leaden lustre, with a sparing adpressed whitish pubescence. Finely and rather deeply punctate. Antennæ about the length of the thorax, piceous, with the first two articles black. Head very deeply and almost rugosely punctate. Thorax about the breadth of the elytra, a half broader than long, rounded on the sides, narrowed in front, truncate, straight before and behind, posterior angles rounded and obtuse. Scutellum large and semicircular. Elytra more than a half longer than the thorax. Abdomen with the fourth segment very short. About the same size and shape as *B. Urticæ*, but readily distinguished by its leaden-black colour and whitish-grey pubescence, with legs and antennæ so dark as usually to appear black, while *B. Urticæ* has a brownish hue mixed with its black, and its legs, antennæ, and mouth are reddish brown, the basal joint of the antennæ excepted, which is usually black, and also sometimes the club, which is generally darker than the preceding articles of the antennæ.

Found in flowers and on plants all over Europe. Common. Not rare in Britain.

2. Brachypterus unicolor.

Küster, Käf. Eur. xviii. 29 (1849).

Niger, nitidus, sparsim fortiter punctatus, subtiliter cinereo pubescens; prothorace lateribus rotundato, angulis posticis rotundatis, anticis rectis; elytris indistincte virescente micantibus. Long. $\frac{4}{5}$–1 lin., lat. $\frac{1}{2}$ lin.

Habitat in Sardinia, Sicilia, &c.

Black, shining, sparingly but deeply punctate, faintly cinereo-pubescent. Thorax rounded on the sides, the posterior angles rounded, the anterior right-angled. Scutellum large, rounded at the apex, punctate, except on the margins. Elytra indistinctly brassy green. Antennæ and legs black.

The only distinguishable differences which M. Küster gives between this species and *B. pubescens* are, that it is smaller, more slender, blacker, less closely pubescent, with the second article of the antennæ reddish brown and the elytra faintly metallic green. It is to be observed, however, that the colour of the basal articles of the antennæ is a character of little or no value. Nine out of ten specimens of *B. pubescens* which have the antennæ reddish have the second article lightest in colour. The basal joint is usually dark, the second rufous, and the rest become gradually darker as they approach the club, which is generally piceous.

I have not seen any undoubted specimens of M. Küster's types; but I have received from Herr von Kiesenwetter a specimen of a species, taken in Sicily, which he thought was Küster's *unicolor*. This specimen, however, is larger and more convex, instead of being smaller and more slender, than *B. pubescens*, and the second article of the antennæ does not differ in colour from the others. It almost looks as if Küster had confounded his specimens, and described his *unicolor* from specimens of *pubescens*, reversing the characters in his contrast. My specimen is somewhat smoother than *pubescens*, the punctuation being rather more widely scattered; it is also decidedly more convex, and has the anterior angle of the thorax more right-angled and less inflexed; but, with these exceptions, I can see little difference between them.

For the above reasons, I am inclined to think that the Sicilian species which I received under that name is Küster's *unicolor*, and I have therefore recorded it as such, merely altering his diagnosis so as to leave the above points open.

3. BRACHYPTERUS URTICÆ.

Kugellan, in Schneid. Mag. 561. 2 (1794). Erichs. in Germ. Zeitschr. iv. 231. 5 (1843). Sturm, Deutschl. Faun. xv. 28. 5. taf. 291. fig. C (1844). Erichs. Naturg. Ins. Deutschl. iii. 132. 5 (1848).

Dermestes Urticæ, Fabr., Payk.

Cateretes Urticæ, var. β, Illig. Käf. Preuss. 395. 2 (1798).

—— ——, Gyll, Duftschm., Steph., Heer, Schönh.

Strongylus abbreviatus, Herbst, Käf. iv. 190 (1792).

Scaphidium scutellatum, Panz. Faun. Germ. 4. 11.

Meligethes erythropus, Marsh., Steph.

Cercus rufilabris (Dej. Cat. 136, ed. 1837).

Piceo-subæneus, nitidus, tenuiter griseo pubescens, punctatus, antennis pedibusque rufis; prothorace lateribus postice sinuatis. Long. $\frac{2}{3}$–1 lin., lat. $\frac{2}{5}$ lin.

Habitat in Europa frequentissimus.

Var. A. Totus piceus, prothorace lateribus postea minus sinuatis et minus reflexis.

Habitat in America boreali.

Convex, brown, with a slight brassy tinge, sparingly clothed with griseous pubescence, moderately deeply punctate. The thorax nearly as broad as the elytra, but only half as long, with the sides rounded, but sinuate in front of the posterior angles, which are expanded and somewhat reflexed, truncate both before and behind, and the posterior angles obtuse. The elytra somewhat tumid. The fourth segment of the abdomen very short. Antennæ and legs rufous. The mouth, and apex of the thighs reddish brown.

The commonest of all the species; feeding in great numbers everywhere in Europe on the nettle (*Urtica dioica*), especially when in bloom. It is found also in North America. Dr. Leconte has sent me a specimen from Pennsylvania, which only differs in the following respects: it is a little smaller, and wholly piceous; the sides of the thorax before the posterior angles are less sinuated and the angles less reflexed. These differences are too slight to allow me to do more than record it as a variety (var. A, *suprà*).

4. BRACHYPTERUS AFFINIS.

Cateretes affinis, Heer, Faun. Col. Helv. i. 411 (1841).

"Statura omnino *B. Urticæ*, oblongo-ovatus, castaneus, confertim subtilius punctatus; pronoto transverso, angulis posticis rotundatis; antennis pedibusque testaceis. Long. $\frac{7}{8}$ lin.

"Habitat in montibus subalpinis prope Linthal."

I have not seen this species. Prof. Heer says it is exceedingly like *B. Urticæ*, but is distinguished from it by a finer punctuation and by its thorax being a little longer.

Subalpine districts in Switzerland (Linthal, &c.).

5. BRACHYPTERUS FULVIPES.

Erichs. in Germ. Zeitschr. iv. 231 (1843).

Statura *B. Urticæ*, niger, nitidus, dense punctatus et cinereo pubescens; thorace lateribus medio subangulatis; pedibus antennisque rufis, his clava picea. Long. $\frac{4}{5}$ lin.

Habitat in Sardinia.

Similar in size and form to *B. Urticæ*; black, shining, closely punctate, and clothed with a cinereous pubescence. Thorax a little narrower than the elytra; sides rounded, and with a slight angle at the middle, nearly equal in breadth in front and behind, posterior angles obtuse. Elytra a half longer than the thorax. Legs, antennæ, and mouth rufous; the club of the antennæ piceous.

The deeper punctuation and close cinereous pubescence are the most distinguishing characters in this species. The only specimen I have seen is in the Berlin Museum, and was brought from Sardinia.

6. Brachypterus pallipes.

Affinis *B. fulvipedi*, Erichs., leviter punctatus et tenuiter pubescens, niger, thorace piceo, elytris parum cupreo micantibus; thorace lateribus rotundato et postice explanato; labro nigro; antennis pedibusque pallide testaceis, clava antennarum obscuriore. Long. $\frac{2}{3}$ lin.

Habitat in Algeria.

Nearly allied to *B. fulvipes*, Erichs., but rather smaller. The thorax with the sides rounded and more expanded posteriorly, and only beginning to be rounded-in at the very base, while in *B. fulvipes* the rounding-in commences at about a quarter of its length from the base.

From Algeria.

7. Brachypterus labiatus.

Erichs. in Germ. Zeitschr. iv. 232 (1843).

B. Urticæ similis, minor, niger, nitidus, parce punctatus, tenuiter pubescens; elytris æneis; labro, pedibus antennisque testaceis, his clava nigra. Long. $\frac{3}{5}$ lin.

Habitat in Sardinia.

Very similar to *B. Urticæ*, but scarcely more than half its size. It is black, shining, sparingly punctate, sparingly pubescent. The elytra with a slight brassy tinge. The labrum, the legs, and antennæ testaceous, except the club of the latter, which is black. The punctuation of the thorax is rather more distinct than that of the elytra, while in *B. Urticæ* it is about equal in both.

The only specimens I have seen are now in the Berlin Museum, and were received from Sardinia.

8. Brachypterus meridionalis.

Küster, Käf. Eur. xv. 38 (1848).

"*B.* niger, nitidus, planiusculus, tenuiter griseo pubescens, subtiliter punctatus; elytris subtilissime transversim rugulosis; antennis piceo-nigris, clava pedibusque rufo-piceis. Long. $\frac{3}{4}$ lin., lat. $\frac{2}{5}$ lin.

"Habitat in Hispania."

I have not seen this species; but Küster says that it is flatter than its allies, that the pubescence allows the shining surface to appear through it, and that the elytra are marked with transverse acicular markings,—characters by no means confined to this species (if it be a species), but shared by *Brachypterus Urticæ*, *B. pubescens*, and most of the other species.

From Carthagena in Spain.

9. Brachypterus Lucasii.

B. pubescens, (Schüppell, ined.) Lucas, Explor. Scient. de l'Algérie, Zool. ii. 219 (1849).

Ater, flavo pilosus; capite thoraceque punctatis; elytris fortiter granariis. Long. $\frac{2}{3}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Algeria.

Much smaller than *B. cinereus*. Black; clothed with yellow hairs, longish and sparingly scattered. Head punctate, the punctures small, close, and very deeply impressed; mouth black; the antennæ black, and each article sparingly sprinkled with longish yellow hairs. Thorax broader than long, rounded anteriorly and posteriorly, as well as the sides, which are dilated and very lightly edged; it is sprinkled with rather large rounded punctures tolerably deeply marked, and less close than those on the head. Scutellum smooth. Elytra convex and strongly shagreened. The underside of the body as well as the legs are of the same colour as above, and clothed with scattered longish yellowish hairs.

M. Lucas has described this species under the name of *B. pubescens*, forgetting that that name was already preoccupied. I have been obliged, therefore, to give it another name, and I have thought I could not do better than dedicate it to that amiable naturalist himself.

From Algeria.

10. Brachypterus rotundicollis.

Piceus, subæneus, nitidus, punctatus, griseo pubescens; thorace coleopteris paulo angustiore, lateribus rotundato; elytris sat longis et angustis; ore et antennis rufis, clava fusca; pedibus testaceis. Long. 1 lin., lat. $\frac{1}{3}$ lin.

Habitat in Syria et Europa meridionali.

Piceous, with a slight brassy hue, shining, densely punctate, clothed with a long griseous pubescence. Thorax slightly narrower than the elytra, with the sides and all the angles rounded; the sides scarcely (if at all) expanded, and not sinuate. Elytra not very convex, rather long. The antennæ (except the club, which is fuscous), mouth, and legs rufous. Pygidium and posterior angles of the penultimate segment alone exposed.

Found in Syria, Germany, &c.

11. Brachypterus Troglodytes.

Piceus, subæneus, nitidus, tenuiter griseo pubescens, punctatus; thorace lateribus rotundato, angulis posticis obtusis, rotundatis, haud sinuatis, explanatis; elytris humeris prominentibus, apice oblique truncato. Long. $\frac{3}{4}$ lin., lat. $\frac{2}{5}$ lin.

Habitat in California.

About the size of *B. Urticæ*; it is allied to it, but may be distinguished from it by the sides of the thorax not being sinuate behind. It is piceous, with a faint brassy tinge, shining, punctate, clothed with a slight griseous pubescence. The head has an impression on each side between the eyes, and a short faint longitudinal line on the vertex. The thorax has its sides rounded and not sinuate, the posterior angles obtuse, rounded, and expanded. Scutellum rather large. Elytra with prominent shoulders, with the sides gently rounded and margined, the apex obliquely truncate. Pygidium and posterior angles of the penultimate segment alone exposed. Antennæ and legs red.

From California. Communicated to me by M. l'Abbé de Marseuil.

12. Brachypterus globularius (Reiche).

Piceus, subæneus, nitidus, confertim punctatus, parce griseo pubescens; thorace coleopteris paulo angustiore, lateribus rotundatis, haud sinuatis, explanatis, disco convexo; elytris fortiter, disco lævius punctatis, apice singulis rotundatim truncatis; antennis, ore pedibusque rufo-piceis. Long. $\frac{4}{5}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in America boreali; Mexico; Connecticut, &c.

Closely allied to *B. Urticæ*. Piceous, with a slight brassy lustre, shining, thickly punctured, sparingly clothed with griseous pubescence. Thorax slightly narrower than the elytra, with the sides rounded, not sinuate, expanded, the disk abruptly convex from the expanded part, with a slight impression on each side of the middle, declining towards the base, with the anterior angles nearly right-angled and the posterior rounded. The scutellum less punctate. The elytra thickly punctured, but the disk less so, the sides gently rounded, and the apex of each elytron truncate and rounded. The mouth, antennæ, and legs rufo-piceous.

Specimens from Connecticut and Mexico are in the Marquis de Laferté's collection.

13. Brachypterus flavipes.

Niger, confertissime punctatus, mediocriter cinereo pubescens; antennis pedibusque flavis; prothorace antice posticeque rotundato. Long. 1 lin., lat. $\frac{1}{2}$ lin.

Habitat in Brasilia.

Oblong, convex, black, thickly and rather deeply punctate, clothed with a moderate cinereous pubescence. Antennæ short, not much longer than the head, yellow. Prothorax arched and rounded both at the anterior and posterior angles, narrowest in front, at its broadest part nearly but not quite so broad as the elytra. Scutellum large, truncate, nearly quadrangular. Elytra not much longer than the thorax. The segments of the abdomen large; the penultimate as long as the last. All the legs yellow.

Collected near Rio Janeiro by the Rev. Hamlet Clark, who has been kind enough to sacrifice his unique specimen to me, in order that it may be preserved in the British Museum.

14. Brachypterus testaceus.

Boheman, Kongl. Svenska Fregatten 'Eugenies' Resa omkring Jorden (Voyage of the Royal Swedish Frigate 'Eugenie,' made in the years 1851–1853), p. 39 (1857–58).

Flavo-testaceus, parum nitidus, crebre et breviter punctulatus, parce cinereo pubescens; oculis nigris; thorace lateribus fere parallelis, leviter rotundatis, angulis rotundatis;

scutello sat magno; elytris vix thorace sesqui longioribus; tibiis apice valde dilatatis. Long. 1 lin., lat. $\frac{1}{3}$ lin.

Habitat in Victoria, in Australia.

Flavo-testaceous, only slightly shining, thickly punctate, and cinereo-pubescent. The thorax transverse and convex, and, viewed directly from above, its sides almost parallel, gently rounded, the angles rounded. Scutellum rather large. Elytra not quite a half longer than the thorax. Tibiæ much dilated at the apex.

This might at first be mistaken for a *Cercus*, but the characters of the claws and mouth show that Prof. Boheman has rightly placed it in this genus.

From Victoria, in Australia.

15. Brachypterus flavicornis.

Küst. Käf. Eur. xv. 40 (1848).

Niger, nitidulus, parce punctatus, tenuiter pubescens; prothorace lateribus rotundato, angulis posticis obtusis; elytris cupreo micantibus; mandibulis, antennis totis pedibusque ferrugineo-rufis. Long. $\frac{3}{4}$ lin., lat. $\frac{2}{5}$ lin.

Habitat in Italia.

Black, somewhat shining and brassy, sparingly punctate and thinly cinereo-pubescent. Thorax with the sides rounded and posterior angles obtuse. Elytra convex in the middle, narrowed behind. Mandibles, antennæ, and all the legs ferruginous.

According to Küster, this species is "very near to *B. fulvipes* and *B. labiatus*; distinguished from the first by the sides of the thorax, which are tolerably rounded, from the last by the black labrum, and from both very distinctly by the antennæ being unicolorous." It appears to me to be nearer to *B. Urticæ*.

I have received a specimen from Count Motschulsky, bearing this name, which corresponds with Küster's description. It is of the size and form of *B. Urticæ*, and has a very slight brassy lustre on the elytra and a longish scattered hoary pubescence.

This forms the passage between this subgenus and the next, but has more of the character of this. The base of the thorax is sinuate, and consequently the posterior angles are turned a little back, but only in a small degree. The elytra, however, are long and the exposed part of the abdomen short.

From Italy. I have placed my specimen in the British Museum.

Note.—The species described by Prof. Boheman, in his 'Insecta Caffraria,' under the name of *Brachypterus subæneus*, does not belong to this tribe. It has a great outward resemblance to *B. cinereus*, but is truly one of the *Strongylinæ*.

(Subgenus Heterostomus.)

Jacq. Duv. Gen. des Coléopt. d'Europe, ii. 138 (1857–59).

Thorax basi elytris haud multum angustior, angulis posticis plus minusve retroaspectantibus. Palpi labiales articulo ultimo ovato. (See Plate XXXII. fig. 7, *e*.)

The base of the thorax is bisinuate, the posterior angles embracing the elytra, which are short and scarcely wider than the thorax. The last article of the labial palpi ovate.

16. Brachypterus gravidus. (Plate XXXII. fig. 7.)

Erichs. in Germ. Zeitschr. iv. 230. 2 (1843). Sturm, Deutschl. Faun. xv. 22. 2. taf. 90 (1844). Erichs. Naturg. Ins. Deutschl. iii. 130. 2 (1848).

Cateretes gravidus, Illig., Duftschm., Schönh.

—— *pulicarius*, Gyll. Ins. Suec. i. 246. 1. Heer, Faun. Col. Helv. i. 410. 1 (1841).

—— *Linariæ*, Steph. Illustr. Brit. Ent. Mand. iii. 53. 4 (1830).

Dermestes gravidus, Payk. Faun. Suec. iii. 448 (1798).

Scaphidium agaricinum, Herbst, Käf. v. 134 (1793).

Brachypterus scutellatus, Kugellan, in Schneid. Mag. 561. 3 (1794).

Cercus atratus (Dej. Cat. 136, ed. 1837).

Niger, opacus, confertissime punctatus, fusco pubescens, antennis pedibusque rufis. Long. $1\frac{1}{3}$–$1\frac{1}{2}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Europa.

Oblong-ovate, rather convex; black, opaque, very thickly punctate, covered with a fine brownish pubescence; antennæ and anterior legs reddish brown. The thorax narrowed in front, with its sides rounded, the base bisinuate, and the character of the subgenus fully displayed, viz. the posterior angles projecting backwards and embracing the shoulders. Scutellum large, triangular. Elytra a third longer than the thorax. Abdomen with the fourth segment as long as the fifth.

Found upon flowers. Not rare on the continent of Europe. Not common in Britain.

17. Brachypterus vestitus.

Kiesenw. in Stett. Ent. Zeit. (1830) p. 223, and Ann. Soc. Ent. France, sér. 2. ix. 578 (1851).

Niger, opacus, confertissime punctatus, griseo pubescens; antennis pedibusque testaceis. Long. $1\frac{1}{2}$–2 lin., lat. $\frac{3}{4}$ lin.

Habitat in montibus Pyrenæis orientalibus.

Allied to *B. gravidus*, but larger; the pubescence stronger, denser, of a different colour, being griseous instead of brownish; the thorax smaller and narrower, and its posterior angles obtuse.

Herr von Kiesenwetter has been kind enough to supply me with typical specimens, which are now in the British Museum. Count Motschulsky sent me a specimen of this species under the name of *Carpophilus fuscus*, but I am not aware whether this name has been published or not.

From the Eastern High Pyrenees.

18. Brachypterus laticollis.

Küst. Käf. Eur. xv. 35 (1848).

"*B.* niger, opacus, confertissime punctatus, rufescente pubescens; thorace elytris latiore; antennis pedibusque anticis rufis. Long. 1 lin., lat. $\frac{2}{3}$ lin.

"Habitat in Dalmatia."

Not having seen this species, I can only reproduce Küster's description: he says it is "about half the size of the smaller individuals of *B. gravidus*, more arched, and distinguished by the brownish-reddish, sparing, slightly finer pubescence and the broad thorax."

From Spalato in Dalmatia.

19. Brachypterus cinereus.

Erichs. in Germ. Zeitschr. iv. 231. 3 (1843). Sturm, Deutschl. Faun. xv. 24. 3. taf. 91. fig. A (1844). Erichs. Naturg. Ins. Deutschl. iii. 131. 3 (1848).

Cateretes cinereus, Heer, Faun. Col. Helv. i. 413. 9 (1841).

Cercus pulicarius, Latr. Gen. Crust. et Ins. ii. 15. 1. (Dej. Cat. 136, ed. 1837.)

Plumbeo-niger, confertissime punctatus, dense cinereo pubescens, antennis pedibusque anterioribus rufis. Long. $\frac{3}{4}$–$1\frac{1}{5}$ lin., lat. $\frac{2}{5}$ lin.

Habitat in Europa.

Distinguished from the foregoing species by its colour, which, although black like them, has a sort of leaden lustre, and by having longer and dense grey pubescence, which gives it a hoary appearance readily recognizable. Its sides are less rounded, and the posterior angles of the thorax do not project so much behind and are more obtuse.

Found over most of Europe, but not in Britain.

20. Brachypterus Antirrhini (Chevr.).

B. cinereo affinis, major et paulo longior, plumbeo-niger, densissime cinereo pubescens, confertim punctatus, convexus; antennis pedibusque anticis et mediis rufo-piceis. Long. $1\frac{1}{8}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Algeria.

Closely allied to *B. cinereus*, but larger and more closely clothed with cinereous pubescence, and with the middle as well as the anterior legs red.

From Algeria. I have received a single specimen from M. Chevrolat, which I have placed in the British Museum.

(Subgenus Brachyleptus.)

Motschulsky, Remarques sur sa Collection de Coléoptères Russes, in Bull. Soc. Imp. Mosc. xviii. 54 (1845)*.

Thorax plus minusve rotundatus, haud elytra amplectens. Elytra brevissima, humeris prominentibus. Abdomen sine segmentulo anali in utroque sexu.

The essential characters of this subgenus are the rounded thorax not embracing the elytra, and the elytra very short and with very prominent shoulders. All the species

* Count Motschulsky proposed a new genus under this name for his species *B. canescens* and for *Strongylus? tinctus*, Mann., taking as his characters the shortness of the elytra and the more globular form of the club of the antennæ. The latter character, however, is an error. Neither of the species he mentions has the club of the antennæ globular; on the contrary, it is constructed on the same fashion as in all the rest of the *Brachypteridæ*, forming an elongate club similar to the club of Hercules, and not like a ball or plate on the end of a stick as in most of the other *Nitidulariæ*. The club in *B. canescens* is, no doubt, a little more dilated than in the others, but has still the elongate character of the club of the *Brachypteridæ*. But, although these characters will not suffice to characterize the Section, the division seems good, and sufficiently recognizable from the other characters above given.

described have the last article of the labial palpi cylindrico-ovate; but as the absence of this character alone would not remove them from it, and as it is very possible that in any new species which may be found the palpi may be differently formed (seeing that there is some variation in its proportions in other species of *Brachypterus*), I have thought it better not to include it among the above characters. There appears to be no additional anal appendage in either sex in this subgenus.

* Thorax subglobose and considerably narrower than the elytra.

21. Brachypterus quadratus. (Plate XXXII. fig. 6.)

Creutz. in Illig. Mag. vi. 337 (1807). Erichs. in Germ. Zeitschr. iv. 230 (1843). Sturm, Deutschl. Faun. xv. 19. taf. 290 (1844). Erichs. Naturg. Ins. Deutschl. iii. 130 (1848).

Niger, opacus, cinereo pubescens, confertissime punctatus; prothorace angustato, postice rotundato. Long. 2 lin., lat. $\frac{2}{3}$ lin.

Habitat in Austria et Europa meridionali: rarior.

Black, opaque, very densely punctate, thickly clothed with grey hairs. Antennæ convex, fully as long as the thorax, with the last three articles enlarged, but not into a rounded club. Thorax narrower than the elytra, rather shorter than broad, in front truncate, straight, anterior angles obtuse, rounded at the sides, somewhat narrowed behind, the base strongly rounded. Scutellum elongate, rounded at the apex. Elytra about a third longer than the thorax, together widely emarginate, the shoulders projecting prominently on each side. The fimbriæ of the penultimate dorsal segment of the abdomen broad and strongly marked. Legs brownish black.

Austria and the south of Europe.

22. Brachypterus canescens.

Motsch. Bull. Soc. Imp. Mosc. xviii. 54 (1845).

Affinis *B. quadrato*, sed duplo major; prothorace subsexangulari, basi truncato, lateribus rotundatim angulato; cæteris fere ut in *B. quadrato*. Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{3}$ lin.

Habitat in Armenia et Russia meridionali.

There is little difference between this insect and *B. quadratus* except in size and in the more angular form of the thorax. The sides of the thorax are so much bent in the middle as to make it almost hexagonal; its base is truncate and narrow, the posterior angles obtuse and rounded, the sides obtusely rounded, and the anterior angles obtuse and rounded.

From South and Eastern Europe, extending into Asia.

** Thorax transverse, scarcely narrower than the elytra.

23. Brachypterus tinctus. (Plate XXXII. fig. 8.)

Strongylus? tinctus, Mann. Bull. Mosc. 1843, p. 255.

Oblongus, convexus, subopacus, crebre punctatus, cinereo pubescens, niger, elytris nigris vel obscure rubro-ferrugineis, cum lateribus, basi et sutura nigris; prothorace basi utrinque oblique sinuato, angulis posticis rotundatis; elytris thorace parum longioribus, humeris prominentibus; antennis pedibusque ferrugineis. Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{4}$ lin.

Habitat in California.

Oblong-square-shaped, more particularly the elytra, convex, thickly punctate, clothed with cinereous pubescence; black, or sometimes with the elytra more or less reddish brown, the sides, the base, and the suture around the scutellum being black. Antennæ with the club not very thick. The thorax with the base extending back in the middle like a broad lobe and obliquely sinuate on each side, disk sinuate behind on each side of the lobe, sides straight behind and narrowed in front, the angles rounded. The posterior lobe is more developed in some specimens than in others, and gives a different aspect to the insect according to whether it is closely applied to the base of the elytra or separate and with the head and thorax bent down. Scutellum small. The elytra only a little longer than the thorax, shoulders prominent. The penultimate dorsal segment of the abdomen with very distinct fimbriæ. Pygidium large, sinuate, and acuminate. Antennæ and legs ferruginous.

From North-west America—apparently found all along the coast from Sitka, whence it was first received by Mannerheim, to San Francisco in California, Mr. Hepburn having sent me specimens from that neighbourhood.

First made known by Mannerheim, who referred the species to the genus *Strongylus* with doubt,—as he says, from not being acquainted with the genera *Brachypeplus*, *Colopterus* (Erichson's first published name for *Colastus*: see Wiegmann's Archiv, 1842), or *Cillæus*, to some one of which he seemed to think it might be referred, he retained it under Dejean's large genus *Strongylus* as most likely to cover it. I have seen a typical specimen from Mannerheim himself in Professor Boheman's collection, which enables me to allot it with certainty to its proper place.

24. BRACHYPTERUS FERRUGATUS.

Br. tincto affinis. Differt clava antennarum minus dilatata, elytris parum brevioribus, creberrime punctatis, minus nitidis. Totus ferrugineus, interdum partibus obscurior. Long. $2\frac{1}{4}$ lin., lat. 1 lin.

Habitat in Oregon.

Allied to *B. tinctus*, but distinct. The antennæ are almost without a club, the last three articles being only a very little and gradually thickened, the whole having a moniliform appearance. Elytra rather shorter than in *B. tinctus*. It is wholly ferruginous, but specimens occur with the head and thorax and the vicinity of the scutellum dark. The punctuation is very close and deep, and the whole surface is clothed with a light flaxen-coloured long pubescence.

Found in Oregon by Mr. Jeffrey, the collector sent out in 1850 by the Edinburgh "Oregon Botanical Association" to collect plants and seeds in British Columbia, Oregon, and California.

(*Genus incertæ sedis.*)

Genus CALONECRUS.

Thomson, Arch. Ent. i. 117 (1857).

Antennæ undecimarticulatæ, duobus ultimis articulis liberis, vel conglutinatis*. Caput liberum, sine sulcis antennariis. Oculi modici, haud basin capitis attingentes. Epistoma porrectum. Labrum emarginatum. Maxillæ forsan bilobæ, lobis conglutinatis. Ligula paraglossis vel alis membranaceis, ovatis, biplicatis. Elytra haud striata. Abdomen supra segmento ultimo solum exposito, fœminis? anali segmento auctum; primo et ultimo segmento longioribus et æqualibus, cæteris modicis et æqualibus; fimbriis vix visis.

Body elongate. Head free, without antennal grooves; eyes moderately large, not reaching to the base of the head. Antennæ with the first article elongate, stout, and dilated; second shorter and smaller; third longer; fourth to eighth small and nearly equal, gradually moniliform and a little broader; ninth short and broad, and forming the first article of the club, but more of the size and shape of the eighth article in other species of *Nitidulariæ*; the rest of the club either composed of two free articles, or apparently composed of only one article, but really of two united. Labrum emarginate. Clypeus distinct. Epistome projecting. Mandibles bidentate; inner side behind the teeth bearded. Maxillary lobes composed of two consistences—corneous and membranous—the former reaching from the base nearly to the apex, the latter oblique and confined to the apex. It has occurred to me that, as in the last articles of the antennæ in the species in which these are united, there may here be two lobes soldered together into one; it is short, bearded at the apex and on the inner side. Maxillary palpi with the first article small, second very large and dilated, third smaller and shorter, fourth conical or pointed and narrow. Labial palpi with the first article small, the second longer, the third elongate elliptic oval. Ligula scarcely extending beyond the base of the labial palpi, but apparently composed of two parts, like a pair of labial lobes; the membranous lobes of the ligula large, rounded, and apparently double. Mentum with two abruptly projecting teeth. Thorax nearly hexagonal, margined, not equal to the elytra in breadth. Scutellum moderate, triangular. Elytra elongate, attenuate at the apex, sides enclosing the abdomen, not margined, not striated. Abdomen above with only the pygidium and the margin of the penultimate segment exposed, and below with the first and last segments largest, the rest moderate and equal. In one of the sexes (supposed to be the female) there is an additional anal segment to the abdomen. Fimbriæ scarcely visible from above. Prosternum not very prominent, resting on the mesothorax; the thorax without axillary pieces. There is a slight eminence in the middle at the posterior part of the metathorax, where it separates towards the trochanters of the posterior legs: from its position, the name of 'umbilical point' suggests itself for this papilla. The coxæ of each pair of legs are nearly equally distant from each other. Tarsi dilated.

* M. Thomson describes the antennæ as being only ten-jointed in his species (*C. Wallacei*); but on careful examination a line of separation can be easily distinguished near the base of the last article, showing that it is composed of two articles; and in a second, very closely allied, species described by Mr. Pascoe under the name of *C. rufipes*, the separation is complete and normal as in other *Nitidulariæ*.

The ligula and its membranous lobes are of especial interest in this genus. Their form, as I made them out, will be seen in Plate XXXII. fig. 9, *e*. I have only, however, had the opportunity of making one dissection of these, and I have figured what I thought I saw. I have thought it better to do this, even although I should have been mistaken, than to stop inquiry as to this apparently singular structure. It will be seen, from the figure, not only that the ligula appears to be broken into two lobes (which is doubtless the result of fracture from the pressure of the slides between which I had placed it for examination), but that its membranous lobes or wings appear to be double; and they certainly had a double action or motion. Its food and mode of life may in some measure account for these peculiarities. I believe it will be found that all insects which feed upon the juices of trees or fruits are provided with special organs for lapping it up, such as very much bearded maxillary lobes, &c. The insects of this genus feed upon a very thick sticky resin or juice of about the consistence of turpentine, called "Kruyin" by the Malays in Borneo, which is produced by a species of *Dipterocarpus*. Mr. Wallace never found them but in this gum: if he took the insects out and placed them near the juice, they immediately made their way back to it, and burrowed into it until they became like flies in amber. He found the greatest difficulty in cleansing them from the gum (indeed, I had noticed that all the specimens which I had seen had gum adhering to them, which I accounted for to myself by supposing they had been carelessly gummed on paper and not cleansed), and the only medium by which he could get it off was oil. The mode of life of this insect being thus peculiar, we need not be surprised if we find some modification of the normal structure in its masticatory organs.

No species has puzzled me more, to assign its true position, than the present. My first idea was to place it where I now have; but on dissecting the mouth I found that it had apparently only one maxillary lobe—a circumstance which compelled me to seek another *locale* for it; and it was only when, by a more careful study of the maxillæ, I found that their lobes showed indications of being composed of two lobes united together, as was the case with the club of the antennæ, that I began to suspect that this might be its true position after all. Like the *Brachypteridæ*, it has no antennal grooves; like most of them, the maxillary palpi have the second article largest and the fourth smallest; and as in them, one of the sexes has an additional anal segment to the abdomen. The hexagonal thorax has the commencement of a parallel in *Brachyleptus tinctus*, and the texture, punctuation, and pubescence are somewhat of the same character in *Brachypterus* and *Calonecrus*. When Mr. Pascoe was kind enough to present me with his unique specimen of *C. rufipes*, I eagerly availed myself of its possession to dissect the mouth, in the hope that as in it those articles of the antennæ which were soldered together in *C. Wallacei* were free, so I might find the maxillary lobes there also separated into two; I did not find this, however, but merely the same structure as in the other.

I have, on the whole, thought this its fittest position; but I place it with diffidence, and merely provisionally.

		CARPOPHILUS.	
Position and Affinities.—	BRACHYLEPTUS.	CALONECRUS.	MYSTROPS.
		TRIMENUS.	

1. Calonecrus Wallacei. (Plate XXXII. fig. 9.)

Thomson, Arch. Ent. i. 117. pl. 10. fig. 3 (1857).

Elongatus, supra depressus, subnitidus, punctatus, pubescens, rufo-ruber; antennis, elytris pedibusque cyaneo-nigris; thorace basi quam apice latiore; elytris angulis posticis anguste incisis, hinc dente acuto extus retro projiciente. Long. 4–5½ lin., lat. 1¼–2 lin.

Habitat in Sarawak.

Elongate, above depressed, somewhat shining, pubescent, rufous-red. Antennæ, elytra, and legs black, or bluish black. Head lightly punctate. Thorax elongate, sparingly and faintly punctate, shining, narrower than the elytra, with the sides angled in the middle, making it nearly hexagonal, apex straight, base slightly bisinuate, the sides both before and behind the middle angulation strongly sinuate, but less so in the females (?) than in the males, anterior angles obtusely rounded, posterior obtusely right-angled, unequal on the surface, being wavingly depressed both before and behind the middle and on each side. Scutellum punctate. Elytra strongly but not very closely punctate, the punctures deepest towards the suture, widest a little before the middle, shoulders projecting, depressed transversely behind the shoulders and scutellum, longitudinally on each side of the suture, on the disk behind the first depression, and transversely at the apex, clothed with a long fine brownish woolly pubescence, thickest upon the shoulders and haunches; the sides turned in upon the abdomen, and broadest opposite the posterior coxæ, slightly margined; the suture for about two-thirds towards the apex has a well-marked sutural stria; apex truncate, slightly rounded, exterior apical angles with a narrow notch cut out, causing the outer side to appear like a large tooth projecting backwards, sutural angles rounded. Below finely punctate* and pubescent. Legs punctate. Tarsi short and small. Males (?) smaller, narrower, and with the sides of the thorax more sinuate than in the females.

From Sarawak. Collected by Mr. Wallace, as already mentioned, in the thick gum of a species of *Dipterocarpus*.

Mr. Wallace found, in company with this insect, a larva which he (doubtless correctly) refers to this species. A description and figure of it will be given in the chapter to be devoted to the larvæ of this family.

2. Calonecrus laticollis.

Valde affinis *C. Wallacei*, thorace planiore et latiore, apice quam basi paulo latiore, lateribus vix sinuatis; elytris pube cirratis, angulis posticis minus incisis et dente exteriore minus acuto; rufus, antennis, elytris pedibusque nigris. Long. 4¾ lin., lat. 2 lin.

Habitat in Sarawak.

Nearly allied to *C. Wallacei*. It is duller, broader, and the thorax and elytra are flatter and more depressed. The thorax is nearly hexagonal, but it is a little broader at the apex than at the base, while in *C. Wallacei* it is decidedly and considerably broader

* M. Thomson, in his description, says that the pygidium and underside are smooth (*lisse*); but in all the species they are decidedly punctate, although less deeply than on the thorax and elytra.

at the base than at the apex; the sides also are scarcely at all sinuate, instead of being, as in *C. Wallacei* (more especially in the males), sinuate both before and behind the dilatation in the middle. The elytra, besides being more depressed, are more dilated and rounded on the sides, and have the surface marked by inequalities, which are well indicated by tufts of long woolly brownish pubescence; these are separated from each other by transverse depressed spaces, one behind the shoulder, one along the apex, and one between these, interrupted on the disk, and further by an elongated depression alongside the suture, and the basal elevation is further separated by two oblique longitudinal depressions parallel to the sides of the scutellum, but at some distance from them.

It is rufous, with the antennæ, elytra, and legs black. The basal article of the antennæ, however, which is largely developed, has a thick tuft of reddish pubescence on the outer margin, and the last two united articles of the club, instead of being rufous as in the other species, are black, with a tinge of red on the last only. The punctuation on the head and thorax is much fainter than in the other species. The thorax is more equal on its surface; it has a semicircular depression behind the head, and another concentric semicircular depression near the base, both with the concave side towards the head. Both the thorax and scutellum are more pubescent than in the other species, and, as already mentioned, the elytra are much more so. The elytra are considerably more thickly and closely punctate, and the excision at the exterior apical angle is more open. In the legs the base of the femora is reddish, and the thighs are not quite so thick as in *C. Wallacei.*

Collected with the other species by Mr. Wallace in Sarawak. I have only seen one specimen since I detected the differences characteristic of the species, and that was in the collection of Mr. Fry, who has obligingly ceded his specimen to me; but I have no doubt that many more unrecognized examples of this species must be standing in collections under the name of *C. Wallacei*, which have been sent home by Mr. Wallace mixed with that species, for I have vague recollections of examples with tufted pubescence on the elytra which did not attract my attention at the time, but which, on examination, will, I think, now be found to belong to this species.

3. CALONECRUS RUFIPES.

Pascoe, in Journ. of Ent. i. 98 (1861).

Valde affinis *C. Wallacei*; minor, minus nitidus, magis punctatus; antennis clava distincte triarticulata; thorace lateribus minus angulatis, disco minus impresso; rufus, elytris nigris, pedibus rufis. Long. $3\frac{1}{4}$ lin., lat. 1 lin.

Habitat in Borneo.

A good species, although so much like *C. Wallacei*, that it might, if not carefully compared with it, be mistaken for a variety of that species. It possesses especial interest from the club of its antennæ showing the usual number of articles free, and not the last two united as in the two other species, thus confirming my conclusion that they are 3-jointed in these species. It is smaller than the smallest specimen of *C. Wallacei* which I have seen. Depressed above, rufous, with the elytra black. The head very thickly punctate. Thorax hexagonal as in *C. Wallacei*, but the lateral angles not nearly so wide nor so angular, much more thickly punctate, subopaque, more equal on the surface of the disk, being without the waving inequalities and depressions upon it; the sides more strongly margined. Elytra much more thickly punctate, more flat and equal on the surface, black. Legs rufous.

From Sarawak. Found by Mr. Wallace, along with the two preceding species, in the gum of a *Dipterocarpus*.

Tribe II. CARPOPHILIDÆ.

Carpophilinæ, Erichs. in Germ. Zeitschr. iv. 233 (1843).

Maxillæ mala simplici. Labrum distinctum. Elytra abbreviata. Abdomen segmentis duobus vel tribus ultimis liberis.

The most easily seized character of this tribe is the short elytra, leaving two or more segments of the abdomen exposed,—a structure which distinguishes it from all the rest of the family except the *Brachypteridæ*; and from them they are separated by the single lobe of the maxillæ. As that, however, is an organ which it requires a dissection of the mouth to discover, some other more easily observed character is desirable; and an approach to such, although not one which can be laid down as without exception, will be found in the presence of antennal grooves in the *Carpophilidæ* and their absence in the *Brachypteridæ*, and in the club of the antennæ, which in the *Brachypteridæ* is gradually elongate and approaching to the form of Hercules's club, while in the *Carpophilidæ* it is ovate or rounded and abrupt.

A large number of this tribe are found upon flowers; others, whose flat depressed form well corresponds with the locality, under bark; one in bees' nests; and a good many in decaying fruits.

Head with mouth projecting. Antennæ inserted on each side at the base of the projecting clypeus, short, with the club large, oval, or round. Antennal grooves usually present, and converging; they are absent in *Mystrops*. Labrum bilobed. The mandibles are strong, and usually terminate in a sharp point, behind which lies a second smaller tooth, and behind that again a slight serration, generally effaced; but this is not absolutely constant: in *Mystrops* the mandible has no teeth at all, only a sharp point; in *Cillæus* it has numerous teeth; and the degree of prominence of the second tooth when it is present is very variable. At the base of the exterior of the mandible is a rounded condyle. The maxillæ are moderately broad, thin, and furnished with a close comb of hairs on the interior side. The maxillary palpi are variable in form, the terminal article usually largest. The ligula is corneous in the middle, with transparent lobes on each side, varying in form in the different genera and even in the different species, but usually extending obliquely forwards and outwards in a sort of elliptical wing-shape. The posterior apex of the prosternum blunt and obtuse, resting slightly on the mesosternum. The abdomen is sometimes convex, at others very much depressed. The breadth of the abdominal segments is variable in different genera, the pygidium being the largest: in some genera it has a fimbria, broad at the anterior margin, narrow behind; in others it is narrow or scarcely visible. The other dorsal segments are in some genera provided with fimbriæ; in others they have them either very small or the suture between the dorsal and ventral parts of the segments is on the margin. The legs are in most species short and strong; the tibiæ finely pubescent, rather broad at the apex, with strong terminal spines; the feet short.

The tribe embraces four or five distinct forms, besides intermediate passages, all of which may again be broken up into subsections or subgenera. It might almost be a question whether the genus *Mystrops* should not be erected into a tribe or subtribe by itself, between the *Brachypteridæ* and the *Carpophilidæ*, on the strength of its elongate antennæ in the males and the absence of antennal grooves; but its affinities with the latter tribe seem too great to warrant this.

The dorsal segments of the abdomen furnish distinguishing characters by which to separate them, in the first place, into two pretty equal divisions, the one containing Erichson's genera *Mystrops*, *Carpophilus*, and *Conotelus*, and the other *Colastus*, *Brachypeplus*, and *Cillæus*. In the first of these divisions the abdomen is somewhat convex, and the pygidium has the fimbriæ narrow and more or less parallel to the margin, and often so little visible as to appear absent, as in *Carpophilus*. In the latter the abdomen is flat, and the pygidium has the fimbriæ broader in front, and curving gradually to the posterior margin, as in *Colastus*. Its absence or presence in the other dorsal segments furnishes a character by which to separate the *Colasti* from the *Brachypepli*. Other distinguishing characters enable any species to be easily referred to one or other of these divisions, viz.:—

Abdomen much depressed and flat. Exposed dorsal portion of abdomen usually much longer and never shorter than the thorax (about equal in *Colastus*). Fimbriæ well marked at least on the pygidium, and, in most genera, on all the dorsal abdominal segments.	LATE-FIMBRIATA. (*Colastus*, *Brachypeplus*, *Cillæus*, &c.)
Abdomen slightly convex. Exposed dorsal portion of abdomen shorter than thorax. Fimbriæ either absent or very narrow and subparallel to the margin.	ANGUSTE-FIMBRIATA. (*Carpophilus*, *Conotelus*, &c.)

It matters little in what order these divisions are taken. On the one hand, *Mystrops* and *Carpophilus* are nearly related to the *Brachypteridæ*, and, if we look to their connexion with them, should come first. On the other, they are (especially through *Haptoncus*) not less nearly related to *Epurea*, the first genus of the following tribe, and, if we look to their relationship with them, should come last. Erichson and Lacordaire have endeavoured to reconcile both affinities by placing *Mystrops* first, and intercalating the *Brachypepli*, &c. (*Late-fimbriata*) between it and *Carpophilus*. I do not think, however, that *Carpophilus* should be separated from *Mystrops*, and I prefer therefore to place both together either at the head of the tribe or at the end. Either arrangement secures a perfectly natural connexion, and accords with the simple sectional characters which I have given above. To adopt Erichson's and Lacordaire's arrangement would require a new selection of characters for division, not difficult to find, but more complicated and less easily seized than those I have chosen. My first idea was to lead from *Brachypterus*, through *Mystrops* and *Carpophilus*, to *Colastus**; but on further consideration I have resolved to place the *Carpophili* at the end instead of at the commencement of the tribe. It makes the transition from the *Brachypteridæ* less natural, but that to *Epuræa* more so, and keeps the arrangement more in accordance with that followed in Lacordaire's 'Histoire des Coléoptères,' which in matters nearly equal is a point of some importance.

Section Late-fimbriata.

Fimbriæ on the pygidium large and distinct, on the other segments scarcely visible. Exposed portion of abdomen about the length of the thorax. Lobes of ligula large and horn-shaped . . . . *Colastus.*

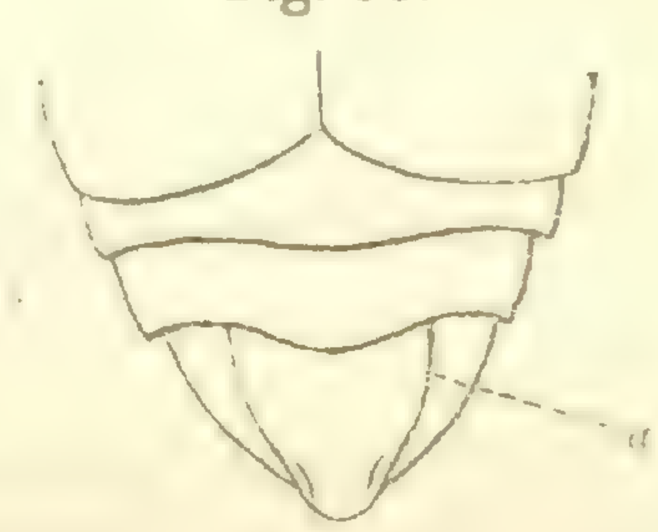
Fimbriæ present in all the exposed dorsal segments of abdomen. Exposed portion of abdomen much longer than the thorax. Lobes of ligula not large nor horn-shaped.

- Fimbriæ broad and curved . . . . *Brachypeplus.*
- Fimbriæ narrow and subparallel to margin of abdomen . . . . *Halopeplus.*

Genus Colastus.

Erichs. in Germ. Zeitschr. iv. 236 (1843). Lacord. Hist. des Coléopt. ii. 294 (1854).
Colopterus, Erichs. in Wiegmann's Archiv, i. 149† (1842).

Fig. 31.



Labrum late bilobum. Ligula alis magnis. Abdomen segmentis primis quatuor brevibus, quinto maximo, sine segmentulo anali in utroque sexu, tribus ultimis expositis. Pygidium fimbriis marginalibus curvatis, antice latis, postice attenuatis; segmenta cætera fimbriis vix visis.

Very flat, depressed, and often broad. Head small and short. Labrum broad and bilobed. Mandibles usually dentate at their extremity. Antennal grooves short and convergent. Antennæ short, not much longer than the head; first article large, second shorter than the third, fourth to eighth short and subequal, ninth to eleventh forming a moderately large oval club. Lobe of the maxillæ a little enlarged and rounded at the end, bearded at the point and on the inner margin; the labial palpi with the last article subsecuriform; the maxillary palpi with the last article cylindric and elongate. Ligula with remarkable broad horn-shaped membranous lobes (Pl. XXXIV. figs. 1 *e*, 2 *e*, & 3 *e*)—a peculiar form, which occurs again a long way off in *Psilotus*, one of the *Nitidulidæ*. Mentum broad, emarginate in front. Thorax broad, emarginate in front, bisinuate at the base, and at least as broad as the elytra. Scutellum rather large, subtriangular. Elytra truncate, leaving the last three segments of the abdomen exposed; the first four abdominal segments short and equal to each other; the fifth (pygidium) at least as large as all the rest united, and without any additional anal segment in either sex. Exposed portion of abdomen about as long as the thorax. Pygidium with the fimbriæ large and distinct; on the other segments they

* It will be seen that this is the arrangement in the Plates, which were begun to be engraved before I finally resolved to follow the present arrangement.

† Erichson changed the name *Colopterus*, which he first proposed for this genus, to *Colastus*, on the ground of its being too near to that of *Colobopterus*, used by Mulsant for a subgenus of the *Aphodii*. In this I think he was unnecessarily fastidious. The name might very well have stood; and although I do not propose to revert to it, I see no objection to making use of it as a subgeneric name for one portion of he genus.

are very small, and confined to the anterior corners. Anterior tibiæ in some species distorted in the males. The first three articles of the tarsi dilated, clothed with hairs below. Claws simple.

	EIDOCOLASTUS.		
Position and Affinities.—CARPOPHILUS.	COLASTUS.	{	BRACHYPEPLUS. / HYPODETUS.
	PSILOTUS.		

For convenience' sake I propose to divide the genus into two subgenera, containing respectively

1. The species in which the anterior tibiæ are distorted in the males—CYLLOPODES; and
2. The species in which they are not so distorted—COLASTUS proper.

Subgenus CYLLOPODES (club-footed).

(See Plates XXXIII. fig. 9, and XXXIV. figs. 1 c^*, 1 c^{**}, 1 c^{***}.)

Caput latum, declive. Thorax postice quadratus, angulis plus minusve rotundatis. Maribus tibiæ anticæ angulatim distortæ et thorax elytris plerumque latior.

Head broad between the eyes, bent down, with the posterior angles rounded. The males have the anterior tibiæ angularly bent, and widened and distorted at the apex. In most of the species the males also have the thorax broader than the elytra.

1. COLASTUS RUPTUS. (Plate XXXIV. fig. 1 c^*.)

Erichs. in Germ. Zeitschr. iv. 237 (1843).

Testaceus, nitidus, tenuiter seriatim rufo-pubescens; thorace lateribus dilatato; elytris crebre seriatim punctatis, apice nigris. Long. $1\frac{1}{2}$ lin., lat. 2 lin.

Habitat in Venezuela, Brasilia, &c.

Oblong, very slightly convex above, bright reddish testaceous, shining, slightly clothed with a pale reddish pubescence. Antennæ testaceous, with the club fuscous. Head densely and rather closely punctate. Thorax bisinuate at the base, gently rounded on the sides, pretty deeply but sparingly punctate; dilated in the males. Scutellum rounded at the apex, sparingly punctate. Elytra a half longer than the thorax, rather closely punctate and pubescent in rows, the apex black. Abdomen more densely punctate. The anterior tibiæ in the males distorted, as if broken at an angle below the middle, and abruptly dilated on the inner side.

Very like the next species, *C. posticus*, which is found in Mexico, and from which it differs in being pubescent and rather more coarsely punctate.

From Venezuela and Brazil, &c.

2. COLASTUS POSTICUS. (Plate XXXIV. fig. 1.)

Erichs. in Germ. Zeitschr. iv. 237 (1843).

Nitidus, subglaber, ferrugineus; thorace maribus dilatato; elytris crebre seriatim punctatis, nigris, basi ferrugineis. Long. $1\frac{1}{2}$ lin., lat. 1 lin.

Habitat in Mexico.

Of the size and appearance of *C. ruptus*. Above slightly convex, ferruginous, shining.

Antennæ fuscous, with the base testaceous. Head glabrous, densely and deeply punctate, and slightly impressed on each side in front. Thorax dilated in the males, slightly rounded on the sides, the basal margin somewhat depressed on each side, sparingly punctate, glabrous, with the lateral margin ciliated. Scutellum rounded, glabrous, sparingly punctate at the base. Elytra a half longer than the thorax, subglabrous, rather closely and regularly punctate in rows, black from the apex to beyond the middle. Abdomen slightly pubescent, rather faintly punctate. The anterior tibiæ are distorted more at right angles than in *C. ruptus* (see Plate XXXIV. fig. 1 *c**).

Very nearly allied to *C. ruptus*, but may be distinguished by the almost entire absence of pubescence on the head, thorax, and elytra, by its darker colour and the more extended space of black on the elytra, and by its being rather less deeply punctate. The thorax continues nearly straight forward for some distance in front of the posterior angles before it rounds-in towards the anterior angles.

From Mexico. Erichson gives Carthagena, in Columbia, as a locality for this species, on the authority of Dejean; but an examination of Dejean's collection shows that, of the specimens standing in it under this name, those from Carthagena are *C. ruptus*, and those from Mexico are partly of this species and partly of the next, *C. scutellaris.*

3. Colastus scutellaris.

C. postico valde affinis, paulo elongatior, minus et levius punctatus; capite et thorace piceo-nigris; elytris nigris, basi circa scutellum anguste transversim rufo-castanea; scutello nigro-piceo vel piceo-castaneo; cæteris rufis. Long. $1\frac{3}{4}$–2 lin., lat. 1 lin.

Variat colore plus minusve saturato.

Habitat in Mexico.

Very nearly allied to *C. posticus*; but it is larger, more elongate, more glabrous and shining, and less deeply and less closely punctate; the thorax is rounded on the edges more gradually. In other respects the characters are nearly the same, with the exception of the colour, which on the head, thorax, and scutellum is black, piceous black, or dark chestnut, instead of bright red. The elytra too have the black portion much more extended, leaving usually only a small, narrow, short basal transverse line (sometimes only a small red spot) on each side of the scutellum. The colour varies also a good deal in the intensity of the black and red on the different parts of the body. The anterior tibiæ nearly as in *C. posticus* (see Plate XXXIV. fig. 1 *c****).

From Mexico.

4. Colastus abdominalis.

Erichs. in Germ. Zeitschr. iv. 241 (1843).

Subdepressus, piceus, abdomine pedibusque rufis. Long. $1\frac{2}{3}$ lin.

Habitat in Brasilia.

Subdepressed, oblong, somewhat shining, sparingly fulvo-pubescent. Antennæ testaceous, the club ferruginous. Head deeply punctate, rufo-piceous. Thorax nigro-piceous, truncate at the base, much dilated in the males, gently rounded on the sides, punctate sparingly on the disk and more deeply and closely on the sides, posterior angles rounded. Scutellum black, sparingly punctate. Elytra somewhat longer than the thorax, punctate-striate, nigro-piceous or black. Abdomen entirely red, above densely, below sparingly punctate. Prosternum piceous. Legs red, moderately distorted in the males.

There is considerable variation in the colour of this species; sometimes the characteristic red colour of the abdomen is absent, it being black or piceous, at others the thorax is reddish piceous, and occasionally the whole body is so.

From Brazil.

5. Colastus bisignatus.

Elongatus, subdepressus, glaber, nitidus, sat fortiter punctatus; niger, elytris singulis plaga basali magna quadrata rufa; capite lato; thorace subquadrato, maribus dilatato, lateribus medio sinuatis; elytris seriatim punctatis; pedibus piceis, tibiis tarsisque dilutioribus. Long. $2\frac{1}{3}$ lin., lat. 1 lin.

Habitat in Venezuela.

Elongate, subdepressed, glabrous, shining, rather deeply punctate, black, with the exception of a large square red patch occupying the greater part of each elytron, leaving only a rather narrow black margin on every side, which is broadest at the apex and narrowest (sometimes almost absent) at the base. Head broad. Thorax subquadrate, dilated in the males, with an impression on each side, and the sides sinuate in the middle, the base bisinuate, all the angles rounded. The scutellum rounded, almost impunctate. Elytra about a half longer than the thorax, punctate in rows, obliquely truncate, the exterior angles rounded and convex. Abdomen faintly punctate. The legs piceous, the tibiæ and tarsi paler.

At first sight this species recalls to mind the brachelytrous insect *Tachinus subterraneus*, the appearance and colouring of which are very closely imitated—especially when the wings are protruded so as partially to conceal the different abdomen. The imitation, however, fails in the texture of this insect, which is coarser, harder, and less delicate.

Found in Venezuela.

6. Colastus biplagiatus.

Cercus biplagiatus (Schönh.).

Ips biplagiata (Dej. Cat. 134, ed. 1837).

Elongatus, subparallelus, punctatus, nitidus, glaber, niger, elytris plaga rufa longitudinali prope scutellum notatis; thorace subquadrato, maribus haud dilatato; elytris leviter seriatim punctatis; subtus piceo-niger, antennis pedibusque piceis; maribus tibiis anticis leviter angulatim distortis. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in Columbia.

Elongate, subparallel, somewhat convex, punctate, glabrous, shining, black, with a longitudinal pale-red patch on the elytra near and parallel to the suture. Head broad, sparsely punctate. Thorax subquadrate, rather convex, rather thickly punctate, punctures round; anterior angles rounded; posterior angles nearly right-angled, with the point rounded; the sides margined, and slightly hollowed at the middle just inside the margin; the base scarcely sinuate; apex broadly emarginate and slightly sinuate. Scutellum rounded, impunctate at the apex, slightly punctate at the base. Elytra subparallel, lightly punctate in rows; the suture depressed, giving the appearance of a stria alongside it; the pale-red patch reaches from the scutellum to fully a fourth of the length of the elytra from the apex. Abdominal segments lightly acicularly-punctate. Antennæ, body below, and legs piceous. The anterior tibiæ less acutely bent (in the males ?) than in the other species of this section.

I have only seen two specimens; and the anterior tibiæ are distorted in both; hence I assume them to be males. The thorax was not dilated in these.

From Columbia.

There is a single specimen in the collection of Professor Boheman of Stockholm, and one in Dejean's collection in the possession of the Marquis de la Ferté. It stands there under the name of *Ips biplagiata*, with the synonym of *Cercus biplagiatus* of Schönherr, and is labelled as having been received by Dejean from Schönherr himself. I cannot find, however, that it has been published by Schönherr.

7. Colastus niger. (Plate XXXIII. fig. 9.)

Elongatus, subparallelus, sat convexus, punctatus, nitidus, glaber, niger, antennis pedibusque nigro-piceis; thorace transverso, subquadrato; elytris crebre seriatim punctatis; maribus tibiis anticis dilatatis, subdistortis (Pl. XXXIII. fig. 9 *c*). Long. 2 lin., lat. $\frac{2}{3}$ lin.

Habitat in Brasilia.

Nearly allied to *C. biplagiatus*.

Elongate, subparallel, somewhat convex, rather coarsely punctate, shining, glabrous, black, the antennæ and legs nigro-piceous. Head broad, declinate, sparsely punctate. Thorax nearly as in *C. biplagiatus*, but narrower, nearly quadrate, a very little narrower in front than behind, sides subparallel, slightly hollowed in the middle near the margin, apex not so deeply emarginate as in *C. biplagiatus* (not dilated in the only specimen I have seen, and which I suppose to be a male). Scutellum large, punctate at the base, smooth at the apex. Elytra a half longer than the thorax, subparallel, punctate in rows, interstices impunctate, each elytron somewhat longitudinally convex so that the suture is slightly depressed, apex of each truncate obliquely inwards and forwards, exterior apical angles rounded, sutural angles obtuse. Abdomen finely and acicularly punctate. Anterior tibiæ bent and dilated (in the males ?), the outer margin obtusely angled, straight towards the apex, sinuate and curved on the inner side; tarsi much dilated.

This is the only species of this section (so far as yet known) which is entirely black. Both it and *C. biplagiatus* have a somewhat different facies from the other species, being more elongate and with the head broader and more declinate. The specimens being unique, I have not ventured to dissect out the ligula, but have no doubt it will be found to conform with those of the other species.

From Rio Janeiro. I have only seen a single specimen of this species. It is in the collection of Professor Boheman.

(Subgenus COLASTUS proper.)

Caput modicum. Maribus thorax haud dilatatus et tibiæ anticæ haud distortæ.

The thorax is not dilated nor are the anterior tibiæ distorted in the males in this subgenus. It may be partitioned into several groups, thus:—

SECTION I. Broad and convex*. Texture not soft nor shagreened. Type, *C. latus* (Pl. XXXIV. fig. 2).

II. Moderately broad and convex. Texture soft. Type, *C. pubescens.*

III. Moderately broad, much depressed, with the thorax as if a roller had passed over it. Type, *C. amputatus* (Pl. XXXIV. fig. 3) and *C. signaticollis* (woodcut, fig. 42).

IV. Elongate.

α. Texture not soft, dull, nor shagreened. Type, *C. decorus.*

β. Texture dull and shagreened. Type, *C. unicolor* (Pl. XXXIV. fig. 4).

γ. Texture soft, dull, not shagreened. Type, *C. infimus.*

SECTION I. Broad and convex. Texture not soft nor shagreened.

α. Colour of the body below red. Thorax red, or mostly red.

8. COLASTUS FERVIDUS.

Subnitidus, sparsim punctatus, totus læte rufus, pube fulva vestitus; elytris seriatim punctatis et pubescentibus. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Habitat apud flumina Amazonum.

Entirely of a bright testaceous red colour, shining, clothed with a somewhat long fulvous pubescence. Head rather coarsely punctate. Thorax more sparingly punctate, short, broad, base strongly bisinuate; posterior angles acute, projecting backwards; anterior angles rounded; sides rounded. Scutellum large, slightly punctate. Elytra punctate and pubescent in rows. Abdominal segments more finely punctate.

From Villa Nova on the Amazons. There is a single specimen in the British Museum.

9. COLASTUS HEYDENI.

C. fervido valde affinis, forsan varietas ejus; nitidus, læte rufus, fulvo pubescens; capite, thorace antice lineis tribus longitudinalibus radiatim divergentibus et pygidio macula centrali nigro-piceis. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Habitat in Brasilia.

Closely allied to *C. fervidus*; perhaps only a variety. It is of a bright testaceous red colour, but has the head, three longitudinal stripes like rays diverging backwards from the anterior part of the thorax, and a longitudinal patch on the middle of the pygidium pitchy black. The thorax is not quite so convex as in *C. fervidus*, but there is little other distinction between them.

From Rio Janeiro. Named in honour of Herr von Heyden, of Frankfort-on-Maine, the study of whose large collection has furnished me with much valuable information. I have seen only a single specimen, which is in the collection of Professor Boheman.

* Of course the word 'convex' is used merely in a comparative sense. It is inapplicable in a literal sense in a genus few of whose members are more convex than a thread-paper.

10. Colastus Bohemani.

C. fervido affinis, sed minus convexus, elytris paullo brevioribus, lateribus eorum minus rotundatis: læte rufus; elytris nigris, plaga magna triangulari circa scutellum rufa. Long. $1\frac{3}{4}$ lin., lat. 1 lin.

Habitat in Brasilia.

Var. nigripennis. Supra leviter convexus, subnitidus, griseo pubescens, punctatus, læte rufus, scutello et elytris nigris; elytris seriatim punctatis et pubescentibus. Long. 2 lin., lat. $1\frac{1}{8}$ lin.

Habitat in Ega apud flumina Amazonum.

Var. Candezei. Major, convexior, læte rufus; elytris (basi excepta) nigris. Long. $2\frac{1}{3}$ lin., lat. $1\frac{1}{4}$ lin.

Habitat in Ega apud flumina Amazonum.

Var. basalis. Subnitidus, fortiter punctatus, pubescentia fulva dense vestitus, læte rufus, elytrorum apice irregulariter piceo; elytris seriatim punctatis. Long. $2\frac{1}{3}$ lin., lat. $1\frac{1}{4}$ lin.

Habitat apud flumina Amazonum.

Allied to *C. fervidus*, but rather less convex. Bright testaceous red, with the exterior margin of the elytra from the apex of the suture to the shoulders black. Antennæ fuscous, with the basal joint testaceous red. Thorax with the sides more densely punctate than the disk, the posterior angles projecting very slightly backwards. Elytra a little shorter and less rounded on the sides than in *C. fervidus*, lightly punctate in rows, with the shoulders and suture rather prominent, each elytron sloping obliquely outwards and backwards.

From Rio Janeiro. A unique specimen in the British Museum. Named as a well-deserved homage to Professor Boheman of Stockholm.

The variety *nigripennis* is somewhat convex and shining above, clothed with much griseous pubescence, punctate. Bright testaceous red, with the scutellum and elytra black. Head closely but not deeply punctate. Thorax sparingly punctured on the disk, more densely on the sides and posterior angles, which project slightly backwards. Scutellum black, large, rounded, punctate except along the apical margin. Each elytron separately somewhat convex, so that the suture is slightly depressed, coarsely punctate and pubescent in rows, apex of each obliquely rounded; there is a slight indication of piceous at the base, next each side of the scutellum. Abdomen slightly punctate.

A single specimen was found at Ega by Mr. Bates, and it is preserved in the collection of the British Museum.

The variety *Candezei* is coloured very much like *nigripennis*, but is larger, more convex, more shining, less pubescent, the pubescence more fulvous, and with the scutellum and a narrow margin at the base of the elytra bright testaceous red, as well as the rest of the body. Elytra black, except the narrow strip at the base, which is broadest next to the scutellum, its breadth there equalling the length of the scutellum, but gradually becoming narrower as it approaches the sides, before reaching which it disappears.

This variety differs from the typical form (*C. Bohemani*) in colour—the elytra being nearly wholly black in the one, and with only the exterior oblique apical half in the other. It is considerably broader, and has (perhaps in consequence) more rows of striæ on the elytra, viz. about twenty-one instead of about fifteen, it is more convex, and it has the sides of the thorax a little more rounded.

Found at Ega by Mr. Bates, and named after M. Candèze, of Liége, in token of admiration of his works on the larvæ of Coleoptera, and more especially of his recent monograph of the family of *Elateridæ*.

The variety *basalis* resembles the typical form in colour, but is rather broader, flatter, more deeply punctate, and more pubescent. Bright testaceous red, with the apical half of the elytra piceous, the anterior margin of the piceous band indeterminate and irregular. Antennæ rufous, with the club fuscous. Thorax with the posterior angles more projecting backwards. Scutellum thickly punctate. The elytra deeply punctate in rows, apex truncate, obliquely rounded, the pubescence fulvous on the black portion of the elytra as well as on the rufous part. Pygidium and abdominal segments less deeply and more finely punctate.

Brought by Mr. Bates from Ega, and described from a single specimen in the British Museum.

The above varieties may by some be considered distinct species. They hover on the borders between species and varieties, but they appear to me scarcely distinct.

11. Colastus dorsalis.

Subdepressus, punctatus, levissime pubescens, supra niger, dorso rufo (videlicet thoracis medio, scutello, elytrorum medio et abdominis medio supra), subtus rufus; pedibus testaceis; antennis testaceis, clava fusca; thorace angulis posticis rotundatis. Long. $1\frac{1}{12}$ lin., lat. $\frac{11}{12}$ lin.

Habitat in Ega apud flumina Amazonum.

Subdepressed, punctate, most feebly pubescent; below testaceous red, above black, with a longitudinal oblong red patch reaching from nearly the anterior margin of the thorax to nearly the apical margin of the elytra and continued to the middle of the dorsal abdominal segments. Head moderately broad, closely but faintly punctate; mouth red; antennæ testaceous, with the club fuscous. Thorax short, transverse, gently rounded on the sides, narrowed in front, but not so much so as in many species; the base almost without sinuation, a little wider than the base of the elytra, posterior angles rounded; punctuation very light on the disk, deeper and more frequent towards the sides. Scutellum red, slightly punctate at the base. Elytra slightly convex, more particularly towards the apex, for the most part gently punctate-striate, although in parts the striation is interrupted and they are there only punctate in rows, faintest towards the suture; the black space at the apex of the elytra enclosing the red dorsal patch is a little broader than that at the apex of the thorax. Abdomen above more pubescent and punctate; the red patch encroaches slightly on the anterior portion of the pygidium, but occupies a broad space on the penultimate segment. Underside testaceous red. Legs testaceous.

From Ega on the Amazons. A single specimen in the British Museum.

β. Colour of the thorax and body black. Elytra black with a red patch.

12. Colastus vulneratus.

Erichs. in Germ. Zeitschr. iv. 240 (1843).
Strongylus pauperculus, Dej. Cat. 135 (1837).
Colastus plagiatus, Erichs. in Germ. Zeitschr. iv. 241 (1843).
Colastus corticalis (Mus. Berol.).

Leviter convexus, nitidus, longius pubescens, piceus vel niger; elytris leviter convexis, macula basali pedibusque testaceis. Long. $1\frac{2}{3}$–2 lin., lat. 1 lin.

Habitat in Brasilia.

Oval, slightly convex, slightly shining, piceous or black, clothed with a long fulvo-griseous pubescence. Head sparsely and deeply punctate; the mouth pale. Thorax bisinuate at the base, rounded on the sides, somewhat convex, deeply but not closely punctate. Scutellum thickly punctate. Elytra a half longer than the thorax, regularly punctate-striate, with the pubescence in rows, and marked by an oblong rufo-testaceous basal patch, interrupted at the suture and parallel to it, extending obliquely to the shoulder on the outer side. Abdomen more thickly punctate, the segments paler at the margins. Body below faintly punctate. Legs testaceous.

It is marked similarly to *C. bimaculatus* and *C. discoideus*, but is more convex, smaller, and with a fulvous pubescence.

I have examined with great care the typical specimens from which Erichson described this species and his *C. plagiatus*, as well as several specimens in other collections which had his authority for the accuracy of their names, but, notwithstanding, I have been unable to find any specific distinction. I have found the extent of the red basal patch on the elytra a little larger and more disposed as a basal fascia in *C. plagiatus* than in *C. vulneratus*; but Erichson does not give this as a distinguishing character: while, on the other hand, I have been unable to detect in his own specimens the characters on which he founded their distinction. He says that *C. plagiatus* is "uncommonly like the preceding (*C. vulneratus*), and is chiefly to be distinguished from it by the deeper punctuation of the somewhat shorter elytra, and the more sparing punctuation and at the same time shorter pubescence of the abdomen." If these differences exist, they are so small in degree that I think myself justified in disregarding them, and in considering both *C. plagiatus* and *C. vulneratus* to be the same species.

This species is sometimes wholly flavescent, doubtless from immaturity. There are several specimens in that state standing apart in the Berlin collection under the provisional name of "*C. corticalis*?" In Count Dejean's collection this species stands under the name of *Strongylus pauperculus*.

From Brazil. Not very rare.

13. Colastus bimaculatus.

Erichs. in Germ. Zeitschr. iv. 239 (1843).

Depressus, niger, subtiliter pubescens; elytris dense striato-punctatis, macula oblonga basali longitudinaliter posita rufa; pedibus piceis. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Habitat in Columbia.

Broad, oval, depressed, black, somewhat shining, coarsely punctate, and sparingly clothed with a slight depressed cinereous pubescence. Antennæ rufo-piceous, with the club black. Head thickly punctate; the mouth piceous. Thorax short, with the base lightly sinuate on each side, and the sides rounded, punctured sparingly and deeply on the disk, more faintly and densely on the sides. Scutellum densely punctate in the middle at the base, smooth at the apex. Elytra about a half longer than the thorax, regularly punctate-striate, sometimes with an oblong red basal blotch (interrupted at the suture, and with the inner margin parallel to the suture, the outer margin extending obliquely outwards and backwards towards the base), at others without any mark. The blotch is as in *C. vetustus*, but does not reach back on the elytra more than the half of their length. Abdomen densely punctate. Body below faintly punctate. Legs piceous; the tarsi ferruginous.

This species differs from *C. vulneratus* in its larger size, less convexity, shorter and more sparing pubescence, lighter punctuation, and different colour of the legs. It differs from *C. discoideus* in its smaller size, finer punctuation, less pubescence, less depressed elytra, and in the different shape of the red patch on the elytra.

From Columbia.

14. Colastus hilaris.

Affinis *C. bimaculato*, sed magis convexus, fortius et parcius punctatus, elytris macula basali rubra majore. Long. 2 lin., lat. 1 lin.

Habitat in Cumana.

Allied to *C. bimaculatus*, but quite distinct; more convex, more sparingly and more deeply punctate; black, the elytra with rows of punctures, deeper and fewer in each row, and with a larger patch of red covering the base of both elytra. Head punctate and pubescent; the mouth and antennæ rufo-testaceous. Thorax convex, somewhat shining, sparingly clothed with long griseous pubescence, sparingly and deeply punctate, slightly more so towards the sides, which are sharply declinate and rounded; base a little wider than the elytra, very deeply bisinuate, the posterior angles projecting backwards, slightly piceo-ferruginous, as is the margin for a short distance forwards; there is a depression at the base on each side of the middle, so that the convex disk extends somewhat backwards towards the scutellum, like a large broad lobe. Scutellum large, rounded, punctate, apex smooth. Elytra somewhat convex, very little longer than the thorax, fulvo-pubescent and punctate in rows, the punctures oblong, not continuing to the apex, which is depressed, the red patch extending quite to the suture and reaching to within a fourth of the apex at the suture, then extending across the elytra in a gentle curve for about a half of their breadth, and then sloping obliquely backwards (*i. e.* backwards as regards the base of the elytra, but forwards as regards the head) to the exterior margin, which it reaches at about a third from the base; it then reverts again along the under side of the margin almost to the very apex; apex of each elytron very obliquely truncate forwards and inwards; sutural apical angles obtuse, exterior apical angles rounded. Abdomen more faintly punctate and griseo-pubescent; margins of segments smooth. Legs rufous.

From Cumana. The only specimen which I have seen is one in the collection of the Marquis de la Ferté, standing under the name which I have adopted.

15. COLASTUS DISCOIDEUS.

Erichs. in Germ. Zeitschr. iv. 239 (1843).
Strongylus bipustulatus, Dej. Cat.

Depressus, niger, subtiliter pubescens; elytris fortiter striato-punctatis, rubris, nigro cinctis; pedibus piceis. Long. 2 lin., lat. $1\frac{1}{2}$ lin.

Habitat in Cayenne.

Scarcely longer than *C. bimaculatus*, and about a half broader, depressed, black, shining, sparingly and slightly griseo-pubescent. Antennæ black, with the two basal articles testaceous. Head densely and deeply punctate; labrum piceous. Thorax short, with the base sinuate on each side, the sides rounded, sparingly but strongly and deeply punctate on the disk, the posterior angles marked with an impression near the base. Scutellum strongly punctate. Elytra closely and strongly punctate-striate, with a large deep-red blotch occupying the base and the disk, its outer side running straight and parallel to the margin, which is narrowly black, its apical side forming a right angle with the outer margin and running parallel to the apex for a short distance, then rounding-in towards the suture and running up to the scutellum and parallel to it; the black apical margin is broader than the lateral edging. Abdomen densely punctate. Body below closely but faintly punctate. Tarsi ferruginous.

Like *C. bimaculatus*, but still broader and more coarsely punctate. It is less pubescent, rather more convex, and with a coarser and closer punctuation on the pygidium and the segments of the abdomen.

From Cayenne. Also collected by Mr. Bates on the Amazons.

16. COLASTUS VETUSTUS.

Similis *C. vulnerato* Er. statura et colore, sed major; differt in elytris haud striato-punctatis: leviter convexus, niger, pubescens, opacus; elytris planis, irregulariter leviter haud seriatim punctatis, plaga basali obliqua rufa; pedibus piceis. Long. $1\frac{3}{4}$ lin., lat. 1 lin.

Habitat in Brasilia.

Similar in form and colour to *C. vulneratus*. Slightly convex, opaque, lightly punctate, and clothed with plentiful long fulvous pubescence. The head is faintly punctate, and has a round impression on each side in front. The thorax is short, transverse, much narrower in front than behind, rather convex above, and with the sides much rounded, the posterior angles projecting much backwards. Scutellum sparingly punctate. The elytra are not punctate-striate, but covered with an irregular fine punctuation; the patch of red is duller in colour than in *C. vulneratus*, and extends backwards parallel to the suture for about two-thirds of its length, separated from it by a space equal to the breadth of the scutellum, and extending outwards at the base beyond the shoulder. Abdomen thickly pubescent and faintly punctate. Antennæ fuscous. Legs fulvous.

Readily distinguished from any of the similarly marked species by the elytra not being punctate-striate but irregularly punctate.

From Brazil.

17. Colastus consobrinus.

Subdepressus, piceus, elytris disco piceo-testaceis, fulvo pubescens; capite crebre et leviter, thorace sparsim et fortiter punctatis; elytris leviter punctatis, vix striato-punctatis; pedibus piceo-ferrugineis. Long. 2 lin., lat. $1\frac{1}{2}$ lin.

Habitat in Brasilia.

Broad, subdepressed, subopaque; thorax somewhat convex. Elytra flat, piceo-testaceous on the disk, fulvo-pubescent; head darker. Antennæ piceous, with the basal articles piceo-testaceous, second article palest. Head thickly but not coarsely punctate. Thorax short, more than twice as broad as long, somewhat shining, coarsely and sparsely punctate, more densely towards the sides; sides gradually rounded towards the front, but less rapidly than in its allies, bisinuate at the base; posterior angles projecting behind. Scutellum longer than broad, rounded at the apex, finely and closely punctate; a narrow margin at the apex not punctate. Elytra about a half longer than the thorax; sides parallel, depressed, closely and finely punctate, the punctures with a slight tendency to run into rows; the disk of each elytron paler than the suture and margins, the pale portion not well defined, rather elongate and somewhat oblique, lying parallel to the sides of the scutellum. Abdominal segments finely punctate. Underside piceous. Legs piceo-ferruginous.

Allied to *C. discoideus* and *C. vetustus*, but distinguished from the former by the punctuation on the elytra being close and scarcely striate, and from the latter (which also has the punctuation on the elytra without rows) by the greater breadth of the thorax, which is less rapidly narrowed in front; the pubescence also is shorter, and the punctuation on the elytra is more distinct, and with a slight tendency to rows, which the other has not. I am not wholly free from doubt, however, whether it may not turn out to be the female of *C. vetustus*.

From Rio Janeiro. Collected by the Rev. Hamlet Clark, who has liberally sacrificed his unique specimen to the British Museum.

18. Colastus dispar.

Oblongo-ovatus, subdepressus, subopacus, fortiter parce punctatus, niger, pubescentia longa grisea sparsim vestitus; thorace prope medium utrinque lineis irregularibus vel spatiis parum elevatis impunctatis instructo; elytris seriatim punctatis et pubescentibus, *maribus* nigris, *fœminis* ferrugineis limbo apiceque nigris; subtus valde pubescens; antennis pedibusque rufo-piceis. Long. $2\frac{1}{3}$ lin., lat. $1\frac{1}{8}$ lin.

Habitat in Mexico.

Rather elongate, oblong-ovate, somewhat depressed, somewhat opaque, black, coarsely but sparsely punctate, clothed with a long, scattered griseous pubescence, very thickly below. Thorax nearly twice as broad as long, subconvex, narrower in front than behind, emarginate in front, the sides somewhat parallel behind, rounded in front, base bisinuate, the posterior angles nearly right-angled; on the disk there is a longitudinal irregular dorsal line or space, narrowed at each end, more closely punctate than the rest, with a gently curved, smooth, impunctate, slightly raised space on each side, then another punctate curved space, and then another impunctate, slightly raised, curved line, all irregular and semiobsolete. Scutellum sparsely punctate. Elytra with rows of rather coarse punctures and pubescence; in the males wholly black; in the females ferruginous, with the margins and apex black. Abdominal segments finely punctate, except at the margins, which are smooth. Antennæ and legs rufo-piceous.

Collected by M. Sallé at Toxpam, in Mexico, in the month of July. It is from his observation that I am enabled to indicate the sexes.

This species is scarcely broad enough to come into this section, it is not depressed enough for the next section, and it is scarcely narrow enough to fall into the third section. On the whole, it comes, on the strength of the ferruginous elytra in the female, better here, beside the somewhat convex species which have a red spot on the elytra, than anywhere else.

19. Colastus maculatus.

Erichs. in Germ. Zeitschr. iv. 244 (1843).
Strongylus signatipennis (Dej. Cat. 135, ed. 1837).
Nitidula 5-maculata (Knoch, in litt.).

Piceus, pubescens; elytris dense fortiter punctatis, maculis rubris notatis. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Var. Elytris rubris, maculis nonnullis fuscis.

Habitat in America septentrionali.

Oblong-oval, slightly convex, subopaque, clothed with griseous pubescence. Antennæ rufous, with the club fuscous. Head thickly and deeply punctate, piceous; mouth rufous. Thorax with the base slightly sinuate on each side, moderately rounded on the sides, closely and deeply punctate; piceous, with the lateral margin rufous. Scutellum thickly punctate, piceous. Elytra a half longer than the thorax, rather thickly and deeply punctate, the punctures scarcely in rows; piceous, with four red spots on each (fig. 32)—two next the suture, which are usually confluent (making one long patch narrowest in the middle), and two on the lateral margin, one of which is near the shoulder, and is sometimes united to the sutural spots (fig. 33), the other near the posterior angle; sometimes the whole elytra are rufous, with the base, the apex, and some minute spots towards the sides fuscous. Abdomen more deeply and less densely punctate, piceous; breast piceous. Legs rufous.

Fig. 32.

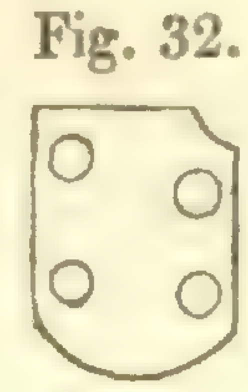


Fig. 33.

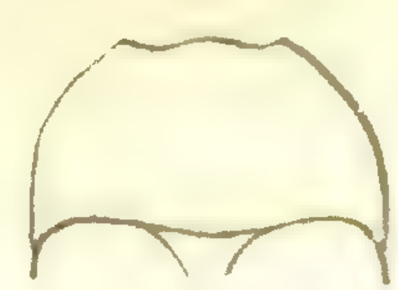
From North America.

γ. Above wholly black or nigro-piceous.

20. Colastus rufipes.

Erichs. in Germ. Zeitschr. iv. 241 (1843).

Fig. 34.



Subdepressus, niger, subnitidus, parce fulvo pubescens; antennis pedibusque rufis; thorace disco parce, lateribus crebre, elytris striatim punctatis. Long. 2 lin.

Habitat in Columbia.

Broad, suboval, somewhat depressed, somewhat shining, sparingly clothed with a short fulvous pubescence, black. Antennæ rufous, with the club fuscous. Head thickly and deeply punctate, piceous, with the mouth rufous. Thorax not twice as broad as long, with the base subsinuate on each side, the sides rounded, the disk sparingly, the sides thickly and deeply punctate. Scutellum sparingly punctate, smooth at the apex. Elytra a half longer than the thorax, regularly punctate-striate. Abdomen above thickly punctate and with the last three segments wholly visible. Legs rufo-testaceous. The abdomen in the male has the pygidium above subacuminate at the apex and the last segment below deeply impressed with a longitudinal fovea.

This species is nearly allied to *C. macropterus*, but broader, has the pubescence more sparing and shorter, and the thorax not so short and more densely punctate on the sides; it is, moreover, distinguished from all the remaining species by the longitudinal fovea on the underside of the last segment. This may possibly, however, be only a sexual character, but it is one which enables it to be most easily identified. It is more elongate than the neighbouring species, and has the thorax more convex, more shining, and less punctate.

From Columbia and Brazil.

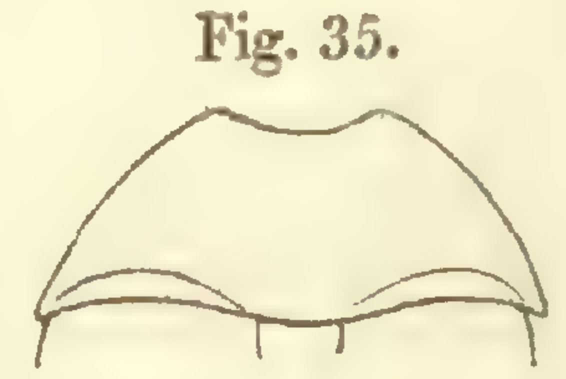
21. Colastus morio.

Nitidula nigra (Melsh. Cat.).

Cercus niger, Say, in Journ. Acad. Nat. Sc. Philad. iii. 195 (1823).

C. morio, Erichs. in Germ. Zeitschr. iv. 242 (1843).

Fig. 35.



[This cut gives the general effect, but the details of the outline are not to be depended on.]

Subdepressus, niger, griseo pubescens; antennis basi pedibusque rufis; thorace crebre punctato, basi profunde fovea curvata utrinque impresso; elytris striatim punctatis; abdomine supra segmentis tribus expositis. Long. $2\frac{1}{3}$ lin., lat. $1\frac{1}{3}$ lin.

Habitat in Pennsylvania et Mexico.

Var. lugens. Minor, minus latus; thorace fovea curvata basali minore, angulis posticis profunde foveatis; abdomine supra segmentis duobus fere solum expositis; pedibus piceis. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Habitat in America meridionali.

Var. perforatus. Crebrius punctatus, punctis minoribus; thorace fovea curvata fere obliterata; abdomine supra segmentis tribus expositis. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Habitat apud Bahia.

Broad, short, ovate, subdepressed, black, somewhat shining, densely clothed with a fulvo-griseous pubescence. Antennæ rufous at the base, piceous at the apex. Head thickly punctate. Thorax very short, truncate at the base, much narrowed in front, a little rounded on the sides, thickly, strongly, and deeply punctate, with the base depressed and marked with a deep, closely punctate, curved depression on each side, reaching into the posterior angles, which are nearly right-angled. Scutellum thickly punctate. Elytra a half longer than the thorax, rather strongly punctate in rows or sometimes in striæ. Abdomen above thickly punctate, pygidium more coarsely than the preceding segments;

the whole of the last three dorsal segments usually exposed. Legs rufous or piceo-rufous.

The most distinguishing characters of this species are its short thorax, very broad behind and rapidly narrowed in front, with a deep curved impression at the base on each side of the middle, extending into the posterior angles. Something like this occurs in the variety *lugens*, which is supposed to come from Brazil; but the abdomen of that variety has only the last two segments distinctly exposed, and the curved impression on the thorax is less marked and interrupted.

I should have preferred to retain the name by which this species was first described (*Cercus niger*, Say); but as Say's description is scarcely recognizable, and Erichson's name is thoroughly and universally established, I feel that I should be doing more harm than good to science by thus stretching too tightly the laws which regulate nomenclature.

From Pennsylvania and the southern parts of North America; extending into Mexico.

The variety *lugens* is smaller and not so broad, the thorax is comparatively narrower, the basal curved fovea on each side of the thorax is less marked—almost confined to a deep oblique fovea in the posterior angles, the abdomen has scarcely more than two segments exposed above, and the legs are darker; but, on the whole, I have not thought the differences sufficiently great to warrant me in recording it as a distinct species.

Believed to be from Brazil, but locality somewhat doubtful. Described from a single specimen, which I have placed in the British Museum.

The variety which I have called *perforatus* may perhaps be a distinct species; but, from its general character and the style of its punctuation, I am inclined to think that it is the climatal variety of *morio* peculiar to Bahia. Its chief difference is the absence, or nearly so, of the curved depression on each side of the base of the thorax. It is not wholly absent, however, and there is a slight trace of the fovea in the posterior angles. Its thorax is considerably more closely punctate, the punctures smaller and more distinct; the scutellum is very thickly and distinctly punctate, except at the very apex; and the elytra are also more distinctly punctate, the rows of punctures more numerous and more irregular, anastomosing a little in some places. I do not see any other very marked difference.

From Bahia. A single specimen was in Mr. Fry's collection, which he has sacrificed to complete the collection of the British Museum.

22. COLASTUS BREVICOLLIS.

Valde affinis *C. morioni*: subdepressus, niger vel piceo-niger, nitidus, griseo pubescens; thorace brevi, lateribus postea valde rotundatis; elytris striato-punctatis. Long. 2 lin., lat. $1\frac{1}{3}$ lin.

Fig. 36.

Habitat apud flumina Amazonum.

Very nearly allied to *C. morio*. Its chief difference is that the thorax is shorter, and is wide behind for a greater space; the sides turn in rapidly near the posterior angles, which are somewhat obtuse, although, owing to the deep sinuation of the base, they are less so than might be expected from the rapid curve of the sides; there is no curved fovea on each side of the base of the thorax; the punctuation is not so close; but in other respects it is almost the same as *C. morio*.

From Ega, on the Amazons. Collected by Mr. Bates.

23. Colastus macropterus.

Erichs. in Germ. Zeitschr. iv. 241 (1843).

Nitidula macroptera, Fab. Syst. El. i. 354. 35 (1801).

Subdepressus, niger vel nigro-piceus, nitidus, fulvo pubescens; thorace parce, elytris seriatim punctatis. Long. 2 lin., lat. 1 lin.

Habitat in Brasilia.

Oblong-oval, subdepressed, pitchy black, fulvo-pubescent. Antennæ testaceous, the club fuscous. Head thickly punctate, rufo-piceous, with the front blackish. Thorax short, scarcely wider than the elytra, more than twice as broad as long, with the base subsinuate on both sides, the sides gently rounded, sparingly but strongly punctate, fusco-piceous, towards the sides gradually rufescent. Scutellum sparingly punctate, nigro-piceous. Elytra a half longer than the thorax, regularly punctate-striate, nigro-piceous, pubescent in rows, not much wider behind than in front. Abdomen above with the last three segments exposed; densely and strongly, below sparingly and faintly punctate, nigro-piceous, the margins of the penultimate segments rufescent. Breast nigro-piceous. Legs rufo-testaceous.

From Brazil, Amazons, Peru, and other parts of South America. In Mr. Fry's collection there is a small specimen from Mexico which scarcely differs except in size.

24. Colastus latus. (Plate XXXIV. fig. 2.)

Latus, subdepressus, sat nitidus, niger vel piceo-niger, elytris interdum piceo-rufis, parce et longe fulvo pubescens; antennis piceo-rufis, clava nigra; thorace disco parce fortiter, lateribus crebre, elytris seriatim punctatis; pedibus piceo-rufis. Long. $2\frac{3}{4}$ lin., lat. $1\frac{2}{3}$ lin.

Fig. 37.

Habitat in Mexico.

Broad, subdepressed, black or piceous, shining, sparingly clothed with a longish, flaccid griseous pubescence. Antennæ rufous, with the club black. Head thickly and strongly punctate. Thorax wider than the elytra, exactly twice as broad as long, rounded on the sides, with the disk sparingly and the sides thickly punctate, and with the base sinuate on each side, the middle somewhat raised and prominent. Scutellum coarsely and sparsely punctate, smooth at the apex. Elytra a half longer than the thorax, coarsely punctate in rows, wider behind than in front; sometimes they are piceous or rufo-testaceous with a darker margin all round. Abdomen finely and sparingly punctate above, and with only the last two segments and the margin or sides of the third visible. Legs rufo-piceous.

From Mexico.

I have seen this species standing in some collections as *C. rufipes*; but it is much broader than *rufipes*, and, besides various other differences, has not the longitudinal fovea on the last ventral segment. It is very closely allied to *C. macropterus*, but considerably larger and with longer pubescence.

25. Colastus tonsus.

Valde affinis *C. lato*; differt pubescentia breviore et magis rufa atque punctis minoribus impressus. Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{2}$ lin.

Habitat in Brasilia.

This species is very similar to *C. latus*. The chief points of difference are, that it has only a short stiff rufous pubescence instead of the longer, flaccid griseous hairs of that species, and that the punctuation is smaller and rather more frequent.

From Rio Janeiro, where it was collected by Mr. Fry, who has presented his specimen to the British Museum.

26. Colastus Thalestris.

Valde affinis *C. lato*; minor, minus nitidus, elytris fere striato-punctatis, abdomine supra subrugose punctato, subtus rufo. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Fig. 38.

Habitat apud flumina Amazonum.

Very nearly allied to *C. latus*, but smaller, of the size and appearance of *C. macropterus* (but with only two segments of the abdomen fully exposed above), less shining, the punctuation a little closer, and the rows of punctures on the elytra almost united into striæ; the underside is rufous or piceo-rufous. In other respects it is very much the same as *C. latus*.

Collected by Mr. Bates at St. Paul's and Ega, on the River Amazons.

Section II. Moderately broad and convex. Texture soft.
Colour of body and thorax rufo-piceous or piceous. Elytra wholly black.

27. Colastus pubescens*.

Statura *C. vulnerati*; valde pubescens, levissime subrugulose punctatus, rufus, textura molli; elytris nigris, substriatis; pedibus rufis. Long. $1\frac{7}{8}$ lin., lat. 1 lin.

Habitat in Brasilia.

Oblong-ovate, somewhat convex, opaque, of a soft texture, very faintly subrugosely punctate, very thickly clothed with a griseous pubescence; rufous, with the disk of the thorax darker (almost piceous) and the elytra black. Thorax broad, short, transverse, narrowed and emarginate in front, with the base truncate, the posterior angles almost right-angled; the sides rounded. Scutellum rather large. Elytra short, very faintly substriate; apex of each elytron very obliquely truncate and rounded. Legs rufous.

The soft and dull texture of this species is like that of *Colastus infimus* or *Carpophilus melanopterus*, the latter of which it also resembles in colour.

From Brazil. In the collection of M. Deyrolle.

* I think it right to mention that the notes from which this description is made were taken at an early period in my study of this family, and before I was so familiar with its characters as I have since become. I therefore have not the same confidence in its completeness as in that of most of the other species.

SECTION III. Moderately broad. Depressed, as if a roller had passed over the thorax.

α. Above wholly black or nigro-piceous.

28. COLASTUS SIMPLEX.

Fig. 39.

Oblongo-ovatus, depressus, niger, subnitidus, sparsim griseo pubescens, leviter, sparsim et sat fortiter punctatus; thorace basi bisinuato; elytris leviter seriatim punctatis; pygidio sat fortiter punctato; abdomine segmentis dorsalibus penultimis et antepenultimis levissime punctatis; antennis pedibusque piceis. Long. 2 lin., lat. $1\frac{1}{8}$ lin.

Habitat in Brasilia.

Var. SALLEI. Parum latior, magis depressus, levius punctatus, thorace lateribus minus rotundato. Long. 2 lin., lat. $\frac{1}{8}$ lin.

Habitat in Mexico.

Allied to *C. morio*, but narrower and more depressed. Oblong-ovate, depressed, black, sparingly clothed with griseous pubescence, sparsely punctate, the punctures not coarse nor deep. The thorax with a flat space in the middle; the base bisinuate, sides rounded, turned in rapidly near the posterior angles, which are obtuse, so that there is a marked break in the profile of the sides between the thorax and elytra; slightly emarginate in front, anterior angles obtuse. Scutellum rather closely punctate at its base, apex impunctate. Elytra black, nigro-piceous near the scutellum, punctate in rows not very close to each other, about eighteen on each elytron, the punctures in the alternate rows in some instances having a tendency to run together, so as to be punctate-striate; the punctures are oblong, instead of round as on the thorax; the pubescence is short, and runs along the rows. Pygidium broad, rather closely punctate, the other abdominal segments very faintly punctate. Legs and antennæ piceous.

This species is not without relations to *C. morio*, and is closely allied to *C. fulvipes* and to *C. ater*. From *C. morio* and its allies it may be distinguished, without close examination, by its narrower and more depressed form and by the flat middle of the thorax. The coarse punctuation of *C. fulvipes*, its parallel form, and parallel sides of the thorax prevent its being confounded with it; and from *C. ater* it may be distinguished by the different colour of the pubescence (which in *C. ater* is black) and by the different punctuation on the elytra, which in this species is oblong and in not very close rows, while in *C. ater* the punctures are closer, round, larger, and scarcely in rows, and, further, by the pygidium of *C. ater* being narrow, raised, and impunctate at the apex. Under the microscope the acicular chitinous texture of the elytra (like that easily seen in the different species of *Calathus*) is visible in this species, and scarcely, or not at all, in *C. ater*.

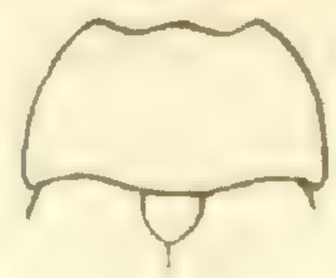
From Santarem.

The variety *Sallei* differs in being a little more depressed and somewhat broader, with the sides of the thorax less rounded, and in being somewhat less punctate, but in other respects is similar, and stands the microscopic test of its texture.

From Mexico.

29. Colastus ater.

Fig. 40.



Oblongo-ovatus, depressus, nitidus, niger, pube longa parce vestitus, fortiter punctatus; thorace basi bisinuato; elytris subseriatim crebre punctatis; pygidio basi punctato, apice lævi et elevato; ore tarsisque piceis. Long. 2 lin., lat. 1 lin.

Habitat in Venezuela.

Closely allied to *C. simplex*. Oblong-ovate, depressed, twice as long as broad, shining, very black, and clothed with a long stiff pubescence, which is black above, except about the base of the elytra, and griseous below; rather deeply but not very closely punctate. Thorax transverse, with the sides rounded, the disk flat, emarginate in front, the anterior angles obtuse and slightly rounded; base a little wider than the base of the elytra, bisinuate, with a depression on each side of the disk; posterior angles scarcely pointed backwards, obtuse and rounded. Scutellum punctate at the base, smooth at the apex. Elytra narrower than the thorax at the base, obliquely truncate, and rounded at the apex; coarsely and thickly punctate in somewhat irregular rows; the punctures roundish, not oblong. Abdomen finely and rather closely punctate, except towards the apex of the pygidium, which is raised, narrow, and impunctate. Mouth, base of antennæ, and tarsi black, with a tendency to piceous or ferrugineo-piceous.

From Venezuela.

30. Colastus fulvipes.

Fig. 41.

Oblongus, parallelus, valde depressus, fortiter et creberrime punctatus, fulvo pilosus, niger vel nigro-piceus; thorace brevi, emarginato, basi truncato, angulis posticis fere rectis, haud elytris latiore; elytris creberrime seriatim punctatis et fere punctato-striatis; antennis nigris, basi picea; pedibus fulvis. Long. $1\frac{2}{3}$ lin., lat. $\frac{5}{6}$ lin.

Var. Totus piceus.

Habitat in Brasilia.

Oblong, parallel, very much depressed, the thorax hollowed out in the middle; very closely and strongly punctate, black or nigro-piceous, clothed with stiff fulvous hairs. Head thickly punctate; mouth piceous. Thorax deeply emarginate in front, anterior angles declinate, projecting and obtusely rounded, subquadrate, base truncate, posterior angles nearly right-angled, most coarsely punctate in the middle, the punctures becoming finer, closer, and less marked towards the sides and angles; sides rounded in front, very slightly behind, so that the profile of the thorax and elytra is nearly continuous. Scutellum coarsely punctate, except at the apical margin. Elytra very closely punctate in rows, the rows (nearly twenty in number) very close to each other, and the punctures in the rows sometimes becoming confluent so as to make them punctate-striate, depressed towards the suture; the apex of each elytron truncated obliquely from the suture, and the external apical angles broadly rounded. Abdominal segments finely punctate, nigro-piceous. Legs fulvous.

From Brazil (Rio Janeiro, &c.). Not rare.

31. Colastus pocularius.

Oblongus, valde depressus, piceo-niger, subnitidus, glaber, leviter punctatus; thorace disco impunctato longitudinaliter excavato; elytris striato-punctatis; antennis pedibusque fulvis. Long. 2 lin., lat. $\frac{7}{8}$ lin.

Habitat in Brasilia.

Oblong, excessively depressed, nigro-piceous, somewhat shining, glabrous; lightly punctate, the elytra more strongly punctate-striate. Head depressed, lightly and sparingly punctate, with a curved impression in front. Thorax transverse, subquadrate, the sides gently declined, subparallel, narrowed and rounded in front, lightly and sparingly punctate, the disk impunctate and hollowed out longitudinally, the posterior angles almost right angles, the anterior declined and obtuse, with the base lightly sinuate on each side. Scutellum large, very faintly punctate towards the base, the remainder smooth. Elytra subquadrate, flat, punctate-striate, with the apex somewhat oblique and rounded, truncate. Pygidium and other abdominal segments lightly punctate. Antennæ and legs fulvous.

One of the very flat, scale-like species, not much thicker than a piece of paper. The large, cup-like, impunctate hollow in the middle of the thorax (which suggested its name) readily distinguishes the species.

From Rio Janeiro. I have seen only one specimen, which is in the collection of Professor Boheman of Stockholm.

β. Black, with rufous marking on thorax and abdomen.

32. Colastus signaticollis.

Fig. 42.

Depressus, oblongo-ovatus, subnitidus, punctatus, pube brevissima fulva vestitus, piceo-niger; capite, vertice, thorace linea dorsali longitudinali basin versus, pectore et abdomine medio et supra et subtus ferrugineo-rufis; thorace lato; elytris seriatim punctatis; pedibus ferrugineo-rufis. Long. $2\frac{1}{2}$ lin., lat. $1\frac{3}{5}$ lin.

Habitat in Provincia Sanctæ Catharinæ in America meridionali.

Oblong-ovate, depressed, shining, punctate, clothed with a very short fulvous pubescence, black or nigro-piceous. Head broad, strongly but not thickly punctured, most so towards the sides; the vertex with a bright rufous spot. Antennæ rufous, club piceous or ferruginous. Thorax black, with a rufous longitudinal streak immediately before the scutellum, transverse, narrowed in front, much declined towards the anterior angles, flat and somewhat sparsely punctured on the disk, thickly on the sides, which are lightly rounded, all the angles obtusely rounded, broader than the elytra at the base, the base truncate and scarcely sinuate. Scutellum rather thickly punctate, except at the apex. Elytra flat, punctate in close rows, which in some instances are a little irregular, the sides inflexed; apex of each elytron little rounded, nearly straight, except at the exterior angles. Abdominal segments punctate above, each with a rufous patch in the middle before the posterior margin of the segment. The whole of the underside rufo-ferruginous, except the sides, which are darker. Legs rufo-ferruginous.

From the southern provinces of Brazil. In the collection of the Copenhagen Museum and in that of M. Deyrolle.

γ. Black, with disk of elytra rufous.

33. COLASTUS SEMITECTUS.

Erichs. in Germ. Zeitschr. iv. 243 (1843). Lacord. Hist. des Ins. Coléopt. pl. 18. fig. 1 (1854).
Nitidula semitecta, Say, in Journ. Acad. Nat. Sci. Philad. v. 182. 8 (1825).

Depressus, piceus vel niger, subglaber; elytris subseriatim punctatis, rufis, lateribus apiceque piceo marginatis. Long. $1\frac{1}{2}$–2 lin., lat. 1 lin.

Habitat in Pennsylvania et partibus meridionalibus Americæ borealis.

Oblong, depressed, piceous, shining, almost glabrous. Antennæ rufous, with the club fuscous. The mouth rufo-piceous. Head flat, sparingly punctate. Thorax with the base lightly sinuate on each side, rounded on the sides, flat on the disk, thickly and strongly punctate, with the posterior angles rounded, rufescent, and wider than the elytra. Scutellum thickly punctate at the base, smooth at the apex. Elytra somewhat longer than the thorax, rather thickly punctate, in rows towards the suture, irregularly towards the sides, testaceous red, with the sides and the apex margined with black or piceous. Abdomen closely and faintly punctate. Legs red.

I have received a variety of this species from Count Motschulsky, under the name of *C. transparens,* in which the elytra are black, with a faint reddish hue showing itself almost imperceptibly on the disk. Erichson mentions that in Hoffmannsegg's collection this species stood under the name of *Nitidula brachyptera,* Knoch.

From Pennsylvania and the southern districts of North America.

δ. Body and thorax more or less reddish or testaceous.

34. COLASTUS AMPUTATUS. (Plate XXXIV. fig. 3.)

Erichs. in Germ. Zeitschr. iv. 243 (1843).

Depressus, glaber, punctatus, rufo-testaceus; elytris seriatim punctatis, plus minusve piceo limbatis. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Brasilia et Columbia.

Flat, depressed, oblong, subparallel, glabrous, shining, rufo-testaceous. Antennæ testaceous, with the club sometimes dusky and rather elongate. Head moderately punctate. Thorax finely and rather sparsely punctate, shorter than broad, transverse, and somewhat quadrate; base truncate, with a very slight bisinuation on each side; disk flat, in some specimens hollowed; sides rounded rapidly in front. Scutellum somewhat triangular, with the apex rounded, faintly punctate at the base, impunctate at the apex. Elytra as long as the head and thorax taken together, rather finely punctate, the punctures arranged in rows, which are pretty close to each other; semitransparent, the marks of the folding of the wings beneath being occasionally seen through them, the exterior margin and apex in some specimens dusky or blackish; when this is the case, the coloration is darkest towards the apex. Segments of abdomen finely punctate, the punctures longitudinal. Legs testaceous or ferruginous.

From Brazil and Venezuela. Common.

35. Colastus circumscriptus.

Erichs. in Germ. Zeitschr. iv. 238 (1843).
C. lunatus (Motsch.).

Depressus, testaceus, pilosellus; elytris seriatim punctatis, nigro cinctis. Long. $2\frac{1}{3}$ lin., lat. 1 lin.

Habitat in Brasilia.

Much depressed, testaceous, shining, sparingly pubescent. Antennæ testaceous, club fuscescent. Head somewhat pilose, sparingly punctate, with an anterior spot and the vertical margin black. Thorax broad, truncate at the base, lightly rounded on the sides, flat, sparingly punctate and slightly pilose, with the middle of the apical margin black. Scutellum sparingly punctate. Elytra somewhat longer than the thorax, flat, closely and regularly punctate-striate, with pubescence in rows, the lateral and apical margins black, the suture piceous. Abdomen sparingly punctate, slightly pilose, with the apex black. Body below and legs testaceous.

Like a large pale *C. amputatus* with some long fulvous pubescence; but it is variable in size, being sometimes no larger than *C. amputatus*. The pubescence is the readiest character by which to distinguish it.

Found in South America from Central America to Brazil.

36. Colastus varius.

Erichs. Cons. Ins. Coleopt. Peruan., in Wiegm. Arch. xiii. 1. 92 (1847).

Fig. 43.

Planus, leviter punctatus, subopacus, pilosellus, testaceus, frontis maculis tribus verticeque, thoracis macula utrinque laterali, margineque basali, pygidii margine apiceque, scutello elytrisque nigris, his striato-punctatis, macula basali testacea. Long. 2 lin.

Habitat in Peruvia.

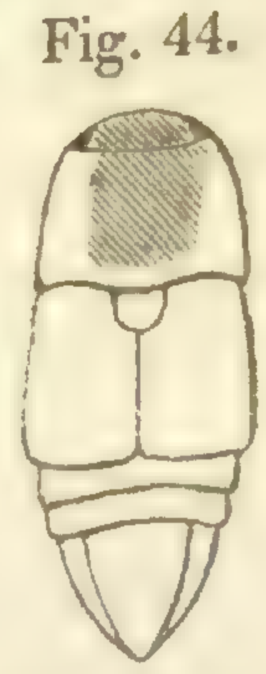
Flat, depressed, somewhat pilose, subopaque, faintly punctate, testaceous. Head with the vertex and three spots in front black. Thorax with the base narrowly black and a small rounded black patch on each side before the middle. Scutellum black. Elytra punctate-striate, black, except the scutellar region. Abdomen with the apex and margins of the pygidium blackish.

Somewhat of the depressed form of *C. amputatus*, but larger, and readily recognized by the peculiar distribution of colour.

From Peru.

37. Colastus melanocephalus.

Fig. 44.



Erichs. in Germ. Zeitschr. iv. 238 (1843).
Strongylus maculicollis (Dej. Cat. 135, ed. 1837).

Depressus, testaceus, fulvo villosulus; capite, thoracis disco anteriore elytrorumque margine exteriore nigris. Long. $3\frac{1}{4}$ lin., lat. $1\frac{2}{5}$ lin.

Habitat in Cayenne.

Oblong, depressed, testaceous, somewhat shining, with long pilose pubescence. Antennæ black, with the last article testaceous. The head thickly and strongly punctate, black, shining, sparingly fulvo-pilose. Thorax truncate at the base, with the sides gently rounded, thickly and strongly punctate, with a longitudinal slightly raised smooth line in the middle, fulvo-pilose, with a large black patch occupying the disk and anterior margin both above and below. Scutellum thickly punctate. Elytra somewhat longer than the thorax, punctate in rows, densely clothed with a longish suberect pubescence, with the exterior margin towards the apex narrowly coloured piceous or black. Abdomen lightly punctate, fulvo-villose. Metasternum with a triangular black patch, sparsely punctate.

A fine, large, and distinct species—the largest of the genus.

From Cayenne. There is one specimen in the Berlin collection, and a pair in Dejean's collection in the possession of the Marquis de la Ferté, where they stand under the name of *Strongylus maculicollis*, Buq.

Section IV. Elongate.

a. Texture shining, and not soft, dull, nor shagreened nor very pubescent.

38. Colastus adustus.

Erichs. in Germ. Zeitschr. iv. 242–3 (1843).
Ips melanura (Dej. Cat. 134, ed. 1837).

Leviter convexus, rufus, subglaber; elytris seriatim punctatis substriatisque, lateribus et apice fuscescentibus. Long. 2 lin., lat. $\frac{2}{3}$ lin.

Habitat in Brasilia.

Oblong, slightly convex, shining, almost glabrous. Antennæ rather short, testaceous, club fuscescent. Head thickly and strongly punctate, rufous, with a piceous spot in the middle. Thorax subquadrate, truncate at the base, rather narrowed in front, with the sides nearly parallel and scarcely rounded, the posterior angles somewhat obtuse, transverse, slightly convex, sparsely and strongly punctate, rufous, with the disk becoming piceous in the middle, not broader than the elytra. Scutellum sparingly punctate, piceous, with the base punctate and the apex smooth and shining. Elytra almost a half longer than the thorax, most obsoletely striate towards the suture, strongly punctate in rows, rufous, the lateral and apical margins becoming piceous. Abdomen rufo-piceous, sparingly and faintly punctate and pubescent. Body below and legs rufo-testaceous.

From Brazil.

39. Colastus decorus.

Leviter convexus, punctatus, subnitidus, rufus; elytris seriatim punctatis, nigris, macula circa scutellum rufa; scutello nigro; thoracis et abdominis disco supra longitudinaliter fuscescente. Long. 2 lin., lat. $\frac{5}{6}$ lin.

Habitat in Brasilia.

Closely allied to *C. adustus*, Erichs., but more coarsely and more closely punctate, and consequently not so smooth and shining; the colour darkest on the disk, and not on the sides as in *C. adustus*. Oblong, somewhat convex, shining, almost glabrous, rufous. Head coarsely punctate, with the middle a little darker. Thorax more sparsely punctate, a little narrower in front, with the apex emarginate and the sides subparallel,—very little rounded, scarcely broader than the elytra, and all the angles obtuse and slightly rounded. Scutellum rounded at the apex, dark chestnut, closely punctate at the base, smooth at the apex, and with a longitudinal fuscescent marking on the disk. Elytra black or nigro-piceous, except a narrow oblique rufous patch parallel to the sides of the scutellum, the suture black; coarsely punctate, the punctures running into rows, which towards the suture become almost punctate striæ; hollowed along the suture, wider behind than in front, the apex of each elytron obliquely rounded, sutural angles obtuse, exterior apical angles rounded. Abdomen above longitudinally marked with a fuscous indeterminate patch, thickly and more finely punctate than the rest of the surface, finely fulvo-pubescent.

From Brazil.

40. Colastus ferrugineus.

Depressus, planus, oblongus, nitidus, testaceo-ferrugineus, leviter pilosellus; capite et thorace fortiter punctatis, elytris seriatim punctatis. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in Brasilia.

Flat, depressed, oblong, more than twice as long as broad, shining, testaceo-ferruginous, sparingly pubescent, hairs reddish. Antennæ of the same colour, with the club fuscescent. Head coarsely punctured. Thorax short, nearly twice as broad as long, truncate at the base, emarginate in front; sides rounded from behind to the front, which is a good deal narrower than the base; coarsely punctured. Scutellum punctured across the base, smooth at the apex. Elytra longer than the thorax, but not quite so long as the head and thorax taken together, inclined towards the suture, becoming insensibly darker towards the apex, rather deeply punctate, the punctures arranged in rows, the punctuation not so coarse as that on the thorax; the pubescence arranged in rows. Underside and legs testaceo-ferruginous. The last two segments of the abdomen moderately punctate, the preceding segment very finely punctate, the remainder not punctate.

From Brazil.

41. Colastus striaticollis.

C. infimo paulo minor: planus, depressus, nitidus, testaceus; capite punctato; thorace transverso, quadrangulari, disco planato striis quatuor punctatis longitudinalibus, lateribus irregulariter punctatis; scutello punctato; elytris striato-punctatis, interstitiis haud punctatis. Long. $\frac{7}{8}$ lin., lat. $\frac{1}{3}$ lin.

Fig. 45.

Habitat in Brasilia.

About the size of *C. infimus*, but not allied to it. It is so shining and so nearly glabrous, that the pubescence can only be seen by a powerful glass. It is flat, depressed, and testaceous; the legs and underside somewhat paler. Head punctate. Thorax transverse, quadrangular, all the angles nearly right angles; the sides very little rounded, somewhat inflexed towards the anterior angles; the disk flat, with four rows of punctures in the middle, reaching neither to the front nor the base; the interstices impunctate, but the spaces on each side irregularly punctate. Scutellum triangular, punctate, except a narrow shining margin. Elytra about a half longer than the thorax, punctate-striate; the interstices not punctate; the apex of each elytron truncate and slightly rounded, the margin not much inflexed nor much rounded. Pygidium very slightly punctate.

From Brazil. In the collection of Professor Boheman.

β. Texture dull and shagreened.

42. Colastus unicolor (obscurus, Erichs.).

Carpophilus unicolor, Say, in Journ. Acad. Philad. v. 183 (1825).
Colastus obscurus, Erichs. in Germ. Zeitschr. iv. 244 (1843).

Oblongus, depressus, niger, pubescens; pedibus rufis; elytris dense ruguloso-punctatis, macula humerali obsoleta rufescente. Long. $2\frac{1}{4}$ lin., lat. $\frac{4}{5}$ lin.

Habitat in Carolina meridionali in America boreali.

Oblong, depressed, black, subopaque, fulvo-pubescent. Antennæ rufous, club piceous. Head punctate-rugose, in front foveolated on each side, wholly rufo-piceous, or sometimes with the front blackish. Thorax truncate and bisinuate at the base, somewhat rounded on the sides, closely punctate, with the lateral margin slightly translucent, all the angles obtuse, the posterior angles projecting backwards. Scutellum closely punctate. Elytra closely punctate, subrugulose, with an obsolete humeral spot and the apical margin piceous. Abdomen densely punctate, the segments margined with piceous. Legs rufous.

This has the close, fine punctuation common among the *Carpophili*, as well as a good deal of their general appearance, which no doubt misled Say into describing it as a species of that genus.

From the Southern States of North America.

γ. Texture soft, not shagreened.

43. Colastus infimus.

Erichs. in Germ. Zeitschr. iv. 245 (1843).
Nitidula truncata, Randall, in Boston Journ. ii. 18 (1838).
(*Colastus truncatus*, Leconte, in Col. Lake Superior, 222 (1850).)

Ovatus, subdepressus, leviter punctatus, griseo pubescens, niger; capite thoraceque piceo-testaceis; elytris subtiliter punctatis, testaceis, limbo laterali postice latiore apicalique nigris; pedibus testaceis. Long. $1–1\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in America boreali.

Shortly ovate, depressed, subopaque, griseo-pubescent, black. Antennæ rufous, with the club fuscous. Head faintly punctulate, piceous, with the mouth rufous. Thorax a little narrower in front than behind, the sides rounded, finely punctate, rufous, with the disk generally piceous, anterior angles declinate, all the angles rounded, the base subsinuate on each side, and narrower than the base of the elytra. Scutellum faintly punctulate, black. Elytra wider and a half longer than the thorax, finely punctate, black, with a large triangular luteous patch, common to both, extending from the shoulders to the interior angle of the apex. Abdomen very faintly punctate, piceous. Breast black. Legs testaceous.

From specimens sent to me by Dr. Leconte, under the name *C. truncatus* of Randall, I am enabled to identify the species described by that entomologist under that name with this species; but I do not think his description sufficiently clear to warrant me in substituting his name for the better-known one of Erichson. I have placed in the British Museum one of Erichson's types which I received from the Berlin Museum through the kindness of Professors Peters and Gerstäcker.

Common throughout North America from Lake Superior to Mexico.

44. Colastus triangularis.

Valde affinis *C. infimo*; differt thorace antice angustiore. Long. 1–$1\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Brasilia.

Very closely allied to *C. infimus*—perhaps only a variety. The chief difference is that the sides of the thorax slope more rapidly towards the front. In other respects I can see little difference. Like *C. infimus* it varies in colour, having sometimes the lighter portions testaceous and at other times pale piceous, the arrangement of the colours, however, continuing the same.

From Brazil.

45. Colastus limbatus.

Leconte, in Proc. Acad. Nat. Sci. Philad. March 1858, 62 (1858).

Depressus, ovalis, niger, griseo pubescens; thorace confertissime subtilius punctato, antrorsum angustato, margine angusto angulisque posticis indeterminate testaceis; elytris confertim subtilius punctatis, piceo-testaceis, limbo omni æquali suturaque nigris; abdomine subtilissime punctulato; pedibus antennisque testaceis, his clava paulo infuscata. Long. 1 lin., lat. $\frac{3}{5}$ lin.

Habitat apud flumen Colorado prope flumen Gilæ in California.

Depressed, oval, blackish, griseo-pubescent. Head finely punctulate. Antennæ testaceous, the club fuscous. Thorax finely and very thickly punctate, narrowest in front, with the margins and posterior angles narrowly and indeterminately testaceous. Scutellum large, very finely punctate, the margin depressed. Elytra very thickly and finely punctate, piceo-testaceous, with the margin all round, base, sides, apex, and suture gradually blackish, the suture less distinctly so than the rest; the apex of each elytron slightly obliquely truncate. Abdomen very finely punctulate. Legs testaceous.

Through the kindness of Dr. Leconte I have seen this species, and agree with him in thinking it distinct from, although it is nearly allied to, *C. infimus*. It is of the same size and texture; but the thorax is more narrowed in front, the colour is muddy piceous black, and the elytra have the disk instead of the scutellar region paler.

From the River Colorado, near the Gila, in California.

46. Colastus obliquus.

Leconte, in Proc. Acad. Nat. Sci. Philad. March 1858, 62 (1858).

Depressus, ovalis, niger, griseo pubescens; thorace subtilius punctato, antrorsum angustato, margine angusto testaceo postice latiore; elytris subtilius punctatis, obscure rufo-testaceis, limbo laterali postice latiore apicalique nigris, sutura paulo infuscata; antennis nigris; pedibus obscure rufis. Long. 1 lin., lat. $\frac{3}{5}$ lin.

Habitat apud flumen Colorado in California.

Variat (immaturus) piceo-testaceus, elytrorum disco ab humeris ad suturæ apicem pallidiore, versus scutellum infuscato.

Depressed, oval, black, griseo-pubescent. Antennæ black. Thorax very faintly punctate, narrowed in front, the margins narrowly testaceous, more widely so behind. Elytra very faintly punctate, obscurely rufo-testaceous, with the lateral and apical margins black, the black part widest behind, the suture slightly fuscescent. Legs obscurely rufous.

I have not seen any specimen of the species described by Dr. Leconte under this name; but, from his description, there seems to be little specific difference between it and his *C. limbatus*. He himself says it is of the same size and form, but differs from it by the less dense punctuation of the thorax, and by the lateral black margin of the elytra being gradually broader from the humerus, and by the base not being margined with black. This coloration would carry it to *C. infimus*, to which, on other grounds, it is nearly allied, and would form the transition between it and *C. limbatus*; but the thorax narrowed in front being specially mentioned as a character, and the extent of its narrowing being the chief distinction between *C. limbatus* and *C. infimus*, I think it most probably a variety of *C. limbatus*. As, however, Dr. Leconte is not in the custom of making species upon slight or insufficient grounds, I have preserved the species and given the whole of his description, so that the reader may judge for himself.

From the River Colorado, in California.

47. Colastus tantillus.

(Leconte, in Agassiz's Lake Superior, 222 (1850).)

Dr. Leconte has recorded (in the appendix to Agassiz's 'Lake Superior') a species under this name as having been found on the shores of that lake, but has given no description of it there, nor am I aware of his having described it anywhere else. I have not seen it, so that I can do no more than notice its existence.

The following dichotomous Table may be of service as a rough guide to the determination of the species of this difficult genus:—

	More or less shining, with the thorax distinctly punctate	1
	More or less dull. Texture soft or shagreened	39
1	Base of thorax nearly straight and its posterior angles rounded or right-angled. Anterior tibiæ distorted in the males	2 (Subg. *Cyllopodes*.)
	Base of thorax bisinuate and its posterior angles pointing more or less backwards. Anterior tibiæ not distorted in males	7 (Subg. *Colastus* proper.)

2	Thorax red	3
	Thorax black or piceous	4
3	Elytra with rows of pubescence	*ruptus.*
	Elytra without rows of pubescence	*posticus.*
4	Elytra black	*niger.*
	Elytra marked more or less with red	5
5	Elytra with the red disposed along the base	*scutellaris.*
	Elytra with the red disposed as a patch surrounded by black	6
6	Red patch occupying nearly the whole of the disk	*bisignatus.*
	Red patch an elongate space near and parallel to the suture	*biplagiatus.*
7	More or less broad	8
	Elongate	35
8	Comparatively convex	9
	Depressed and flat, as if a roller had passed over the thorax	26
9	Body below red	10
	Body below black or piceous	13
10	Thorax wholly red	11
	Thorax partly red	12
11	Elytra wholly red	*fervidus.*
	Elytra more or less black	*Bohemani.*
Bohemani	Scutellum and scutellar region of elytra red	Var. *Bohemani* (type).
	Only the apical half of elytra black	Var. *basalis.*
	Whole of elytra black, except a narrow basal strip. Scutellum red.	Var. *Candezei.*
	Whole of elytra and scutellum black	Var. *nigripennis.*
12	Thorax red, with three black or piceous lines in front	*Heydeni.*
	Thorax black, middle red	*dorsalis.*
13	Thorax black. Elytra black, with one or more red or pale spots	14
	Thorax and elytra wholly black or piceous	20
14	Elytra with one red patch	15
	Elytra with more than one red spot	*maculatus.*
15	Elytra punctate in rows	16
	Elytra irregularly punctate all over	19
16	Outer margin of red patch parallel to the sides of the elytra	*discoideus.*
	Outer margin of red patch passing obliquely from base or side inwards	17
17	Red patch on elytra reaching to the suture	*hilaris.*
	Red patch on elytra interrupted by a black space from the suture	18
18	Legs rufous	*vulneratus.*
	Legs piceous	*bimaculatus.*
19	Punctures on elytra with a slight tendency to striation. Abdomen above piceous, with the middle darker	*consobrinus.*
	Punctures on elytra wholly irregular. Abdomen black	*vetustus.*
20	Apex of abdomen with a deep emargination and fovea below	*rufipes.*
	Apex of abdomen without a deep emargination and fovea below	21
21	Thorax without a curved basal fovea	22
	Thorax with a curved basal fovea on each side	*morio.*
morio	Curved basal fovea deep and uninterrupted	*morio* (type).
	Curved basal fovea interrupted and with a separate deep fovea in the posterior angles	Var. *lugens.*
	Curved basal fovea almost obliterated	Var. *perforatus.*

22	Elytra rather flat	*brevicollis.*
	Elytra somewhat convex or sloping outwards	23
23	Three dorsal segments of abdomen exposed	24
	Little more than two dorsal segments of abdomen exposed	*Thalestris.*
24	Thorax scarcely wider than the elytra, and elytra not much wider behind than in front	*macropterus.*
	Thorax wider than the elytra, and elytra wider behind than in front	25
25	Pubescence griseous, sparing, but long, flaccid, and woolly	*latus.*
	Pubescence rufous, stiff, and short	*tonsus.*
26	Above wholly black or nigro-piceous	27
	Above not wholly black	30
27	Glabrous	*pocularius.*
	More or less clothed with hairs or pubescence	28
28	Pygidium smooth, narrow, and impunctate at the apex	*ater.*
	Pygidium broadish and punctate	29
29	Sides of thorax turned in at the base, so that the profile of the thorax and elytra is not continuous	*simplex.*
	Sides of thorax almost, but not quite, continuous with the elytra	*fulvipes.*
30	Ground-colour black with red or rufous markings	31
	Ground-colour reddish or testaceous	32
31	Black, with rufous marks on thorax and abdomen	*signaticollis.*
	Black, with disk of elytra red	*semitectus.*
32	Wholly rufous, a little darker along the margins	*amputatus.*
	Not wholly rufous or testaceous	33
33	Rufo-testaceous. Elytra encircled with black	*circumscriptus.*
	Testaceous, marked with black or piceous	34
34	Head, front, and thorax, except the sides and base, black	*melanocephalus.*
	Head and thorax with small black marks. Scutellum and most of elytra black	*varius.*
35	Slightly convex	36
	Flat and depressed	37
36	The sides darkest	*adustus.*
	The sides lightest	*decorus.*
37	Thorax with four longitudinal punctate striæ	*striaticollis.*
	Thorax without longitudinal punctate striæ	38
38	Coarsely punctate	*ferrugineus.*
	Finely punctate and shining	*politus.*
39	Elytra punctate in striæ	*pubescens.*
	Elytra not striate	40
40	Dull and shagreened	*unicolor.*
	Rather dull and soft in texture	41
41	Elytra with scutellar region palest	42
	Elytra with disk palest	*limbatus.*
42	Thorax narrowest in front and sloping gradually from behind forward	43
	Thorax very little narrower in front than behind, and with the sides nearly straight for a short space in the middle	*infimus.*
43	Thorax black, with a narrow testaceous margin widest behind	*obliquus.*
	Thorax testaceous or piceous, darkest in the middle	*triangularis.*

Genus BRACHYPEPLUS*.

Erichs. in Germ. Zeitschr. iv. 245 (1843).

Caput sulcis antennariis convergentibus. Labrum haud bilobum. Epistoma porrectum. Thorax basi truncata, angulis posticis subrectis. Elytra striata vel costata. Abdomen segmentis 1mo et 2do plus minusve brevibus, 3tio et 4to majoribus, 5to maximo, ultimis tribus expositis, segmentis expositis thorace longioribus fimbriisque distinctis instructis. Tibiæ apice extus canaliculatæ.

Body long, and in most species depressed. Head rather small. Epistome somewhat projecting. Eyes rather small. Antennæ a little longer than the head, the first article somewhat enlarged and widened on the outer side, the second a little thicker than those which follow, the third somewhat elongate, the rest gradually smaller, the two before the club slightly increased in breadth, the club usually round. Antennal grooves narrow, slightly converging. Labrum rounded in front, with a feeble trace of a division in the middle, sometimes with a notch on each side. Mandibles usually with two small teeth behind the point. Maxillæ short, with a brush of hairs at the end and on the inner side. Maxillary palpi moderately short, somewhat longer than the maxillæ, the first article short, the second unequal and large, the third shorter, the fourth longer and usually tumid. Ligula corneous, with a broad ciliated membranous lobe on each side. Labial palpi short, the first article very small and slender, the second thick, the third somewhat more compressed, truncate at the point. Mentum broad, bi-emarginate, with a prominent tooth in the middle. Thorax about the breadth of the elytra, transverse, broader than long, somewhat narrowed in front, with the apex feebly emarginate and the base truncate, straight or slightly sinuate, the posterior angles nearly right angles, and the sides with a narrow margin, which in some species is fringed with hairs. Prosternum not projecting. Metathorax without axillary pieces. Scutellum variable in form, generally transverse. Elytra costate or striate, short, truncate, margined on the sides, the exterior apical angles rounded. The abdomen more or less parallel; above with three segments exposed, which are longer than the thorax, but not so long as thorax and elytra united; below with the first two segments shorter than the rest (in the subgenera *Liparopeplus* and *Adocima* very little shorter), the two following somewhat longer, the last the longest of all. All the exposed dorsal segments have a broad well-marked fimbria along the margin, extending in a ring across the segment under the immediately preceding segment. The under side of the abdomen is also generally furnished with a slight indication of fimbriæ; in some of the species, more particularly in *Adocima bella*, there is as well-defined a fimbria on the under side as on the upper; and in almost all the species of *Brachypeplus* and its allies they extend in a more or less developed ring across the anterior margin of the segment below as well as above. In most of them this is concealed from view by the overlapping of the segment in front; but in some it can be very distinctly

* The name *Brachypeplus* has been previously used for a genus of Hymenoptera; but it seems to be carrying purism too far to propose to change a well-established name merely because it has been previously used in the nomenclature of another class of animals. The promulgation of any such new names may properly be objected to for the future, and disowned whilst they are still fresh, but after they have acquired currency I do not think they should be meddled with. The practical mischief done by such double employment of names is much less trifling than the inconvenience caused by changing them.

seen, and in *Adocima* it is very marked*. The pygidium in the males (?) has a short additional anal appendage. The stigmata are on the upper side, close to the fimbriæ. Legs short. Coxæ of middle legs near each other. The thighs below with a flat channel for the reception of the tibiæ, which have at the apex on the outer margin a small channel for the reception of the tarsi; the inner side of the apex has small terminal spurs. The tarsi can scarcely be said to be dilated; the first three articles have a brush of hairs beneath; the last article, longer than all the rest put together, has simple claws.

Position and Affinities.—Colastus. Brachypeplus. Cillæus.

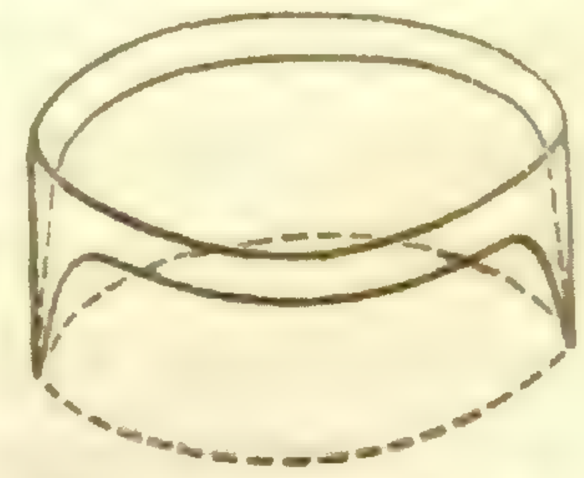
The species included in this genus may be divided into various subgenera, which arrange themselves naturally together according to the countries from which they come. The chief characters are the following:—1. In the New Holland species the margins of the thorax are ciliated or fringed with hairs, and the lobes of the ligula are very slightly developed. 2. In the Caffrarian and East Indian species the margins of the thorax are not fringed, and the lobes of the ligula are well developed. 3. In the species from West Africa and South America the margins of the thorax are not fringed, and the lobes of the ligula are very slightly developed. And these, again, may be subdivided into other sections.

The following dichotomous Table may save time in the determination of the section to which the species belong:—

	Abdomen with the first two segments considerably shorter than the rest	1
	Abdomen with the first two segments very little shorter than the rest	5
1	Margins of thorax fringed with hairs (the ciliation sometimes not visible without a lens)	2
	Margins of thorax not fringed with hairs	3
2	Broad, convex, the first article of the antennæ greatly developed	*Onicotis.*
	Depressed and elongate, with the first article of the antennæ not unusually developed	*Tasmus.*
3	Pubescent	4
	Not at all or very slightly pubescent	*Leiopeplus.*
4	Mandibles with the apex bicuspid or tricuspid. Abdomen with the pygidium longer than broad, so that it appears rapidly attenuated behind	*Selis.*
	Mandibles with the apex pointed. Abdomen with the pygidium not longer than broad, so that it does not appear rapidly attenuated behind	*Brachypeplus* proper.
5	Depressed	*Adocima.*
	Convex	*Liparopeplus.*

* This shows that the explanation of the fimbriæ which I have given at p. 256 does not apply to all the forms of this section. It does apply to most of them, as can be easily seen by a dissection of the segments of *Colastus*, *Carpophilus*, &c.; but the *Brachypeplidæ* form an exception; and the occurrence of this deviation in that section would form a good sectional character were it not that in many species it can scarcely be seen without destroying the insect. The structure of the segments where fimbriæ occur both above and below them can be easily explained by imagining a repetition of the arrangement in the simpler type, where they occur only on the dorsal surface, the fimbriæ and transverse continuation of them as rings both above and below forming the framework into which the remainder of the segment, viz. a dorsal plate and a ventral plate, respectively fit.

Fig. 46.



N.B. Rounded to show more clearly the supposed structure.

The *Brachypepli proper* may be divided into those

A. With the lobes of the ligula rounded—South American and Caffrarian species.

B. Those with them not rounded (elongate, concave, &c.)—Asiatic species.

Which last, again, may be divided

α. Into those with a transverse quadrangular scutellum—Bornean and Malayan species,

β. And those with a transverse but not quadrangular scutellum—East Indian species.

(Subgenus ONICOTIS (ὀνικὸς and ὠτὶς, eared like an ass).)

Corpus sat convexum, fere glabrum, lateribus fortiter ciliatis. Antennæ articulo basali valde dilatato. Mandibulæ latæ, compressæ, dilatatæ, dente subito exserto. Ligula lobis curtis circumplicatis. Abdomen segmentis 1mo et 2do brevibus.

Body somewhat convex, oval, almost glabrous, with a dense stiff fringe of hairs all round the sides both of thorax, elytra, and abdomen. Antennæ with the basal article very largely developed, as in *Amphotis*, but to a greater extent (Pl. XXXIV. fig. 10 *a*), and fitting into a vacant space in front of the eye, so that the profile of the head when the antennæ are retracted is continuous; the remaining articles as in the other species of *Brachypeplus*. Labrum transverse, with a notch on each side of the middle. Mandibles broad, flat, with a short sharp tooth, slightly serrated behind, projecting abruptly from the broad margin (Pl. XXXIV. fig. 10 *g*). Maxillæ and maxillary palpi as in other *Brachypepli*. Ligula with short membranous lobes, which are apparently folded upon its front and back (Pl. XXXIV. fig. 10 *e*). Mentum broad, bi-emarginate. Labial palpi with the second article longest, and third subconical. Eyes triangular above, rounded beneath, and margined above by a narrow segment of the head separated from the rest by a deep groove, so as to look like an eyelid; the basal article of the antennæ, lying in front of the eye when at rest, protects it. Thorax narrowest in front. Scutellum triangular, its apical angle rounded. Elytra costate. Abdomen as broad as the elytra, with the pygidium rounded; all the segments margined, the first and second considerably shorter than the rest; fimbriæ simple and parallel, small on the pygidium.

1. BRACHYPEPLUS AURITUS. (Plate XXXIV. fig. 10.)

Elliptico-ovalis, convexus, nitidus, ferrugineo-piceus, elytris nigris; capite et thorace partim fortiter punctatis, partim lævibus; elytris crenato-striatis; abdomine leviter punctato. Long. $2\frac{2}{3}$ lin., lat. $1\frac{1}{6}$ lin.

Habitat in Australia in nidis apum.

Elliptic-oval, convex, shining, ferrugineo-piceous, with the elytra black. Texture above rather hard, below flexible and elastic. Head with two large foveæ on the inner side of each eye, leaving a prominent smooth nasal ridge in the middle; a few punctures behind. Thorax convex, smooth, with a few punctures, chiefly in patches, which are for the most part in foveæ or depressions; the punctures made as if from behind forwards; there is a double ovate fovea on each side of the middle in front, another on each side behind, more apart, and another, less deep depression along the margin backwards from the anterior angle; slightly emarginate and bisinuate in front, sides sloping forwards and rounded-in in front; anterior angles obtuse, posterior projecting a little backwards. Scutellum transverse, triangular, with the apical angle rounded, depressed at the base, which gives it the appearance of being pentangular. Elytra deeply crenate-striate, the punctures in the striæ close and transverse, the striæ reaching neither to the base nor the apex; the stria next the suture deeper than the rest and wider at the base than at the apex, arising from two striæ being there united; the striæ become effaced at the sides; at the shoulder they are shortened; there are only six of the full size: the sides are deeply declinate, the margins expanded, and there is a deep longitudinal hollow along the margin near the base; along the apex the elytra become depressed for a short narrow space, so that they fit closely to the surface of the abdomen; the apex is truncate, nearly straight; the sutural apical angles right angles, the exterior apical angles obtuse and somewhat rounded. Abdomen with the segments margined with a double line; fimbriæ not broad, simple, and subparallel with the sides—except on the pygidium, where they are short, broad at the base, and soon disappear; each segment with stigmatic depressions on either side; very finely punctate in the centre, coarsely and irregularly on each side. Underside of the insect hollowed (when turned up, it is like a decked boat with bulwarks all round); shining, finely punctate, and slightly pubescent; densely ciliated all round with stiff, curved ferruginous setæ.

From New South Wales (Sydney district).

I first received a single specimen of this species from Mr. Sharp MacLeay, and was puzzled by its unusual form and structure, which seemed to indicate a peculiar habit of life. Some light has lately been thrown upon this, however, by Mr. Frederick Smith of the British Museum, who has received a number, both of the larva and perfect insect, alive, in the nest of a wild bee sent from Australia, and which were devouring the substance of the nest. Its peculiar form and structure are suggestive of arrangements for defence analogous to those of the limpet and other animals which occasionally have to stand a siege. Its texture is too hard for the army among which it has intruded itself to penetrate with their weapons. When placed on a level surface, its margins are closely applied to the ground all round. The upper surface is an elliptical dome, and the segments and joints are guarded with peculiar care—the unguarded chinks which exist about the eyes in other species being in this one defended by a special gate in the shape of the first article of the antennæ, the beauty and exactitude of whose fitting require to be seen to be appreciated. The elytra are depressed at the apex, so that they may lie close to and continuous with the abdomen; and the hollow underside and ciliated or fringed margins seem to be adaptations for the purpose of enabling it to retain its place against efforts to remove it. The fringe of strong, stiff hairs, extending all along the sides of the thorax, elytra, and abdomen, has in all probability something to do with this. It might almost be thought that this hollow underside, with its enclosing margins, indicates some pneumatic arrangement for holding on like a limpet. It is easy enough to conceive how this might be done: the stigmata, being on the upper side of the abdomen, give the means of swelling out the body below, so as to leave scarcely any hollow, as it is soft and flexible; then, on the air being expelled, the belly would be drawn in and a vacuum left below, which should have the desired effect.

(Subgenus TASMUS*.)

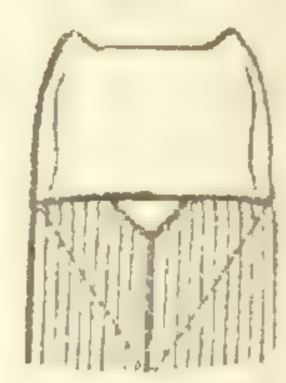
Corpus depressum, elongatum, pubescens. Thorax marginibus ciliatis. Mandibulæ leviter bidentatæ. Ligula lobis curtis circumplicatis. Abdomen segmentis 1mo et 2do brevibus.

Body depressed, elongate, pubescent. Eyes small, reaching the base of the head. Mandibles feebly bidentate at the apex. Labrum short and transverse. Ligula short, with membranous lobes, very little projecting, apparently folded round and united to the ligula on the front and back. Labial palpi with the last article longest, straight on the inner side, conico-rounded on the outer. Thorax fringed with hairs at the margins. Abdomen as broad as the elytra, not gradually attenuated, the first and second segments considerably shorter than the rest; fimbriæ distinct, subparallel except on the pygidium.

2. BRACHYPEPLUS BASALIS.

Erichs. in Wiegm. Arch. f. Naturg. Jahrg. viii. Bd. 1. 149. 54 (1842).

Fig. 47.



Parallelus, vix nitidus, niger, antennis, tibiis tarsisque rufis; elytris subtiliter striatis, macula magna basali subtriangulari testaceo-rufa. Long. $1\frac{2}{3}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Tasmania.

Parallel, very slightly shining, black. Antennæ rufous. Head closely punctate, in front slightly bifoveolate, very slightly nigro-pubescent, with the mouth rufous and palpi testaceous. Thorax a little shorter than broad, slightly narrowed in front, with the sides a little rounded, the posterior angles somewhat acute, densely but lightly punctate, slightly nigro-pubescent, the sides griseo-pubescent, the lateral margin reflexed; rufo-piceous, densely fringed with short hairs. Scutellum large, transverse, densely punctate. Elytra rather more than a half longer than the thorax, faintly striate, with the interstices punctulated, nigro-pubescent, with a large basal subtriangular testaceo-rufous patch clothed with longer pubescence of the same colour, less marked near the suture. Abdomen faintly and densely punctate, slenderly nigro-pubescent, with the antepenultimate segment luteo-pubescent on the back; fimbriæ, except on the pygidium, widest behind; under side of abdomen slightly griseo-pubescent. Legs piceous, with the tibiæ and tarsi rufous.

From Van Diemen's Land.

3. BRACHYPEPLUS BINOTATUS. (Pl. XXXIV. fig. 5.)

Fig. 48.

Affinis *B. basali*: angustus, nitidus, niger; antennis basi rufa, clava nigra; elytris macula basali aurantiaca transversa, ad suturam interrupta; abdomine piceo, segmentorum marginibus rufescentibus. Long. $1\frac{2}{3}$–2 lin., lat. $\frac{1}{2}$–$\frac{3}{5}$ lin.

Habitat in Victoria in Australia.

Allied to *B. basalis*. Narrow, black, shining. Antennæ rufous, with the club dark. Head finely punctate, bifoveolate in front. Thorax much punctate, narrowest in front, but with the sides nearly parallel, and slightly rufescent and translucent towards the

* Derivative from Tasmania, the habitat of the species which was first described.

posterior angles, fringed with hairs. Scutellum moderate, punctate. Elytra nearly twice as long as the thorax, striate, with the interstices bearing fine, delicate, distinct punctures; the basal half marked with a broad deep-orange-coloured band, interrupted at the suture by a space as broad as the scutellum, clothed with pubescence of the colour of the part on which it is found. Abdomen piceous, paler in the middle, and with the margins rufescent, finely punctate; fimbriæ, except on the pygidium, widest behind. Legs testaceous.

From Victoria. More common in collections than *B. basalis.*

4. Brachypeplus blandus.

Fig. 49.

Affinis *B. binotato*: oblongo-ovatus, latior, magis pubescens; antennis rufis, clava fusca; prothorace lateribus parum sinuatis, expansis et rufescentibus; elytris thorace parum latioribus, macula basali aurantiaca ad suturam interrupta; abdomine supra segmento antepenultimo aurantiaco, penultimo medio piceo-rufo, lateribus piceis; pygidio piceo, subtus piceo-ferrugineo. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in Victoria in Australia.

Very closely allied to *B. binotatus.* Oblong-ovate, broad, very pubescent. Antennæ rufous, with the club dusky. Head finely punctate and bifoveolate in front. Thorax broader, more expanded than in *B. binotatus*, thickly clothed with long black pubescence, and with the sides more rufescent and densely fringed with short hairs. Scutellum moderate. Elytra costate, the striæ between the costæ comparatively coarsely and transversely punctate, black, with a broad orange-coloured band stretching across the basal half, interrupted at the suture. Abdomen piceous above, piceo-ferruginous below, very pubescent, above with the first exposed segment orange-coloured, the second exposed segment piceo-rufous in the middle; pygidium piceous black; fimbriæ, except on the pygidium, widest behind. Legs rufo-testaceous. The pubescence throughout is long and plentiful, and of the colour of the surface below it.

From South Australia, between Melbourne and the gold-diggings.

The three species, *B. basalis*, *B. binotatus*, and *B. blandus*, are very like each other, and are confounded in most collections. The following distinctions will enable them to be easily recognized and separated:—*B. blandus* is broader than either of the other two. The club of the antennæ is red in *B. basalis*, black or dusky in *B. binotatus* and *B. blandus*. The basal patch on the elytra in *B. basalis* is dull and testaceo-rufous; in the others it is deep orange, enlivened by the silky sheen of a lighter orange-coloured pubescence: in *B. basalis* it is a large, single, triangular patch around the scutellum; in the others it is separated into two nearly square patches by a space at the suture as broad as the scutellum. In *B. basalis* the elytra are a very little larger and wider behind. In *B. basalis* and *B. binotatus* they are not costate but merely striate, and the flat interstices are regularly and finely punctate, the punctures small, round, and separate from each other. In *B. blandus* it is the striæ which are punctured, and their width and depth are increased, so that the interstices stand up as narrow impunctate costæ, and the punctures are coarse, transverse, and rugose. The abdomen above is black, or nigro-piceous, with testaceous pubescence on the penultimate segment, in *B. basalis*; in *B. binotatus* the margins of the segments in all, and frequently the segments themselves, are slightly rufescent, especially the middle of the penultimate segment; and in *B. blandus* the abdomen is ferrugineo-piceous, with the whole of the antepenultimate segment orange-coloured and the middle of the penultimate segment rufous.

5. Brachypeplus MacLeayii.

Fig. 50.

Oblongus, modice latus, subparallelus, postice paululum latior, leviter crebre punctatus, subtiliter pubescens, lateribus dense testaceo ciliatis, elytris levissime striatis; piceo-niger, ore, thoracis lateribus, elytris versus basin pedibusque piceo-rufis; subtus ferrugineo-piceus. Long. $2\frac{1}{3}$ lin., lat. $\frac{5}{6}$ lin.

Habitat in Australia.

Oblong, subparallel, moderately broad, a little broadest behind, very finely and very thickly punctate (the punctures minute points), finely and shortly pubescent, the pubescence of the colour of the parts where it is present; nigro-piceous, with the mouth, antennæ, sides of the thorax, the basal margin of the elytra, and the legs piceo-rufous; sides densely ciliated. Head bifoveolate in front. Thorax broader than long, but not so transverse as in most of the other species, apex emarginate, anterior angles slightly projecting and rounded; sides narrowest in front, gently rounded, widest in the middle, margined, expanded within the margin, more especially towards the posterior angles, which are nearly right angles but somewhat acute and looking slightly backwards; the base slightly bisinuate: the fringe of hairs along the sides well developed, stiff, testaceous. Scutellum rounded. Elytra nigro-piceous, slightly rufous at the very base, not broader than the thorax, most faintly striate, the striæ not punctate themselves, but in certain lights having the appearance of being punctate from the general fine semirugose punctuation of the surface of the elytra; there is a longitudinal depression on each side of the suture immediately behind the scutellum; sides sharply declinate, more particularly in front, strongly margined, and densely fringed with testaceous hairs; apex truncate, nearly straight; external apical angles rounded, sutural apical angles right angles. Abdomen above somewhat convex in the middle; fimbriæ as broad behind as before, curved, united by a narrow dorsal ring concealed from view by the preceding segments; under side ferrugineo-piceous. Legs rufous.

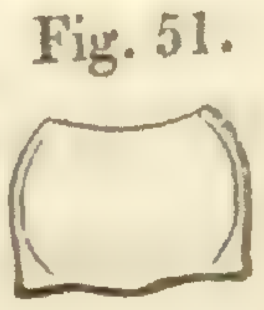
The fringe of hairs along the sides is stronger and longer in this species than in *B. basalis* and *B. planus*, but not so much so as in *B. auritus*.

From Australia (Sydney), &c. I have received a single specimen from Mr. Sharp MacLeay.

6. Brachypeplus planus.

Erichs. in Wiegm. Arch. f. Naturg. Jahrg. viii. Bd. 1. 149. 53 (1842).

Fig. 51.



Elongato-oblongus, niger, opacus, antennis pedibusque rufo-piceis; scutello semicirculari; elytris subtiliter striatis. Long. $2\frac{1}{2}$–3 lin., lat. $\frac{7}{8}$ lin.

Habitat in Tasmania.

Oblong, depressed, black, opaque. Antennæ rufo-piceous. Head thickly punctate, very slightly nigro-pubescent, in front obsoletely bifoveolate, the mouth piceous. Thorax a little shorter than broad, very little narrowed in front, thickly punctate, faintly nigro-pubescent, flat, with the margin reflexed, densely fringed with short hairs; sides lightly rounded, posterior angles right angles. Scutellum (fig. 52) large, subpentagonal, punctulate, nigro-pubescent. Elytra flat and smooth, a half longer than the thorax, truncate, depressed, lightly striate, with the interstices obsoletely rugulosely punctate in rows. Abdomen above thickly and lightly punctate, with the antepenultimate segment entirely and the penultimate at the base fulvo-pubescent; fimbriæ, except on the pygidium, widest behind. Metathorax and ventral segments of abdomen griseo-pubescent. Legs piceous; tarsi fulvous.

Fig. 52.

From Van Diemen's Land. Not common.

7. Brachypeplus castaneipes.

B. plano valde affinis; minor, angustior, prothoracis lateribus paulo rectioribus, antice minus rotundatis; antennis pedibusque castaneis vel ferrugineo-piceis. Long. $2\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Australia.

This is the South-Australian representative of the Tasmanian species, *B. planus*. It is a good deal smaller, and apparently narrower, although, perhaps, the proportions are the same. In every detail it tallies very closely with that species, except, perhaps, that the sides of the thorax are straighter and less rounded-in in front. The inflexed margins of the elytra and the under side of the thorax are ferrugineo-piceous, and the antennæ and legs are still lighter, instead of being dark piceous as in *B. planus*; but this variation of colour is a character of small value.

This will be regarded as a species or a variety according to the predisposition of the reader.

From Melbourne.

(Subgenus Brachypeplus proper.)

Corpus elongatum, plus minusve depressum et pubescens. Thorax marginibus haud ciliatis. Ligula lobis sat prominentibus. Abdomen segmentis 1mo et 2do brevioribus, pygidio inter fimbrias basi longitudine latiore.

Body more or less depressed, elongate, usually pubescent. Mandibles either without a tooth behind the point, or with a very small one almost effaced. Labrum transverse, with the margin feebly bi-emarginate. Ligula short, with the membranous lobes rather prominent. Thorax with the sides not fringed with hairs. Scutellum transverse, rounded at the apex, pentagonal or quadrangular. Abdomen with the first two segments considerably shorter than the rest; not rapidly attenuated behind; the breadth of the pygidium between the fimbriæ at the base greater than its length.

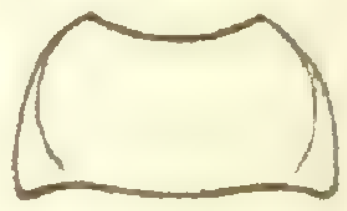
The non-ciliation of the margins serves to distinguish this subgenus from the subgenera *Onicotis* and *Tasmus*, the moderate attenuation of the apex of the abdomen from the subgenus *Selis*, its pubescence from *Leiopeplus*, and its short first two segments from *Liparopeplus* and *Adocima*.

SECTION I. Ligula with the membranous lobes rounded.

8. BRACHYPEPLUS DEPRESSUS.

Erichs. in Germ. Zeitschr. iv. 247 (1843).

Fig. 53.



Niger, depressus, subopacus, tibiis tarsisque ferrugineis; prothorace lateribus haud sinuatis, postea reflexis; elytris striatis, interstitiis seriatim punctatis. Long. 2 lin., lat. $\frac{2}{3}$ lin.

Var. Elytris interdum puncto humerali obsoletissime testaceo.

Habitat in Caffraria.

Depressed, somewhat opaque, black, faintly nigro-pubescent. Antennæ ferruginous, with the club piceous. Head faintly punctulate, lightly bifoveolate in front; mouth piceous. Thorax as broad as the elytra, rather faintly rugulosely punctate, shorter by a half than its breadth, narrowed in front; apex emarginate; anterior angles obtusely rounded; sides reflexed narrowly in front, more widely towards the posterior angles, which are nearly right angles and slightly looking back; base bisinuate. Scutellum transverse, griseo-pubescent. Elytra a little longer than the thorax, subcostate, punctate-striate, the interstices punctate in rows, subrugulose, irregularly depressed; a depression beside the scutellum, one within the shoulder, an oblique large slope behind the shoulder, sometimes with a testaceous spot on the shoulder, griseo-pubescent at the base; apex broadly rounded at the exterior angles; sutural apical angle a right angle. Abdomen thickly and lightly punctate; fimbriæ broad, with the inner margin curved, depressed, of nearly equal breadth behind and before, except on the pygidium. Body below faintly griseo-pubescent. Legs piceous, the tibiæ and tarsi ferruginous.

From the Cape of Good Hope, Natal, and other parts of South Africa.

9. BRACHYPEPLUS DEYROLLEI.

B. depresso valde affinis; paulo minor, prothorace minus transverso, lateribus postice rectioribus; niger, elytris ad basin piceo-nigris et ad suturam paulo ferrugineo-piceis, minus fortiter costatis et punctatis. Long. $1\frac{1}{2}$ lin.

Habitat in Guinea.

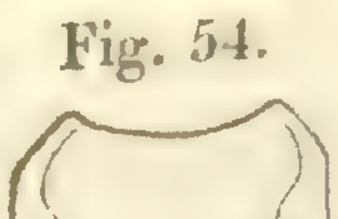
Nearly allied to *B. depressus*; rather smaller; the thorax not so transverse, and with its sides more parallel posteriorly. Black. Elytra nigro-piceous at the base and somewhat ferrugineo-piceous at the suture; not so deeply punctate nor so much costate as in *B. depressus.*

From the coast of Guinea. I have seen only a single example, which is in the collection of M. Deyrolle at Paris.

10. BRACHYPEPLUS CAFFER.

Boheman, Ins. Caffr. i. 561 (1848).

Fig. 54.



Oblongus, depressus, piceus, subnitidus, tenuiter cinereo pubescens; labro, antennis (clava excepta), tibiis tarsisque rufo-piceis; prothorace confertim punctulato; elytris seriatim parum profunde punctatis, interstitiis leviter carinatis. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in regione fluminis Limpoponis in Africa australi.

Oblong, depressed, piceous, somewhat shining, and feebly cinereo-pubescent. Head shorter than broad, nigro-piceous, faintly and thickly punctate, with the labrum and palpi rufo-ferruginous. Antennæ short, rufo-piceous, sparingly pubescent, with the club rounded and fuscous. Thorax a half shorter than its breadth, nigro-piceous, feebly griseo-pubescent, somewhat shining, above somewhat convex, faintly variolosely punctate, the punctures very shallow large pits, from the centre of which the hairs spring; in front lightly emarginate; anterior angles subobtuse; sides from the apex to the base with the margins rather broadly reflexed, obscurely ferruginous, straight except towards the apex, with the posterior angles right angles and not pointing backwards. Scutellum short, broad, nigro-piceous, faintly and closely punctate, slightly pubescent, with the apex sub-truncate. Elytra scarcely a half longer than the thorax, and not broader than its base, nigro-piceous, somewhat convex, variolosely punctate (not very deeply) in rows in the same way as the thorax, the interstices narrow, slightly keeled; the sides reflexed and margined, straight; truncate at the apex, with the exterior apical angles rounded; the shoulders almost rectangular, not prominent. Abdomen above punctate and rather thickly pubescent; the fimbriæ well marked, widest behind, except on the pygidium, and with a tubercle in the anterior corner, close to the stigmatic depression, which is very deep. Underside nigro-piceous, faintly and closely punctate. Legs obsoletely punctulated, sparingly pubescent; thighs piceous; tibiæ and tarsi rufo-piceous.

Nearly allied to *B. depressus*. The peculiar variolose punctuation of this insect serves to distinguish it from that species, as well as from any others which are likely to be confounded with it.

From the neighbourhood of the river Limpopo, in South-east Africa.

11. Brachypeplus parallelus.

Fig. 55.

Elongatus; angustus, niger, subopacus, fortiter punctatus; prothorace elongato, lateribus fortiter reflexis, subparallelis, postice sinuatis; elytris fortiter punctato-striatis; antennis pedibusque ferrugineo-piceis. Long. $2\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Natalia.

Narrower and more elongate than *B. depressus*. Antennæ ferrugineo-piceous. Head finely but very thickly rugosely punctate, with two flat depressions in front. Thorax somewhat narrower than the elytra, deeply, distinctly, and thickly punctate, somewhat longitudinally convex; oblong, with the sides somewhat sinuate and the margins rather deeply reflexed; anterior angles declinate, obtusely rounded; apex emarginate, emargination bisinuate; posterior angles nearly right angles; base bisinuate. Elytra about a half longer than the thorax, deeply punctate-striate, oblong and parallel, without the depressions on the surface which occur in *B. depressus*, truncate at the apex, with the exterior angles rounded. Abdomen finely punctate and pubescent; fimbriæ with the inner margin slightly curved; the stigmatic depression is not so marked as in *B. Caffer*, and the tubercle within it is absent, or nearly so. Legs ferrugineo-piceous.

From Natal.

12. Brachypeplus pilosellus.

Fig. 56.

Oblongus, parallelus, depressus, leviter punctatus, parce breviterque pubescens; piceo-brunneus, prothoracis lateribus, sutura abdomineque dilutioribus; pedibus testaceis; elytris subcostatis, interstitiis punctatis. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Sierra Leone.

Oblong, parallel, depressed, slightly punctate; under the microscope it is seen to be sparingly sprinkled with short, stiff testaceous hairs; piceo-brunneous, paler on the sides of the thorax, and with the elytra ferrugineo-piceous. Head slightly punctate; mouth testaceous. Antennæ ferruginous. Thorax slightly punctate, most so on the sides and posterior angles, and with short, rather stiff hairs standing in all directions; transverse, broader than long, narrower in front, and with the apex scarcely emarginate; sides gently rounded, margined, and reflexed (most widely behind and in front); anterior angles obtuse and slightly rounded at the points; posterior angles nearly right angles; base truncate, slightly bisinuate, and faintly margined. Scutellum transverse, nearly quadrate, punctate. Elytra subcostate, the interstices feebly rugosely punctate-striate, most so towards the base, the costæ bearing short hairs; the sides declinate, slightly rounded, widest a little behind the middle, margined; the suture and a narrow basal line paler; apex truncate, almost straight, with the sutural and exterior angles rounded. Abdomen very faintly punctate and faintly pubescent; fimbriæ broad, flat, expanded, and well marked, subparallel except on the pygidium, but rather widest behind. Underside faintly punctate and pubescent. Legs testaceous.

This species is interesting from its affinity to *B. anceps*, the commonest species on the opposite coast of South America. It is like it, but smaller, darker, and sparsely clothed with stiff hairs; the thorax less parallel, more rounded, and more strongly margined; the scutellum more transverse; the sides of the elytra not so parallel, widened behind the middle; and the fimbriæ of the abdomen wider, flatter, and more prominent.

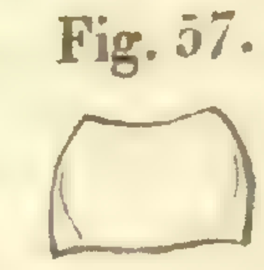
From Sierra Leone and Portuguese Senegal. I am indebted for this species to Mr. Pascoe, who has had the kindness to give it up to me, although unique in his collection. I have placed it in the British Museum.

13. Brachypeplus mutilatus.

Erichs. in Germ. Zeitschr. iv. 246 (1843).

Ips Brasiliensis (Faldermann, Dej. Cat. 134, ed. 1837).

Fig. 57.



Oblongus, subdepressus, niger, subopacus, pube fulvo-grisea depressa sparsim vestitus, ore pedibusque ferrugineis; prothorace ante medium cito angustiore; scutello transverso; elytris thorace sesquilongioribus, striatis, interstitiis seriatim punctatis, basi suturaque testaceis. Long. 2 lin., lat. $\frac{5}{8}$ lin.

Habitat in insulis Indicis occidentalibus.

Oblong, subdepressed, black, slightly shining, sparingly clothed with a slight, depressed, fulvo-griseous pubescence. Antennæ ferruginous, with the club piceous. Mouth ferruginous. Head faintly and sparsely punctured, obsoletely bifoveolate in front. Thorax rather shorter than broad, slightly narrowed in front, with the sides somewhat rounded, thickly punctured, with the lateral margin reflexed; piceous; paler on the sides. Scutellum transverse, with the apex rounded, punctulate. Elytra a half longer than the thorax, faintly striate, with the interstices punctate in rows, subrugulose, with the base and suture obsoletely testaceous. Abdomen thickly and faintly punctate, somewhat shining; fimbriæ with the inner margin much curved, wide behind except on the pygidium. Legs ferruginous; thighs picescent.

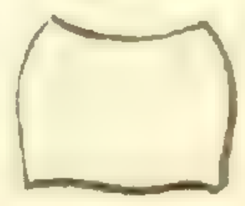
From St. Thomas's and other West Indian islands; also from the neighbouring coast of Guiana, &c.

14. Brachypeplus anceps.

B. diluticollis (Motsch.).

Oblongus, depressus, testaceo-fuscus, capite et elytris obscurioribus, subopacus, fusco pubescens, subtiliter ruguloso-punctatus; elytris leviter costatis, interstitiis subgeminato-punctatis; pedibus testaceis. Long. $2\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Fig. 58.



Habitat in Brasilia, Guiana, Columbia, &c.

Oblong, more than twice as long as broad, depressed, testaceo-fuscous, darkest on head and elytra, rather opaque, finely rugulosely punctate, fusco-pubescent. Antennæ testaceous; club fuscous, except the last article, which is testaceous. Head with two foveæ in front; mouth paler. Thorax with margins paler than disk, truncate at the base, somewhat quadrate but shorter than broad, margined; sides nearly parallel, not much rounded in front; anterior angles obtuse and somewhat rounded, posterior almost right angles, very slightly turned back. Scutellum not very large, rugosely punctate, transverse, subquadrangular. Elytra longer than thorax, each with eight or nine very narrow raised lines running longitudinally, the interstices subrugulosely punctate in double rows. Exposed dorsal portion of abdomen about as long as the elytra; the segments rather long, slightly shining, finely punctate, and faintly pubescent; fimbriæ nearly parallel, very little wider behind than in front. Legs testaceous.

From Trinidad, Guiana, Brazil, Columbia, the Amazons, &c.

15. Brachypeplus prolixus (Mus. Berol.).

Elongatus, angustus, subparallelus, longus, depressus, opacus, textura molli, crebre levissime punctatus, pubescens, nigro-fuscus, ore, antennarum basi, prothoracis lateribus pedibusque ferrugineo-piceis; thorace subquadrato; elytris costatis, interstitiis crebre leviter punctatis. Long. $2\frac{1}{3}$–$2\frac{2}{3}$ lin., lat. $\frac{2}{3}$ lin.

Fig. 59.

Habitat in Caraccas.

Elongate, narrow, long, depressed, subparallel, opaque, closely and very finely punctate, and pubescent, of rather soft texture, blackish brown. The head with two large foveæ in front; the mouth and base of antennæ ferrugineo-piceous. Thorax subquadrate, not emarginate in front, margined in front except in the middle; the sides ferrugineo-piceous, very slightly rounded and margined but scarcely expanded; the anterior angles declinate and slightly rounded, the posterior angles somewhat explanate, reflexed, obtuse, and slightly rounded; the base slightly bisinuate, margined. Scutellum transverse, subquadrangular, punctate. Elytra a half longer than the thorax, costate; the interstices closely and lightly punctate, with the sides slightly declinate, margined, and very slightly sinuate, the exterior apical angles rounded, the sutural angles almost right angles. Abdomen smooth, very thickly and lightly punctate; fimbriæ nearly parallel, except on the pygidium. Legs ferrugineo-piceous.

From Caraccas. Collected by M. Sallé.

16. Brachypeplus tenuis.

Fig. 60.

Parvus, elongatus, oblongus, parallelus, niger, obscurus, pubescens, subtiliter punctatus; elytris subcostatis. Long. $1\frac{1}{3}$ lin., lat. $\frac{1}{3}$ lin.

Habitat apud Lagoa Santa in Brasilia.

Small, elongate, slender, oblong, parallel, dull, black or nigro-piceous, pubescent, faintly punctate; under a powerful glass the punctures on the thorax are seen to be shallow variolose pits. Head bi-impressed in front. Antennæ with the base ferrugineo-piceous and the club fuscous. Thorax a fourth broader than long, anterior angles rounded, the sides straight, posterior angles nearly right angles, a little pointed backwards, the base bisinuate. Scutellum transverse, subquadrangular, punctate and pubescent. Elytra punctate-striate, with the pubescence disposed in lines, giving them a subcostate appearance; about twice the length of the thorax; apex of each elytron very slightly rounded, exterior apical angles rounded. Abdomen about as broad as the elytra; fimbriæ not very broad, the inner margin curved, widest behind except on the pygidium. Underside, with the middle of the last segment and the margin of the preceding, ferrugineo-piceous. Legs dull ferrugineo-piceous, pubescent.

This is the smallest species I have met with.

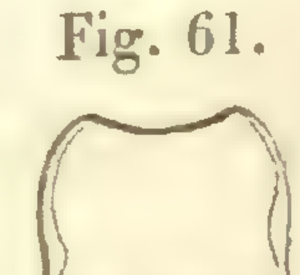
Described from a unique specimen found by M. Reinhardt, under the bark of dead trees, near Lagoa Santa in Brazil, and now in the Museum of Copenhagen.

Section II. Ligula with the membranous lobes prominent, but not rounded, on both sides.

* Body not very broad. Scutellum rounded or transversely pentagonal.

17. Brachypeplus orientalis.

Fig. 61.



Oblongus, subdepressus, leviter fulvo pubescens, subopacus, fusco-piceus, ore, antennarum basi, prothoracis lateribus, elytris pedibusque ferrugineo-testaceis; elytris costatis, interstitiis striato-punctatis. Long. $1\frac{1}{2}$ lin., lat. $\frac{1}{2}$ lin.

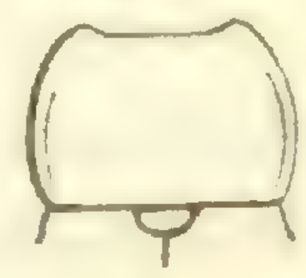
Habitat in Borneo.

Oblong, subdepressed, fusco-piceous, fulvo-pubescent, subopaque, with the mouth, the base of the antennæ, the sides of the thorax, the elytra, and the legs ferrugineo-testaceous. Head longitudinally bifoveolate in front, the epistome raised prominently between the foveæ. Thorax short, transverse, flat, lightly rugosely punctate, somewhat narrower and rounded in front, with the sides margined and slightly explanate; anterior angles rounded, posterior somewhat acute, a little pointed backwards, the base bisinuate and margined except in the middle. Scutellum broad, transverse, semicircular. Elytra longer than the thorax, costate, with stiff testaceous hairs running along the costæ, the interstices transversely punctate-striate, the interstice next the suture depressed and more closely punctate; the sides parallel, somewhat declinate, and margined; the external apical angles broadly rounded, the sutural angles less so. Abdomen fuscous, slightly convex in the middle, very faintly punctate, the pubescence springing from the punctures (the punctuation not observable except with a powerful glass); fimbriæ nearly parallel. Legs testaceous.

Found by Mr. Wallace in the fruit of the Durian (*Durio zibethinus*), at Sarawak in Borneo.

18. Brachypeplus patruelis.

Fig. 62.



Valde affinis *B. orientali*; minus latus, paulo minus depressus, prothorace lateribus æqualiter levissime rotundato, basi fere recte truncato. Long. $1\frac{1}{2}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in India orientali.

So close to *B. orientalis* that it is with much hesitation I separate it. It is not so broad nor so depressed, more punctate, and the sides of the thorax are more equally rounded. In *B. orientalis* there is a slight tendency to sinuation near the posterior angles, which is absent in this species. *B. orientalis* has the thorax more depressed than the elytra, and has the base sinuate in front of the scutellum as well as on the sides, which is scarcely the case in this species. This is also lighter in colour, being wholly piceo-testaceous and a little more shining.

From the East Indies.

19. Brachypeplus omalinus. (Plate XXXIV. fig. 7.)

Fig. 63.

Elongatus, oblongus, subdepressus, griseo pubescens, leviter punctatus, piceus, prothorace lateribus dilutioribus, ore, antennis (clava obscura excepta) pedibusque ferrugineo-testaceis; elytris costatis, luride testaceis, lateribus, sutura et apice tenuiter piceis. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Taprobana.

Elongate, oblong, subdepressed, subopaque, lightly punctate and griseo-pubescent, piceous, with the sides of the thorax paler; the mouth, the antennæ (except the club, which is fuscous), and the legs ferrugineo-testaceous; the elytra of a lurid testaceous colour enclosed by a narrow piceous margin. Head lightly bi-impressed in front. Thorax transverse, subconvex, the sides subparallel and slightly narrowed in front, the anterior angles rounded, the posterior obtusely right angles, the apex slightly sinuate, the base bi-emarginate, the sides and part of the base next the sides slightly and narrowly margined. Scutellum transverse, semicircular, punctate. Elytra almost a half longer than the thorax, slightly costate, with a row of transverse punctures in the interstices; the sides margined and sinuate in the middle, the exterior angles rounded. Abdomen moderately convex; fimbriæ with the inner margin straight and oblique, wider behind than in front.

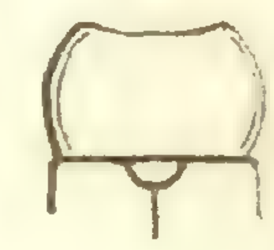
Allied to *B. orientalis*; it is smaller, narrower, and more convex, less pubescent, the sides of the thorax more narrowly margined, and the posterior angles obtusely right angles and somewhat rounded instead of having the right angles sharp and looking a little backwards. The colour of the elytra is lurid testaceous instead of ferrugineo-testaceous.

From Ceylon.

20. Brachypeplus notatus.

B. orientali affinis, sesquiminor, angustior, magis convexus, minus depressus: piceo-brunneus, ore, antennarum basi, prothorace pedibusque ferrugineo-testaceis; elytris plaga magna transversali apicali indeterminata pallide testacea. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Fig. 64.



Habitat in Taprobana.

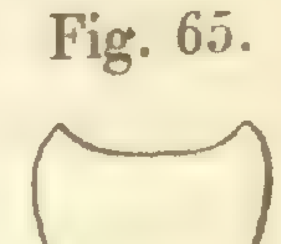
Oblong, somewhat convex, slightly shining, punctate and pubescent, brunneo-piceous, with the mouth, the base of the antennæ, the thorax (more especially the lateral margins), the margins of the segments of the abdomen, and the legs ferrugineo-testaceous. Elytra with a large transversal, rounded, ill-defined pale testaceous patch near the apex, occupying nearly their posterior half. Head faintly punctate, bifoveolate in front. Thorax transverse, widest a little before the middle, broader than long, slightly convex, with the base truncate and nearly straight in front; the anterior angles obtuse and a little rounded, the posterior right angles, sides feebly rounded and margined. Elytra wider than the thorax, faintly costate or lineate, with hairs upon the costæ and with a row of rather large, shallow, irregular punctures on the interstices. Abdomen very faintly punctate; fimbriæ with the inner margin straight, very nearly parallel to the outer side.

From Ceylon. I am indebted for this species to the kindness of Mr. Nietner. I have placed it in the British Museum.

21. Brachypeplus Wallacei.

Elongatus, oblongus, parallelus, depressus, punctatissimus, niger; prothorace antice latiore; elytris subcostatis, interstitiis variolose seriatim punctatis; pedibus ferrugineo-piceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{1}{2}$ lin.

Fig. 65.



Habitat in insula Mysol prope Ceram.

Oblong, elongate, flat, depressed, very thickly punctate, and very slightly pubescent on the sides and on the abdomen. Black, with the mouth, antennæ, and legs ferrugineo-piceous. Head very thickly and finely punctate, bifoveolate in front. Thorax slightly convex on the disk, broadest in front, apex emarginate; sides sloping from behind forwards, margined, and canaliculate at the margins, anterior angles projecting, declinate and rounded, posterior angles right angles and depressed; middle flat, very thickly, equally, and somewhat coarsely punctate; the punctures under a powerful glass are seen to be variolose. Scutellum triangular, very thickly and somewhat coarsely punctate. Elytra subcostate, the interstices with a row of flat, variolose, disk- or horseshoe-shaped punctures, the costæ towards the sides more prominent; sides vertically declinate, a little widest behind the middle; a little wider at the shoulders than the base of the thorax; shoulders not prominent, rounded; apex straight, truncate, sutural apical angles right-angled, exterior apical angles rounded. Abdomen somewhat rugosely punctate and pubescent, the punctures variolose; the segments with a line along the posterior margin; fimbriæ with the inner margin nearly straight, and, on the pygidium, continuing parallel to the outer margin nearly to the apex. Legs ferrugineo-piceous.

From Mysol, an island to the north of Ceram. A unique specimen was found by Mr. Wallace, and is now in the British Museum.

** Body broad. Scutellum quadrangular, or nearly so.

22. BRACHYPEPLUS LATUS.

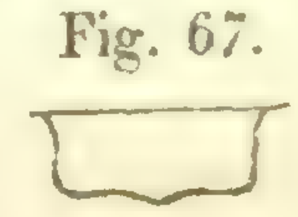
Fig. 66.

Oblongus, latus, depressus, opacus, rugoso-punctatus, niger, cinereo pubescens; prothorace postice bifoveolato; elytris leviter costatis, interstitiis planis, rugoso-punctatis; tarsis testaceo-piceis. Long. 3 lin., lat. $1\frac{2}{5}$ lin.

Habitat in Borneo prope Sarawak.

Oblong, broad, depressed, opaque, rugosely punctate, black, cinereo-pubescent. Head thickly but lightly rugosely punctate, deeply bifoveolate on each side in front; antennæ and mouth piceous; maxillæ testaceous. Thorax slightly shining, more strongly rugosely punctate, with a large, rather deep fovea on each side near the posterior angles, with the sides and base margined, narrower in front than behind, strongly bisinuate at the base, with the posterior angles nearly right-angled, rather sharp, and slightly pointing backwards, the anterior angles obtuse, rounded, and declinate; the sides are very slightly and almost imperceptibly ciliated. Scutellum (fig. 67) transverse, subrectangular. Elytra subquadrate, broader than long, feebly costate; the sutural costa straight, the rest oblique, with a long triangular interstice between the sutural and the second costa; the interstices flat, broad, irregularly rugosely punctate; the shoulders rather large, not very prominent; the sides rather deeply margined, not very much inflexed; the apex truncate and feebly margined, and the external apical angles rounded. Abdomen broad and expanded, the sides rounded; the fimbriæ rather broad, curved, and slightly raised at the inner margin. Underside thickly but less rugosely punctate. Legs rather slender, nigro-piceous; tarsi paler, testaceo-piceous.

Fig. 67.



There is a smaller variety found at Singapore, which differs in no respect, that I can see, except size. It is about $2\frac{2}{3}$ lines in length and 1 line in breadth, instead of being 3 lines by $1\frac{2}{5}$.

It is interesting to find a tendency to the ciliated sides which are characteristic of the Australian *Brachypepli*, in a species inhabiting a country which approaches their locality.

Found under bark by Mr. Wallace at Sarawak and at Singapore.

23. BRACHYPEPLUS LOWEI. (Plate XXXIV. fig. 9.)

Fig. 68.

Oblongus, opacus, rugoso-punctatus, cinereo pubescens, niger, elytris disco rufo, tibiis tarsisque rufis; prothorace lateribus postice expansim foveolatis; elytris costatis, interstitiis striato-punctatis. Long. 3 lin., lat. $1\frac{1}{6}$ lin.

Habitat in Borneo ad Sarawak.

Allied to *B. latus*, but narrower and smaller. Oblong, opaque, rugosely punctate, cinereo-pubescent; black, with the disk of the elytra rufous. Head and thorax as in *B. latus*, with the posterior foveæ of the latter less deep and more expanded, extending to the base and the sides. Elytra with a narrow black margin surrounding the rufous disk on every side; the costæ more marked than in *B. latus*; the interstices punctate-striate, narrower, and not flat. Abdomen with the fimbriæ raised and inner margin curved. Legs with the thighs black; knees, tibiæ, and tarsi rufous. In other respects like *B. latus*.

Found at Sarawak in Borneo, &c. I have named this species after Dr. W. H. Lowe, of Balgreen near Edinburgh, an excellent naturalist and a much-prized friend.

(Subgenus SELIS (σελὶς, a margin).)

Corpus elongatum, pubescens, depressum. Thorax marginibus haud ciliatis. Labrum leviter bilobum vel emarginatum. Ligula lobis subovatis. Abdomen postice cuneatum, pygidio basi latitudine longiore, fimbriis prominentibus.

Body more or less depressed, elongate, pubescent. Thorax with the sides not fringed with hairs. Labrum slightly bilobed or emarginate. Mandibles with the apex narrow and salient, the one bicuspid, the other with five or six small teeth. Ligula with the membranous lobes subovate. Scutellum rounded at the apex. Abdomen rapidly attenuated or wedge-shaped behind, the pygidium being longer than broad; fimbriæ prominent. In other respects nearly as in *Brachypeplus* proper.

This subgenus diverges more from the normal type of the *Brachypepli* than any of the sections into which I have divided them, except *Onicotis* and *Liparopeplus*; and these three might perhaps rank as separate genera of *Brachypeplidæ* instead of merely subgenera.

24. BRACHYPEPLUS CUNEATUS. (Plate XXXVI. fig. 11.)

Elongatus, antice oblongus et parallelus, subopacus, punctatus et parum pubescens; elytris costatis, piceo-brunneis; prothorace et abdomine testaceo-piceis. Long. $2\frac{2}{3}$ lin., lat. 1 lin.

Habitat in insula Batchian.

Elongate, oblong and parallel in front, wedge-shaped behind, punctate, sparingly pubescent, subopaque, brownish piceous. Head dark brown, thickly punctate and slightly pubescent; epistome very short, widened a little in front, and with a slight, narrow, impunctate, almost imperceptibly raised line running longitudinally up the middle of it; the margin over the basal joint of the antennæ rather raised and swollen, with a slight depression behind it. Antennæ pale testaceous, with the club darker, the basal article swollen. Thorax transverse, slightly convex, somewhat flattened on the disk, emarginate in front, narrower in front than behind; sides expanded and with a large reflexed margin, somewhat narrowed towards the base, but so little as to be almost straight for the posterior two-thirds of their length; for the anterior third they are gently rounded and declinate to the anterior angles, which are rounded; posterior angles nearly right-angled; base bisinuate; thickly and rugosely but not deeply punctate, rather closely clothed with brown pubescence, which is directed on each side backwards and inwards to the mesial line; testaceo-piceous, paler and translucent towards the margins. Scutellum rounded, thickly punctate, and pubescent. Elytra scarcely broader and nearly a half longer than the thorax, flat, not so opaque, slightly shining, somewhat depressed towards the suture, costate, and with pubescence running along the costæ; the interstices rather broad and punctate, with transverse impressions; sides nearly parallel, with a deeply canaliculated reflexed margin, apex truncate, exterior apical angles a little rounded; piceous brown, with the shoulders and sides paler. Abdomen slightly shining, the margins raised, and fimbriæ prominent, finely but not closely punctate, slightly pubescent, fuscous, darkest in the middle, and with the sides testaceo-piceous. Underside paler. Legs pale testaceous.

Found by Mr. Wallace in rotten Kanary-fruit in the island of Batchian.

25. Brachypeplus apicalis.

Elongatus, oblongo-ovatus, subopacus, subdepressus, leviter punctatus, testaceo pubescens, læte rufo-testaceus; elytris costatis et striato-punctatis, apice late nigro; abdomine pygidio coarctato, apice subacuto, medio fuscescente et segmento penultimo fusco notato. Long. 2 lin., lat. $\frac{2}{3}$ lin.

Fig. 69.

Habitat in Mysol.

Elongate, oblong-ovate, subopaque and subdepressed, faintly but closely punctate, clothed with testaceous pubescence, clear rufo-testaceous. Head thickly punctate, with a slight transverse depression at the base of the epistome. Thorax transverse, slightly convex, with the sides very little rounded and very slightly expanded, a little narrower in front than behind; apex emarginate; base truncate, straight; anterior angles obtusely rounded, posterior angles nearly right-angled, but slightly obtuse; punctate, the punctures rugose and somewhat variolose, the pubescence rather long, loose, and soft. Scutellum with the apex rounded, slightly punctate and pubescent. Elytra nearly a half longer than the thorax, about the breadth of the thorax, slightly costate and pubescent, the costæ a little bent, being rather nearer the suture in the middle than at either the base or apex, the interstices transversely punctate; sides subparallel, declinate, margined and rather widely canaliculated; humeral angles gently and little rounded; apex truncate, exterior apical angles greatly rounded, sutural angles right-angled; the apex for more than a third and less than a half of the length of the elytra black, the black portion not reaching quite so far forward on the outer margins. Abdomen conical, the pygidium ending in a projecting blade at the apex, the dorsal part extending further than the ventral; the fimbriæ of the penultimate and antepenultimate segments slightly sinuate on the inner side, extending across the anterior margin of the segments, with an elevated papilla or thickened edging (behind which are the stigmata) at about a third from the front: the fimbriæ of the pygidium are sinuate on the inner side and widest in front; there is a longitudinal brown mark on the pygidium, widest behind, and a somewhat square fuscous mark in the middle of the penultimate segment.

Collected by Mr. Wallace in the island of Mysol, north of Ceram.

26. BRACHYPEPLUS CAUDALIS.

B. apicali valde affinis; prothorace paulo magis transverso, minus convexo, lateribus versus angulos posticos magis explanatis; læte flavus, capite saturatiore; elytris totis nigris, basi et regione scutellari exceptis; cæteris ut in *B. apicali*. Long. 1$\frac{3}{5}$ lin., lat. $\frac{2}{3}$ lin.

Fig. 70.

Habitat in insula Batchian.

Very closely allied to *B. apicalis*. It has the thorax less convex and a little shorter and more transverse, the sides towards the posterior angles more explanate, the punctures deeper, and the pubescence less. Clear yellow, with the head a little darker, and the elytra wholly black, except a triangular space from behind the shoulders to the suture, reaching to about the middle of its length; the margin also is pale to the very apex. It is as if the black apex in *B. apicalis* had extended obliquely up towards the shoulder; the transverse punctuation in the interstices of the elytra is deeper than in that species. In other respects it corresponds with it, and is no doubt its representative in Batchian—the different islands of the Malayan Archipelago having often representatives or varieties of the species found in other islands.

Collected by Mr. Wallace in the island of Batchian.

(Subgenus LEIOPEPLUS (λεῖος, smooth; πέπλος, robe).)

Corpus depressum, elongatum, nitidum, haud vel vix pubescens. Thorax marginibus haud ciliatis. Ligula lobis curtis, sat densis. Abdomen postice haud cuneatum.

Body depressed, elongate, scarcely, if at all, pubescent, shining, and of a harder texture than most of the other species. Thorax not ciliated on the sides. Ligula with the lobes expanded somewhat similarly to those of *Carpophilus*, rather thick, and densely ciliated all over the surface. Scutellum transverse, triangular or pentangular (see fig. 73). Abdomen not wedge-shaped behind. Fimbriæ rather broad, sinuate on the pygidium, widest behind on the other segments, with a raised tubercle (behind which the stigmata lie) in the hollow of their curve.

27. BRACHYPEPLUS RUBIDUS. (Plate XXXIV. fig. 6.)

Murray, in Ann. Nat. Hist. iv. 356 (1859).

Elongatus, sat latus, depressus, planus, nitidus, punctatus, læte rufo-ferrugineus, capite elytrorumque apice nigris; elytris rugose punctato-striatis, striis haud apicem et marginem attingentibus, interstitiis leviter, apice et margine dense et rugose punctatis. Long. 3½ lin., lat. 1 lin.

Fig. 71.

Habitat in Calabaria antiqua in Africa occidentali.

Elongate, rather broad, flat, depressed, shining, bright rufo-ferruginous, with the head, the apex of the elytra, and the tip of the pygidium black; punctate; elytra punctate-striate. Head thickly and finely punctate, bi-impressed in front, leaving the epistome like a nasal ridge in the middle, and on the outer side of the impressions another raised space on each side. Mandibles and maxillæ ferruginous. Thorax transverse;

sides rounded and margined, broadly explanate at the posterior angles; apex not margined, emarginate, about as broad in front as behind; widest before the middle, anterior angles somewhat obtuse and rounded, posterior angles sharp, right-angled, scarcely looking backwards; base truncate and bisinuate, the middle projecting slightly like a truncate lobe, a faint longitudinal impression on each of its sides; the disk flat and of a subcordate form, truncate both before and behind; finely punctate, more sparingly on the centre than towards the sides. Scutellum transverse, pentangular, angles (except basal angles) rounded, punctate along the base. Elytra slightly wider behind than in front, rather coarsely punctate-striate, the striæ disappearing towards the sides and apex, the punctuation in the striæ transverse, interstices very finely and sparingly punctate; sides declinate and broadly margined, the black at the apex reaching about halfway up the elytra and gradually disappearing. Abdomen very faintly pubescent, the pygidium finely punctate, the preceding segments only punctate in front; fimbriæ well marked, wider behind than in front, except on the pygidium. Legs rather stout, rufous.

From Old Calabar. Sent by my valued friend the Rev. W. C. Thomson, from whom I have received a multitude of treasures from his missionary station in that country.

There is also a specimen, from Portuguese Senegal, in the Marquis de la Ferté's collection.

28. Brachypeplus niger.

Murray, in Ann. Nat. Hist. iv. 357 (1859).

B. rubido valde affinis; niger, major, et fortius punctatus. Long. 4 lin., lat. $1\frac{1}{8}$ lin.

Habitat in Calabaria antiqua in Africa occidentali.

Closely allied to *B. rubidus*; black, larger, and much more coarsely but still finely punctate; all the characters are somewhat exaggerated, but it does not seem to differ in other respects.

From Old Calabar.

29. Brachypeplus Lafertei.

B. nigro similis: niger, levissime punctatus; prothorace angulis posticis retroaspicientibus; elytris levissime seriatim punctatis, vitta rufa humerali. Long. 3 lin., lat. $1\frac{1}{8}$ lin.

Fig. 72.

Habitat in Senegallia Lusitanica.

Similar in form to *B. rubidus* and *B. niger*. Oblong, parallel, very flat and depressed, shining, very faintly punctate. Black, with a red humeral vitta behind the shoulder reaching halfway down the elytra. Antennæ testaceous, club fuscous. Head sparingly punctate, with a deep impression on each side in front. Thorax differently shaped from that of the above species, narrower in front than behind instead of being nearly equal, and the widest part is behind the middle towards the posterior angles, instead of being before the middle, the sides gently rounded, anterior angles rounded, posterior angles rounded, projecting a little backwards; base trisinuate, one curve in front of the scutellum and one on each side; the sides margined with a narrow explanate portion, wider a little before the posterior angle and with a depression at the base within the posterior angle; the disk flat, and of a semilunate form in front; very finely, almost invisibly, punctate, except on the declinate sides, on which the punctuation is more perceptible. Scutellum (fig. 73) transversely subtriangular, depressed at the apex, nearly impunctate. Elytra flat, sides declinate, straight from the shoulder, slightly rounded and with a strong margin, depressed at the suture, apex gently rounded both at sutural and exterior angles; punctate in rows (eight or nine), becoming occasionally punctate-striate, the interstices with a faint row of punctures irregularly placed. Abdomen scarcely punctate in the middle, more distinctly on the sides; fimbriæ rather broad, with a less marked raised point than in its allies, and a large deep fovea on the dorsal segment near the fimbrial suture; on the ventral side with similar large deep foveæ corresponding to those on the upper side of the abdomen, more punctate (somewhat faintly rugosely) on the underside of the abdomen; prothorax and metathorax shining and impunctate in the middle. Legs piceous.

Fig. 73.

From Portuguese Senegal. In the collection of the Marquis de la Ferté.

(Subgenus LIPAROPEPLUS (λιπαρὸς, obese; πέπλος, robe).)

Corpus convexum, haud pubescens. Thorax marginibus haud ciliatis. Labrum emarginatum. Ligula lobis brevibus. Abdomen convexum, haud postice cuneatum; segmentis omnibus (pygidio excepto) longitudine fere æqualibus.

Body convex, not pubescent. Thorax with the sides not ciliated. Labrum transverse, emarginate. Ligula with the lobes very short and little developed. Scutellum transverse, not quadrate. Abdomen convex, not wedge-shaped behind; all the segments nearly equal in length, except the pygidium, which is longest.

* Much punctate and not very shining.

30. BRACHYPEPLUS CONVEXUS.

Elongatus, angustus, convexus, nitidus, punctatus, parcissime et levissime breviter testaceo pubescens, nigro-piceus; elytris saturatioribus, subcostatis, costis leviter seriatim punctatis, interstitiis fortiter striato-punctatis; pedibus ferrugineis. Long. $1\frac{2}{3}$ lin., lat. $\frac{9}{16}$ lin.

Fig. 74.

Habitat in Bahia.

Elongate, narrow, convex, shining, punctate, with a few scattered short testaceous hairs; nigro-piceous, with the elytra darker. Head thickly and deeply punctate, with a fovea on each side of the epistome, which is marked off behind by a semicircular line. Thorax subquadrate, broader than long, convex, with the sides much declinate, rounded, margined, all the angles rounded, the base margined and slightly bisinuate, strongly and thickly punctate, the punctures pitted, round, shallow, and raised in the middle. Scutellum transverse, pentagonal, the lateral angles rounded. Elytra parallel, rather longer than the thorax, the sides declinate and emarginate, with small but rather prominent shoulders, the apex obliquely truncate and the external apical angles rounded; deeply punctate-striate, the punctures roundish, the interstices with a faint interrupted line or row of light punctures, which are oblong or quadrangular, these interstices appearing as costæ between the striæ. Abdomen above somewhat convex, very faintly punctate (punctures shallow and pitted), the fimbriæ rather raised. Below chestnut-coloured. Legs ferruginous.

From Bahia.

** Smooth and very shining.

31. BRACHYPEPLUS COLASTOIDES.

Convexus, elongatus, subparallelus, oblongo-ovatus, nitidus, subtiliter punctatus; supra capite, prothorace et elytris nigerrimis, cæteris læte rufis, subtus (thoracis lateribus exceptis) læte rufus; elytris subtiliter punctato-striatis, interstitiis subtiliter seriatim punctatis, interdum fere punctato-striatis. Long. 2–$2\frac{1}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Calabaria antiqua in Africa occidentali.

Convex, elongate, subparallel, oblong-ovate, finely and not closely punctate; texture hard and shining. Above with the head, thorax, and elytra intense (almost blue-) black; the abdomen and underside bright rufous, except the sides of the thorax. Head very shining, faintly punctate, the punctures only visible with a strong glass; a deep semi-lunate impression behind the epistome, the convex side in front. Labrum short, broad, transverse, and slightly emarginate, rufous; mouth rufous. Antennæ rufous, except the club, which is fuscous. Thorax convex, broader than long, subquadrate, emarginate in front, widest a little before the middle, most faintly punctate, a little more perceptibly so at the sides, which are rounded, scarcely margined, very narrowly edged; anterior angles rounded, posterior obtusely rounded; base sinuate. Scutellum scarcely punctate, pent-angular, the angles rounded except at the base, with an impression on each side of the apex. Elytra twice as long as the thorax, slightly punctate-striate, with the interstices bearing a still finer row of punctures, which are occasionally united into a punctate stria, the striæ scarcely reaching to the apex; each elytron rounded at the apex; sides declinate, slightly inflexed, and faintly margined. Abdomen rufous, convex, very finely punctate, a little more punctate towards the sides; fimbriæ not wide nor much curved, nearly parallel, depressed at the junction of the segments. Underside rufous, shining, and most faintly and partially punctate. Legs ferrugineo-rufous. The female is a little more parallel in form than the male.

From Old Calabar.

The number of subgenera into which I have divided this genus renders a dichotomous Table of the species of less importance; but, to save the worker as much time as possible, I have added one.

Dichotomous Table of Species of Brachypeplus.

	Abdomen with the first two segments considerably shorter than the rest	1
	Abdomen with the first two segments very little shorter than the rest	29
1	Margins of thorax ciliated	2
	Margins of thorax not ciliated	8

2	Convex, and with the first article of antennæ largely developed	*auritus.*
	Depressed and elongate, with the first article of antennæ only moderately developed .	3
3	Base of elytra broadly marked with rufous	4
	Base of elytra not broadly marked with rufous	6
4	Rufous marking on base of elytra triangular, and extending (although more faintly) over the scutellar region on both elytra	*basalis.*
	Rufous marking on base of elytra transverse, subquadrangular, and interrupted at the suture	5
5	Abdomen piceous, the margins only of the segments rufescent	*binotatus.*
	Abdomen with the antepenultimate segment and middle of penultimate segment rufous	*blandus.*
6	Base of elytra narrowly and indistinctly margined with rufous	*MacLeayii.*
	Elytra wholly black	7
7	Antennæ and legs dark piceous	*planus.*
	Antennæ and legs ferrugineo-piceous	*castaneipes.*
8	Distinctly pubescent	9
	Not at all or very slightly pubescent	27
9	Mandibles with the apex cuspidate. Abdomen rapidly attenuated behind	10
	Mandibles pointed. Abdomen not rapidly attenuated behind	12
10	Elytra piceous brown, with the sides and shoulders paler	*cuneatus.*
	Elytra rufo- or flavo-testaceous, with the apex black	11
11	Apex of elytra transversely black	*apicalis.*
	Apex of elytra obliquely black	*caudalis.*
12	Scutellum with sides starting nearly at right angles from the base	13
	Scutellum with sides more or less sloping inwards from the base	21
13	Body above wholly black	14
	Body above not wholly black	18
14	Punctuation variolose	*Caffer.*
	Punctuation not variolose	15
15	Thorax distinctly narrower in front	*depressus.*
	Thorax scarcely or not narrower in front	16
16	Thorax widest in the middle and equally narrow both before and behind	*prolixus.*
	Thorax widest before the middle	17
17	Very small, only $1\frac{1}{3}$ line in length	*tenuis.*
	Not unusually small, $2\frac{1}{2}$ lines in length	*parallelus.*
18	Thorax lighter in colour than the elytra	*anceps.*
	Thorax not lighter in colour than the elytra	19
19	Thorax black. Elytra slightly paler at base and suture	*Deyrollei.*
	Thorax ferrugineo-piceous	20
20	Elytra paler at the base, and clothed there with lighter pubescence	*mutilatus.*
	Elytra uniform ferrugineo-piceous throughout	*pilosellus.*
21	Body not very broad. Scutellum rounded or transversely pentagonal	22
	Body broad. Scutellum quadrangular or nearly so	26
22	Body above wholly black. Scutellum elongate, triangular	*Wallacei.*
	Body above not wholly black. Scutellum with the apex rounded	23
23	Elytra enclosed with a narrow dark margin	24
	Elytra not enclosed with a dark margin	25

24	Elytra wholly lurid testaceous within the margin	*omalinus.*
	Elytra with only the apical half pale	*notatus.*
25	Thorax a little darker than the elytra	*orientalis.*
	Thorax of same hue as elytra	*patruelis.*
26	Wholly black	*latus.*
	Elytra with the disk red	*Lowei.*
27	Thorax rufous	*rubidus.*
	More or less black	28
28	Wholly black	*niger.*
	Black, with a red patch on the elytra	*Lafertei.*
29	Much punctate and only slightly shining	*convexus.*
	Slightly punctate and very shining	*Colastoides.*

Genus Grammophorus (γραμμὴ, a line; φορὸς bearer: referring to the raised lines on the thorax).

Corpus subdepressum, parum pubescens, sat nitidum. Caput latum, mandibula sinistra apice bifida, dextra acutissima. Antennæ quam in *Brachypeplidis* cæteris longiores, pilosæ, clava oblongo-ovata. Prothorax transverso-quadratus, marginibus lateribus breviter ciliatis, disco lineis elevatis lævibus instructus. Scutellum magnum, acute triquetrum. Elytra segmenti abdominalis tertii basin obtegentia. Abdominis segmenta duo prima abbreviata. Tibiæ anticæ armatæ, posteriores margine externo spinulosæ.

Body subdepressed, slightly pubescent, rather shining. Head broad; mandibles on the left side with the apex bifid, on the right side with the apex very acute. Antennæ longer than in the allied species of *Brachypeplus*, pilose, and with the club oblong-ovate. Prothorax transversely quadrate, with the sides shortly ciliated along the margin, and bearing some smooth raised lines on the disk. Scutellum large, sharply triquetral. Elytra covering the base of the third abdominal segment. Abdomen with the first two segments short. Anterior tibiæ armed; the posterior spinulose on the posterior exterior margin.

I owe the description of this genus and species to my friend Professor Gerstäcker, of the University of Berlin.

Grammophorus cælatus (Mus. Berol.).

Breviusculus, fere parallelus, subdepressus, nitidulus, parce flavescenti-sericeus, rufo-ferrugineus, capite, antennarum basi elytrorumque dimidio apicali piceis; capite prothoraceque fortiter punctatis, hoc lineis quatuor discalibus lævibus instructo; elytris regulariter punctato-striatis, striis subsulcatis, interstitiis uniseriatim punctatis. Long. $1\frac{1}{3}$ lin., lat. vix $\frac{1}{2}$ lin.

Habitat in Columbia.

Rather short, almost parallel, subdepressed, somewhat shining, sparingly clothed with a silky flavescent pubescence, rufo-ferruginous, the head, the base of the antennæ, and the apical half of the elytra piceous. The head rufo-piceous, strongly but sparsely punctate, behind deeply constricted, smooth behind the stricture; the mandibles rufous.

Antennæ rather long, piceous except at the base, beset with stiff flavescent hairs; the club rather large, clothed with a flavescent silky pubescence. Prothorax a half broader than long, slightly narrower in front, with the sides very gently rounded, the anterior angles somewhat obtuse, the posterior almost right-angled; above strongly punctate, with four longitudinal callose raised parallel lines upon the disk, disappearing towards the apex. Scutellum transversely triquetral, with the apex acute, strongly punctate. Elytra a half longer than the thorax, piceous behind, regularly punctate-striate, with the striæ sub-sulcate, and with yellow hairs in the punctures, the interstices feebly punctate in single rows. Abdomen with the last three segments rufo-ferruginous above, very little shining, almost opaque, sparsely and faintly punctate. Body below subcoriaceous, bright ferruginous, with the metasternum obsoletely but thickly punctate on each side. Legs bright ferruginous.

From Columbia, where it was collected by M. Moritz. Unique in the Berlin Museum.

Genus Adocimus (ἀδόκιμος, adulterine).

Caput sulcis antennariis. Labrum integrum. Oculi mediocres, fere capitis basin attingentes. Thorax angulis posticis rotundatis. Elytra striata vel seriatim punctata. Abdomen supra segmentis tribus expositis, segmentis primis duobus brevissimis, reliquis longioribus; maribus? segmentulo anali ventrali auctum; fimbriis lateribus parvis, sed marginibus anticis segmentorum singulorum lata fimbria instructis. Pedes omnes coxis distantibus, intermedii magis distantibus.

Body elongate, oblong, parallel, and depressed. Head moderate; eyes moderate, and reaching nearly, but not quite, to the base of the head. Epistome projecting. Antennæ short, stout, of an elongate club shape; first article rather swollen; second not so large, obovate; third smaller; fourth longer; fifth, sixth, and seventh short and broad; eighth lenticular; ninth long and broad; tenth shorter, but as broad; eleventh rounded; club nearly half the length of the whole antenna. Antennal grooves short, distinct, slightly converging. Labrum simple, scarcely rounded. Mandibles with the outer profile slightly sinuate before the point, the point with two or three minute denticulations on the inner side, and behind these a not very wide fringe of hairs. Maxillæ rather short, flat, and stout, with an abundant brush of hairs at the termination and on the inner side. Maxillary palpi shorter than the maxillæ, the third article largest and much dilated on the outer side, the terminal article cylindrico-conical. Ligula corneous, short and broad, of an inverted pyramid shape, broadest in front, the apex truncate, and apical angles slightly rounded, a tuft of hairs projecting at each. Labial palpi short, the second article dilated on the outside, the terminal short, cylindrico-conical. Mentum biemarginate, the middle truncate, with a slight emargination. Prothorax about the breadth of the elytra, transverse, with the posterior angles broadly rounded; margins thick and rounded-in towards the underside. Scutellum broad, pentagonal. Elytra with the base straight and shoulders square, striate, apex truncate, and exterior apical angles rounded. Abdomen with the second segment shortest, first next shortest, third and fourth nearly equal, and pygidium a little longer. Fimbriæ very small behind, widening in front, and extending in a raised band quite across, both above and below; a deep stigmatic depression lies on each side. The margins of the segments and of the fimbriæ are rounded and thickened.

Legs short and rather stout. Tibiæ with the apex truncate somewhat obliquely outwards, but much less so than in the *Brachypepli*, and the channel for the reception of the tarsi slight. Tarsi short, and last article short. Claws simple.

Position and Affinities.—BRACHYPEPLUS. ADOCIMUS. CILLÆUS.
ORTHOGRAMMA.

ADOCIMUS BELLUS. (Plate XXXVI. fig. 5.)

Elongatus, oblongus, parallelus, depressus, planus, nitidus, glaber, aurantiaco-flavus, elytris nigris. Long. $3\frac{1}{2}$ lin., lat. $\frac{7}{8}$ lin.

Habitat in insula Mysol prope Ceram.

Elongate, oblong, parallel, depressed, flat, shining, glabrous, bright orange-yellow, with the elytra black, except a narrow edging round the scutellum. Head smooth and impunctate. Club of the antennæ fuscous. Thorax transverse, broader than long, very flat, smooth, and impunctate, the sides and posterior angles rounded, the anterior angles apparently rounded, but declinate near the point, and actually right-angled. Scutellum rather broad, impunctate, pentangular, the apical angle and angles next it rounded. Elytra clear black, with a narrow shade of yellow next the scutellum; smooth, with four or five faint impunctate lines within the shoulder, inclined obliquely inwards from the base; beyond these impunctate oblique lines there are three or four faint rows of punctures, becoming less oblique towards the apex, which is truncate, straight, with the exterior angles rounded; base straight and shoulders square. Abdomen above with the fimbriæ very marked, the dorsal ring rounded, thickened on the margins, and extending rather broadly across the base of each segment; the segments themselves prominent, slightly punctate, more so towards the sides, and with their edges thick and rounded, and with a deep stigmatic depression on each side; below with a similar fold or ring, and fimbriæ and stigmatic depression.

From the island of Mysol, near Ceram. Collected by Mr. Wallace. A single specimen is in the British Museum.

Genus CILLÆUS.

Laporte, Etud. Ent. p. 133 (1835).
Erichs. in Germ. Zeitschr. iv. 247 (1843).
Lacordaire, Histoire des Insectes, Coléoptères, ii. 297 (1843).

Caput sulcis antennariis. Labrum integrum. Oculi parvi, haud basin capitis attingentes. Elytra striata vel seriatim punctata. Abdomen elongatum, supra segmentis tribus expositis, segmentis primis duobus brevissimis, reliquis longioribus; maribus? segmentulo anali ventrali auctum; fimbriis subparallelis et antecedentibus angustioribus. Pedes intermedii coxis distantibus.

Body long, flat, and depressed, much like a *Brachypeplus*. The head is large, and broader in the males; and in most of the species the epistome is slightly porrect, although in some it is not. The eyes are projecting, small, and not reaching to the base of the head. Antennal grooves short, converging, well marked. Antennæ not much longer than the head; the first article oval, thicker than the rest; the second cylindrical, somewhat longer than the third, the fourth to the eighth inclusive gradually becoming longer and thicker, and the ninth to the eleventh forming a compressed oval club. Labrum rounded in front. Mandibles short, strong, thick at the back, curved, bicuspid at the point, and in some species subserrated behind. Lobe of the maxillæ small, strongly bearded on its inner side, and in some species (*C. castaneus* and *C. megacephalus*, which should, perhaps, form a different genus) with a curved tooth behind. Maxillary palpi with the first article small, second large, third smaller, and last elongate and as large as the two preceding united. Labial palpi short, with the first joint small, second a little longer and usually thicker than the last, which is somewhat oval. Ligula oval, keeled, with coriaceous paraglossæ ciliated on their inner side; in some species with short, rounded, membranous lobes. Mentum transverse, varying in form in the different species. Prothorax a little longer than broad, and slightly narrowed behind. Scutellum large, transverse, subtriangular. Elytra truncate, leaving the last three abdominal segments exposed. Legs short and robust, thighs slightly canaliculated below for the reception of the tibiæ; posterior tibiæ furnished with small spines on their external margin, and no channel for the reception of the tarsi, which are feeble—their first three articles very short, dilated, and furnished with long hairs below, the fourth minute, the last long, and with the claws simple. Prosternum flat. Mesosternum broad, large, and flat, on the same level as the prosternum and mesosternum, merely divided from them by sutures. Middle coxæ more widely separated from each other than either the anterior or posterior. The first two abdominal segments very short, the rest longer; a small additional ventral anal segment in one sex, probably the males. Fimbriæ narrow, subparallel, with a very slight curve in front.

BRACHYPEPLUS.
Position and Affinities.—ADOCIMUS. CILLÆUS. ITHYPHENES.
ORTHOGRAMMA.

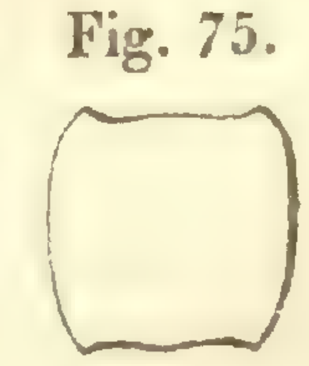
* **Inner side of maxillæ with a curved basal tooth.**

1. CILLÆUS CASTANEUS. (Plate XXXV. fig. 2.)

Laporte, Etud. Ent. 133 (1835).

Læte dilute castaneus, leviter punctatus; thorace subquadrato; elytris longis, sat fortiter striato-punctatis, postice lævioribus, interstitiis leviter punctatis. Long. 4–5 lin., lat. $\frac{5}{6}$–$1\frac{1}{8}$ lin.

Fig. 75.



Habitat in Madagascaria.

Elongate, flat, shining, finely punctate, pale chestnut-coloured. Head rather thickly and distinctly punctate, transversely depressed and bi-impressed in front. Labrum punctate, with a smooth line up the middle diverging in front. Thorax subquadrate, with all the angles rounded, sparsely and irregularly finely punctured, with a smooth longitudinal impunctate space in the middle; sides declinate and margined, posterior angles with an impression close to the angle. Scutellum transversely triangular, slightly rounded, impunctate, except very slightly along the sides. Elytra a half longer than the thorax, with the sides inflexed and the suture depressed; finely punctate-striate, the stria next the suture deeper and wider than the others, especially at the base; all the striæ effaced before reaching the apex, which is pretty thickly finely punctate; the interstices for the most part impunctate, but some with a few straggling, almost imperceptible irregular punctures; exterior apical angles rounded, sutural angles right-angled. Abdomen more finely and closely punctate than the rest of the body, with large depressions on each side of the last three segments both above and below; dorsal exposed portion of the abdomen about the length of the elytra. Underside finely punctate and slightly pubescent. Legs punctate.

From Madagascar.

2. Cillæus megacephalus.

Laporte, Etud. Ent. 134 (1835).
Ips terminata (Dej. Cat. 134, ed. 1837).

Læte dilute castaneus, elytris apice tenuiter nigris vel fuscis; capite lato, thorace antice latiore; maribus capite et thorace latioribus. Long. 5 lin., lat. $1\frac{1}{6}$ lin.

Fig. 76.

Habitat in Madagascaria.

Very nearly allied to *C. castaneus*. It is, however, larger and throughout rather more coarsely punctate. The labrum is different—larger, more prominent, and prolonged instead of transverse, and is dull and more punctate; it has only a trace of the longitudinal smooth line diverging in front which we find in *C. castaneus*. The mandibles are larger, stronger, and more strongly toothed at the tip. The head is much broader in front and more deeply punctate. The thorax is differently shaped: instead of being subquadrate it is subcordate, broadest in front, and the posterior angles more obtuse and reflexed. The scutellum is a little more punctate. The apex of the elytra has a narrow black margin. The head and thorax are very much enlarged and widened in the males. In other respects it is the same as *C. castaneus*.

From Madagascar.

** Inner side of maxillæ without a basal tooth.

3. Cillæus obscurus. (Plate XXXV. fig. 3.)

Laporte, Etud. Ent. 134 (1835).
Ips obscurella (Dej. Cat. 134, ed. 1837).

Nigro-piceus, subpubescens, leviter et sparsim punctatus; thorace antice parum latiore; elytris thorace longioribus, striato-punctatis; abdomine pubescente, segmentis postice rufo-translucentibus; subtus piceus, palpis, antennarum basi pedibusque piceis vel testaceo-piceis. Long. 3 lin., lat. $\frac{3}{4}$ lin.

Fig. 77.

Habitat in Madagascaria.

Elongate, narrow, slightly punctate and finely pubescent, nigro-piceous. Head, thorax, and scutellum somewhat shining, elytra and abdomen subopaque, the margins subciliated. Head broad, finely punctate, with the epistome marked off by a semicircular line. Labrum small, rather projecting, flat, opaque, punctate. Thorax broadest in front, bisinuate in front, scarcely sinuate behind, depressed on the sides and at the posterior angles. Scutellum triangular, very slightly punctate. Elytra longer than the thorax, faintly punctate-striate, with a tendency to become costate, some of the alternate interstices being slightly raised; the striæ effaced before the apex; apex slightly rounded, with the external angles rounded, sutural angles slightly obtuse. Abdomen pubescent and finely punctate, with a longitudinal impression on the last three segments both above and below, but not so deep below; dorsal exposed portion of abdomen about a third of the length of the thorax longer than the elytra; margins of segments ferrugineo-piceous. Underside finely and closely punctate and pubescent. Legs short and stout, dark ferrugineo-piceous.

From Madagascar.

4. Cillæus linearis. (Plate XXXV. fig. 4.)

Erichs. in Germ. Zeitschr. iv. 249 (1843).

Glaber, dilute testaceus, nitidus, subtiliter punctatus; thorace oblongo; elytris thorace fere duplo longioribus, colore saturatioribus. Long. 3 lin., lat. $\frac{1}{2}$ lin.

Habitat in Columbia.

Linear, depressed, glabrous, shining, clear pale testaceous. Mandibles black. Head a little narrower than the thorax, with the forehead flat, faintly punctate. Thorax about the breadth of the elytra, rather longer than broad, somewhat oblong, slightly narrowed towards the base, depressed, faintly punctate. Scutellum very faintly punctate. Elytra about twice as long as the thorax, faintly irregularly punctate, not striate, darker than the rest of the body. Abdomen more thickly punctate, the dorsal segments marked longitudinally with fuscous, the dorsal exposed portion of the abdomen about equal in length to the thorax and elytra taken together.

From Columbia.

5. Cillæus longipennis.

Fig. 78.

Longus, linearis, angustus, parallelus, depressus, testaceo-castaneus, griseo pubescens, punctatus, subopacus; thorace latitudine longiore; elytris thorace fere duplo longioribus, levissime lineatis, interstitiis seriatim elongato-punctatis; abdomine aciculatim granulato et punctato. Long. $2\frac{3}{4}$ lin., lat. $\frac{2}{5}$ lin.

Habitat in Madagascaria.

Long, linear, narrow, parallel, depressed, testaceous chestnut, dull, griseo-pubescent, punctate, subopaque. Head moderately punctate. Labrum transverse, short, indented on the margin. Thorax with the sides nearly parallel, very slightly narrowed in front and behind, irregularly punctured, the punctures rather deep, scattered, and elongate; anterior angles obtuse and rounded, posterior angles nearly right-angled, sides margined. Scutellum not very large, piceo-castaneous, punctate. Elytra nearly twice the length of the thorax, scarcely broader than the general width of the thorax, a little broader at the base than its base, very finely and closely lineate, the interstices impressed with a row of longitudinal punctures, in some places running together so as to make an interrupted line; shoulders not prominent, rectangular, rounded, sides slightly margined; apex scarcely obliquely truncate, exterior apical angles rounded, sutural apical angles right-angled. Abdomen acicularly shagreened, with a scattered griseous stiff pubescence issuing from punctures (which seem as if made from behind forwards); the segments with a darker chestnut band near the margin, the margin itself thin, testaceous, and pubescent; dorsal exposed portion of the abdomen about two-thirds of the length of the thorax longer than the elytra. Underside with the breast piceo-testaceous. Legs testaceous.

This seems to come near Laporte's *C. filiformis* in size and form. It differs from his short description, however, in colour and some other points.

From Madagascar. A single specimen in the collection of the Marquis de la Ferté.

6. CILLÆUS VERMIS.

Fig. 79.

Parvus, linearis, elongatus, parallelus, depressus, piceo-testaceus, mollis, punctatus et valde pubescens; thorace paulo latitudine longiore; elytris pube lineatim vestitis, haud vel vix punctatis. Long. $1\frac{7}{8}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Madagascaria.

Small, narrow, linear, elongate, slender, depressed, parallel, piceo-testaceous, punctate, and very pubescent. With a good lens the acicular chitinous texture may be seen on the thorax, but not so marked as on the abdomen of *C. longipennis*. Head darker, very pubescent. Thorax nearly quadrangular, sides parallel, almost as broad as long, scarcely perceptibly margined; angles nearly right-angled, the points rounded; very pubescent, with scattered, longish, shallow punctures. Scutellum not large. Elytra a little more than a half longer than the thorax, very pubescent, the pubescence lying in rows; punctures not perceptible; apex squarely truncate; exterior apical angles rounded, a little darker towards the apex. Abdomen with the dorsal exposed part half the length of the body, paler than the rest, more finely pubescent, and without punctures. Underside pale. Legs pale testaceous.

From Madagascar. A single specimen in the collection of the Marquis de la Ferté.

Note.—The three following species are described by Laporte as belonging to this genus; but as his descriptions are insufficient to identify them, and as it is even doubtful whether they really do belong to the genus as now defined (Laporte having supposed it to belong to the *Omalidæ*, a group of the *Staphylinidæ*), and as, moreover, I have no traditional knowledge of the species he had in view, I merely give a copy of his descriptions, leaving it to the reader to try and make them out for himself.

7. CILLÆUS SUTURALIS.

Laporte, Etud. Ent. 133 (1835).

"Niger, punctatus; elytris flavis, sutura apiceque nigris, leviter punctato-striatis; segmentis abdominis postice pedibusque testaceo-brunneis. Long. 2 lin., lat. $\frac{1}{2}$ lin.

"Habitat in Madagascaria."

Black, punctate, with the elytra yellow, the suture and the apex black, lightly punctate-striate. Abdomen with the posterior margins of the segments and legs testaceo-brunneous.

From Madagascar.

8. Cillæus thoracicus.

Laporte, Etud. Ent. 134 (1835).

"Pubescens, punctatus, brunneo-rufus; thorace antice transversim paulo carinato; elytris longis, obscuris, leviter striato-punctatis; pedibus rufis. Long. $1\frac{1}{2}$ lin., lat. $\frac{1}{3}$ lin.

"Habitat in Madagascaria."

Pubescent, punctate, brunneo-rufous; the thorax somewhat keeled transversely in front. Elytra long, obscure, lightly punctate-striate. Legs rufous.

From Madagascar.

9. Cillæus filiformis.

Laporte, Etud. Ent. 134 (1835).

"Valde elongatus, linearis, punctatus, pubescens; capite et thorace rufescentibus; elytris longis, obscuris, pube brunnea vestitis; abdomine obscuro, segmentis crinibus flavis marginatis; antennis pedibusque rufis. Long. $2\frac{3}{4}$ lin., lat. $\frac{1}{3}$ lin.

"Habitat in Madagascaria."

Very much elongated, linear, punctate, pubescent, with the head and thorax reddish. Elytra long, obscure, covered with brown hairs. Abdomen obscure, with the margins of the segments bearing yellow hairs. Legs and antennæ red.

From Madagascar.

Genus Ithyphenes (ἰθὺς, obvious; φένω, I kill,—alluding to the projecting mandibles).

Corpus elongatum, valde depressum. Caput latum, epistomate porrecto et emarginato; oculis parvis, haud basin capitis attingentibus; sulcis antennariis brevibus. Labrum integrum. Maxillæ ad basin uncinatæ. Thorax subcordiformis. Elytra striata. Abdomen supra segmentis ultimis tribus expositis, segmentis omnibus fere æqualibus, secundo solum paulo minore.

Body elongate, flat, and much depressed*. Head broad, with the sides rounded, and widest behind the eyes; epistome with a broad projection which is emarginate, and each side of the projection is emarginate also; eyes small, far forward, at the base of the mandibles, and not reaching near to the base of the head. Antennæ slender, rather long, and club small; first article large, and swollen in front, nearly as large as the club;

* By far the greater number of the specimens of the species of this genus and *Orthogramma* which have come to Europe were collected by Mr. Wallace, and in almost every one of them the thorax appears hollowed and cup-shaped, the elytra curled-in longitudinally or sloped to the suture, and the abdomen longitudinally hollowed; nevertheless, as I find that this is not the case in one or two examples of the less rare species which I have received from other hands, but that they are merely flat, I am led to suppose that Mr. Wallace had obtained his specimens shortly after they had left the chrysalis and while still retaining marks of immaturity. Consequently I have assumed that these hollowed specimens would be flat in their normal condition, and have so treated them.

second to eighth articles slender, and nearly equal in thickness; second rather small and short, widest at the apex, not so long as the third, rather longer than the fourth; third of same form as second, but a little thinner and longer; fourth and fifth equal, shorter than second; sixth shorter and thinner; seventh a little thicker, but short; eighth the smallest of all the articles, making a slight interruption before the club; ninth to eleventh making a small, somewhat rounded club; ninth and tenth shallow, short, cup-shaped; and eleventh rounded. Antennal grooves converging. Labrum somewhat concealed by the epistome, small, narrow, sharply emarginate, or almost bidentate. Mandibles strong, projecting, deeper than broad, bicuspid at the apex, and with another tooth a little further back on the inner side. Maxillæ thin, hooked at the apex, with the inner side fringed with hairs, and at the base a curved tooth. Maxillary palpi about the length of the maxillæ, slender, the first article small, the second and third about equal, and the last article long and ovate. Ligula short, truncate in front, with a thin, slender, membranous lobe, like a small maxilla, ciliated on the inner side, projecting on each side of the front of the ligula. Labial palpi slender, the first article small, second longer, third as long as the second, a little thicker and more dilated on the exterior side. Mentum biemarginate. Prothorax somewhat cordiform, a little longer than the head, as broad as it in front, not half so broad at the base. Scutellum semicircular. Elytra feebly striate, longer than the thorax, wider than its base, square at the shoulders, rounded at the apex, especially on the exterior angles. Abdomen above with the last three segments and the margin of the fourth exposed; the sides not straight, each segment being rounded on the sides and narrower behind than before; fimbriæ of the penultimate and antepenultimate segments widest behind, and stretching across the segment in front; pygidium with the fimbriæ widest in front. Legs with the thighs large, flat, and broad. Tibiæ very short and rather stout, without a channel on the outside of the apex for the reception of the tarsi. Tarsi slender, except the basal article, which is large.

Position and Affinities.—CILLÆUS. ITHYPHENES. ORTHOGRAMMA.
CUCUJUS.

ITHYPHENES GNATHO. (Plate XXXVI. fig. 2.)

Elongatus, valde depressus, nitidus, flavo-testaceus, capite antice picescente, elytris apice nigro; capite lato, impunctato, epistomate porrecto et leviter emarginato; thorace postice quam antice dimidio angustiore, elytris breviore et postice angustiore, impunctato; scutello transverso, semicirculari, impunctato; elytris pone medium latioribus, levissime substriatis, striis versus latera et apicem obliteratis, versus apicem singulis foveolatis, apice oblique rotundato; abdomine segmentis utrinque punctulatis, medio impunctatis. Long. $4\frac{1}{2}$ lin., lat. $\frac{4}{5}$ lin.

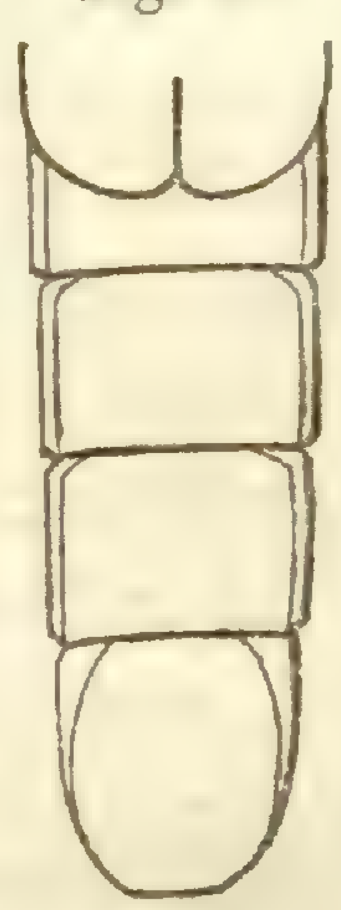
Habitat in insula Saylu in Nova Guinea.

Elongate, very much depressed, shining, yellowish testaceous, with the front of the head and the mouth becoming piceous; the elytra with the apical two-thirds black. Antennæ piceo-rufous, with the club dusky. Mandibles nearly black. Head broad, impunctate. Thorax in front as broad as the head, behind narrower than the elytra, a half narrower behind than before; apex truncate, base slightly rounded, anterior angles rounded, posterior obtusely rounded, sides gently curved, impunctate, with a faint dorsal line. Scutellum semicircular, transverse, impunctate. Elytra longer than the thorax, with the sides and the apex smooth and impunctate, bearing within the shoulders nearly effaced traces of eight or nine striæ; a large fovea on each elytron near the apex just within a line drawn straight from the shoulders, which are square, sides gradually expanding until behind the middle, where they begin to turn in and gradually round-in to the suture; margin of the apex and sides rounded and inflexed. Abdomen with each segment narrowest at the base and rounded in the middle, so that the sides of the abdomen are not even, but a succession of curves; each segment impunctate in the middle, but bearing effaced punctures next the sides. Legs with the thighs and the tarsi pale, the knees and tibiæ slightly darker.

From Saylu, one of the New Guinea Islands. Collected by Mr. Wallace. Unique in the British Museum.

Genus Orthogramma (ὀρθὸς, straight; γραμμὴ, a line).

Fig. 80.



Corpus lineare, valde depressum. Caput elongatum; epistomate plus minusve porrecto, emarginato et denticulato; oculis parvis, haud prope basin capitis attingentibus; sulcis antennariis brevibus. Labrum integrum. Thorax elongatus, oblongus. Elytra striata. Abdomen supra quatuor segmentis ultimis expositis, segmentis omnibus fere æqualibus, secundo solum paulo minore.

Body linear, parallel, flat, and excessively depressed. Head oblong, parallel, about as long as the thorax. Epistome more or less projecting, and toothed or with one or more emarginations. Every species of the genus seems to have a differently formed epistome. Eyes small, far forward, and not reaching nearly to the base of the head. Antennæ rather stout; first article swollen and dilated externally, second shorter, but longer and stouter than the third, which is short, moniliform, and a very little longer than the following articles, fourth to seventh moniliform and equal, eighth a very little broader, ninth to eleventh forming a large oval club. Antennal grooves short, indistinct, and slightly converging. Labrum rounded in front. Mandibles with the outer margin thickened, capable of being bent downwards so as to be little seen from above, and with two or three teeth. Maxillæ of moderate size, with a brush of hair on the inner side. Maxillary palpi longer than the maxillæ, first article small, second a little longer than the third, the terminal article longest, cylindrico-ovate. Ligula corneous, short, and broad; apex of the paraglossæ seen projecting behind (Plate XXXV. fig. 5 *e*). Membranous wing or lobe short, broad, and curved. Labial palpi short, the second article largest, last article ovato-conical. Mentum biemarginate; a prominent rounded tooth in the middle. Prothorax a little longer than the head, scarcely wider than its base, and about the breadth of the elytra, nearly oblong, not margined. Scutellum transverse. Elytra striate, not much longer than the thorax, with the exterior apical angles rounded and the apex truncate. Abdomen straight on the sides, with all the segments long and nearly equal, the second a little the shortest and the last a little the longest, and rounded; above with the last three segments and a part of the second exposed, the second of a duller and softer texture than the last three*; all the exposed segments have a narrow fimbria along the margin, widest in front in the pygidium, and very slightly turned-in at the anterior margin of the other segments. Legs very short; thighs flat and broad; tibiæ stout, without a channel on the outside of the apex for the reception of the tarsi; tarsi long and slender, the terminal article (claw-joint) as long as all the rest taken together; anterior tarsi dilated and shorter in the males.

Position and Affinities.—Ithyphenes. Orthogramma. Cillæus.

1. Orthogramma longiceps. (Plate XXXVI. fig. 3.)

Elongata, parallela, punctata, subnitida et testaceo-flava; capite antice fuscescente, abdomine supra fusco, elytris piceo-fuscis, basi piceo-testaceis; capite distincte punctato, fortius antice, medio antice longitudinaliter impresso, epistomate bidentato; thorace antice quam postice latiore, ante medium latissimo, modice convexo, punctato; elytris oblique subcarinato-lineatis, interstitiis gemellato-punctatis, postice obliteratis; abdomine leviter punctato. Long. $4\frac{1}{3}$ lin., lat. $\frac{3}{4}$ lin.

Fig. 81.

Epistoma.

Habitat in insula Dorey.

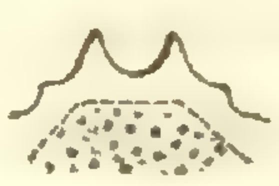
Elongate, parallel, punctate, somewhat shining, testaceous yellow, with the head fuscescent in front, the abdomen above fuscous, and the elytra piceo-fuscous, with the base paler or piceo-testaceous. Head not very flat; epistome with two projecting teeth (fig. 81), and extending backwards from between them there is a rather deep longitudinal punctate impression for about a third of the length of the head, more deeply punctate in front, more faintly behind. Antennæ piceo-testaceous, terminal article paler. Thorax nearly as broad as long, but narrower behind than in front, broadest a little before the middle, truncate straight in front, sides sloping in a gentle curve from before backwards, and declinate towards the front, posterior angles rounded, anterior nearly right-angled, the points of the angles rounded; distinctly punctate, somewhat convex, unequal on the surface as if portions had been slightly flattened, and with a slight mesial longitudinal impression. Scutellum triangular, broad, irregularly and sparsely punctate. Elytra about a half longer than the thorax, and about equally broad, with a few faint longitudinal ridges, between which is a double row of punctures obliquely directed from the base inwards, deepest towards the base, effaced towards the apex, which is smooth, the sutural row of punctures deepest and largest. Wings when expanded extending beyond the body. Abdomen faintly punctate, with a longitudinal impression. Underside testaceous yellow.

Collected by Mr. Wallace in the island of Dorey in New Guinea. A single specimen is in the British Museum.

* This softer texture shows that when alive the second segment, with the exception of its harder posterior margin, is covered by the elytra; but in all the specimens which I have seen a large portion of that segment has been visible from above.

2. ORTHOGRAMMA PUNCTICEPS.

Fig. 82.



Epistoma.

Elongata, linearis, parallela, depressa et nitida, capite testaceo-rufo, antice fuscescente, thorace testaceo-rufo, scutello, elytris et abdomine nigro-piceis, pedibus piceis; capite antice declinante, excavato et fortiter punctato, postice et lateribus vix punctato, epistomate bidentato et lateribus biemarginato; thorace antice quam postice latiore, medio impunctato, circa medium leviter punctato; elytris punctato-striatis; abdomine medio lævi et impunctato, lateribus prope fimbriis sat fortiter punctatis. Long. 4 lin., lat. $\frac{1}{2}$ lin.

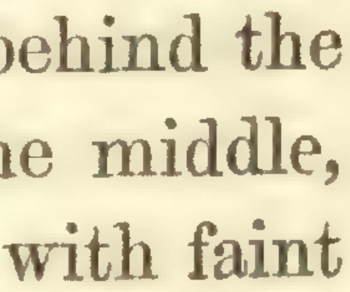
Habitat in Sarawak.

Elongate, linear, parallel, depressed, rather shining, the head and thorax testaceo-rufous, the former becoming fuscous in front, the mandibles nigro-piceous, and the antennæ rufo-piceous; the scutellum, elytra, and abdomen nigro-piceous; the scutellum and the margins of the segments of the abdomen with a rufescent tinge; the legs piceous. Head with the front part sloping towards the mouth, the slope depressed and deeply foveolated just behind the epistome, which has two projecting teeth (fig. 82) and is slightly biemarginate on each side; the sloping punctured portion is rounded on its sides, narrowest behind, and the posterior margin is truncate; the sides of the head are smooth, rather rounded, and impunctate, and the back smooth, with the exception of a slight oblique fovea on each side. The mandibles have one very large tooth behind the point. The thorax is narrower behind than in front, widest a little before the middle, both base and apex truncate, the disk smooth in the middle and surrounded with faint punctures, slightly longitudinally corrugated at the base; anterior angles slightly declinate and obtuse, posterior angles distinctly obtuse. Scutellum slightly and irregularly punctate along the base. Elytra punctate-striate, the striæ sloping from the base obliquely inwards and becoming effaced before reaching the apex; there are a few very long fine hairs projecting from the sides of the elytra. Abdomen above with the fourth segment dull, opaque, and impunctate, the remaining three smooth, impunctate, and shining in the middle; on each side next the fimbriæ deeply and irregularly punctate. Thighs very thick and stout, and tarsi very long and slender.

Collected by Mr. Wallace at Sarawak in Borneo. There is a specimen in the British Museum.

3. ORTHOGRAMMA FISSICEPS.

Fig. 83.



Epistoma.

Elongata, linearis, depressa, nitida et testaceo-rufa, lateribus capitis et thoracis, scutello abdomineque piceo-fuscis, elytris nigris; capite antice linea profunda angustaque longitudinaliter medio impresso; thorace antice quam postice parum latiore; elytris leviter oblique striatis, lateribus apiceque impunctatis. Long. $3\frac{7}{8}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in insula Dorey.

Elongate, linear, depressed, shining, testaceo-rufous, with the mouth and sides of the head and of the anterior portion of the thorax piceous, the scutellum and abdomen piceo-fuscous, the margins of the basal segments testaceous, the elytra black; legs piceous black, tarsi testaceous. Head smooth, very faintly (almost imperceptibly) punctate in front, impunctate behind; epistome with two slight projections, somewhat bent down, and separated by a rather wide emargination (fig. 83), behind which extends, for nearly the half of the length of the head, a deep, longitudinal, irregularly, rather strongly punctate fovea. Thorax very faintly punctate, rather narrower behind than in front; sides gently curved, declinate towards the front, anterior angles nearly right-angled, posterior angles rounded; front truncate, straight; base truncate, but rounded towards the angles. Scutellum broad, nearly impunctate, longitudinally hollowed. Elytra with two or three fine, very faintly punctate striæ running obliquely inwards from the base within the shoulder, but becoming effaced towards the apex and sides, which are perfectly smooth; a few long, fine hairs ranged along the outer margin. Abdomen above with a longitudinal hollow along all the segments, which are smooth and impunctate, except the pygidium, which is faintly punctate, and all with a few scattered long hairs, more especially along the margins. Thighs very stout.

Collected by Mr. Wallace in the island of Dorey in New Guinea. A single specimen is in the British Museum.

4. Orthogramma fuscipennis. (Plate XXXV. fig. 5.)

Fig. 84.

Epistoma.

Elongata, linearis, valde depressa et nitida, plus minusve punctata, capite et thorace piceo-ferrugineis, elytris abdomineque fusco-piceis, pedibus ferrugineis; epistomate porrecto et profunde emarginato; thorace capite haud multum longiore, leviter sparsim punctato, medio levissime lineato; elytris punctato-striatis, interstitiis lævibus; abdomine sparsim sat fortiter punctato et leviter pubescente. Long. $2\frac{3}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Borneo.

Linear, elongate, very much depressed, shining, more or less punctate; head and thorax piceo-ferruginous; elytra and abdomen fusco-piceous. Head oblong, large, broad, flat, sides parallel, sparsely and finely punctate, most on the middle and scarcely or not at all on the sides; epistome bidentate and emarginate (fig. 84); antennæ ferruginous, with the club dusky; mandibles unequally tridentate, and with the outer side raised like a ledge (see Plate XXXV. fig. 5 *g*), ferruginous, with the tip darker. Thorax suboblong, with the apex and base about equal in breadth, not wider than the head, the sides gently rounded, widest a little behind the middle, the margin on the sides sinuate, broadest in front, anterior angles nearly right-angled, posterior angles obtuse,—a small, punctate, roundish fovea in each posterior angle,—the disk sparsely punctate, a very fine median longitudinal line running from the base forwards for two-thirds of the length of the thorax, and an elongate faint punctate impression on each side of it near the base; the apex not emarginate, the base not sinuate, both slightly rounded. Scutellum very broad and short, rounded posteriorly, smooth, impunctate, except one or two punctures near the base. Elytra a little longer than, but scarcely so broad as, the thorax, sides parallel; punctate-striate, the striæ effaced before the apex, the interstices impunctate, the space next the suture widest, depressed towards the suture; apex with the exterior angles sloping and rounded, the sutural angles nearly right-angled. Abdomen sparsely and distinctly punctate, with fine, longish hairs, more frequent towards the sides; the pygidium with the fimbriæ very much raised. Legs ferruginous.

From Sarawak in Borneo. This is not so rare in collections as the other species.

5. ORTHOGRAMMA DENTICEPS.

Fig. 85.

Epistoma.

Elongata, linearis, depressa, nitida et testaceo-rufa, capite antice fuscescente, elytris fuscis; abdomine pygidio piceo-fusco, segmentis cæteris testaceo-piceis, marginibus testaceis; capite antice medio longitudinaliter impresso et punctato, epistomate fortiter bidentato; thorace antice quam postice latiore; elytris leviter punctato-striatis; abdomine pygidio levissime punctato, segmentis cæteris vix punctatis. Long. 3 lin., lat. $\frac{2}{5}$ lin.

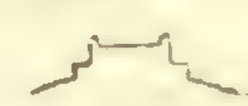
Habitat in Singapore.

Elongate, linear, depressed, shining, testaceo-rufous, the head becoming fuscous in front; the elytra fuscous; the abdomen, except the pygidium, piceo-testaceous, with the margins of the segments testaceous; antennæ rufous, with the club dusky; legs testaceo-rufous. Head smooth and shining, impunctate behind, thickly but finely punctate in front; epistome with two projecting teeth (fig. 85). Thorax rather narrower behind than in front, anterior angles nearly right-angled, posterior angles obtusely rounded, sides declinate towards the front, apex truncate, disk finely punctate, more sparingly in the middle. Scutellum piceo-testaceous, impunctate. Elytra very finely punctate-striate, the striæ running obliquely inwards from the base and not extending beyond the shoulder, and becoming effaced before the apex. Abdomen scarcely punctate, except on the pygidium, which has a few fine punctures: some long hairs are scattered over the abdomen, more particularly along the sides and towards the apex.

From Singapore. Collected by Mr. Wallace.

6. ORTHOGRAMMA PLANICEPS.

Fig. 86.



Epistoma.

Elongata, linearis, parallela, depressa, nitida, testacea, capite antice piceo, elytris testaceo-piceis apice nigris; abdomine testaceo-piceo, medio longitudinaliter piceo, segmentorum marginibus pallide testaceis; capite plano; epistomate medio porrecto et truncato, utrinque parvo denticulo instructo; thorace longo, antice quam postice parum latiore, impunctato, linea dorsali lævi longitudinali; elytris levissime punctato-lineatis, lineis apice lateribusque obliteratis. Long. $2\frac{3}{4}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in peninsula Malayensi.

Elongate, linear, parallel, depressed, shining, testaceous, with the elytra testaceo-piceous, palest in the region of the shoulders and becoming black towards the apex; the abdomen testaceo-piceous, darker in the middle and pale on the margins of the segments; mandibles and sides of the head in front gradually darker than the rest; antennæ testaceous, club dusky. Head long, flat, sloping slightly to the front, finely punctate on the flat disk, impunctate on the sides; epistome porrect in the middle, the projecting portion truncate, with a slight projection or tooth on each side of the truncate part (fig. 86). Thorax long, very nearly equal in front and behind, but rather narrower behind; posterior angles rounded, anterior declinate and nearly right-angled; apex truncate; impunctate, with a fine dorsal line reaching from the base to about a fourth of the length of the thorax from its apex. Scutellum impunctate. Elytra very finely punctate-lineate, the lines, which are about seven on each elytron, becoming effaced towards the sides and apex. Abdomen shining and impunctate, except a few faint punctures towards the base of the pygidium. Legs testaceo-piceous; tarsi pale testaceous.

Collected by Mr. Wallace in the Malayan Peninsula. There is a specimen in the British Museum.

7. Orthogramma Saundersii.

Fig. 87.

Epistoma.

Linearis, elongata, depressa, nitida et ferrugineo-picea, elytris nigris, abdomine piceo-nigro; antennis ferrugineis, clava fusca; pedibus piceo-testaceis, tarsis testaceis; capite antice levissime punctato et linea levi punctata impresso, medio longitudinaliter impresso, postice impunctato, utrinque fovea parva instructo, epistomate bidentato, leviter et crebre punctato; thorace impunctato; elytris vix lineatis; abdomine fere impunctato, pygidio sparsim leviter punctato. Long. $2\frac{1}{4}$ lin., lat. $\frac{1}{4}$ lin.

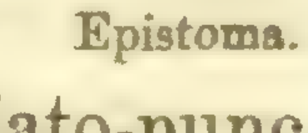
Habitat in insula Dorey in Nova Guinea.

Slender, narrow, linear, depressed, shining. Head, thorax, and scutellum ferrugineo-piceous; elytra black; abdomen piceous black; antennæ ferruginous, with the club dusky; legs piceo-testaceous, tarsi testaceous. Head smooth and shining, impunctate behind, very finely punctate towards the front, and with the epistome more closely punctate, slightly projecting on each side in front (fig. 87); between them, extending back longitudinally for some space, is a slightly depressed line irregularly punctured, on each side of which, further back than the line of the antennæ and not so far back as the line of the eyes, is a small fovea. Thorax about as wide behind as before; anterior angles nearly right-angled, posterior rounded; impunctate. Scutellum impunctate. Elytra with mere faint traces of lines towards the suture, the rest smooth; a few long hairs along the exterior margin. Abdomen smooth, with a few faint punctures and hairs; the pygidium somewhat more punctate.

From Dorey, one of the New Guinea Islands. Collected by Mr. Wallace, and named in honour of Mr. Wilson Saunders.

8. Orthogramma breviceps.

Fig. 88.



Epistoma.

Elongata, linearis, valde depressa, irregulariter punctata, sat nitida et glabra; capite, thorace et abdomine ferrugineo-rufis, antennis pedibusque rufis; epistomate levissime quinquies emarginato; elytris testaceis, apice brunneo; thorace lineis tribus longitudinaliter leviter impresso; elytris striato-punctatis, interstitiis impunctatis; abdominis segmentis dilutioribus. Long. $1\frac{2}{3}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in insula Nicobaria.

Elongate, linear, very much depressed, irregularly punctate, somewhat shining, ferrugineo-rufous. Head shorter than in *O. fuscipennis*, flat, irregularly and rather thickly punctate; eyes larger than in most of the other species; epistome apparently with four, but in reality with six, small teeth on the margin, caused by five slight emarginations (fig. 88). Thorax longer than the head, very much depressed, with a longitudinal smooth depression in the middle scarcely punctate; on each side of this there is a slight longitudinal elevation, and, again, on each side of these a less marked depression; on the outer sides of these the surface is more deeply punctate, punctures mostly elongate; the sides are nearly parallel and straight, slightly declinate, more so in front; anterior angles nearly right-angled, posterior angles rounded; apex straight, base somewhat rounded, the edges of both a little turned up. Scutellum shining, impunctate. Elytra testaceous or livid testaceous, with the apex more or less livid brown, very little longer than the thorax, parallel, hollowed towards the suture and scutellum; humeral angles distinct; sides straight when seen from above, but slightly declinate and inflexed, and, seen from the side, a little widest behind the middle; punctate-striate, the interstices impunctate; apex with the exterior angles rounded and sloping obliquely to the suture, but when near the suture becoming truncate; sutural angles right-angled. Abdomen ferrugineo-rufous, with the pygidium somewhat piceous; the fimbriæ very strongly marked; a slightly raised longitudinal line in the middle of the penultimate and antepenultimate dorsal segments. Legs testaceous.

This stands in some collections as Laporte's *Cillæus filiformis*, but it is obviously different—being glabrous, while his species is described as pubescent.

From Nicobar. In the Hope collection at Oxford; also in the Copenhagen collection and in the British Museum.

Genus HALEPOPEPLUS (χαλεπὸς, hard; πέπλος, robe).

Caput sulcis antennariis convergentibus. Labrum simplex, transversum. Epistoma leviter porrectum, subconvexum. Thorax basi et angulis rotundatus. Prosternum prominens. Elytra striata. Abdomen thorace longius, segmentis primo et secundo brevioribus, tertio et quarto majoribus, quinto maximo, supra segmentis ultimis tribus expositis; fimbriis modicis, subparallelis. Tibiæ apice vix canaliculatæ.

Body long, subconvex, subdepressed on the disk. Texture hard. Head rather large and broad. Epistome broad, only slightly projecting. Eyes rather small. Antennæ with the first article enlarged, second small, third longer (second and third as long as the five following), fourth to eighth small, gradually increasing in breadth, ninth to eleventh forming the club, of which the ninth occupies the greater part; club roundish. Antennal grooves distinct, short, and converging. Labrum transverse, slightly emarginate in the middle. Mandibles with a simple point, not toothed behind. Maxillary lobe rather broad, with the apex oblique and terminated by a fringe of long hairs, but without any on the inner side. Maxillary palpi somewhat longer than the maxillæ; first article minute, second somewhat pyriform, third short, fourth cylindric conic. Ligula corneous, with a broad, ciliated, membranous lobe, apparently double, on each side (Plate XXXV. fig. 1 *e*). Labial palpi with the first article small, the second tumid and subglobose, the third broad, subcylindrical, widest at the apex—the three together having a considerable resemblance to the stalk and head of a Scotch thistle. Mentum broad, deeply emarginate, the sides of the emargination irregularly indented. Prothorax with the sides and all the angles rounded, sides margined; apex slightly emarginate, base not sinuate. Scutellum transverse, rounded on the posterior side. Elytra striate, narrower behind than before, truncate; sides margined. Abdomen with the first two segments shorter than those which follow; pygidium longest; three segments exposed above, and bearing moderately broad fimbriæ, which are subparallel, slightly convexly sinuate on the inner side; there is an additional minute anal appendage in the males (?). Legs stout; tibiæ with only a small, short trace of the channel for the reception of the tarsi which occurs in the *Brachypepli*; tarsi moderately dilated.

This genus forms the passage between the *Brachypepli* and *Conotelus*. It has the structural characters and size of the former, with a tendency to the form of the latter. The differences between it and the normal characters of *Brachypeplus* are the following. In *Brachypeplus* the form of the body is oblong, narrow, parallel, usually flat and depressed. In this genus the body is somewhat convex, and begins to diminish from the thorax backwards, giving it a long cuneiform shape like that of *Conotelus*. The texture in *Brachypeplus* is generally somewhat flexible, rather soft, subrugose, and pubescent. In *Halepopeplus* it is hard, shining, and without pubescence. The thorax in the former has the posterior angles usually more or less right-angled, the base straight and applied to the elytra. In *Halepopeplus* the base and posterior angles are rounded. The prosternum is prominent and projecting backwards, almost entirely covering the mesosternum, instead of being narrow and flat. The fimbriæ of the abdomen are more parallel. The channel on the outside of the apex of the tibiæ, which is so marked in the *Brachypepli*, has here almost disappeared.

Position and Affinities.—BRACHYPEPLUS. HALEPOPEPLUS. CONOTELUS.
CAMPSOPYGA.

1. HALEPOPEPLUS BIPUSTULATUS.

Elongatus, nitidus, leviter punctatus, niger, capite antice, antennis, maxillis, elytris singulis macula apicali rubris; elytris punctato-striatis. Long. 4 lin., lat. $1\frac{1}{3}$ lin.

Fig. 89.

Habitat apud flumina Amazonum.

Elongate, faintly punctate, shining, black, with a curved dull-red band across the head behind the clypeus; the anterior margin of the clypeus dull red, the antennæ and maxillæ testaceous red, and a patch on the elytra near the apex red. Head finely and closely punctate; two impressions, one on each side of the middle, and almost united; the dull-red band in front of the head interrupted by a narrow black line in the middle. Thorax one-fourth broader than long, subquadrate, smooth, and convex, with all the angles broadly rounded, very finely and equally punctate all over, feebly emarginate in front; sides, front, and base margined. Scutellum transverse, subpentangular, the posterior angles rounded. Elytra one-fourth longer than the thorax, a very little narrower behind than at the base; sides abruptly declinate, deeply margined, slightly sinuate and hollowed out within the margin, depressed towards the suture; punctate-striate, striæ eight and a half in number; the stria next the suture broader, being double at the base; last external stria beyond the shoulder deepest in the middle; the striæ are effaced a little before they reach the apex, which is then irregularly punctate; the interstices are most faintly punctate in rows; the red patch near the apex is somewhat conical in shape, leaning outwards, and its base (the side next the apex) truncate and parallel to the apex, which is obliquely truncate; the sutural apical angles are right-angled, slightly sinuate; the exterior apical angles are rounded. The abdomen is closely and finely acicularly punctate. Underside of abdomen more coarsely (almost subrugosely) acicularly punctate, the last three segments each with a large fovea on each side, which is not present in the first two. Underside of thorax ferrugineo-piceous. Thighs and tarsi ferrugineo-piceous; tibiæ nigro-piceous.

A unique specimen in the British Museum.

Collected by Mr. Bates near Ega, on the Amazons. Found flying over dead trunks of trees in sunshine in the driest weather.

2. Halepopeplus erythropyga.

Valde affinis *H. bipustulato*; niger, capite linea transversa, elytris singulis macula apicali et abdomine pygidio rubris; cæteris fere ut in *H. bipustulato*. Long. $3\frac{3}{4}$ lin., lat. $1\frac{1}{4}$ lin.

Habitat apud flumina Amazonum.

Very closely allied to *H. bipustulatus*, perhaps one of its sexes; but as I have only seen single specimens of each, it is premature to say. It is rather narrower; the head is not so broad; the thorax not so much dilated, and consequently rather larger; the elytra are each more convex and more depressed towards the suture, and the sutural stria is more punctate; the red patch at the apex of each elytron is rather larger, and the last segment of the abdomen is wholly red instead of black. In other respects it is almost identical with *H. bipustulatus*.

From the Amazons. Found under the same circumstances, flying in the sunshine over dead timber.

3. Halepopeplus Batesii. (Plate XXXV. fig. 1.)

Valde affinis *H. bipustulato*; aurantiacus, elytrorum limbo atque abdomine (segmento ultimo excepto) nigris. Long. $3\frac{3}{4}$ lin., lat. $1\frac{1}{4}$ lin.

Habitat apud flumina Amazonum.

Nearly allied to *H. bipustulatus*. Bright orange-coloured, with the margins of the sides, the apex, and the abdomen, except the last segment, black. The impressions on the head are united into a large, transverse, deeply punctate impression across the head, behind the labrum. Thorax more rounded, more emarginate in front, more shining, and finely punctate. Elytra less depressed towards the suture; the striæ effaced further from the apex than in *H. bipustulatus*. In other respects this species does not appear to differ from it.

It is not impossible that all the three species which I have above described may prove to be varieties of the same.

From the Amazons. Collected by Mr. Bates under the same circumstances as the preceding species or varieties.

Genus CAMPSOPYGA (καμψὸς, incurved, and πυγὴ, pygidium).

Fig. 90.

Caput oculis sat magnis, basin attingentibus, sulcis antennariis convergentibus. Labrum integrum. Mandibulæ apice bicuspidatæ. Elytra striata. Abdomen segmentis tribus dorsalibus expositis, segmento secundo breviore, ultimo longiore, cæteris fere æqualibus; fimbriis pygidii postice angustioribus, segmentis expositis cæteris postice latioribus. Tarsi dilatati.

Body subfusiform. Head short, with the epistome slightly projecting. Eyes prominent, extending to the back of the head. Antennal grooves small, narrow, converging. Antennæ with the first article large, depressed, and dilated in front, second smaller, but larger than the following, third small, longer than those which follow, and slender at the base, fourth, fifth, and sixth, lying very close together, short, slender, and about equal, the sixth a little thicker than the fourth, seventh and eighth more distinct, short, transverse, and lenticular, ninth, tenth, and eleventh forming a large ovate club, equal in length to the articles from the third to the eighth. Labrum entire. Mandibles with the apex bicuspid. Maxillary lobes short and rather narrow, bearded on the inner side. Maxillary palpi with the first article very small, second rather large, dilated on the outer side, third shorter, fourth longest, cylindrico-conical. Ligula emarginate, with a membranous obovate lobe projecting nearly straight in front on each side. Labial palpi slender; first article short, second longer, and apical article rather the longest. Prothorax subdepressed, rather narrower in front than behind. Scutellum rounded. Elytra striated. Abdomen above with the last three segments and the margin of the fourth exposed; the second shortest, the last longest, and the rest nearly equal; the pygidium not emarginate at the apex; fimbriæ sinuate, those of the last segment widest in front, of the other segments widest behind. Prosternum slightly keeled, scarcely projecting behind; metathorax without axillary pieces. Legs moderate; posterior coxæ more widely apart than the others; tarsi dilated.

This genus has considerable resemblance to *Prosopeus*, but differs in several respects. The mandibles have the apex bicuspid instead of being simple. The labial palpi are slender instead of thick; the ligula and its membranous lobes are differently formed. The thorax is rather narrower in front than behind, while it is the reverse in *Prosopeus*. The abdomen has three segments fully exposed above, while in *Prosopeus* there is little more than two. The fimbriæ, instead of being nearly parallel as in *Prosopeus*, are narrow in front and broad behind, except on the pygidium, where they are narrow behind and broad in front. The pygidium also is deeply emarginate in *Prosopeus* and not in *Campsopyga*.

HALEPOPEPLUS.

Position and Affinities.—BRACHYPEPLUS. CAMPSOPYGA. PROSOPEUS.

MACROSTOLA.

CAMPSOPYGA PALLIDIPENNIS. (Plate XXXVI. fig. 8.)

Elongato-fusiformis, subdepressa, nitida, fere glabra, piceo-brunnea vel nigro-picea, ore, antennarum basi thoracisque marginibus testaceis; elytris piceo-testaceis, basi et lateribus saturatioribus; capite et thorace leviter punctatis; elytris leviter striato-punctatis, interstitiis impunctatis; abdomine levissime punctato. Long. $2\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Venezuela.

Somewhat elongate-fusiform, subdepressed, shining, slightly punctate, almost glabrous, piceous, with the antennæ (except the club, which is fuscous), the mouth, the sides of the thorax, and the legs testaceous; the breast fuscous; the elytra piceo-testaceous, with the base and sides darker. Head finely punctate, with an impression on each side behind the epistome. Thorax finely and sparsely punctate, a little longer than the head, about a half broader than long, transverse, widest about the middle, slightly narrower in front than behind; sides rounded, apex very slightly emarginate; anterior angles rounded, posterior obtuse; base slightly bisinuate; the testaceous margin rather broad, and encroaching a little both on the base and the apex. Scutellum rather large, rounded at the apex, slightly punctate. Elytra a half longer than the thorax, a little wider than its base, punctate in rows, the interstices not punctate, punctures roundish; humeral angles nearly right-angled, rounded; apex obliquely truncate; exterior apical angles rounded, sutural angles right-angled, shoulders not prominent; suture, base, neighbourhood of scutellum and shoulders, sides, and apex all a little darker than the disk and somewhat fuscous. Abdomen slightly convex, finely punctate, and slightly pubescent.

This species has much general resemblance to the species which I have described under the name of *Prosopeus subæneus*, from the Cape of Good Hope.

From Venezuela. Received from the Berlin Museum, and now in the British Museum.

Genus HYPODETUS (ὑπόδετος, shod, bearing shoes or sandals,—in allusion to the dilated tarsi).

Caput oculis magnis, basin ejus attingentibus; epistomate porrecto; sulcis antennariis convergentibus. Mandibulæ cuspidatæ. Ligula angustata, sine alis. Thorax elytris angustior. Elytra striata vel subcostata. Abdomen postice attenuatum; segmentis omnibus (ultimo maximo excepto) fere æqualibus; fimbriis fere parallelis, pygidii postice angustioribus. Tarsi valde dilatati.

Body elongate, and somewhat conical at each end. Head rather broad; the eyes very large, reaching to the base of the head; and the epistome very prominent, narrow, and projecting. Labrum transverse, faintly emarginate. Mandibles with the sides straight, bicuspid, with a slightly bearded lamella on the inner side (Pl. XXXV. fig. 6 *g*). Antennæ with the basal article large and dilated, second article subglobose, third longer, fourth short, fifth longer, sixth shortest and smallest of all, seventh and eighth gradually a little wider, ninth to eleventh forming the club, the eleventh being the largest (Pl. XXXV. fig. 6 *a*). Antennal grooves short and converging. Maxillary lobes moderate in size, shortly bearded all over from the point for nearly half their length (Pl. XXXV. fig. 6 *f*). Maxillary palpi not very stout, with the second and terminal articles longest and nearly equal in size, the first article minute, and the third short (Pl. XXXV. fig. 6*f*). Ligula narrow and oblong, the paraglossæ extending beyond it, nearly of the same breadth, and terminating in a flat brush of hairs like a painter's flat brush. Plate XXXV. fig. 6*e*, which is intended for this, does not give a correct representation of it. There is no appendage at the base of the second article of the labial palpi, and the termination of the ligula is as shown in the woodcut (fig. 91). I only discovered its true nature, since the Plate was engraved, by finding the paraglossæ (A) shifted a little out of their place behind the ligula (B), as shown in fig. 92. Labial palpi with the second article elongate, and third more slender, subcylindrical, and slightly shorter (fig. 91). Mentum emarginate, without a projecting tooth in the middle (Pl. XXXV. fig. 6*e*). Prothorax rather narrower behind than in front, margined. Scutellum transverse. Elytra wider than the thorax, somewhat costate. Abdomen below with all the segments nearly equal, except the pygidium, which is largest; three segments exposed above, the margin of the fourth visible; the fimbriæ well marked, rather broad, widest in front on the last segment, nearly parallel on the other segments. Prosternum dilated behind the anterior coxæ. Metathorax without axillary pieces. Legs stout; femora with a channel below to receive the tibiæ; tibiæ dilated, with a channel on the outside of their apex to receive the tarsi, and each side of this channel thickly fringed with hairs. Tarsi very much dilated, and clothed below with long hairs.

Fig. 91.

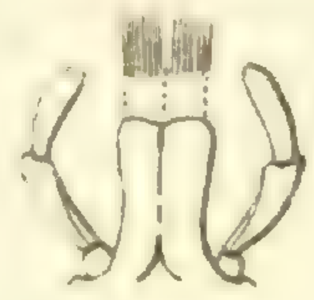
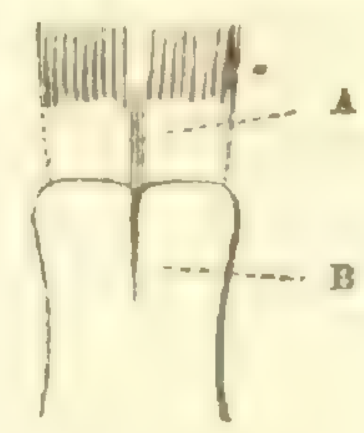


Fig. 92.



The most visible characters on which this genus is founded are the thorax narrower than the elytra, and the abdomen attenuated behind, so as to give it a conical outline. A less visible character is the difference in the ligula and maxillæ. I have met with no similar ligula in the group; and the maxillæ are so slightly bearded as to appear little more than pubescent—a character which, although occurring not unfrequently in the other groups of the *Nitidulidæ*, is rare among the *Carpophilidæ*.

This genus is out of its place here. It is certainly one of the *Brachypeplidæ*, and should come before *Cillæus* and *Orthogramma* instead of after them. It has the fimbriæ, the tibiæ, and the elytra of *Brachypeplus*. But if I had placed it there, I must have separated *Adocimus* from *Brachypeplus* or else from *Cillæus*; and as that genus forms the passage between these genera, I have had no alternative but to separate this from its nearest allies. It breaks off from *Brachypeplus* at the subgenus *Selis*.

	CARPOPHILUS.	
Position and Affinities.—BRACHYPEPLUS.	HYPODETUS.	CAMPSOPYGA.
	PROSOPEUS.	

HYPODETUS XANTHURUS. (Plate XXXV. fig. 6.)

Subfusiformis, subdepressus, nitidus, fere glaber, levissime punctatus; piceo-brunneus, abdomine saturatiore, pygidio flavo; elytris subcostatis. Long. 4 lin., lat. $1\frac{1}{3}$ lin.

Habitat in Brasilia?

Somewhat elongate, subfusiform, attenuated behind, somewhat narrowed in front, subdepressed, shining, finely and sparsely punctate, piceo-brunneous. Head punctate, with an impression across it behind the projecting epistome. Thorax transverse, broader than long, with the apex slightly emarginate, broadest before the middle, narrower and slightly sinuated behind, rounded in front, narrower behind than in front; anterior angles rounded, posterior angles approaching to right angles, but the point is obliquely cut off and obtusely rounded; punctate; base bisinuate, truncate. Scutellum broad, transverse, semicircular. Elytra at least a half longer than the thorax, about one-third wider, the base straight, and the shoulders prominent close to the humeral angles, which are rounded; sides nearly parallel, almost straight, declinate; there is a longitudinal depression inside the shoulders, and the suture is slightly depressed; subcostate, the costæ slightly sinuate, the interstices faintly punctate somewhat irregularly in rows; exterior apical angles slightly rounded, nearly straight, sutural angles nearly right angles. Abdomen rather thickly punctate, darker than the other parts of the body; pygidium flavous. Body below testaceous.

Believed to be from Brazil. I received a single specimen many years ago among a number of Brazilian insects, and I have never seen a second. Now in the British Museum.

Genus PROSOPEUS (προσωπεῖος, disguised).

Fig. 93.

Caput oculis sat magnis, basin ejus attingentibus; epistomate modice porrecto; sulcis antennariis convergentibus. Labrum integrum. Mandibulæ apice simplici. Thorax elytris angustior. Elytra striata. Abdomen segmentis duobus et apice tertii dorsalibus expositis, segmento secundo breviore, ultimo longiore, cæteris fere æqualibus; fimbriis distinctis, subparallelis, latioribus, pygidii antice dilatatis, postice angustatis; pygidio profunde emarginato. Tarsi dilatati.

Body subfusiform. Head short, with the epistome somewhat projecting. Eyes prominent, extending to the back of the head. Antennal grooves small, narrow, converging. Antennæ with the first article rather large and dilated in front; second smaller, ovate; third elongate; fourth to eighth short and nearly equal; seventh and eighth a little broader; ninth, tenth, and eleventh forming a large ovate club. Labrum entire. Mandibles with the apex simple. Maxillary lobes short, bearded from the apex on the inner side. Maxillary palpi with the first article very small, second dilated on the outer side, third shorter, fourth longest, cylindrico-conical. Ligula broad, with a short, semiovate membranous lobe placed obliquely in front on each side. Labial palpi stout, with the first article small, the second and third rather stout, subovate, nearly equal. Prothorax subdepressed, broader in front than behind, and narrower at the base than the elytra. Scutellum rather large. Elytra striated. Abdomen above with two segments and the margin of a third segment exposed, the second segment shortest, the last longest and emarginate at the apex, the rest nearly equal; the fimbriæ not wide, subparallel. Prosternum not keeled, but projecting somewhat behind. Metathorax without axillary pieces. Legs not very robust. Tarsi dilated.

BRACHYPEPLUS.

Position and Affinities.—CAMPSOPYGA. PROSOPEUS. MACROSTOLA.

CARPOPHILUS.

PROSOPEUS SUBÆNEUS. (Plate XXXIII. fig. 10.)

Subfusiformis, subdepressus, subæneo-brunneus, nitidus, punctatus, thorace lateribus rufo-testaceis translucentibus; elytris humeris, macula suturali prope apicem fere scutellum attingente et altera parva medio indistincte subtestaceis; elytris striatis, interstitiis seriatim punctatis. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in Caffraria.

Subfusiform, subdepressed, subæneo-brunneous, shining, punctate. Head strongly punctate. Antennæ testaceous. Thorax elongate, broader in front than behind, with the sides rufo-testaceous, slightly rounded, broadest before the middle, translucent, scarcely margined but slightly reflexed, rugosely punctate, more especially in front, with the disk slightly convex, slightly impressed on each side before the base; anterior angles nearly right-angled, posterior angles obtuse. Scutellum nigro-piceous or black, lightly punctate. Elytra broader and about a third longer than the thorax, a good deal broader than the base of the thorax, punctate-striate, punctures angular, interstices with a row of punctures, subquadrate; the shoulders square and rather prominent, the sides almost parallel, the apex of each elytron truncate obliquely inwards and forwards, exterior apical angles rounded, sutural angles slightly obtuse; the base with an elongate spot near the suture, reaching almost from the scutellum to the apex, and another small spot in the middle, indistinctly subtestaceous. Abdomen with fimbriæ and margins of last three segments below translucent and subtestaceous. Legs testaceous.

From the Cape of Good Hope.

Transition-Genera between the LATE-FIMBRIATA *and* ANGUSTE-FIMBRIATA.

Genus MACROSTOLA (*μακρὸς*, long; *στολὴ*, vest: alluding to the elytra).

Caput oculis maximis, tota capitis latera occupantibus; epistomate porrecto. Labrum integrum. Ligula angusta, alis membranaceis angustatis. Elytra elongata, striata vel seriatim punctata. Abdomen tribus segmentis expositis, haud fimbriatis, segmento secundo brevi, primo, tertio et quarto fere æqualibus, ultimo longiore.

Subconvex, elongate, conical both in front and behind. Head with the epistome projecting. Antennæ (Pl. XXXV. fig. 7 *a*) with the first article large and dilated, second smaller but thickish, third of same length as the second but more slender, fourth equal in thickness to but shorter than the third, fifth shorter and slightly thicker, sixth and seventh slightly thicker and more quadrate and about the same length as the fifth, eighth short and somewhat lenticular, ninth and tenth large, and eleventh smaller, these three forming a club so closely united as on a cursory view to look as if only composed of two articles. Labrum entire. Mandibles bicuspid at the apex. Maxillæ bearded on the inner side, without any tooth at the base. Maxillary palpi four-jointed, the second and third joint largest, the fourth conical. Ligula elongate and narrow, the tips of the paraglossæ visible on each side of the apex of the ligula*. Labial palpi three-jointed, the

* The structure of the ligula and paraglossæ in this species is very instructive. The ligula is seen in fig. 7 *e*, in

first joint very short, the second long and curved, the last straight on the inner side, gradually thickened towards the middle on the outer side. Mentum transverse, emarginate. Eyes very coarsely granulated and of very large size, occupying the whole of the space behind the antennæ and between them and the thorax: each eye is nearly as broad as the head between them. Prothorax small, transverse, subquadrangular. Scutellum large and broad. Elytra long, fully twice the length of the thorax, leaving the last three segments of the abdomen exposed. Exposed dorsal segments of abdomen shorter than the elytra, and very little, if any, longer than the thorax; fimbriæ absent, the suture between the ventral and dorsal segments of the abdomen being placed at the margin; the second segment of the abdomen the shortest, but not very short; the first, third, and fourth about equal in length; the last not very large—longer than the penultimate segment, not longer than the two penultimate segments taken together. Prosternum flat, slightly projecting and rounded, resting upon the mesosternum, which is flat and broad. The metathorax without axillary pieces. Legs moderate; tibiæ without a channel for the reception of the tarsi; tarsi not greatly dilated.

This genus is exceptional so far as regards the fimbriæ: they are as little developed as in a *Carpophilus*; but the other characters combine to show that its place is among the broadly fimbriated species of this group, and therefore I have put it here, although this character belies the very name I have given to the section in which it is placed. It is one of those cases in natural history which put at defiance all attempts to walk by absolute rules or invariable characters.

		CILLÆUS.	
Position and Affinities.—	PROSOPEUS.	MACROSTOLA.	CONOTELUS.
		CARPOPHILUS.	

1. MACROSTOLA STRAMINEA. (Plate XXXV. fig. 7.)

Subconvexa, elongato-fusiformis, nitida, glabra, læte castaneo-testacea, leviter punctata; elytris leviter punctato-striatis, interstitiis lineatis, sutura haud depressa. Long. 3 lin., lat. $\frac{3}{4}$ lin.

Habitat in Mexico.

Subconvex, elongate-fusiform, shining, glabrous, lightly punctate, bright testaceous chestnut. Head punctate, bifoveolate in front. Thorax transversely oblong, gently and slightly rounded in front, not emarginate, faintly punctate; posterior angles right-angled, anterior rounded. Scutellum faintly punctate at the base. Elytra subparallel, slightly narrower in front and behind, punctate-striate, with a faint line sometimes subpunctate in the interstices, the striæ reaching almost, but not quite, to the apex; humeral and exterior apical angles rounded, not depressed at the suture; convex and truncate at the apex; sutural angles nearly right-angled. Abdomen finely and thickly punctate.

From Mexico. Collected by M. Sallé.

Plate XXXV.; the paraglossæ in fig. 7 e*, which shows the back view. When the ligula is laid on the front of this, we have fig. 7 e**, which we see on looking into the mouth.

2. Macrostola lutea.

Cillæus luteus (Moritz).
Ips striatus (Schönh.).

Statura *M. stramineæ* et ei valde affinis, minor, luteo-testacea; elytris striato-punctatis, interstitiis haud lineatis. Long. 2 lin., lat. $\frac{1}{2}$ lin.

Habitat in America centrali, apud Cumanam, &c.

Of the form and appearance of *M. straminea*, to which it is very closely allied. Considerably smaller, luteo-testaceous; the head and thorax very faintly punctate; scutellum impunctate; elytra longitudinally convex, with the suture depressed, punctate-striate, without any line between the striæ. In other respects as in *M. straminea*.

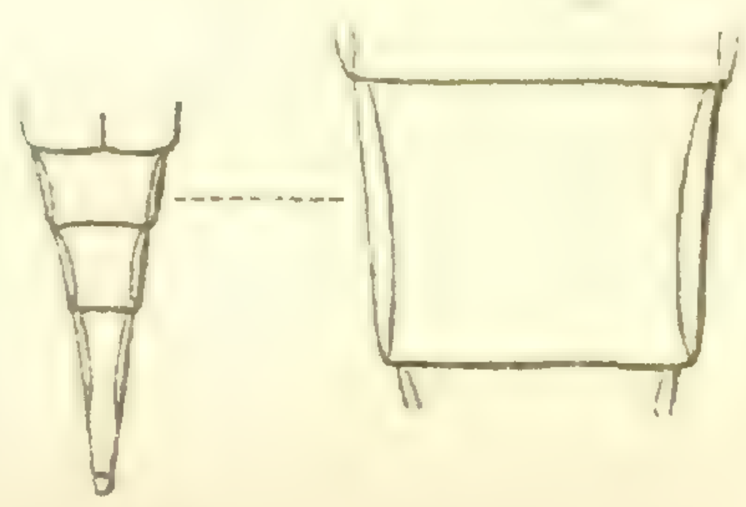
Easily distinguished from *M. straminea* by its smaller size, luteous colouring, more sparing and feebler punctuation, by the depressed suture of the elytra, and chiefly by the absence of the line between the striæ on the elytra.

From Cumana.

Genus Conotelus.

Erichs. in Germ. Zeitschr. iv. 249 (1843).
Lacordaire, Histoire des Ins. Coléoptères, ii. 298 (1854).

Fig. 94.



Caput sulcis antennariis, epistomate porrecto; oculis basin capitis attingentibus. Labrum integrum. Palpi labiales incrassati. Elytra levissime seriatim punctata vel striata. Abdomen segmentis primo et secundo brevissimis, tertio et quarto magnis, quinto elongato-conico, maris segmentulo anali dorsali auctum; fimbriis angustis, lateribus parallelis.

Small, narrow, convex, elongate, tapering from before backwards. Head moderate. Epistome slightly porrect. Eyes large and projecting, and occupying the whole side of the head from the antennæ to the base. Antennal grooves well marked and very convergent. Antennæ (Pl. XXXV. fig. 8 *a*) scarcely so long as the head: the first article a little enlarged on the outside; second as large, globular; third longer than any of the five following, which become shorter and thicker by degrees; the ninth, tenth, and eleventh forming a thick and globular club, truncate at the end. Labrum entire. Mandibles small, sharp at the point, the point with two or three small teeth or serrations behind it. Mentum short, broadly and feebly emarginate, with a fissure in the midst. Maxillary lobe coriaceous, strongly bearded on the inner side. Maxillary palpi short; first article very small, second short and dilated on the outside, third short and cylindrical, last article as long as the rest united, cylindrical, and truncate at the apex. Ligula (Pl. XXXV. fig. 8 *e*) coriaceous, with a small, rounded, membranaceous lobe at each of its anterior angles. Labial palpi robust: first article very small; second very large, thick, rounded, and truncate; third also large, but not quite so large, truncate. Prothorax not quite so broad as the elytra, transverse, convex. Elytra leaving the last three abdominal segments exposed, either striate or punctate in rows, although in some species so faintly as to be almost imperceptible. Abdomen elongate, tapering to the extremity: the first two segments very short, the next two long, the last elongate-conical; a small anal segment added in the males. The last segment appears to vary much in different individuals, being sometimes very long and narrow, but this seems to depend on the size of the insect. I have only found the long, produced tail or apical segment in large individuals in which the other segments are also larger and longer. Metathorax with the epimera and parapleura narrow, and without axillary pieces. Fimbriæ usually* very narrow and parallel to the sides. Legs short; thighs feebly canaliculated below; tibiæ without any channel for the reception of the tarsi; the first three articles of the tarsi dilated and hairy beneath; claws simple.

All the species of this genus are confined to the tropical regions of the American continent.

Position and Affinities.—MACROSTOLA. HALEPOPEPLUS. CONOTELUS. CARPOPHILUS.

1. CONOTELUS CONICUS.

Erichs. in Germ. Zeitschr. iv. 251 (1843).
Stenus conicus, Fabr. Syst. El. ii. 603 (1792).

Var. C. FUSCIPENNIS.

Erichs. in Germ. Zeitschr. iv. 251 (1843).
Ips gracilis (Dej. Coll.).

Niger, nitidus; thorace crebre punctato; elytris subseriatim punctatis, fuscis; pedibus testaceis. Long. $1\frac{2}{3}$ lin.

Habitat in insulis Indicis occidentalibus.

Black, somewhat shining. Antennæ and labrum rufo-piceous. Head subrugulosely punctate, bifoveolate in front. Thorax a little shorter than broad, thickly punctate, with the interstices leathery in appearance. Scutellum sparingly punctulate, rounded at the apex. Elytra punctate in rows, the punctures distinct, tolerably deep and well defined, and pretty far apart; fuscous, becoming black at the apex. Abdomen shining, more sparingly and faintly punctate, with the segments margined with piceous; below piceous, the anterior segments black at the base. Legs testaceous.

Under the microscope the thorax appears very distinctly (almost deeply) and sparsely punctate, without being mixed with pittings or variolose flat punctuation. The punctures on the elytra are also distinct, oblong in shape, and in rows, but not in striæ. It is easily distinguished by the widely punctate-striate elytra.

From the West Indies.

The variety *C. fuscipennis* (which is from Cuba) differs from the type in being nearly a half smaller, the mouth and antennæ paler, and the punctuation more sparing and more widely scattered. Erichson himself points out the affinity of these varieties. I have examined the typical specimen, which is founded upon a unicate, and it appears to me to be merely a variety, smaller in size, and, as is usually the case in such instances, more faintly punctate.

* The exceptions are *C. rufipes*, *C. Mexicanus*, and *C. Stenoides*; and in these the fimbriæ are raised, prominent, and not so narrow as in the other species.

2. Conotelus obscurus.

Erichs. in Germ. Zeitschr. iv. 252 (1843).
Stenus spissicornis, Fab. Syst. El. ii. 603 (1792).

Niger, capite, thorace elytrisque opacis, his subtilissime seriatim aciculariter punctatis, nigro-fuscis; abdomine nitido; pedibus testaceis. Long. $1\frac{3}{4}$–2 lin., lat. $\frac{1}{2}$ lin.

Habitat in partibus meridionalibus Americæ borealis.

Black. Antennæ testaceous, with the club ferruginous. Head opaque, very thickly and faintly variolosely punctate, bifoveolate in front. Thorax very slightly narrower in front than behind, very thickly and faintly rugulose, opaque, most obsoletely subvariolosely punctate. Scutellum closely and faintly rugulosely punctate, opaque, with the apex rounded. Elytra very closely and faintly rugulose, densely and very faintly and obsoletely punctate-striate (punctures shallow pits), opaque, obscure fuscous, becoming black on all the margins. Abdomen sparingly and faintly punctate, shining, the segments margined with piceous, the last wholly piceous below. Legs testaceous.

Under the microscope the punctuation of the thorax is a mixture of larger and smaller, flat, variolose, pitted depressions. The serial punctures on the elytra are likewise flat, variolose, reminding one of rain-drops on sand.

Found in the south of North America.

3. Conotelus niger.

Erichs. in Germ. Zeitschr. iv. 253 (1843).
Brachychlamys nigra (Germ.).

Niger, capite, thorace elytrisque opacis; pedibus testaceis, basi piceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Brasilia.

Of the form and size of, and very closely allied to, *C. obscurus.* Black. Antennæ testaceous, the first two articles and the club piceous. Head opaque, with the forehead punctate-rugose, bifoveolate in front. Thorax very closely rugulose, very much obsoletely punctate, opaque. Scutellum closely and faintly rugulosely punctate, opaque, truncate at the apex. Elytra very closely and faintly rugulose, very faintly and most obsoletely punctate in rows, opaque, black. Abdomen sparingly and obsoletely punctate. Legs testaceous, with the thighs piceous at the base.

Distinguished from all the other species by its much more deeply punctate-rugose thorax.

From Brazil and other parts of South America.

4. Conotelus vicinus.

Erichs. in Germ. Zeitschr. iv. 253 (1843).

Niger, subnitidus, capite, thorace elytrisque opacis, pedibus piceis. Long. $1\frac{1}{2}$–$1\frac{3}{4}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Columbia.

Black, somewhat shining. Antennæ piceous, club black. Head opaque, with the forehead punctate-rugose, bifoveolate in front. Thorax very thickly and finely rugulose, opaque. Scutellum very thickly punctate, opaque, truncate at the apex. Elytra very thickly and faintly rugulose, opaque, concolorous, with almost imperceptible, small, shallow surface-impressions in rows, the impressions smaller, closer together, and more oblong than in *C. femoralis*. Abdomen thickly punctate, somewhat shining. Legs pitchy black.

Very closely allied to *C. niger*, *C. femoralis*, *C. rufipes*, and *C. Mexicanus*. The following are some of the distinguishing points:—*C. niger* has the thorax much more coarsely punctate than any of the rest. *C. femoralis* has the surface more opaque and not so shining, the elytra with a slightly brownish-purple tinge, and the antennæ and legs testaceous instead of nearly black. *C. rufipes* is more opaque and not of so clear a black; so is *C. Mexicanus*, which, besides, is smaller and has black legs.

From Columbia.

5. Conotelus femoralis.

Erichs. in Germ. Zeitschr. iv. 253 (1843).

Niger, capite, thorace elytrisque opacis, antennarum basi pedibusque testaceis, femoribus piceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Columbia.

Black. Antennæ testaceous, with the first article and the club piceous. Head opaque, faintly rugosely punctate, bifoveolate in front. Thorax very closely and faintly rugulose, opaque, margined, the margin continuing along the base. Scutellum very thickly punctate, opaque, with the apex truncate. Elytra very closely and faintly rugulose, opaque, brownish purplish black, with almost imperceptible, small, flat, shallow, roundish surface-impressions in rows, the margin well marked. Abdomen sparingly and finely punctate, shining. Legs testaceous, with the thighs piceous.

Very nearly allied to *C. niger*, *C. vicinus*, *C. rufipes*, and *C. Mexicanus*. See the remarks on them made under *C. vicinus*.

From Venezuela.

6. Conotelus rufipes.

C. femorali affinis; differt thorace rugoso et haud punctato, pedibus testaceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Mexico.

Nearly allied to *C. femoralis*, and doubtless the Mexican representative of that Columbian species; rather smaller; and chiefly to be distinguished by the thorax and elytra having a texture like fine morocco-leather, and the thorax without punctures or nearly so. Head, thorax, and elytra dull. Abdomen somewhat shining. The elytra have slight traces of a linear arrangement of the rugosities. Abdomen somewhat shining and sparsely and finely punctate; fimbriæ broader than in most of the other species. Antennæ rufous, with the club dusky. Legs testaceous, thighs a little darker.

Collected by M. Sallé in Mexico.

7. CONOTELUS MEXICANUS.

C. vicino affinis; differt thorace rugoso et haud punctato, pedibus nigris. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{5}$ lin.

Habitat in Mexico.

Closely allied to *C. vicinus*; and as *C. femoralis* and *C. vicinus* are very closely allied to each other in Columbia, so are *C. rufipes* and *C. Mexicanus* in Mexico, where they take their place. Smaller than *C. vicinus*; less shining and of a less clear black, it being rather a dull, very slightly brownish, black. Head, thorax, and elytra opaque, instead of being somewhat shining as is the case in *C. vicinus*. The thorax instead of being finely punctate is finely confluently rugose like morocco-leather. The elytra have very slight traces of a linear arrangement of its rugosities. The abdomen is somewhat shining and finely and sparsely punctate; fimbriæ broader than in *C. vicinus*. Legs black.

Collected by M. Sallé in Mexico.

8. CONOTELUS SUBSTRIATUS.

Erichs. in Germ. Zeitschr. iv. 253 (1843).
C. nitidus (Motsch.).

Niger, nitidus, punctulatus, elytris subtiliter punctato-striatis, interstitiis punctulatis; pedibus piceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Columbia et America centrali.

Black, shining. Antennæ testaceous, with the first article and the club piceous. Head very closely punctulate, bifoveolate in front. Thorax closely punctate, with the sides very faintly rugulose. Scutellum very faintly and obsoletely punctulated, with the apex rounded. Elytra faintly and neatly punctate-striate, the striæ becoming obsolete at the apex, the interstices flat, very faintly punctulate. Abdomen sparingly and obsoletely faintly punctulate. Legs piceous, knees and tarsi testaceous.

From Columbia.

9. CONOTELUS NITIDUS.

C. substriato affinis: niger, nitidus, sparsim et sat fortiter punctatus, convexus; thorace brevi, transverso, longitudine latiore; scutello transverso, truncato; elytris striato-punctatis, fortius et minus regulariter quam in *C. substriato*, interstitiis sparsim punctatis; abdominis segmentis brevibus; pedibus piceis. Long. $1\frac{1}{3}$ lin., lat. $\frac{2}{5}$ lin.

Habitat in Brasilia.

Black, shining, shorter than most of the others, convex, with the sides rounded; covered sparingly with distinct punctures. Thorax short, transverse, broader than long; base rounded, angles rounded and obtuse. Scutellum transverse, truncate. Elytra with irregular and interrupted rows of punctures, deeper but more interrupted than in *C. substriatus*; the interstices with an occasional puncture forming a widely scattered row, and with a great accumulation of punctures near the base; an elongate impression on each side of the suture towards its base. The exposed segments of the abdomen distinctly covered with scattered large punctures shorter and apparently broader than usual.

I have seen only a single specimen, from Brazil, in Prof. Boheman's collection.

10. Conotelus luteicornis.

Erichs. in Germ. Zeitschr. iv. 254 (1843).

Niger, nitidulus, parcius punctulatus, elytris subtiliter punctato-striatis, interstitiis sublævibus, pedibus testaceis. Long. $1\frac{1}{2}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Brasilia.

Black, somewhat shining. Antennæ testaceous, with the club black, the first article piceous. Head sparingly punctate, bifoveolate in front. Thorax sparsely punctate, with the sides very faintly rugulose. Scutellum very faintly sparingly punctate, rounded at the apex. Elytra neatly and faintly punctate-striate, the striæ becoming obsolete at the apex, the interstices having a leathery appearance, sparingly and obsoletely punctulated. Legs testaceous.

From Brazil.

11. Conotelus Stenoides.

C. humeralis (Motsch.).

Elongatus, angustatus, subdepressus, opacus, punctatus, fusco pubescens, niger; antennis testaceis, clava ferrugineo-testacea; pedibus testaceis; thorace lateribus sub lente forte serratis; elytris tenuissime seriatim punctatis et subcostatis; abdomine angustato, fimbriis elevatis. Long. $1\frac{1}{3}$–2 lin., lat. $\frac{2}{5}$ lin.

Habitat in America centrali.

Long, narrow, slender, subdepressed, very opaque, black or brown-black, granularly and variolosely punctate, and fusco-pubescent. Antennæ testaceous, with the club large, oblong, piceo- or ferrugineo-testaceous. Mouth piceous. Head very finely subrugosely punctate, the punctures, although very small, still more variolose than sharp, slightly depressed on each side of the epistome, which is rather prominent. Thorax subquadrate, about as broad as long, a little narrower behind than in front, scarcely emarginate in front; the sides nearly straight, slightly narrowed in front and obliquely cut off behind, the angle at which they turn in very obtuse, rounded; anterior angles nearly right-angled, very slightly obtuse; posterior angles apparently very obtuse; disk somewhat convex, with slight irregular depressions, sides slightly expanded and canaliculate: the margins, under the microscope, are seen to be more or less jagged or serrated, more coarsely punctate and pubescent than the head, the pubescence lying from the sides transversely towards the middle, and the punctures faintly variolose. Scutellum transverse, broad, truncate, punctate and pubescent as on the thorax. Elytra wider and about a half longer than the thorax, with what appears to be a series of very slender raised lines, between which is another less raised line. These are, however, caused by the pubescence running in lines. If it is scraped off, the costæ disappear or nearly so. Between them is a series of variolose punctures (eight rows in all), and the general texture of the elytra is subgranulated; shoulders rounded, not prominent, sides straight and slightly margined; apex somewhat obliquely truncate; sutural apical angles right-angled, exterior apical angles rounded. Abdomen faintly punctate; fimbriæ raised and prominent. Legs testaceous.

From Panama. I owe this well-marked species to the kindness of M. de Motschulsky.

The following dichotomous Table may assist in determining the species of this difficult genus:—

	Wholly of one colour	1
	Elytra not so black as the rest of the body	2
1	Margins of thorax not crenulated	3
	Margins of thorax crenulated	*Stenoides.*
2	Elytra punctured in rows, punctures distinct, apart, rather deep and decided	*conicus.*
	Elytra with small variolose impressions in rows	*obscurus.*
3	Elytra clearly but finely punctate-striate	4
	Elytra very indistinctly punctate in rows	5
4	Striæ on elytra not interrupted, and interstices not punctate	6
	Striæ sometimes interrupted, and interstices with a widely scattered row of punctures.	*nitidus.*
5	Thorax punctate	7
	Thorax rugose like morocco-leather	8
6	Antennæ and legs black	*substriatus.*
	Antennæ (except the club) and legs testaceous	*luteicornis.*
7	Thorax strongly and thickly punctate	*niger.*
	Thorax not deeply punctate	9
8	Legs testaceous	*rufipes.*
	Legs black	*Mexicanus.*
9	Thorax and elytra dull. Legs testaceous	*femoralis.*
	Thorax and elytra somewhat shining. Legs black	*vicinus.*

Section Anguste-fimbriata.

Abdomen fimbriis angustatis vel vix perspicuis. Elytra haud striata*.

Genus Ctilodes (κτίλος, a ram (battering-ram); εἶδος, appearance).

Caput oculis haud basin attingentibus; epistomate protenso, medio profunde excavato; sulcis antennariis convergentibus. Labrum bifidum, membranaceum, barbatum, elongatum. Mandibulæ magnæ, apice bicuspidatæ, interne dentatæ. Abdomen fere sine fimbriis; segmentis ultimis duobus expositis; secundo et tertio brevioribus.

Large, subcylindrical, oblong-ovate, irregularly punctate. Head large, broad, and when at rest dependent. Eyes not large, not projecting, and not reaching to the base of the head. Epistome conical and projecting, but at the point deeply excavated, leaving a

* But for some exceptional species in the previous section, I should have added the presence or absence of striæ on the elytra to the breadth of the fimbriæ as a character for separating the sections. The whole of the *Anguste-fimbriata* (with the exception of those I have placed as transitional genera) have the elytra without striæ. The whole of the *Late-fimbriata* (with the exception of a few *Colasti*) have them more or less distinctly striated.

projecting tooth on each side. Labrum elongate, membranaceous, projecting, covered entirely with long hairs, bilobed, divided straight up the middle, the exterior margins sloping obliquely outwards and backwards. Antennæ rather longer than the head; first article not thick, but nearly as long as the seven following articles taken together; second article rather long, but much shorter than the first; third article longer than the second; fourth article also rather long, but shorter than the second; fifth, sixth, and seventh articles short, small, and nearly of the same size; eighth broader; ninth, tenth, and eleventh forming the club, which is flat and round. Antennal grooves very well marked, convergent. Mandibles large, thick, coarse, strongly punctate, slightly bent in an elbow on the outside, bicuspid at the apex, and with a rounded tooth or projection, and a fringed plate or beard behind it, on the inner side. Maxillæ large, thickly bearded at the apex and on the inner side*. Maxillary palpi slender, subcylindrical, with the first article small, the second and third rather long, the second longer than the third, and the fourth elongato-fusiform and as long as the second and third taken together. Ligula corneous, with two large, subovate, transparent, membranous lobes. Labial palpi slender, cylindrical, first article minute, second and third nearly equal in length. Mentum broad, with a double margin (Pl. XXXVI. fig. 1 *e*), both margins broadly emarginate. Prothorax subcylindrical. Scutellum rounded at the apex. Elytra not striated, irregularly punctate, subquadrate, subcylindrical. Abdomen somewhat convex, with the last two segments exposed above; below, the second and third segments shortest and nearly equal, first and fourth nearly equal, last longest; fimbriæ scarcely present. Metathorax without axillary pieces. Legs stout. Tibiæ expanded on the inner side towards the apex, and there parallel to the outer side and thickly clothed with strong hairs. Tarsi much dilated, and thickly clothed with hairs. Claws simple and short.

The insect on which this genus is founded, although possessing characters too peculiar to allow it to be treated otherwise than as a distinct genus, has most affinity with the subcylindrical species of *Carpophilus*.

		BOSTRICHUS.	
Position and Affinities.—	CONOTELUS.	CTILODES.	CARPOPHILUS.
		LUCANUS.	

CTILODES BOSTRICHOIDES. (Plate XXXVI. fig. 1.)

Oblongo-ovatus, subcylindricus, sat nitidus, crebre et fortiter punctatus, niger; labro tarsisque fulvo barbatis. Long. $5\frac{1}{4}$ lin., lat. $2\frac{1}{8}$ lin.

Habitat in insula Morty prope Gilolo.

Oblong-ovate when the head is protruded, when bent down oblong in front and oblong-ovate behind, subcylindrical, somewhat shining, thickly and deeply punctate, black; the labrum and the tarsi thickly clothed with bright reddish fulvous hairs. Head transversely depressed behind the forehead, and with a deep, concave, subcordiform depression in front, the broad bicurved end in front; sides of the epistome sinuate, margins transverse

* In the examination of this part it became broken, and the fragments showed that it had split longitudinally into horizontal plates.

above the base of the antennæ. Thorax nearly quadrate, all the angles, apex, and sides rounded; base truncate, bisinuate; a slight depression immediately behind and along the apex, and two transverse, slight, broad depressions running across, the one a little before the middle, and the other a little before the base. Scutellum wholly punctate. Elytra with a slight depression around the scutellar region, and another still more slight behind it; shoulders square; sides seen from above straight, but from the sides rounded; the apex of each elytron truncate obliquely from the suture outwards and backwards, exterior apical angles broadly rounded, sutural angles obtuse. Underside punctate. The hairs on the inner side of the expansion of the tibiæ bright fulvous.

This singular insect, although a perfect Nitidularian and closely allied to *Carpophilus*, is interesting from its evident tendency to a relationship with *Bostrichus* and *Lucanus*. The fulvous-red hairy labrum and the large, coarse, geniculated mandibles of these families are here reproduced. We know nothing of its habits or mode of life, but it needs no ghost to tell us that, like the *Lucanidæ* and *Bostrichidæ* whose mandibles and labrum it respectively bears, it is a Xylophagous insect.

A single specimen was collected by Mr. Wallace in the island of Morty, near Gilolo. It is now in the British Museum.

Genus CARPOPHILUS, Leach.

Steph. Illustr. Brit. Ent. iii. 50 (1830).
Erichs. in Germ. Zeitschr. iv. 254 (1843).
Sturm, Deutschl. Ins. xv. 33, taf. 292 (1844).
Erichs. Naturg. Ins. Deutschl. iii. 134 (1848).
Lacord. Hist. des Ins. Coléopt. ii. 295 (1854).

Caput sulcis antennariis; epistomate porrecto. Labrum bilobum. Abdomen fimbriis vix perspicuis; segmentis duobus vel tribus expositis, plerumque secundo tertioque brevissimis; maris segmentulo anali ventrali auctum.

A numerous genus of insects, scattered over the whole world. Some of the species are cosmopolitan, having probably been introduced into distant countries by the agency of man. They are found in flowers, under the bark of trees, and in decayed fruits.

Their form is for the most part short, broad, and more or less depressed. Head broad. Eyes variable in size. Epistome raised and projecting; antennal grooves short and convergent. Antennæ a little longer than the head, the first article enlarged or widened on the outside; second cylindrical, thicker and a little shorter than the third; fourth to eighth short; ninth to eleventh forming a large club more or less rounded or oval. Labrum bilobed, the lobes rounded. Mandibles broad, their tip usually preceded by a small tooth on the inner side. Lobes of the maxillæ rather broad, ciliated at the apex and on the inner side. Maxillary palpi with the last article conical and as long as all the rest together. Labial palpi with the last article a little widened and truncated at the apex. Ligula entire, its angles with a membranous wing, which is slightly falcate, rounded at the end, and ciliated on the inner or anterior side. Mentum transverse, broadly emarginate in front. Prothorax transversal or subquadrate, feebly emarginate in front, with the sides margined, in most species as broad as the elytra and bisinuate behind.

Scutellum rather large. Elytra not striated, leaving the last two or three abdominal segments exposed, each elytron usually more or less obliquely truncate from the suture backwards; exterior apical angles rounded. Abdomen with the second and third segments usually very short; first, fourth, and fifth tolerably large; an additional rounded ventral anal segment in the males. Prosternum widened and rounded behind, reaching to the mesosternum. Metathorax without axillary pieces. Fimbriæ absent or minute. Legs short, robust; thighs canaliculated below to receive the base of the tibiæ, which are widened at the apex, their terminal spurs rather strong; the first three articles of the tarsi dilated, hairy beneath; claws simple.

These characters must not be expected to be found rigidly applicable to every species which belongs to this genus. It contains such a large number of species, many of which I have not had the opportunity of dissecting, that it is not improbable that some may turn out to deviate in one or other of the more minute characters. The more important characters will, however, be found in them all.

(Subgenus UROPHORUS (οὐρὰ, tail; φορὸς, bearer).)

Abdomen segmentis tribus ultimis supra expositis; elytris haud elongatis.

This subgenus differs from the normal *Carpophili* in having the last three dorsal segments of the abdomen exposed, instead of only two, while the elytra are only of moderate length. There is another subgenus (*Heterodontus*) in which three segments are exposed, but in it the elytra are much elongated and as it were overshadow the exposed segments. In this it is not so. With one exception, all the species yet known are shining, nearly glabrous, and hard in texture, while the other *Carpophili* are more or less pubescent and either shagreened or soft.

1. CARPOPHILUS RUBRIPENNIS.

Erichs. Ins. Deutschl. iii. 135 (1848).

Ips rubripennis, Heer, Faun. Col. Helv. i. 417 (1841).

Carpophilus castanopterus, Erichs. in Germ. Zeitschr. iv. 256 (1843).

Oblongus, subcylindricus, confertim punctatus; elytris castaneis vel rubris, antennis pedibusque rufis. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in Europa meridionali.

A very distinct species. Oblong, subparallel, moderately convex, nearly glabrous, with scarcely any perceptible pubescence, black, somewhat shining; antennæ red; mouth more or less ferruginous. Head thickly and deeply punctate, the forehead on each side with a slight impression. Thorax of the breadth of the elytra, a half broader than long, rounded on the sides, widest in front, towards the sides more densely and very coarsely punctate, the punctures variolose; more sparsely and finely punctate in the middle; the marginal edging with a deep furrow, disappearing behind the anterior angles, which are somewhat projecting and rounded, the posterior angles very obtusely rounded; an impression on each side, some distance within these angles, in which the punctures are deeper. Scutellum finely punctate at the base. Elytra a half longer than the thorax, thickly punctured, red, with a narrow edging of black at the base, and a wider one at the apex, both gradually passing from black into red; seen from above, the sides seem straight and parallel, but looked at from the side are seen to be gently rounded, and with their margins clear piceous red, deeply canaliculated, the furrow widest in the middle; apex of each elytron truncate obliquely from the suture backwards, exterior apical angles rounded, sutural obtuse. Breast and abdomen thickly punctured; segments of abdomen griseo-pubescent, the margins of the segments translucent and rufescent. Legs red.

Erichson in his Monograph in Germ. Zeitschr. treats *C. rubripennis* as possibly distinct from his *C. castanopterus*, because Heer in his description of the thorax gives as a character "margine laterali longitudinaliter obsolete impresso," which he could not find in his specimen (nor can I in mine); but in his 'Insekten Deutschlands,' published subsequently, he unites them.

Found in Austria, Sicily, Sardinia, Italy, &c., but very rare. Through the kindness of Dr. Schaum of Berlin I have been enabled to place a specimen in the British Museum.

2. Carpophilus humeralis.

Erichs. in Germ. Zeitschr. iv. 255 (1843).
Nitidula humeralis, Fab. Syst. El. i. 354. 31 (1792).
Ips humeralis, Dej. Cat. p. 134 (1837).
Brachypterus picinus, Bohem. Ins. Caffr. i. 560 (1848).

Parum latus, subquadratus, parum convexus, nigro-piceus, punctatus, parcissime pubescens, fere glaber, nitidus, durus; mandibulis palpisque rufo-ferrugineis, antennis pedibusque rufo-testaceis; capite prothoraceque crebre mediocriter punctatis, hoc utrinque ante basin leviter impresso; elytris dilutioribus, sat crebre mediocriter punctatis, singulis basi ad callum humeralem interdum macula obsoleta ferruginea. Long. $1\frac{3}{4}$ lin., lat. $\frac{2}{3}$ lin.

Var. A. Elytris macula humerali absente.

Var. B. Glaber, minus fortiter punctatus; elytris totis castaneis.

Habitat in Madagascaria, Caffraria, India orientali, insula Mauritia, China, Java, etc.

Somewhat convex, subquadrate, rather broad, nigro-piceous, shining, punctate, very sparingly pubescent; texture hard. Head slightly convex, thickly punctate; the mandibles on the inner side and the palpi rufo-ferruginous. Antennæ short, rufo-testaceous, club darker, sparingly pubescent. Thorax shorter than broad, thickly punctate, slightly pubescent on the sides, lightly impressed transversely on each side before the base; in front rather deeply rounded, emarginate, the anterior angles obtuse; the sides gently rounded, widened in the middle, with the margins slenderly reflexed, very little narrowed behind, posterior angles obtuse, base slightly curved. Scutellum short, broad, rounded at the apex, very finely punctate. Elytra scarcely a half longer than the thorax, not broader than its base, somewhat convex, rather thickly punctate, usually marked near the shoulders with an indeterminate, obsolete ferruginous spot, shoulders not very prominent, sides somewhat widened in the middle, the apex of each elytron truncate obliquely backwards from the suture, sutural apical angles obtuse, exterior apical angles rounded.

Body below nigro-piceous, somewhat shining, faintly thickly punctate. Legs rufo-testaceous, obsoletely punctulate, sparingly pubescent.

From Madagascar, Mauritius, Natal, Caffraria, East Indies, Java, and China.

3. Carpophilus foveicollis.

Valde affinis *C. humerali* Fab., forsan varietas ejus; major, magis depressus, magis punctatus; thorace fovea grandi prope angulos posticos, angulis anticis et interdum lateribus ferrugineis, elytris basi intus humeros macula ferruginea majore. Long. 2 lin., lat. $1\frac{1}{4}$ lin.

Habitat in Macassar, in Pulo Penang et in Celebes.

Very nearly allied to *C. humeralis*. It is usually larger than that species. It is not so convex, and has a squarer and more massive appearance; the head is proportionally not quite so broad. The punctuation throughout is not only coarser, but more frequent and close. The slight depression on the thorax near each of the posterior angles in *C. humeralis* is here a deep, somewhat transverse, coarsely punctate fovea. The elytra are not so convex, are a little flatter on the surface, and have a depression behind the shoulder. The anterior angles of the thorax, and sometimes also the posterior angles, are ferruginous; sometimes also the whole of the sides. The ferruginous spot at the base of the elytra next the shoulder in *C. humeralis* is larger, and extends from the shoulder to the scutellum, and the elytra have sometimes the whole disk rufo-ferruginous or rufo-testaceous; when the insect is fresh and unrubbed there is a fine, sparing, testaceous silky pubescence upon the elytra. Sometimes the insect is wholly black, without any part ferruginous at all, except the legs.

All these differences, it will be seen, are merely differences in degree, and if looked at very strictly would, I think, prevent this being regarded as more than a climatal variety. As, however, it looks distinct, it will probably be practically more serviceable to the entomologist who may not be acquainted with it, if I give it a place as a distinct species, which I do, however, only provisionally and with this explanation.

From Macassar and Pulo Penang, Celebes. Collected by Mr. Wallace.

4. Carpophilus adumbratus. (Plate XXXIII. fig. 5.)

Sat latus, subdepressus, subnitidus, fere glaber, textura dura, punctatus; testaceus, capite, thoracis disco, elytris humeris et apice, et corpore subtus plus minusve obscure fuscis vel nigris. Long. $2\frac{1}{4}$ lin., lat. $1\frac{1}{4}$ lin.

Var. C. conspicuus. Locis adumbratis vivide nigris.

Habitat in China boreali.

Broad, subdepressed, rather shining, nearly glabrous, with a hard texture, punctate; testaceous, with the head, the disk of the thorax, the shoulders and apex of the elytra, and the underside more or less obscurely fuscous or black. Head thickly punctate, with a somewhat curved impression in front. Antennæ testaceous, with the club obscure. Thorax transverse, broader than long, sparsely punctate, more thickly so on the disk, narrower in front, the sides slightly rounded, with a small impression a little before, and another, less distinct, a little behind their middle, anterior angles rounded, posterior angles obtuse, base straight; disk bi-impressed on each side a little behind the middle. Scutellum shining, very slightly punctulate towards the base. Elytra a half longer than the thorax, rather strongly and sparsely punctate, more thickly punctured with smaller punctures near the suture; shoulders prominent, sides subparallel, very slightly rounded, the apex truncate almost straight; a fuscous or dark fawn-coloured band stretching across the apex and reaching nearly halfway up the side and a quarterway up the suture, and not so far up between them; sometimes the apical margin of this band is paler. The shoulder has usually a dark curved streak bending backwards and inwards towards the suture; the disk, obliquely from the shoulder to the suture behind the middle, is also dark in some individuals. Abdomen punctate. Prosternum testaceous; mesosternum, metasternum, and abdomen infuscate or black. Legs testaceous.

Var. *conspicuus*. The darker parts of this species are usually, as above mentioned, of a dark fawn or fuscous colour; but there is a specimen in Mr. Bowring's collection in which they are wholly black, giving the insect so different an appearance, that I have thought it advisable to record it as a variety under this name.

From North China.

5. Carpophilus discolor.

(Klug, inedit.); Erichs. notat. sed haud descrip. in Germ. Zeitschr. iv. 256 (1843).
C. badius (Dup.).

Oblongo-ovatus, sat latus, parum convexus, nitidus, glaber, punctatus, ferrugineo-piceus, thoracis lateribus dilutioribus. Long. $1\frac{3}{4}$ lin., lat. $\frac{5}{6}$ lin.

Habitat in Madagascaria.

Oblong-ovate, broadish, somewhat convex, shining, glabrous, punctate, ferrugineo-piceous. Head distinctly sparsely punctate, very slightly obliquely impressed in front; mouth testaceo-rufous. Antennæ testaceo-rufous, with the club fuscous. Thorax narrower in front than behind, the sides declinate, rounded; anterior angles obtusely rounded, posterior angles obtuse; sparsely punctured on the disk, more thickly towards the sides; apex truncate. Scutellum rounded, smooth, impunctate, except a few indistinct punctures at the base. Elytra scarcely wider than the thorax at the base, not much longer than the thorax, rather convex, the sides declinate and rounded, most so before the middle, the margination strong, and leaving a furrow inside reaching behind the middle, very distinctly punctured; shoulders rather prominent; apex of each elytron truncate obliquely and roundly backwards from the suture. Abdomen convex above, more finely and obscurely punctate, subpubescent. Legs ferrugineo-rufous.

Collected by Goudot in Madagascar, and not very rare in collections.

6. Carpophilus nitidus.

Affinis *C. discolori*, parum major, latior, oblongo-ovatus, parum convexus, nitidissimus, punctatus, aterrimus, antennarum basi pedibusque læte testaceis. Long. 2 lin., lat. 1 lin.

Habitat in Calabaria antiqua.

Allied to *C. discolor*; rather larger, broader, oblong-ovate, convex, shining, punctate, deep black. Head not distinctly punctate, very smoothly subpunctate. Mandibles and palpi black; base of the antennæ clear testaceous. Thorax as in *C. discolor*, but more convex, especially in front, the lateral margin stronger. Elytra broader and less distinctly punctate. Legs clear testaceous. In other respects as in *C. discolor*.

Most readily distinguished from *C. discolor* by the general colour, by the mandibles and palpi being black, and by the clearer pale testaceous legs and base of the antennæ: the punctuation on the head is much finer and closer than on the thorax, while in *C. discolor* it is of the same character.

From Old Calabar. Received from the Rev. W. C. Thomson and placed in the British Museum.

7. CARPOPHILUS RUBIGINOSUS.

Convexus, oblongo-ovatus, subnitidus, confertim punctatus, sparsim pubescens, rubiginosus; thorace utrinque postice profunde foveolato. Long. $1\frac{1}{2}$–$2\frac{1}{3}$ lin., lat. $\frac{4}{5}$–1 lin.

Habitat in Java.

Convex, oblong-ovate, very thickly punctate, somewhat shagreened, sparsely pubescent, rubiginous. Head even, very little impressed on each side in front. Antennæ rufous, club fuscous. Thorax transverse, much narrower in front than behind, sides gently rounded, broadest part behind the middle; apex emarginate, emargination rounded; anterior angles nearly right angles, posterior angles obtuse; disk convex, coarsely and thickly punctate, in some individuals darker than the rest of the body; there is a short smooth line in front of the scutellum, and a deep fovea on each side towards the posterior angles; base bisinuate; sides deeply margined. Scutellum subpentagonal, apical angles rounded; smooth, except towards the base, which is punctate, pubescent, and darker in colour. Elytra convex, with the sides bulging and rounded, deeply margined, most so towards the base, widest a little before the middle, more pubescent and less coarsely punctate than the thorax; shoulders little prominent, the scutellum and sutural region and the outer margins darker-coloured; apex of each elytron truncate obliquely backwards from the suture, exterior apical angles rounded, sutural apical angles obtuse. Abdomen convex; segments large, except the pygidium, which is smallest. Legs rufous.

From Java. Collected by Mr. Wallace. In the British Museum.

Species mihi invisa.

8. CARPOPHILUS CAUDALIS.

Leconte, Proc. Acad. Nat. Sci. Philad. Feb. 1859, 70.

"Elongatus, depressus, piceus, nitidus, subtiliter pubescens, elytris macula magna rubrotestacea triangulari utrinque ornatis, pedibus antennisque rufis, his clava infuscata; abdomine segmentis tribus detectis, segmento quarto paulo longiore. Long. $1\frac{1}{2}$ lin.

"Habitat in California.

"Elongate, depressed, piceous, shining, finely pubescent. Antennæ rufous, with a dusky club. Thorax short, the sides rounded, rather thickly punctate. Elytra twice as long as the thorax, more strongly margined, punctulate, with a large testaceous-red triangular patch on each side. Abdomen with the last three segments exposed, the fourth segment a little longer. Legs rufous."

Dr. Leconte mentions that this species precisely resembles in colour and sculpture his *C. discoideus*, but differs in the abdomen being much longer, and in having three segments exposed instead of only two. Dr. Leconte suggests that it may be the female of that species. I have not seen it, and have merely reproduced his description. If it has an affinity to *C. discoideus*, it can have little to the other species of this subgenus.

From Fort Tejon, Nebraska, in California, &c.

(Subgenus Carpophilus proper.)

Caput oculis modicis. Abdomen segmentis duobus ultimis solum expositis et secundo et tertio cæteris distincte brevioribus.

This subgenus embraces a large number of species, many of which differ considerably in form from each other, and I have broken it up into corresponding sections; but all have the eyes moderate and only the last two segments of the abdomen exposed, and the second and third segment much shorter than the other segments.

Section I. Texture hard, shining, and nearly glabrous.

9. Carpophilus marginellus. (Plate XXXIII. fig. 1.)

Motsch. Etudes Ent. vii. 40 (1858).

Oblongo-ovatus, parum convexus, nitidus, fere glaber, durus, punctatus, tenuiter griseo pubescens, piceo-ferrugineus, disco thoracis et singulorum elytrorum gradatim nigris. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in India orientali, Taprobana, China, &c.

Oblong-ovate, somewhat convex, shining, almost glabrous, hard in texture, feebly griseo-pubescent, punctate, piceo-ferruginous, the disk of the thorax and of the elytra becoming gradually black. Head bifoveolate in front, punctate. Thorax with the sides nearly straight for the posterior two-thirds of their length, then turned-in in front, apex emarginate, anterior angles declinate, nearly right angles, posterior angles slightly obtuse, sides and base slightly margined, base truncate; a rather deep punctate impression on each side near the posterior angles, the rest of the thorax rather thickly but faintly punctate. Scutellum transverse, pentangular, the base punctate, the apex smooth. Elytra of the breadth of the thorax and continuous with it, punctate; sides parallel and straight when seen from above, seen from the sides inflexed, slightly rounded and margined; base straight, with the humeral angles sharply rectangular; the shoulders close to the side, and within them a slight longitudinal impression; apex obliquely truncate; exterior apical angles rounded. Underside ferruginous, paler than the upper side. Abdomen slightly punctate. There is an appearance of broad faintly-marked axillary pieces on the metathorax of this species, but I regard this only as a resemblance caused not by a suture but a line. There is no other instance of their occurrence in any of the *Carpophilidæ*. Legs ferruginous.

Not unlike *C. humeralis*, Fab., in appearance, but, besides having only two segments of the abdomen exposed, is smaller, differently punctate, and otherwise distinct.

From the East Indies, Ceylon, Hongkong, &c.

10. Carpophilus rubescens.

Affinis *C. marginello*; oblongo-ovatus, subconvexus, nitidus, durus, fortiter et crebre punctatus, glaber, rubidus, thoracis disco, elytrorum lateribus et abdominis apice saturatioribus. Long. $1\frac{2}{5}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Borneo.

Allied to *C. marginellus*, but may be at once distinguished from it, independent of its lighter colour, by the absence of the large fovea on each side near the base of the thorax. Oblong-ovate, somewhat convex, shining, of a hard texture, strongly and closely punctate, glabrous, testaceous red. Head not so coarsely punctate as the thorax and elytra, with a small, shallow, round depression on each side at the base of the epistome, the base somewhat darker than the rest. Thorax wider than long, subquadrangular, the posterior two-thirds of the sides nearly straight and parallel, very slightly sinuate, anterior third rounded-in to the anterior angles, which are somewhat obtuse and blunt; the apex is emarginate; the posterior angles obtuse, the sides being turned in at a very short distance before the angle; disk darker than the sides, even, and without depressions, a narrow impunctate elevation in front of the suture; coarsely punctate, punctures round and deep; along the posterior straight part of the sides there is a double longitudinal impression, making a slight fold; base truncate, slightly sinuate. Scutellum rather broad, smooth and shining at the apex, punctate behind. Elytra about a half longer than the thorax, a little wider than its base, subparallel as seen from above, sides gently rounded, shoulders distinct; more finely punctate than the thorax, punctures elongate and aciculate, as if made from behind; suture, base, and sides darker than the disk, the sides nearly black. Abdomen finely and acicularly punctate, the apex of the pygidium above dark. Legs and underside rufous.

Collected at Sarawak in Borneo by Mr. Wallace.

11. Carpophilus cuneiformis.

Statura *C. marginelli*, dignoscitur thorace elytris latiore elytrisque paulo brevioribus et postice angustioribus; subtilius punctatus, thoracis linea marginali basali profundiore et magis extensa. Long. lin., lat. lin.

Habitat in Celebes.

Very like *C. marginellus*. It is darker in colour, being dark piceo-ferruginous, with the head, apex of the thorax, and base and suture of elytra ferruginous. It is more finely punctate (almost acicularly) and more silky. The thorax is more convex, wider, more especially in front, and has the basal marginal line deeper and more extended. The elytra are narrowed posteriorly and bulge out in the middle; their apex is smooth and impunctate. Abdomen very finely punctate. Legs ferruginous. The metathoracic axillary piece or line, or the imitation of one, which is present in *C. marginellus*, is here absent, and its place supplied by the small pseudo-axillary piece, formed by the enlargement of the posterior lip of the middle cotyloid cavities, which occurs in several species of the genus.

From Celebes. Collected by Mr. Wallace.

12. Carpophilus antiquus.

Melsh. Proc. Acad. Philad. ii. 105 (1846).
Cercus punctulatus, Melsh. ibid. ii. 104.

Colore et textura *C. marginello* Er. haud dissimilis: forma differt; oblongus, parum depressus, nitidus, durus, fere glaber, leviter punctatus, saturate castaneus, thoracis disco elytrorumque apice piceo-brunneis; tibiis posticis abrupte dilatatis, dilatatione parallela. Long. $1\frac{1}{3}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in America boreali.

Something like *C. marginellus* in colour and texture. Oblong, somewhat depressed, shining, hard, nearly but not quite glabrous; the pubescence sparse, fulvous, and almost confined to the abdomen; lightly punctate, of a dark chestnut colour, with the disk of the thorax and the apex of the elytra gradually becoming piceo-brunneous or black. Head sparingly and lightly punctate, very faintly bi-impressed in front. Thorax broader than long, nearly equal in breadth in front and behind, sides slightly rounded, rather deeply margined, the margination narrowest about the middle; apex scarcely emarginate, anterior angles obtuse, rounded, posterior angles obtuse, base truncate; very finely and not closely punctate, a depression close to the side before the posterior angle somewhat more deeply punctate. Scutellum with a very few punctures towards the base. Elytra about the same breadth as the thorax, more deeply punctate than it, most punctate at a longitudinal depression near the scutellum on each side of the suture, with the sides nearly straight, slightly rounded, margined, and canaliculate, slightly attenuated towards the apex, which on each elytron is truncate obliquely backwards from the suture; exterior apical angles acute and rounded, sutural angles obtuse; shoulders not prominent. Abdomen very finely punctate and pubescent. Legs obscure ferruginous; posterior tibiæ with their apical half abruptly dilated, the dilatation parallel.

From Tennessee and the neighbouring districts of North America.

13. Carpophilus ferrugineus.

Oblongus, parum latus, depressus, durus, nitidus, glaber, punctatus, læte ferrugineus; tibiis posticis dilatatis, sed dilatatione haud parallela. Long. 1–$1\frac{1}{3}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Mexico.

Oblong, rather broad, depressed, hard, shining, glabrous, punctate, light ferruginous. Club of the antennæ fuscous. Head very sparingly and very lightly punctate, impressed on each side in front. Thorax transverse, with the sides subparallel, very slightly rounded, very lightly and sparingly punctate, not more thickly upon the sides than on the disk; sides deeply margined, the margination not narrowest in the middle, widest and deepest at the posterior angles; anterior angles rounded, posterior angles obtuse. Scutellum scarcely punctate. Elytra about as wide as the thorax, a half longer, the sides subparallel, rather strongly and sparsely punctate; apex declinate, and each elytron obliquely truncate; apex and suture sometimes becoming gradually blackish. Abdomen with its segments pubescent. Posterior tibiæ dilated, but not parallelly.

Allied to *C. antiquus*. Smaller, more depressed; thorax not wider than the elytra, and more parallel than in that species. The colour is usually wholly bright ferruginous, although in some specimens it is gradually darker towards the apex and suture. The posterior tibiæ, although dilated at the apex, have not the abrupt, flat, parallel dilatation from its middle which there is in *C. antiquus*.

From Mexico. Collected by M. Sallé.

14. Carpophilus succisus.

Erichs. in Germ. Zeitschr. iv. 259 (1843).
C. pinguis (Mus. Berol.).
C. Catharinensis (Deyr.).

Subdepressus, niger, subnitidus, tenuissime pubescens; pedibus rufo-testaceis; elytris fuscis, parce subtiliterque punctatis, lateribus subtilissime rugulosis. Long. 1–$1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Columbia.

Short, broad and parallel, oblong, subdepressed, above nigro-piceous, fusco-piceous, or chestnut, somewhat shining, texture hard, rather deeply punctate, slenderly clothed with a very short and fine pubescence. Antennæ ferruginous, with the club piceous. Mouth rufo-piceous. Head closely punctate, lightly foveolate on each side in front. Thorax of the breadth of the elytra, subquadrate, very slightly narrowed in front, punctate, with the disk smoother, the base as well as the sides margined, the sides a little rounded, reflexed; anterior angles declinate, somewhat rounded and obtuse; posterior angles obtuse. Scutellum smooth, very faintly punctulate at the base. Elytra a half longer than the thorax, fuscous, more thickly but more faintly punctate than the thorax, acutely margined on the sides, very faintly rugulose towards the sides. Abdomen densely punctate, with the segments margined with piceous. Body below piceous. Legs rufo-testaceous.

The texture of this species is softer than that of the preceding, and approaches that of *C. sexpustulatus*. It has some resemblance to small specimens of *C. marginellus*, but, besides various other differences, it is more quadrate in form, and has not the appearance of metathoracic axillary pieces which that species possesses. The thorax has a harder and more shining appearance than the elytra; and these have a somewhat leathery and dull appearance, besides being softer. Erichson says it is similar in appearance to *C. dimidiatus*; but this is only a superficial resemblance. Its thorax is shining and with only a few unobtrusive scattered hairs, in place of being dull and thickly punctate and with an almost villose pubescence.

From South America. Its chief metropolis seems to be Columbia, but it extends considerably further both to the south and to the north.

Section II. Texture moderately soft and slightly shining. Body depressed. Elytra not twice as long as the thorax, moderate in size*.

15. Carpophilus corticinus.

Erichs. in Germ. Zeitschr. iv. 263 (1843).

Oblongus, subdepressus, subtiliter punctatus, testaceus, piceus vel magis minusve brunneus; thorace elytrisque fortius marginatis, elytris ad basin latioribus. Long. $1\frac{1}{2}$ lin., lat. $\frac{5}{8}$ lin.

Habitat in America boreali.

Oblong, subdepressed, testaceous, piceous, or chestnut, very little shining, faintly and slenderly griseo-pubescent. Antennæ with the club fuscous. Head faintly punctate, subimpressed on each side in front. Thorax of the breadth of the elytra, scarcely narrower in front, emarginate at the apex, subsinuate on each side of the base, a little rounded at the sides, all the angles sub-right-angles; rather densely punctate, with the disk depressed, the lateral margin distinct and reflexed. Scutellum thickly and faintly punctate. Elytra oblong, a half longer than the thorax, faintly but more densely punctate than the thorax, with the lateral margin very distinct, reflexed. Abdomen faintly punctate, the pygidium longitudinally impressed.

This species has considerable relation to the genus *Epurea*. Not only does its general appearance suggest its connexion with it, but its texture is that of an *Epurea*, and it undoubtedly is one of the links which connect *Carpophilus* with that genus.

From North America.

16. Carpophilus compressus.

C. corticino affinis; minor, magis depressus, magis opacus, thorace parum breviore, lateribus minus rotundatis et levius marginatis; cæteris ut in *C. corticino*. Long. $1\frac{1}{8}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Rio Janeiro.

Very closely allied to *C. corticinus*. A larger series of specimens (I have only seen one) may show that they are the same species. It is a good deal (nearly a third) smaller than *C. corticinus*, rather more depressed, more opaque, more pubescent; the thorax seems a little shorter or more transverse, its sides are somewhat straighter, the margins not so well marked. The elytra seem not quite so much attenuated behind. In other respects there is little or no difference between it and *C. corticinus*.

From Rio Janeiro. Collected by the Rev. Hamlet Clark.

17. Carpophilus ligneus.

Oblongus, subdepressus, punctatus, parce testaceo pubescens, castaneo-brunneus; elytris testaceo-rufis, circa scutellum saturatioribus; abdomine nigro-piceo; antennis pedibusque castaneo-piceis. Long. $1\frac{1}{3}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Mexico.

* This section is related to that immediately preceding on the one hand, and to the section *Ecnomorphus* on the other, but I have separated it from the latter in order to form the transition to the following Sections III., IV., &c.

Oblong, subdepressed, punctate, somewhat shining, sparingly testaceo-pubescent, chestnut-brown. Head with a very deep fovea on each side, slightly connected together behind the epistome, which is prominent. Thorax piceous chestnut, broader than long, with the disk flat and depressed, faintly transversely impressed, the anterior angles nearly right angles, with the point rounded, the posterior angles obliquely cut off and the points rounded, base straight, truncate; very finely punctate and more shining than the elytra and scutellum. Scutellum rounded, punctate. Elytra nearly a half longer than the thorax, broader at the base than the base of the thorax, but scarcely broader than its sides, rather thickly punctate, testaceo-rufous, darker near the scutellum and base, the shoulders prominent and paler in colour, another raised larger prominence near the apex of the scutellum, the suture darker in colour, sides sharply rounded immediately behind the shoulder, slightly so afterwards, apex of each elytron obliquely truncate. Abdomen nigro-piceous, pubescent, and punctate. Legs castaneo-piceous.

Like *C. corticinus* in colour, but of a firmer consistency, and readily distinguished from it by the posterior angles of the thorax being obliquely cut off, which is not the case with *C. corticinus*. It is a question whether it has not more natural affinity with the section *Ecnomorphus*, in which the elytra are wider at the base than the thorax, than with this. It may find a place in either; and in the dichotomous Table of the species given at the end of this genus I have placed it in that section. The coloration on the elytra near the scutellum sometimes varies into two spots darker than the rest.

From Nicaragua in Mexico. Collected by M. Sallé.

18. Carpophilus fulvipes.

Motsch. Etud. Ent. vii. 42 (1858).

C. fusculus, Motsch. Etud. Ent. vii. 42 (1858).

Oblongus, depressus, postice attenuatus, subtiliter granulatim punctatus, subnitidus, niger vel fusco-niger, ore pedibusque fulvo-testaceis. Long. $1\frac{1}{5}$–$1\frac{4}{5}$ lin., lat. $\frac{1}{2}$–$\frac{2}{3}$ lin.

Habitat in Taprobana.

Oblong, depressed, narrowed behind, finely punctate, slightly shagreened, somewhat shining, black or blackish brown. Head rounded, with a broad impression on each side in front, finely and equally punctate. Antennæ black. Mouth fulvo-testaceous. Thorax transverse, slightly convex, flattish on the disk, on which is a longitudinal smooth line in front of the scutellum; sides gently rounded, declinate towards the anterior angles, which are obtuse; apex scarcely emarginate; posterior angles almost right angles, very slightly obtuse, and with the margin very slightly reflexed; base truncate, slightly bisinuate. Scutellum triangular, with a slightly raised smooth space on each side, punctate in the middle. Elytra depressed, of the breadth of the thorax, quadrate, slightly narrowed behind, impressed behind the scutellum, punctate; sides declinate and slightly rounded, margined and canaliculate; apex obliquely truncate; exterior apical angles rounded, sutural obtuse. Abdomen attenuate, finely punctate. Legs fulvo-testaceous.

M. de Motschulsky gives this as one of the types of the subgenus *Ecnomorphus*, which he proposes for the reception of those species which are like *C. sexpustulatus*. I admit that such a subdivision is warranted; but this species does not belong to it. It has not the characters which he assigns to that section, but belongs to the section of normal *Carpophili*, such as *C. hemipterus*, &c. He figures and describes the anterior tarsi as bearing below long claviform hairs. It does not quite appear whether in this he refers to both sexes or only to the male. He has been speaking previously of the male, and, although the sentence is separated by a semicolon, he may still refer to it. If he refers to both sexes, then I can assure him he is mistaken. I have examined, under high powers, the tarsi of a female which he was kind enough to present to me, and can say with perfect confidence that the hairs under its anterior tarsi in no respect differ from the usual form of hairs. The appearance he has figured is so unusual that I cannot help thinking that he has been deceived by some adhesion of gum or other extraneous body. In like manner, his characters drawn from the club of the antennæ are due to an accidental displacement of the articles from their proper position. (See my remarks upon the characters of the section *Ecnomorphus*, posteà.)

M. de Motschulsky has also briefly noticed another species which he considers closely allied to this, and perhaps only a variety. I have not seen it; but as the only characters he gives to distinguish it from *C. fulvipes* are that it is smaller, browner, and with the posterior angles of the thorax slightly reflexed—this last being a character which is also found in *C. fulvipes*,—I have been unable to see any ground for constituting it even a variety. Still I should have done so, in deference to the opinion of M. de Motschulsky, had it not been for the doubt which he himself expresses as to its distinctness; for although his descriptions are often insufficient to warrant his conclusions, I render full justice to the *flair entomologique* by which he often instinctively separates nearly allied species from each other.

From Ceylon.

19. Carpophilus planatus.

Parvus, subfusiformi-oblongus, depressus, subnitidus, punctatus, griseo subpubescens, niger, ore, antennis pedibusque ferrugineis; thorace utrinque bi-impresso, angulis omnibus rotundatis. Long. $1\frac{1}{3}$ lin., lat. $\frac{5}{8}$ lin.

Habitat in Victoria in Australia.

Small, subfusiformly oblong, depressed, somewhat shining, punctate, griseo-subpubescent, black. Head very lightly punctate, almost smooth, with a curved impression in front. Mouth and antennæ ferruginous. Thorax a half broader than long, narrower in front than behind, on each side towards the posterior angles rather deeply impressed, the disk flat and subimpressed on each side, all the angles rounded, the base as well as the sides distinctly margined; thickly punctate, the disk a little smoother. Scutellum punctate. Elytra nearly a half longer than the thorax, thickly punctate at the base, scarcely punctate at the apex, griseo-pubescent, especially at the base, the disk depressed and impressed, apex narrowly declinate, truncate scarcely obliquely, sides almost straight and parallel, slightly rounded at the humeral angle, exterior apical angle rounded, sutural angle nearly a right angle. Abdomen, especially pygidium, finely nigro-pubescent, penultimate segment shining. Legs ferruginous.

From Victoria in Australia.

SECTION III. Body elongate and depressed, with the surface of the thorax as if a roller had passed over it; above the medium size. Texture more or less shining, shagreened.

20. CARPOPHILUS LACERTOSUS.

Punctatus, parum pubescens, niger, elytris purpureo-brunneis; thorace angulis posticis obtusis, basi bisinuato; elytris alutaceis; pedibus piceis. Long. $1\frac{1}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Venezuela.

Elongate, subfusiform, thickly but not very deeply punctate. Head bi-impressed on the margin in front. The mandibles and other parts of the mouth piceo-ferruginous. Thorax transverse, and not much narrower in front than behind; the sides form an equal curve; the anterior angles are rounded, and the posterior obtuse; base bisinuate. Scutellum black, broadly triangular. Elytra slightly widest behind the middle, once and a half the length of the thorax, finely punctate and pubescent; apex of each elytron very obliquely truncate. Abdomen somewhat shining, finely punctate. Legs piceous.

This species has considerable resemblance to *C. lugubris* in the next section, but it is depressed and flattened on the back, has not the dark pubescence which is on it, and is without the rufous margins of the thorax and the rufous spot on the shoulders of the elytra. It is also narrower, the elytra are purple-brown, and their texture is somewhat leathery.

From Venezuela and the neighbouring parts of South America. Apparently not rare.

21. CARPOPHILUS PURPUREIPENNIS.

C. lacertoso valde affinis; paulo major et fortius punctatus; thorace antice angustiore, margine piceo; elytris purpureo-nigris, humeris interdum piceis. Long. $1\frac{1}{2}$ lin., lat. $\frac{4}{5}$ lin.

Habitat in Venezuela.

This is very near to *C. lacertosus*, and is possibly only a variety of it. It is a little larger and more deeply punctate (as is usually the case with larger specimens). The thorax is narrower in front and has its margin piceous. The elytra are purplish black; the shoulders in some instances piceous.

From Venezuela.

22. CARPOPHILUS RUFITARSIS.

Oblongo-ovatus, latus, sat depressus, subtiliter crebre punctatus, nitidus, niger, tarsis rufis. Long. $2\frac{1}{3}$ lin., lat. 1 lin.

Habitat in Guatemala.

Large, oblong-ovate, broad, depressed, faintly thickly punctate, very shining for this group, black. Head bi-impressed at the sides near the eyes in front. Antennæ nearly twice the length of the head, slender, basal joints piceous, club elongate conical. Thorax narrower in front than behind, apex slightly emarginate, the sides lightly rounded, the anterior angles rounded, the posterior obtuse, base sinuate near the angles, the middle gently rounded, extending broadly a very little further back than the angles; disk smooth, broad, and lightly thickly punctate, the punctures coarser towards the sides, and more particularly in a rather deep impression close to the sides a little behind the middle. Scutellum broad, transverse, triangular, more finely punctate than the thorax. Elytra broader at the base than the thorax, longer than the thorax, together broader than long, irregularly faintly punctate, and with some slight depressions here and there on the disk; shoulders rather prominent, sides strongly margined and deeply canaliculate, rounded, more sharply in front and behind than in the middle; apex of each elytron obliquely truncate; exterior apical angles obtuse, rounded; sutural angles obtuse. Abdomen very faintly thickly punctate. Below thickly punctate. Tarsi rufous.

From Guatemala. Collected by M. Sallé.

SECTION IV. Body more or less elongate, subdepressed, thorax not flat; above the medium size. Texture shagreened, very thickly pubescent, and opaque. Colours black and sombre.

23. CARPOPHILUS LUGUBRIS.

Subdepressus, subopacus, dense punctatus, griseo pubescens, sordide niger; thorace margine rufescente; elytris humero obscure ferrugineo; pedibus piceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in America boreali et in America meridionali.

Subdepressed, subopaque, densely punctate, griseo-pubescent, rather dirty-looking black. Head very thickly punctate, with an impression on each side in front. Antennæ piceous, with the club black. Labrum piceous. Thorax slightly convex, a little narrower than the elytra, rather narrower in front than behind, anterior angles obtuse, posterior somewhat obtuse and very slightly looking back, the sides turned-in at the angles; rounded on the sides, which are griseo-pubescent, and somewhat expanded, translucent, and rufescent, especially towards the posterior angles; margined, the edging of the margins reflexed. Scutellum thickly punctate. Elytra almost a half longer than the thorax, scarcely wider than the thorax at their base, the sides rapidly widened near the base, and then not much more widened afterwards; sides scarcely rounded, except at the base and the apex, and there only slightly; densely and faintly punctate, black, the shoulders obscurely ferruginous, slightly nigro-pubescent, at the base clothed with a denser griseous pubescence; slightly convex behind, rather flat on the disk; apex of each elytron obliquely truncate; exterior apical angles rounded, sutural obtuse. Abdomen more finely punctate, lightly griseo-pubescent, with the segments margined with piceous. Legs piceous.

Easily distinguished from its allies, *C. niger* and *C. lacertosus*, by the margin and the posterior angles of the thorax, as well as the shoulders of the elytra, being rufescent.

From various parts of North and South America, such as Venezuela, Caraccas, Florida, &c.

24. CARPOPHILUS BREVIPENNIS.

Blanchard, in D'Orbigny's Voy. dans l'Amér. Mérid. vi. 2. Ins. (1837–43).

Subdepressus, opacus, crebre punctatus, pubescens, niger; thorace fovea majore utrinque prope sed pone medium, foveaque minore utrinque, his exterioribus; elytris piceo-nigris, basi et callo humerali tenuiter obscure ferrugineis; ore, antennis (clava fusca excepta) pedibusque ferrugineo-piceis. Long. 2 lin., lat. $\frac{3}{4}$ lin.

Habitat in Peruvia.

Rather large, subdepressed, opaque, densely pubescent and closely punctate, black. Head with a semicircular line between the anterior inner corners of the eyes. Thorax more coarsely punctate than the head, rather broader than long, narrower in front than behind, the sides rounded-in anteriorly, anterior angles rounded, posterior obtuse, depressed on the disk, with a large shallow fovea on each side of and a little behind the middle, exterior to that a smaller and shallower depression, and close to and along the slightly raised margin another depression about one-third from the front, and another narrow depressed line or gutter near the posterior angles, base bisinuate, posterior angles pointing backwards. Elytra rather wider than thorax, piceous black, with the humeral callus and the base narrowly obscurely ferruginous; exterior apical angle rounded. Mouth, base of antennæ, and legs ferrugineo-piceous.

From Peru. In the collection of the Jardin des Plantes.

25. Carpophilus niger.

Erichs. in Germ. Zeitschr. iv. 263 (1843).

Cercus niger, Say, Journ. Acad. Nat. Sc. Philad. iii. 195. 2.

Latus, parum opacus, subdepressus, niger, griseo pubescens, punctatus; thorace lateribus minus rotundatis, margine irregulari fere serrato, repando, angulis posticis obtusis; elytris disco et pone humeros impressis. Long. 2–2$\frac{3}{4}$ lin., lat. 1–1$\frac{1}{4}$ lin.

Habitat in America boreali.

Broad, subdepressed, black, nearly opaque. Antennæ piceous, the club black. Labrum piceous. Head thickly punctate, impressed on each side in front. Thorax a little narrower than the elytra, narrowed in front, rounded on the sides, very closely strongly punctate, behind lightly bi-impressed on each side, with the disk black, the sides griseo-pubescent, the lateral margin rufescent, reflexed, slightly expanded, and the edge irregular, almost faintly serrate; both anterior and posterior angles obtusely rounded. Scutellum thickly punctate. Elytra almost a half longer than the thorax, densely and faintly punctate, slenderly nigro-pubescent, clothed at the base with a thicker griseous pubescence. Abdomen faintly punctate, slightly griseo-pubescent, with the segments margined with piceous. Legs piceous.

This species may be distinguished from *C. lacertosus* by its greater size, and by the sides of the thorax being less declinate and less rounded, and by its margins being piceous and translucent. It is distinguished from *C. lugubris* by its posterior angles being gently obtuse; from *C. rufimanus*, to which it approaches nearest in point of size, by its coarser punctuation and pubescence; and from both *C. lugubris* and *C. brevipennis* by its non-ferruginous shoulders. The coarse punctuation on the thorax makes its edges almost serrate. There is a small metathoracic axillary piece, which is smoother than the neighbouring surface, and slightly punctate in the centre.

From North America, where it appears to be pretty extensively distributed.

26. Carpophilus Triton.

Affinis *C. nigro*; grandis, oblongo-ovatus, subdepressus, subopacus, crebre granulose punctatus, griseo pubescens, nigro-fuscus; antennis, ore, thoracis lateribus pedibusque rufescentibus, thoracis margine fere lævi. Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{4}$ lin.

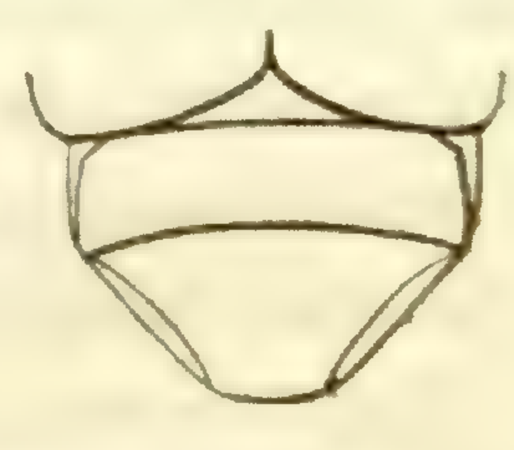
Habitat in Sunggari.

Nearly allied to *C. niger*. Large, subdepressed, sloping slightly to each side as from a longitudinal ridge in the line of the suture, oblong-ovate, subopaque, thickly granulosely punctate, griseo-pubescent, brownish black. Head deeply bi-impressed in front; antennæ, mandibles, and other parts of the mouth rufescent, club of the antennæ darker. Thorax transverse, nearly twice as broad as long, narrower in front than behind, unequal, the sides in the middle nearly straight, and turning in with a short curve to the posterior angles, in front of which is a marginal depression, and with a larger and more gentle curve to the anterior angles; rather expanded, rufescent, and with a marginal channel (widest at the posterior angles) formed by the raised edging of the margin; edge of margin almost smooth, very slightly irregular towards the anterior angles, which are obtuse; apex emarginate, the emargination curved; posterior angles obtuse; base subsinuate, with a curved depression from nearly the middle of the base to the front of the posterior angles; disk raised, and somewhat irregularly depressed in the middle, the sides sloping from the disk. Scutellum transverse, rounded. Elytra a half longer than the thorax, at the base wider than the thorax, slightly widened about the middle, sides rounded and margined, shoulders prominent and with a slight tendency to rufescence, and a slight elevation behind obliquely towards the suture; apex of each elytron truncate obliquely, margin of the apex rufescent. Exposed portion of the abdomen fully longer than the thorax, margins of the segments rufescent; the surface more finely punctate and pubescent than the rest, assuming a more finely shagreened appearance. Legs rufescent.

This species is very closely allied to the *C. niger* of North America. It is larger, fuscous instead of deep black, with the margins of the thorax, antennæ, and legs rufescent. In *C. niger* the sides of the thorax are straighter, more parallel, and less rounded-in at the posterior angles. It is the Asiatic representative of that species, and perhaps scarcely entitled to a place as a distinct species.

From Sunggari. I owe this species to M. Obert, of St. Petersburg, from whom I have received many interesting species from the interior of Siberia.

Fig. 95.



Section V. Body broad and convex, and with the thorax separately convex. The fimbriæ usually more developed than in most of the other species. Colours black and sombre.

27. Carpophilus Morio (Klug).

C. nigerrimus (Dup.).

Latus, depressus, niger, subopacus, crebre punctatus, breviter nigro pubescens; thorace convexo, disco postice depresso, linea brevi longitudinali lævi ante scutellum, angulis anticis rotundatis; elytris planis, lateribus rotundatis. Long. $2\frac{1}{3}$ lin., lat. 1 lin.

Habitat in Madagascaria.

Broad, depressed, black, densely punctate, rather dull, with short black pubescence. Head with a semicircular line drawn between the anterior margins of the eyes; antennæ black. Thorax nearly twice as broad as long, widest before the middle, sides somewhat parallel until about a third from the front, when the anterior angle is rounded in, making the thorax a good deal narrower in front than behind, convex in front, flat on the posterior part of the disk, the posterior half of which is surrounded by an oblique curved impression, and on this flat circular space is a slight, smooth longitudinal line in front of the scutellum; sides with a distinct, raised, reflexed margin; base sinuato-truncate; anterior angles rounded, posterior angles obtuse and slightly turned back. Scutellum transversely triangular, with a narrow shining margin. Elytra flat, not raised towards the suture, duller and more pubescent and a little longer than the thorax, humeral angles not rounded, but terminating in a point, sides deeply margined; apex very obliquely truncate, exterior apical angles rounded, sutural apical angles obtuse. Abdomen with the penultimate segment more shining and less punctate on the disk than on the sides. Underside coarsely punctate and with a griseous pubescence. Legs slightly piceous.

This species might have a place in the previous section, for it is somewhat depressed and elongate, and not unlike *C. niger*, but smaller and shorter. It is, however, still more nearly allied to the convex broad species, and therefore I have put it at their head, indicating its affinity to the previous section while retaining it in this.

From Madagascar.

28. Carpophilus funereus.

C. Morioni affinis; sat convexus, fortiter punctatus, dense pubescens, opacus, niger; thorace antice angustiore, angulis anticis obtusis, haud rotundatis; pedibus piceis. Long. $1\frac{3}{4}$ lin., lat. $1\frac{1}{8}$ lin.

Habitat in Taprobana.

Moderately convex, very deeply and thickly punctate, densely pubescent, opaque, black. Head very slightly bi-impressed in front; antennæ black. Thorax narrowed in front, widest behind the middle, sides deeply margined, gently rounded, curved rapidly in at the posterior angles, which are obtuse and slightly turned back; anterior angles obtuse, not rounded; base deeply bisinuate; there is no dorsal line on the disk. Scutellum transverse, subpentangular, finely punctate. Elytra about once and a half the length of the thorax, with the sides deeply margined, especially towards the base, and declinate; when viewed from the side they are seen to be widest immediately behind the shoulder; truncation of apex moderately oblique. Abdomen finely punctate and pubescent. Legs piceous; tarsi rufous.

This species is similar to *C. Morio*, but is easily distinguished by the thorax being widest behind the middle instead of before the middle, and by its anterior angles being simply obtuse instead of rounded. The punctuation is very close and fine, giving it a dull, opaque, and sombre appearance.

Found by Mr. Templeton or Colonel Champion in the island of Ceylon, and now in the collection of the University of Oxford.

29. Carpophilus tristis.

Erichs. in Germ. Zeitschr. iv. 264 (1843).

C. nigro paulo brevior et magis depressus, latus, niger, opacus, nigro pubescens; thoracis margine lato, repando; elytris alutaceis; pedibus piceis. Long. $1\frac{2}{3}$ lin., lat. 1 lin.

Habitat in Brasilia.

Black, opaque, nigro-pubescent. Antennæ black, with the base piceous. Head closely punctate. Thorax of the breadth of the elytra, slightly rounded on the sides, densely and rather deeply punctate, equal, with a broad reflexed lateral margin faintly expanded; anterior angles pointed, obtuse; posterior angles obtuse at the very angle; base truncate, not sinuate. Scutellum thickly punctate. Elytra a half longer than the thorax, leathery in appearance, faintly punctulate. Abdomen faintly punctate. Legs piceous.

The leathery texture of the elytra furnishes a good character for distinguishing this from any allied species that are likely to be confounded with it.

From Brazil.

30. Carpophilus tectus.

C. Morioni affinis; latus, fusiformis, subconvexus, subnitidus, crebre punctatus, parce et breviter nigro pubescens, niger, antennis pedibusque rufo-testaceis; thorace elytrisque utrinque leviter obliquantibus ut tectis. Long. 2 lin., lat. 1 lin.

Habitat in Borneo et Singapore.

Like *C. Morio.* Broadly fusiform, subconvex, very slightly shining, thickly punctate, sparingly clothed with a short black pubescence. Black; antennæ rufo-testaceous, club darker. Head slightly punctate, very slightly bifoveolate on each side of the base of the epistome, which is punctate; mouth piceous. Thorax somewhat convex, with a tendency to a ridge behind, which culminates in a smooth narrow longitudinal line in front of the scutellum; sides gently rounded, widest immediately before the posterior angles, which are obtuse and slightly looking back, slightly margined; anterior angles obtusely rounded; apex slightly emarginate, base bisinuate, middle more produced than the sides. Scutellum transversely pentagonal, declinate in front, punctate, smooth at the apex. Elytra usually highest at the suture, each elytron sloping a little from it, sides straightly declinate, rounded, margined and canaliculate; thickly punctate and pubescent, smoother towards the suture; the humeral angles not rounded, but terminating in an obtuse point; exterior apical angles rounded, apex obliquely truncate; sutural angles slightly obtuse. Abdomen very finely punctate and pubescent. Below punctate and pubescent. Legs rufo-testaceous.

Collected by Mr. Wallace at Sarawak and Singapore.

31. Carpophilus flavipes.

C. tecto affinis; minor, convexus, crebre et fortiter punctatus, nigro pubescens, subopacus, niger, antennarum basi testaceo-picea, pedibus flavo-testaceis. Long. $1\frac{1}{3}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Celebes et Singapore.

Allied to *C. tectus*. Smaller, convex, thickly punctate, nigro-pubescent, somewhat opaque, black, with the legs testaceous yellow. Head scarcely impressed in front, with the mouth and the base of the antennæ testaceo-piceous. Thorax very convex, very coarsely punctate and slightly pubescent, and with a small fovea on each side of the middle near the scutellum, and a larger one more towards the posterior angles; narrower in front than behind, with the sides rounded, but seen from above nearly parallel for its posterior half, with the remainder in front rounded; the apex scarcely emarginate, anterior angles slightly obtuse, posterior angles more so, base bisinuate. Scutellum pentagonal, punctate towards the base. Elytra very convex, punctate, but not so coarsely or thickly as the thorax, more pubescent, sides rounded, shoulders prominent, apex of each elytron truncate obliquely, exterior apical angles rounded, sutural angles obtuse. Abdomen convex. Body not so coarsely punctate below as above. Legs flavo-testaceous.

This is very near to *C. tectus*; but its smaller size, greater convexity, and the thorax less produced behind induce me to treat it as a distinct species.

From Singapore, and Macassar in Celebes. Collected by Mr. Wallace.

32. Carpophilus variolosus.

Convexus, late ovatus, subopacus, confertissime punctatus, nigro pubescens; niger, antennis piceis, clava fusca, tarsis piceis; capite, thorace elytrisque variolose punctatis. Long. $1\frac{3}{4}$ lin., lat. 1 lin.

Habitat in Sarawak.

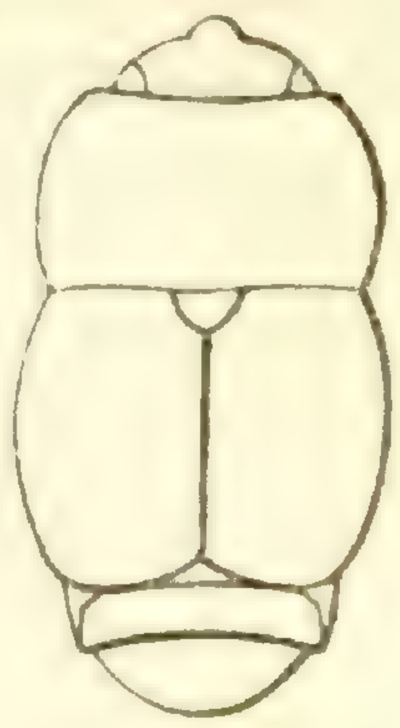
Convex, broad-ovate, subopaque, thickly punctate, nigro-pubescent, black. Head thickly variolosely punctate, largely, rather deeply, and obliquely impressed on each side in front. Antennæ nearly twice the length of the head, piceous, with the club fuscous; club broad, much compressed. Thorax transverse, convex, sides rounded slightly for the posterior two-thirds, considerably for the anterior third; apex emarginate, emargination round; anterior angles declining, nearly right angles, posterior angles very obtuse; base truncate, very slightly sinuate towards the angles; very coarsely and thickly punctate, the punctures variolose, giving the surface a more than usually shagreened appearance; the convexity of the thorax regular and without impressions; the pubescence scarce and brownish black. Scutellum rounded, finely punctate and pubescent. Elytra convex, scarcely broader at the base than the thorax, wider in the middle, sides rounded and margined, humeral angle pointed, shoulder placed a little back, exterior apical angle rounded, sutural very slightly obtuse; apex of each elytron obliquely truncate; rather thickly punctate and pubescent. Abdomen finely punctate and pubescent. Below punctate. Legs black, tarsi piceous.

The variolose and coarse punctuation is a ready character for distinguishing this species. When examined under the microscope the punctures are seen to be variolose, or flat at the bottom like a rain-drop on sand. This pitting, however, is not visible with an ordinary lens, either in this species or in any other species where it occurs; it requires a higher power to make it visible.

From Sarawak. Collected by Mr. Wallace.

33. Carpophilus obesus.

Fig. 96.



Convexus, oblongo-ovatus, grossus, parum nitidus, punctatus, niger, antennarum basi picea; thorace valde convexo, marginato, margine canaliculato; elytris convexis, pone humeros impressis, lateribus marginatis et profunde canaliculatis. Long. $1\frac{3}{8}$ lin., lat. $\frac{7}{8}$–$1\frac{1}{8}$ lin.

Habitat in insulis Aru et Dorey in Nova Guinea.

Convex, large and obese-looking, oblong-ovate, somewhat shining, punctate, black, and nigro-pubescent. Antennæ with the base piceous. Head with a more or less distinct semicircular depression at the base of the epistome, and a slight fovea at each end of it, finely and rather thickly punctate. Thorax transverse, very convex, not much narrower in front than behind, when viewed from above with the sides nearly straight, but actually rounded, widest behind, margined; anterior angles rounded, posterior obtuse, apex scarcely emarginate; thickly punctate, more faintly on the disk, rather coarsely towards the sides; base bisinuate, the middle broad, slightly raised, and reaching further back than the sides, with a smooth narrow dorsal line extending a short distance forward in front of the scutellum, and a rounded depression on each side from the base to the sides. Scutellum rather large, rounded, finely punctate at the base, apical margin smooth. Elytra longer than the thorax, not quite so long as head and thorax, convex, with a large depression behind the shoulders, which are rather prominent; sides rounded, widest in the middle, margined, deeply canaliculate, apex obliquely truncate, exterior apical angle rounded, sutural obtuse. Pygidium convex, faintly punctate, and with longish pubescence. Fimbriæ distinct.

From the Aru Islands, and the island of Dorey, New Guinea. From Mr. Wallace.

The specimens from the island of Dorey, one of the New Guinea Islands, are less convex and a little less punctate than the specimens from the Aru Islands.

34. Carpophilus puncticeps.

Oblongo-ovalis, convexus, subnitidus, punctatus, breviter et parce nigro pubescens, niger; thorace rotundato et convexo; elytris convexis, sutura leviter elevata, utrinque prope suturam impressione longitudinali subparallela medio latiore instructa. Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Calabaria antiqua in Africa occidentali.

Oblong-oval, convex, somewhat shining, punctate, sparingly clothed with short black pubescence, black. Head strongly and densely punctate, the epistome less punctate; antennæ black. Thorax rotundate and convex, strongly punctate, the disk more sparingly so, with a faint dorsal posterior raised line, the sides rounded, all the angles obtuse, the base bisinuate. Scutellum broad, rounded. Elytra lightly punctate, convex, with the suture slightly raised, and on each side with a subparallel longitudinal impression broadest in the middle; the sides rounded, rather deeply margined, the apex of each elytron rounded, the sutural apical angles obtuse, the exterior apical angles rounded. Pygidium convex, very faintly punctate. Legs piceous.

From Old Calabar. I have received a pair of this species from the Rev. W. C. Thomson.

35. CARPOPHILUS HOFFMANSEGGII.

C. obeso valde affinis; thoracis elytrorumque marginibus minus reflexis. Long. $1\frac{1}{2}$ lin., lat. 1 lin.

Habitat in Madagascaria?

Very closely allied to *C. obesus*; may be distinguished by the margins of the thorax and elytra being less reflexed.

There are two specimens of this insect in the Berlin Museum. But my detailed description and note of the locality has fallen aside; I have a vague impression that it is from Madagascar.

SECTION VI. Body convex and fusiform. Texture so closely punctate as to appear shagreened. Elytra with paler spots or markings.

36. CARPOPHILUS HEMIPTERUS. (Plate XXXII. fig. 10.)

Steph. Illustr. Brit. Ent. iii. 50. 1 (1830). Shuck. Brit. Col. Delin. 25. 229, pl. 30. fig. 6 (1840). Erichs. in Germ. Zeitschr. iv. 256. 4 (1843). Sturm, Deutschl. Ins. xv. 36. 1, taf. 292. fig. *a*, A (1844). Erichs. Ins. Deutschl. iii. 135. 2 (1848).

Dermestes hemipterus, Linn., Degeer.
Nitidula flexuosa, Payk., Herbst.
Nitidula bimaculata, Oliv., Gyll., Schönh.
Nitidula dimidiata, Fab.
Nitidula cadaverina, Fab.
Stenus Ficus, Fab.

Var. A.

Nitidula quadrata, Fab.
Cateretes pictus?, Heer, Faun. Col. Helv. i. 413 (1841).
Cateretes dimidiatus, Heer, Faun. Col. Helv. i. 413 (1841).

Fig. 97.

Niger, pubescens, prothoracis lateribus pedibusque ferrugineis; elytris apice lato sinuato et macula humerali luteis. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Var. A. Fuscus, elytris testaceis, plaga scutellari fusca.

Habitat ubique.

Convex, black or brown, slightly shining, and densely clothed with griseous pubescence, especially on the sides of the thorax and abdomen. Antennæ reddish yellow, with the club fuscous. Head small, deeply punctate, the mouth testaceous, underside piceous. The thorax is at its base of the breadth of the elytra, narrower in front, little rounded on the sides, before and behind almost straight, truncate, all the angles apparently rounded, but on closer examination the anterior angles are obtuse and declinate, and the posterior angles obtuse; moderately convex, densely punctate. Scutellum rather large, punctate. Elytra a little longer than the thorax, deeply, and in the middle almost rugosely, punctate; the whole apex and a spot at the shoulder testaceous. Abdomen finely punctate. Legs reddish yellow.

This species is spread over the whole world, and exhibits considerable variation in the colouring and the particular proportions and even form of some of the parts, but never so much so as to alter the general effect. For example, the following variations occur in the form, with intermediate degrees of each, viz. :—

1. The posterior angles of the thorax nearly right angles.
2. The posterior angles of the thorax nearly rounded.
3. The posterior angles of the thorax obliquely cut off.

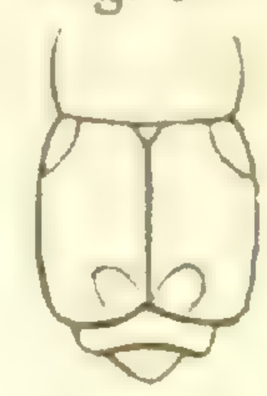
In colour, again, it varies as much, the variations, however, being all referable to greater or less intensity of colouring.

Before I had seen so large a series of specimens from all parts of the world as I now have, I was disposed to make several species, in which var. 1 would have represented the usual European form, var. 2 a form from South America, var. 3 from the Fiji Islands; but a more extended examination showed me that all these varieties are to be found in the specimens from any one place, and are therefore not to be regarded.

37. Carpophilus 4-signatus.

Erichs. in Germ. Zeitschr. iv. 257 (1843).

Fig. 98.



Statura omnino *C. bipustulati*; subdepressus, confertissime punctatus, niger, antennarum basi pedibusque piceis, elytris maculis duabus testaceis. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Europa meridionali et Asia.

Of the form of *C. bipustulatus*, black, throughout cinereo-pubescent; antennæ black, with the base piceous. Head densely punctate. Thorax slightly narrowed in front, slightly rounded on the sides, very convex and less faintly punctate in the middle, somewhat rugulose towards the sides, subimpressed on each side behind. Scutellum thickly punctate. Elytra a little longer than the thorax, very thickly punctate, with two testaceous spots, the one minute on the shoulder, the other larger near the suture before the apex. Abdomen densely and faintly punctate, with the last segment smooth towards the apex; the ventral segments margined with piceous. Legs piceous, with the knees and tarsi rufous.

Found in Sicily, Smyrna, &c.

38. Carpophilus ligatus (Motsch.).

(*C. vittatus*, Motsch.)

Oblongo-ovatus, subnitidus, punctatus, niger; elytris fuscis, vitta oblonga testacea prope apicem et suturam; antennis pedibusque ferrugineis. Long. $1\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Taprobana.

Oblong-ovate, somewhat shining, punctate, black; elytra fuscous, with an elongate testaceous patch near the suture and apex. Head closely punctate, depressed in the middle in front, distinctly impressed on each side by a slender, short transverse line. Thorax narrower in front, with the sides slightly rounded; the anterior and posterior angles obtusely rounded; punctate, more deeply towards the sides, rather deeply impressed on each side behind; the base slightly margined, as well as the sides. Scutellum transversely subpentagonal. Elytra subdepressed, of the length of the thorax, more lightly punctate than the thorax; the shoulders not very prominent, fuscous, with an oblong quadrangular patch near the scutellum and near the apex, the sides somewhat declinate, rounded and margined. The exposed segments of the abdomen large and very lightly punctate. Antennæ ferruginous, with the club fuscous. Legs ferruginous.

Sometimes the testaceous part of the elytra encroaches upon the brown, so that they are wholly testaceous with merely a brown vitta reaching from the shoulder to the apex.

From Ceylon and other parts of the East Indies.

39. Carpophilus bifenestratus.

Fig. 99.

C. bisignato similis, sed minor, crebrius et fortius punctatus et convexior; thorace magis quadrato; elytris singulis macula rufa, latere exteriore angulari, versus suturam et scutellum obliqua. Long. $1\frac{1}{8}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Taprobana.

Smaller and more convex than *C. bisignatus* of Boheman, more closely and deeply punctate. Thorax more quadrate, the anterior angles obtuse, the posterior rounded, base somewhat rounded. Each elytron with a red spot, angular on the outer side, oblique on the inner side. The woodcuts here given are only intended to show the form and position of the red spot; in other respects they have no pretensions to accuracy.

From Ceylon.

40. Carpophilus biguttatus (Klug) (Erichs.).

Ips sanguineofasciata (Dup.) (Dej. Cat. 134, 1837).
Carpophilus bilunatus (Cat. Mus. Jard. Pl.).

Fig. 100.

Valde affinis *C. bisignato*; angustior, minus convexus, præsertim thorace; elytris lateribus magis parallelis, macula rufa magis antrorsum posita et paulo transversa; pedibus rufo-ferrugineis. Long. $1\frac{1}{4}$–$1\frac{1}{3}$ lin., lat. $\frac{1}{2}$–$\frac{3}{5}$ lin.

Habitat in Madagascar.

Nearly allied to *C. bisignatus* of Boheman. Narrower, not so convex, more especially the thorax. The pubescence short and feeble both on thorax and elytra. Elytra with the sides more parallel, not more pubescent than the thorax, with the red spot more in front and somewhat transverse. Legs rufo-ferruginous.

From Madagascar.

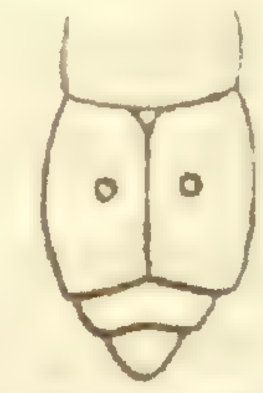
41. Carpophilus bipustulatus.

Erichs. in Germ. Zeitschr. iv. 258 (1843).
Sturm, Deutschl. Ins. xv. 39, taf. 292. fig. p, P. (1844).
Erichs. Ins. Deutschl. iii. 136 (1848).
Ips bipustulata, Heer, Faun. Col. Helv. i. 416 (1841).

Fig. 101.

C. bipustulatus.

Fig. 102.



C. bipustulatus, var.

Niger, pubescens, antennis medio pedibusque ferrugineis, elytris macula media rufa obliqua. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Europa meridionali.

About the size and appearance of *C. hemipterus*; somewhat more depressed, black, feebly shining, thinly clothed with fine grey pubescence, more thickly on the sides. Antennæ red, with the first article piceous brown and the club black. Head small, sparsely and finely punctate, the epistome separated from the forehead by a somewhat rounded impression. Thorax behind of about the breadth of the elytra, and there about a third broader than long, considerably narrower in front, feebly rounded on the sides, in front and behind straight, truncate, all the angles somewhat rounded; sparsely and finely punctate on the disk, more thickly and somewhat rugosely on the sides, with a shallow round depression on each side behind at some distance from the posterior angles. Scutellum thickly and finely punctate at the base, and with thick pubescence. Elytra a little longer and more pubescent than the thorax, thickly punctate, the shoulders, which are somewhat projecting, and the apical margin very finely punctate, with fine black pubescence, the outer margin with two rows of fine greyish hairs; each elytron with a yellowish reddish spot with grey pubescence, the shoulders brownish. Abdomen not very thickly punctate, the pubescence in the middle of the segments fine and black, on the sides and at the point thicker and grey. Legs red; the thighs somewhat darker.

This species is rather narrower and more elongate than *C. hemipterus*. The elytra are without a humeral spot, although the colour is sometimes a little lighter at the shoulder, and the medial spot is somewhat oval and obliquely directed to the shoulder.

There is a variety which has the red spot reduced to a mere point, as shown in fig. 102.

From Austria, Sardinia, and other parts of the south of Europe.

42. Carpophilus bisignatus.

Bohem. Ins. Caffr. i. 563 (1848).

Fig. 103.

Note.—Outline of figure not exact. These cuts are merely meant to show the position and form of the red spot.

Affinis *C. bipustulato*; angustior, subovatus, sat latus et modice convexus, niger, tenuiter cinereo pubescens; capite et thorace confertim punctulatis; elytris crebre rugoso-punctatis, rugis obsolete longitudinalibus, singulis prope sed paulo pone medium macula sat magna rufa fere rotunda paulo obliqua ex adverso scutelli; pedibus piceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Caffraria, Natalia, &c.

Allied to *C. bipustulatus*; narrower, subovate, rather broad and moderately convex, thickly punctate, finely cinereo-pubescent, black, with a red patch on each elytron. Head with a transverse faint line uniting two transverse foveæ immediately behind the epistome. Thorax with the disk less coarsely punctate than the sides, with a deep and more coarsely punctate fovea on each side a short space in front of the posterior angles, narrower in front than behind, with the posterior two-thirds of the margin nearly parallel, but with a slight sinuation corresponding to the deep fovea; a small fovea at the anterior margin on each side behind the sides of the head, anterior margin scarcely emarginate, posterior sinuato-truncate; both anterior and posterior angles obtuse, the lateral margins with a narrow raised edge somewhat roughened by the coarse punctuation. Elytra flattened, sloping obliquely from the suture, less coarsely punctate than thorax, a little widest behind the middle, thickly rugosely punctate, the punctures obsoletely longitudinal; each elytron with a rather large subrhomboidal oblique spot in the middle near the suture, with its lateral margins both straight, the posterior margin extending from its sutural angle obliquely forwards and outwards, and the anterior margin rounded. Legs piceous.

From Caffraria, Natal, &c.

43. Carpophilus binotatus (Mus. Berol.).

Fig. 104.

Elongatus, subfusiformis, subdepressus, confertissime punctatus, cano pubescens, fere opacus, niger; elytris singulis macula sat magna rufa, antennarum basi pedibusque piceis, tarsis piceo-ferrugineis. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Sierra Leone.

At first sight suggesting more affinity with the section to which *C. dimidiatus* belongs (subgenus *Myothorax*) than to this; but a careful examination shows that it is only a very elongate and depressed form, belonging to the same section as *C. hemipterus*. Elongate, subfusiform, subdepressed, nearly opaque, very closely punctate, with a hoary pubescence, black, with a red spot on each elytron. Head impressed on each side in front. Antennæ piceous, with the club dusky. Thorax subquadrate, broader than long, slightly narrower in front than behind, sides very slightly rounded and margined, anterior angles slightly declinate, obtuse, posterior obtusely rounded, base nearly straight. Scutellum rounded at the apex. Elytra scarcely so much as a half longer than the thorax, about as broad as the base of the thorax, sides slightly declinate and rounded when viewed from the side, apex very slightly obliquely truncate; each elytron with a red patch occupying a large part of the middle, its inner side near the suture, at first parallel to it, afterwards extending obliquely outwards in front, its posterior margin extending somewhat in a curve obliquely forwards, its outer edge rounded, and the anterior portion oblique; sometimes the red has extended so far along the suture as to make the whole patch somewhat like a rounded triangle or broad cone with its base applied against the suture. Abdomen rather long. Legs piceous, tarsi piceo-ferruginous.

From Sierra Leone. In the British and Berlin Museums, &c.

Section VII. Body convex and fusiform. Texture so closely punctate as to appear shagreened. Elytra without paler spots or markings.

44. Carpophilus Bakewellii.

Elongato-ovatus, subdepressus, niger, rugoso-punctatus, subopacus, fusco pubescens; thorace angulis posticis oblique truncatis, fovea utrinque pube cinerea vestita; antennis pedibusque piceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Victoria in Australia.

Elongate-ovate, subdepressed, thickly punctate, the punctures flat and pitted, clothed with a fuscous pubescence, griseous in parts in certain lights, scarcely shining, except on the segments of the abdomen. Mouth and antennæ piceous; club darker. Head rather broad, with a faint curved line, deeper at each side behind the epistome. Thorax transverse, slightly convex, but somewhat flat on the disk behind, narrowest in front;

apex truncate, nearly straight; sides with a rather deep canaliculation within the margin, very gently rounded, most so towards the front, declinate and almost inflexed at the anterior angles, which are obtuse; posterior angles obliquely truncate at the point, anterior corner of this truncation rounded, posterior not, base trisinuate and margined; there is a depression on each side of the disk rugosely punctate, in which a lighter pubescence than that on the rest of the surface lies, pointing towards the sides, and only visible when looked at from the side. Scutellum broadly triangular, with the apex rounded. Elytra not a great deal longer than the thorax, flat on the back; sides slightly widened and rounded a little behind the shoulder, and narrowed and rounded-in again near the apex, canaliculated within the margin, deepest below the shoulders, which without being high are distinct; there is a depression within the shoulders, and another longitudinal depression on each side of the suture, and the base of the suture itself is depressed; very coarsely punctate at the base, more lightly towards the apex, and clothed with a longish dark fuscous pubescence, which is thick towards the base, sparing towards the apex; apex of each elytron obliquely truncate; exterior apical angles obtusely rounded. Abdomen somewhat shining above, segments more punctate and pubescent behind than in front. Underside rather thickly punctate. Legs deep ferrugineo-piceous.

From the flattening of the disk and back of the elytra this might perhaps appear more properly placed in the third section, but it is in other respects convex, and is among its natural allies here.

From Melbourne. I have received specimens from Mr. MacLeay, which are now placed in the British Museum. There are also specimens in the Oxford Museum and in that of Mr. Bakewell, to whom I have dedicated it.

45. Carpophilus dolens.

Parvus, ovatus, parum depressus, subnitidus, creberrime leviter punctatus, niger, pedibus rufo-piceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Senegallia?

Somewhat of the form of *C. Bakewellii*, but smaller, more depressed, and black. Small, ovate, somewhat depressed, slightly shining, thickly punctate, the punctures somewhat flat and pitted. The head rather deeply impressed on each side in front. Thorax somewhat narrowed in front, bi-impressed and coarsely punctate on each side behind, very finely punctate, base bisinuate, anterior angles obtusely rounded, posterior angles nearly right-angled, with the point rounded. Scutellum very faintly and sparingly punctate. Elytra more opaque than the thorax, subrugosely punctate, depressed, shoulders not prominent, sides declinate, slightly margined and rounded, disk somewhat flat, slightly impressed near the suture, near the shoulder, and on the sides; exterior apical angles rounded, apex obliquely truncate. Abdomen with the two exposed segments large and broad, finely punctate. Legs rufo-piceous.

Supposed to be from Senegal. Described from a single specimen now in the British Museum.

46. Carpophilus sericeus.

Motsch. Etud. Ent. vii. 41 (1858).

Depressus, opacus, punctatus, castaneus, pube longa grisea sericea vestitus. Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in India orientali.

Said by Count de Motschulsky to be similar in form to *C. marginellus*; larger and more depressed, opaque, punctate, clothed with a longish cinereous silky pubescence; elytra chestnut-coloured, abdomen and underside black. Antennæ rufo-piceous; club blackish. Thorax less strongly punctate than the elytra. Elytra short, depressed, and somewhat quadrate, with the sides a little rounded, margined, the margin canaliculate towards the base, not so towards the apex, which is slightly obliquely truncate, very finely punctate. Underside of prothorax rather strongly punctate. Legs rufo-piceous.

From the East Indies. Count de Motschulsky sent me a specimen, but unfortunately its head and thorax were lost on the way—an accident which prevents me saying more upon them than is contained in M. de Motschulsky's own description. The fragment, such as it is, is in the British Museum.

47. Carpophilus obsoletus.

Erichs. in Germ. Zeitschr. iv. 259 (1843).

Carpophilus cribellatus, Motsch. Etud. Ent. 1858, p. 41.

C. hemiptero paulo minor et magis depressus, confertissime punctatus, nitidulus, parcius cinereo pubescens; niger, pedibus testaceis; elytris lateribus rugulosis, nigro-fuscis, macula humerali obsoleta picea. Long. $1\frac{1}{2}$ lin.

Habitat in Taprobana, India orientali, Siam, Aden, et insulis Philippinis.

Var. C. strigipennis, Motsch. Etud. Ent. 1858, p. 41.

Niger et plerumque minor. Long. $1\text{–}1\frac{1}{2}$ lin.

Habitat in Taprobana et Siam.

Somewhat smaller and more depressed than *C. hemipterus*, black, somewhat shining, sparingly cinereo-pubescent. Antennæ ferruginous. Head densely and rather deeply punctate, obsoletely impressed on each side in front. Thorax of the breadth of the elytra, scarcely narrower in front, very thickly and somewhat strongly punctate, rugulose towards the sides, with a fovea near the posterior angles; anterior angles obtusely rounded; posterior angles nearly rectangular, but with the point broadly rounded; pubescence directed from the sides towards the middle and slightly backwards. Scutellum transverse, subpentagonal, apical angles rounded, faintly punctate at the base, smooth at the apex. Elytra a little longer than the thorax, very thickly punctate, towards the sides finely rugulose, nigro-fuscous, with a minute obsolete piceous humeral spot. Abdomen thickly punctate, with the segments margined with piceous; pygidium subacuminate at the apex. Legs testaceous.

The species described by M. de Motschulsky under the name *C. strigipennis* is only a slightly darker and smaller variety.

From Ceylon, East Indies, Siam, &c.

48. Carpophilus chalybeus.

Subfusiformis, convexus, chalceo-piceo-niger, subnitidus, crebre punctatus, sericeo pubescens. Long. $1\frac{1}{2}$ lin., lat. $\frac{4}{5}$ lin.

Habitat in Sunggaria.

Var. canus (*obscurus*, Motsch.).

Niger, haud chalybeo tinctus.

Habitat in Dauria.

Subfusiform, nearly as much attenuated before as behind, convex, greenish-brassy piceous black, somewhat shining, clothed with a longish silky hoary pubescence, thickly punctate, punctures round and cupped. Head with the epistome slightly marked off from the rest of the head. Antennæ nigro-piceous, with the club dusky black. Thorax narrower in front than behind, apex not emarginate, sides gently rounded, anterior angles very little obtuse, slightly reflexed at the tip, posterior angles obtuse, rounded, base bisinuate, middle further back than the sides: the pubescence and the punctuation combine to give the surface a velvety appearance, the pubescence pointing inwards and backwards to a point on the median line a little before the scutellum. Scutellum transverse, somewhat pentagonal, apical angles rounded, very pubescent. Elytra a little longer than the thorax, and a little broader than it at the base, rather convex, slightly depressed behind the shoulders, which are rather prominent and rounded, sides very slightly rounded, declinate, widest a little behind the shoulder, with a longitudinal line running down along the side beyond the shoulder; apex of each elytron obliquely truncate, exterior apical angles rounded, sutural angles obtuse. Abdomen with the exposed segments large, and about equal in length; fimbriæ scarcely observable. Legs black; tarsi nigropiceous.

From Sunggari. I owe this species to M. Obert, of St. Petersburg.

The non-æruginous variety is from Dauria, and was sent to me by M. de Motschulsky.

49. Carpophilus cribratus.

Parum convexus, oblongus, subfusiformis, opacus, fortiter punctatissimus, griseo pubescens; niger, ore, antennis pedibusque rufis; thorace lateribus postice subsinuatis, angulis posticis subacutis et retro projicientibus. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Patria ignota.

Slightly convex, subfusiform, opaque, strongly and very thickly punctate, griseopubescent, black. Head punctate, impressed in front; the mouth and antennæ rufous, except the club, which is fuscous. Thorax subquadrate, the anterior angles obtuse, declinate, almost inflexed, the sides straight, except near the apex, where they are rounded in, apex straight, subsinuate behind the middle, causing the posterior angles to appear acute and a little like a curved tooth projecting backwards and outwards; before the scutellum with a short, slightly raised dorsal line; the base truncate, sinuate on each side towards the angles. Scutellum and base of the elytra declining to the base of the thorax. Elytra with the sides straight until behind the middle, when they become narrower; margins of the sides declinate, moderately rounded, and edged; apex of each elytron obliquely truncate; exterior apical angles broadly rounded. Legs rufous.

A very distinct species; readily distinguished by its coarse punctuation and by the posterior angles of the thorax projecting backwards.

Habitat unknown. A single specimen in the collection of Herr Dohrn, of Stettin.

50. CARPOPHILUS FUSUS.

Elongatus, fusiformis et antice et postice fere æqualiter attenuatus, sat convexus, niger, punctatus, nigro pubescens; prothorace versus basin longitudinaliter utrinque bi-impresso; tarsis rufo-piceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in insula Dorey prope Novam Guineam.

Elongate, fusiform, nearly as much attenuated in front as behind, rather convex, black, punctate, sparingly nigro-pubescent. Head with a slight transverse impression, and a small fovea on each side of it behind the epistome. Thorax broader than long, about as broad as the length of the head and thorax, narrower in front than behind; sides somewhat parallel for the posterior two-thirds, thence gently rounded to the apex, which is nearly straight; anterior angles much declinate, obtuse, with the point rounded; posterior angles nearly right angles, slightly obtuse and blunt; disk longitudinally convex, with a depression close to and all along the side, and another longitudinal depression within that, proceeding from the base and disappearing about halfway forward, these depressions more deeply and thickly punctate than the rest of the surface; base slightly bisinuate. Scutellum depressed at the base, rounded at the apex. Elytra about equal in length (at the suture) to the thorax, disk flat, sides nearly parallel, deeply declinate and slightly inflexed, the margin rounded, widest a little behind the shoulder; apex of each elytron obliquely truncate; exterior apical angles rounded, sutural angles obtuse. Abdomen with the two exposed segments long (about the length of the elytra), finely punctate and pubescent. Underside punctate. Legs with the tarsi rufo-piceous.

Found by Mr. Wallace in the island of Dorey, one of the New Guinea Islands, and in the island of Morty, north of Gilolo.

Species mihi invisa.

The following species probably belongs to this or the preceding section; but as I have not seen it, and the description is insufficient, I merely reproduce M. Lucas's description.

51. CARPOPHILUS IMMACULATUS.

Lucas, Explor. Scient. de l'Algér. Zool. ii. 218 (1849).

"Ater, capite granario punctatoque; thorace subtilissime marginato; scutello elytrisque fortiter punctatis, sparsim flavo-testaceo pilosis; segmentis abdominis supra subtilissime punctulatis, corpore infra sat fortiter punctato; pedibus fusco-rufescentibus tarsisque ferrugineis.

"Habitat in Oran in Algeria."

Black. Head subrugosely punctate. Thorax very faintly margined. Scutellum and elytra strongly punctate and sparsely clothed with a testaceous-yellow pile. Abdomen with the exposed segments very finely punctate, the body below rather strongly punctate. Legs rufescent-fuscous; tarsi ferruginous.

From Oran in Algeria.

SECTION VIII. Body very convex and colours bright.

52. CARPOPHILUS MELANOPTERUS. (Plate XXXII. fig. 11.)

Erichs. in Germ. Zeitschr. iv. 262 (1843).

Subovatus, obesus, subopacus, convexus, apterus, læte rufus, elytris nigris, opacis, abdomine subnitido. Long. $1\frac{1}{2}$–2 lin., lat. $\frac{3}{5}$–1 lin.

Habitat in partibus meridionalibus Americæ borealis.

Generally about twice the size of *C. hemipterus*, but sometimes no larger, obese, convex, rufous, subopaque, finely punctate. Antennæ with the club black. Head finely punctate, subimpressed on each side in front. Thorax convex, very thickly finely punctate, subrugulose, gently narrowed in front, truncate at the apex, subsinuate on each side at the base, with the sides slightly rounded, acutely margined; anterior angles obtuse, posterior angles rounded. Scutellum triangular, closely punctate. Elytra convex, a little longer than the thorax, finely punctate, black or bluish black, opaque, with the shoulders and the apex sometimes subrufescent, apex obliquely truncate; sutural angles obtuse, exterior apical angles rounded. Abdomen very thickly punctate. Legs testaceous.

From South Carolina, Mexico, &c.

53. CARPOPHILUS RUFUS.

Sat magnus, parum convexus, aurantiaco-rufus, subopacus, creberrime leviter punctatus, breviter rufo pubescens; thorace angulis posticis abrupte incurvatis. Long. 2 lin., lat. 1 lin.

Habitat in Mexico.

Large, rather broad and slightly convex, above orange-red; the abdomen a little darker and somewhat piceous, below wholly piceo-ferruginous, closely and very finely punctate, subopaque, with a close, short, concolorous pubescence. Head with two impressions in front between the eyes. Thorax nearly twice as broad as long, wider behind than in front; sides for the anterior four-fifths sloping gradually to the apex, for the posterior fifth incurved rapidly and abruptly to the posterior angles, making these angles appear as if cut off, but the real angle is further in towards the base; apex not emarginate, anterior angles slightly obtuse, posterior angles excessively obtuse and slightly reflexed at the tip, disk somewhat flat in the middle. Scutellum rounded at the apex. Elytra a little wider than the thorax, not much longer than broad, not much declinate towards the margin, the inflexed portion on the underside rather wide, widest behind the shoulder; apex of each elytron obliquely truncate; disk impressed near the scutellum and near the shoulder. Abdomen more coarsely and sparingly punctate; pygidium longer than penultimate segment.

From Mexico. In the collection in the Jardin des Plantes.

54. CARPOPHILUS PALLIPENNIS (FLORALIS, Erichs.).

Cercus pallipennis, Say, Journ. Acad. Nat. Sc. Philad. iii. 194 (1823).
Carpophilus floralis, Erichs. in Germ. Zeitschr. iv. 261 (1843).
Var. *Carpophilus canus* (Erichs.).

Subovatus, convexus, niger, dense punctatus, griseo pubescens; antennis testaceis, elytris pedibusque testaceis vel rufo fuscis. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Arkansas prope montes rupestres et in Mexico.

Subovate, short, convex, densely punctate, griseo-pubescent, black, with the elytra testaceous or reddish brown. Antennæ testaceous, with the club black. Labrum rufous. Head very thickly punctate, bifoveolate in front. Thorax transverse, gently narrowed in front, truncate at the apex, with the sides and all the angles rounded, convex, very thickly and rather deeply punctate, with the back behind and on each side obliquely impressed. Scutellum very thickly punctate. Elytra almost a half longer than the thorax, very thickly and rather deeply punctate, apex obliquely truncate, truncation somewhat rounded; exterior apical angles rounded, sutural angles obtuse. Abdomen closely punctate. Legs testaceous or reddish brown.

Dr. Schaum had in his collection a dark specimen of this species, standing under the name of *C. canus*, Erichs., which he has been good enough to cede to me for the British Museum.

From Mexico, Arkansas, and other parts of North America.

SECTION IX. (Subgenus MYOTHORAX (*μυὼν*, a muscular part; and *θώραξ*, thorax).) Body subcylindrically convex, oblong. Thorax subquadrate (see fig. 105).

55. CARPOPHILUS MACULATUS.

Oblongus, convexus, leviter et parce punctatus, griseo pubescens, subnitidus, nigrofuscus; elytris ferrugineo obscure maculatis. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in insula Oahu.

Oblong, convex, lightly and sparingly punctate, griseo-pubescent, nigro-fuscous. Head punctate and pubescent, scarcely impressed in front, the vertex behind with a transverse obscure ferruginous mark. Antennæ obscurely ferruginous. Thorax of the same breadth before as behind, convex, transversely subquadrate; the sides deeply declinate, nearly straight, slightly rounded in front and behind, most rounded behind; anterior angles nearly right angles, with the point rounded, posterior angles rounded; apex somewhat bisinuate, base truncate; very finely and sparingly punctate on the disk, more coarsely punctate and more pubescent towards the sides; sides of thorax when looked at from the side wider than sides of elytra, when looked at from above apparently nearly equal in breadth. Scutellum nigro-piceous, punctate. Elytra rounded-in at the shoulder, seen from the side slightly rounded, widest behind the shoulder; the sides, seen from above, nearly parallel; apex of each elytron truncate a little obliquely; exterior apical angle nearly a right angle, rounded; sutural angles almost right angles; finely and sparingly punctate, dark chestnut, somewhat dull, with a ferruginous patch along the base covering the shoulder, another near the suture about its middle, and another near the outer margin a little further back. Abdomen thickly griseo-pubescent and punctate, margins of the segments narrowly rufescent. Legs obscurely ferruginous.

From Oahu.

56. CARPOPHILUS VITTIGER.

Carpophilus biguttatus ?, Motsch. Etud. Ent. 1858, p. 43.

Elongatus, subopacus, punctatus, cano valde pubescens; nigro-fuscus, ore, capite basi elytrisque basi et vitta a basi usque pone medium obscure rufo-testaceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in India orientali et insulis Waigiou, Aru, Morty, Dorey, &c.

Var. ROBUSTUS. Thorace magno, magis punctato, elytris haud breviore.

Habitat in Waigiou.

Var. NIGRITUS. Totus niger, capitis basi et interdum elytrorum basi exceptis.

Habitat in insula Waigiou, prope Novam Guineam.

Var. TESTACEUS. Totus testaceus.

Habitat in insula Waigiou, prope Novam Guineam.

Var. LIMBALIS. Testaceus, elytris limbo angusto apicali nigro.

Habitat in insula Dorey.

Var. DILUTUS. Testaceus, elytris basi et vitta suturali dilutioribus.

Habitat in Macassar.

Elongate, narrow, subopaque, punctate, hoary pubescent, the pubescence, when not rubbed, long and woolly, nigro-fuscous. Head obscure fuscous, its base and the mouth and antennæ rufo-testaceous, mandibles darker at the apex. Thorax subquadrate, a little narrower before than behind, wholly fuscous, rather smooth, sparsely and lightly punctate, with the base as well as the sides lightly margined, the anterior angles almost right angles, the posterior rounded: a doubtful dorsal line behind; it is broader, particularly in front, in some individuals than in others—in some instances so much so as to be broader before than behind—probably a sexual character. Scutellum fuscous. Elytra of the breadth of the thorax and continuous with it, longer than the thorax, with the sides subparallel, lightly margined, with the apex very slightly obliquely truncate; fuscous, the base and a rather broad stripe extending from the base to behind the middle, parallel to the suture, obscurely rufo-testaceous, the suture itself fuscous. The last two segments of the abdomen long, punctate posteriorly, almost impunctate in front, and the pygidium flat and conical. Legs rufo-testaceous.

This is a most variable species, and if we had only one or two of the extreme forms, it would unquestionably have figured as two or three species at least; but as I have been furnished with a large series by Mr. Wallace, I have been enabled to arrive at a more correct conclusion. The varieties differ not only in colour, but in the development of the thorax and the comparative length of the thorax and elytra. These pass, by such trifling degrees, from one to the other, that no doubt as to their being mere varieties can exist.

Were the various forms peculiar to different islands, I might have separated them; but it is not so, the different varieties are found in the same island as well as in the other islands: one is entirely black; another is entirely testaceous; another is testaceous, with a black edging to the apex of the elytra, in some instances narrow, in others broad; and another is testaceous, with the usual vitta paler or whitish.

From the East Indies, Borneo, and the Malayan Archipelago. Collected by Mr. Wallace at Macassar, also in the island of Waigiou, near New Guinea, and in the islands of Dorey, Aru, Morty, &c.

Count de Motschulsky, in mentioning the species which he included in his proposed subgenus *Ecnomorphus* (of which *C. sexpustulatus* was to be the type), says,—"A third species from the Indian continent is the *Ecnomorphus biguttatus*, Motsch., which singularly resembles *E. sexpustulatus* not only in its form and in its coloration, but is distinguished from it by its thorax being larger and more square, not at all rounded on the sides, nor narrowed behind, by the base of the abdomen being of a testaceous brown, and by the elytra having only a testaceous spot in the middle." The charàcters here given are wholly inconsistent with any affinity with *C. sexpustulatus*; and as I find that M. de Motschulsky made a similar error with regard to his *C. fulvipes*, of which he has had the kindness to send me specimens, I have come to the conclusion that his *E. biguttatus* may possibly be one of the varieties of this species, which is the only East Indian species I know of which comes near it in colour.

57. Carpophilus oculatus.

Affinis *C. maculato*; major, magis nitidus, saturate castaneus vel ferrugineo-niger; capite postice, ore, antennis thoracisque angulis anticis ferrugineis; elytris ferrugineis, apice, sutura et macula rotundata in medio nigris; abdomine nigro-piceo, lateribus ferrugineis; pectore nigro-piceo; pedibus ferrugineis. Long. $1\frac{2}{3}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in insula Borabora.

Nearly allied to *C. maculatus*; larger, more shining, less pubescent; dark chestnut-coloured or ferruginous black. Head very finely punctate, with the mouth and the back of the head ferruginous; antennæ ferruginous. Thorax subquadrangular, longer than in *C. maculatus*, more shining, very finely punctate, most thickly so on the sides, which are subparallel, very slightly rounded, and very much declinate; anterior angles obtuse and rounded, posterior angles rounded, base slightly sinuate; disk dark chestnut, anterior angles with an adjoining portion of the apex and sides ferruginous. Scutellum triangular, dark chestnut, finely punctate. Elytra longer and more parallel than in *C. maculatus*, a little wider behind the middle, not rounded-in at the shoulder as in that species, rather faintly granulosely punctate; dark ferruginous, with the apex and the suture black or nigro-piceous (the apex black for about a fourth of the length of the elytra, the suture narrowly black); the remaining ferruginous disk on each elytron has a large black spot in the middle, which spreads to the side so as almost to reach it; sides deeply margined, apex of each elytron obliquely truncate, sutural angles obtuse, exterior apical angles obtuse, rounded on the outside. Abdomen piceous black, with the sides ferruginous, very finely punctate and pubescent. Breast nigro-piceous. Legs ferruginous.

From Borabora. A unicate in the Museum at Copenhagen; collected on the voyage of the Danish frigate 'Galathea.'

58. CARPOPHILUS MUTABILIS.

Fairm. Essai sur les Coléoptères de la Polynésie, in Rev. et Mag. de Zool. June 1849, p. 26.

Parum depressus, punctatus, elytris prothorace sesqui longioribus; colore variabili: brunneus, prothoracis lateribus et elytrorum macula arcuata rufis; interdum testaceus, prothoracis disco et elytrorum macula brunneis. Long. 1–$1\frac{1}{2}$ lin.

Habitat in Tahiti.

Elongate, slightly depressed, thickly punctate, with a silky pubescence. The thorax more finely punctate than the elytra, with the angles rounded, and sometimes with a scarcely perceptible line in the middle. Elytra once and a half as long as the thorax, truncate. The colour is very variable: in young individuals it is rather bright testaceous, with the disk of the thorax and a spot upon each elytron brownish; afterwards, by transition, the colour becomes reddish, with the disk of the thorax, a spot in the middle of the elytra, and the extremity brown; the normal colour is brownish black, with the circumference of the head, that of the thorax, an arched blotch on each elytron, the abdomen, and the legs of an obscure sanguineous red. In one variety there remains nothing of red but the posterior part of the head and a narrow transverse band at the base of the elytra.

Very common all the year round at Tahiti in all kinds of decaying fruits, but more particularly in oranges and citrons.

M. Fairmaire says that this species is allied to *C. obsoletus*, Erichs., but differs from it by its longer elytra, less depressed body, and differently disposed coloration. From his description, however, it seems more allied to the preceding species or to *C. vittiger*; but as I have not seen it, and it does not entirely agree with either, I can only reproduce it, leaving it to be hereafter determined whether it is distinct or not.

59. CARPOPHILUS FUMATUS.

Bohem. Ins. Caffr. i. 564 (1848).

Subovatus, modice convexus, piceus, parum nitidus, cinereo pubescens; antennis pedibusque rufo-testaceis; capite prothoraceque subtiliter crebre punctulatis; elytris rufo-testaceis, evidenter crebre rugoso-punctatis, apice infuscatis. Long. $1\frac{1}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Caffraria.

Equal in size to *C. hemipterus*. Head above somewhat convex, piceous, a little shining, slenderly pubescent, finely thickly punctulate. Antennæ short, rufo-testaceous, with the club fuscous and rounded. Thorax scarcely a half shorter than broad, piceous, above moderately convex, finely thickly punctulate, slenderly cinereo-pubescent, in front gently emarginate, anterior angles obtuse, sides immediately behind the apex moderately, then a very little more widely rounded, behind subtruncate, with the posterior angles obtuse. Scutellum short, broad, subtriangular, piceous, subopaque, finely thickly punctulate. Elytra a half longer than the thorax and not broader than its base, finely thickly rugosely punctate, slenderly cinereo-pubescent, truncate in front, the shoulders a little raised, subangular; the sides slightly margined, at the middle a little more widened and rounded, with the apex of each obliquely truncate, the exterior angles obtuse; moderately convex, rufo-testaceous, slightly shining, with the apex more or less infuscate. Body piceous, slightly shining, finely thickly punctulate, slightly cinereo-pubescent. Legs rufo-testaceous, obsoletely punctulate, sparingly pubescent.

Exceedingly close to *C. mutilatus*; probably only a variety. Its thorax is more quadrate and pubescence finer. In other respects there is little perceptible difference.

From Caffraria.

60. Carpophilus australis.

C. fumato affinis, major et elongatior; oblongo-ovalis, punctatus, subpubescens, pallide castaneus, elytris dilutioribus, sutura et spatio scutellari brunneis, abdomine saturatiore, ore pedibusque testaceis, mandibulorum apice piceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Victoria in Australia.

Similar in appearance to *C. fumatus*; larger and more elongate, and with the thorax narrower in front. Oblong-oval, punctate, subpubescent, pale chestnut-coloured, with the elytra paler and the suture and scutellar space brunneous, the abdomen darker, the mouth and legs testaceous, the apex of the mandibles piceous. Thorax narrowed in front, sides subparallel, scarcely rounded except towards the anterior angles, where they are rounded in. In other respects as in *C. fumatus*.

Most readily distinguished from its congeners by its thorax being more narrowed in front, the sides sloping straight to the slightly rounded anterior angles. It has, in fact, considerable affinity with the section in which I have placed *C. hemipterus*.

From Melbourne in Australia.

61. Carpophilus angustatus.

Parallelus, angustatus, sat convexus, niger, opacus, pubescens, rugose punctatus; thorace subquadrato, angulis rotundatis; elytris callo humerali obsolete ferrugineo; antennis pedibusque ferrugineo-piceis. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Var. Totus fuscus, griseo pubescens.

Habitat in Madagascaria.

Elongate, parallel, narrow, rather convex, black, opaque, pubescent, and rugosely punctate. Head with a shallow depression on each side between the eyes. Thorax subquadrate, slightly narrower in front than behind, all the angles rounded, a depression towards the posterior angles. Elytra rather convex, the humeral callus showing an indication of dark ferruginous; the penultimate segment of the abdomen above showing a tendency to a paler margin. Antennæ and legs ferrugineo-piceous.

From Madagascar.

Among the specimens from Madagascar in the collection of the Jardin des Plantes is one wholly fuscous and with a light griseous pubescence. It is a trifle narrower than the typical example of this species, but I can see no other difference, and I have therefore recorded it as a variety.

62. Carpophilus ochropterus (Klug).

C. quadraticollis, Mus. Jard. Pl.

C. lividus, Dej. Cat. p. 134.

Fig. 105.

Elongatus, subconvexus, crebre punctatus, ferrugineo-fuscus, subtus ferrugineus, thorace supra nigro vel fusco, lateribus et elytris dilutioribus; thorace quadrato, fere latiore antice quam postice. Long. $1\frac{1}{2}$ lin., lat. $\frac{2}{3}$ lin.

Var. Totus ferrugineus.

Habitat in Madagascaria et Caffraria.

Subcylindric, elongate, subconvex, ferrugineo-fuscous, thorax sometimes fuscous or black, darkest on the disk; the elytra paler, sometimes yellowish, and palest on the disk; densely punctate and with short pubescence. Head convex, with a triangular smooth space (of which the apex is pointed backwards) immediately behind the labrum. Thorax large and square, if anything a little wider before than behind, with the sides and anterior angles steeply declinate; disk less coarsely punctate than the rest; a short smooth line in front of the scutellum; sides and base narrowly margined, apex scarcely margined, a shallow depression towards the posterior angle; anterior angles obtuse, posterior angles rounded. Scutellum smooth and impunctate. Elytra scarcely longer than the thorax, very slightly longer than broad, margins edged and exteriorly broadly inflexed, less coarsely punctate than the thorax, apex obliquely truncate. Abdomen densely punctate.

There is considerable variation in the size and colour of this species. The thorax is in some instances wholly testaceous, in others wholly fuscous, and again testaceous with the disk fuscous.

It has very much of the character of *C. mutilatus*, but is twice its size. It is still nearer to *C. luridus*, but is more coarsely punctate. I am not quite satisfied that it is really distinct from it, but place it so until we obtain more information and additional materials.

From Madagascar, Natal, and Caffraria.

63. Carpophilus luridus.

(Dej. Cat. 134, ed. 1837.)

C. ochroptero et *C. mutilato* intermedius; hoc sesqui major, interdum rufo-ferrugineus, interdum ferrugineus, cum thoracis disco et corpore subtus fusco vel nigro, antennis pedibusque ferrugineis; *C. mutilato* magis punctatus; thorace quadrato, fere latiore antice quam postice. Long. $1\frac{1}{2}$ lin., lat. $\frac{5}{8}$ lin.

Habitat in Europa, America boreali, America meridionali, India orientali &c.

Subcylindric, oblong, very coarsely punctate, testaceo-rufo-pubescent, rufo-ferruginous or ferruginous, with the disk of the thorax and the abdomen and body below fuscous. Head with the epistome rounded. Thorax with the sides declinate, the anterior angles somewhat right-angled, the posterior broadly rounded, the sides and base margined. Scutellum rounded at the apex, somewhat fuscous, finely punctate. Elytra with the sides gently rounded and margined; apex of each elytron obliquely truncate. Legs rufous.

From Europe, North America, South America, East Indies, Ceylon, &c.

I have received this insect from Ceylon, mixed up with *C. mutilatus*, and I am almost inclined to think that they may be varieties of the same species. The only difference that I can see, besides size and stronger punctuation, is that the thorax is more quadrate than in *C. mutilatus*. In this species the squareness is more marked; but it will be seen from my remarks upon *C. vittiger* that this may perhaps be a sexual character—at any rate a variable one. The specific name proposed for *C. ochropterus* in the Museum of the Jardin des Plantes (*C. quadraticollis*) would have been better applied to this.

64. Carpophilus mutilatus.

Erichs. in Germ. Zeitschr. iv. 258 (1843).
Nitidula hemiptera, Fab. Ent. Syst. i. 1. 261 (1792).
Nitidula pallens?, Blanch. in d'Orbigny, Voy. dans l'Amér. Mérid. vi. 2. Ins. 64 (1837–43).
Carpophilus mutilatus, Woll. Ins. Mad. 116 (1854).

Subcylindrico-oblongus, rufo-ferrugineus, pubescens, crebre subtiliter punctatus; thorace subquadrato; elytris thorace vix longioribus; abdomine infra colore saturatiore. Long. $1\frac{2}{3}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Europa meridionali, in Madera, in India orientali, in India occidentali, in Australia &c.

Subcylindric-oblong, sparsely clothed with a rather long pale testaceous pubescence, densely and finely punctate, not shining, flavo-testaceous or rufo-ferruginous. Head punctate, with longer pubescence than that on the thorax: the usual impressions on each side in front are either absent or very slight. Thorax convex, large, subquadrate, rather strongly punctate, the punctures variolose, the pubescence all directed to a point immediately in front of the scutellum; sides declinate, angles all obtusely rounded, apex and base nearly straight, truncate; the disk usually somewhat darker than the sides. Scutellum also darker, moderate in size, rounded, nearly impunctate, a few faint small punctures only at its base. Elytra scarcely (perhaps a very little) longer than the thorax, not wider than the thorax, shoulders distinct, but not very prominent, sides straight when seen from above, declinate and slightly rounded, margin distinct; testaceous, paler than the thorax, near the scutellum and along the apex slightly darker than the rest of the elytra, finely and not very closely punctate, punctuation becoming thicker towards the suture, pubescence long; the apex declinate, each elytron truncate obliquely, exterior apical angles obtusely rounded, sutural angles obtuse, right angles at the very point. Abdomen above rufo-ferruginous, with a tinge of fuscous; underside and legs rather darker. Legs robust.

I am inclined to think, from M. Blanchard's description and the examination of a mutilated fragment of the type in the Museum of the Jardin des Plantes, that his *Nitidula pallens* belongs to this species.

This species is now found in most countries to which commerce has penetrated. Its original habitat is supposed to be the West Indies.

65. Carpophilus dimidiatus.

Erichs. in Germ. Zeitschr. iv. 259 (1843).

Nitidula dimidiata, Fab. Ent. Syst. i. 1. 261. 27 (1792); Syst. El. i. 354. 36 (1792).

Carpophilus pusillus, Steph. Illustr. Brit. Ent. iii. 51. 2 (1830); Manual, 122. 975 (1839).

C. auripilosus, Woll. Ins. Mad. 117 (1854).

C. cephalotes (Mus. Berol.).

C. mutilato valde affinis, minor: subcylindrico-oblongus, fuscus, testaceus, testaceo-rufus, rufo-ferrugineus, testaceo-fuscus, piceus vel nigro-piceus, elytris interdum partibus dilutioribus; dense et fortiter punctatus, pubescens ut in *C. mutilato*; thorace quadrato; elytris thorace longioribus. Long. 1–$1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Europa, America boreali, India occidentali, Madera, India orientali, Australia &c.

Very closely allied to *C. mutilatus*, from which I feel scarcely warranted in separating it. It is smaller, and decidedly more coarsely and deeply punctate; more especially the variolose punctuations on the head and thorax are larger and deeper. It is proportionally shorter and broader. The thorax has the anterior angles squarer (more high-shouldered as it were), although in some specimens this difference is not so perceptible as in others, there being a slight difference in individuals in this respect. The colour is variable, from dark brown (almost black) to rufo-testaceous. There is usually a pale, oblique, rather broad band on each elytron, running from the shoulder to the suture near the apex, forming together the letter V, so that the scutellum is surrounded with a triangular large dark patch, and the pale colour also extends backwards for a short distance along the margin or the base. Traces of this distribution of colour may even be seen in the darkest individuals; for, after the elytra are wholly black, the pubescence on the space where the V-like band should be is usually more abundant and paler. It is to be remarked that in this family the punctuation generally partakes of the colour of the surface from which it springs. The darker the specimens are, the deeper also is the punctuation. The elytra are proportionally shorter, and not so declinate at the apex as in *C. mutilatus*. In this species they are usually very little longer than the thorax; in that species about one-fourth or one-third longer.

Found in all parts of the world.

A single specimen is recorded by Mr. Wollaston as having been taken in the neighbourhood of Funchal, in Madeira. He supposed it to be a distinct species, and named it *auripilosus* from the pale yellowish pubescence with which it is clothed; but I do not find the pubescence more golden than is usually the case in *C. dimidiatus*. The elytra are perhaps a little longer, but not sufficiently so to make it a distinct species. It is a small individual with the least-developed form of thorax (narrowed in front) which is found in this group. In the collection of Mr. Wollaston's Madeiran insects in the British Museum. It has also been found by him in the Canary Isles.

This is a most variable species, both as to colour, punctuation, and form of the thorax; but I have been unable to find more than one species in it. The most confusing character is the thorax—in some specimens comparatively narrowed in front and not very convex or large, in others large, broad, wide in front, and very convex. It is possible that these are sexual distinctions, and that the same characters will be found to distinguish the sexes in all this oblong group. A large light-coloured variety stands in the Berlin Museum under the name of *C. cephalotes*.

66. CARPOPHILUS PALLESCENS.

C. dimidiato affinis; multo levius punctatus, pubescentia brevi æqualiter vestitus, testaceus, elytrorum apice saturatiore. Long. 1 lin., lat. $\frac{1}{3}$ lin.

Habitat in insula Waigiou prope Novam Guineam.

Allied to and very like *C. dimidiatus*, but, instead of being somewhat coarsely punctate as seen under the lens, its surface is so finely punctate as to be almost imperceptible. The pubescence is short and regularly distributed, instead of being, as in *C. dimidiatus*, all directed to a point in front of the scutellum. The sides of the thorax are much declinate and strongly margined, the posterior angles rounded, and the anterior angles obtuse. Its colour is testaceous, in some specimens darker on the apex of the elytra and abdomen. In other respects there is little difference between it and *C. dimidiatus*.

From the island of Waigiou, near New Guinea.

67. CARPOPHILUS PILOSELLUS.

Motsch. Etud. Ent. 1855, p. 41.

C. dimidiato valde affinis; minor, levius punctatus, pube breviore et magis sericea; thorace antice parum angustiore; scutello minore: capite et thorace dilute castaneis, elytris testaceo-piceis, abdomine piceo-nigro, pedibus piceis. Long. 1–$1\frac{1}{5}$ lin., lat. $\frac{1}{4}$–$\frac{1}{3}$ lin.

Habitat in India orientali et in Celebes.

Closely allied to *C. dimidiatus*. Smaller, narrower, and comparatively more elongate; more finely punctate, and with a shorter and more silky pubescence disposed as in that species; the thorax slightly narrower in front; the scutellum somewhat smaller. The head and thorax pale chestnut; the elytra testaceo-piceous; the abdomen and underside piceous black; the legs piceous.

From the East Indies and the island of Celebes.

68. CARPOPHILUS NOTATUS (Klug).

C. dimidiato similis, elytrorum medio macula obsoleta rufa. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Madagascaria.

Similar to *C. dimidiatus*, with an obsolete rufous patch in the middle of the elytra.

From Madagascar. In the Berlin collection.

69. Carpophilus truncatus (Klug).

(*C. Madagascariensis* (Dup.).)

C. dimidiato affinis; parum latior; niger, punctatus, cinereo pubescens; thorace fortiter punctato, elytris thorace vix longioribus, pedibus piceis. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Var. Elytris piceis, humeris dilutioribus.

Habitat in Madagascaria.

Allied to *C. dimidiatus*; a little broader and wholly black; punctate, cinereo-pubescent. Thorax more deeply punctate than the elytra, the punctures variolose, with a short impunctate dorsal line before the scutellum; the posterior angles less obtuse than in *C. dimidiatus*, almost right angles. Elytra very little longer than the thorax; the shoulders sometimes paler. Abdomen rather convex.

From Madagascar.

70. Carpophilus nepos.

C. dimidiato valde affinis; minor, nigro-fuscus; elytris thorace longioribus, luteo-testaceis, lateribus et apice nigro-fuscis; abdominis segmentis expositis brevibus. Long. 1 lin., lat. $\frac{1}{4}$ lin.

Habitat in Brasilia.

Very like *C. dimidiatus*. It is smaller; the two segments of the abdomen which are exposed are shorter than in it; the elytra about a third longer than the thorax, while in *C. dimidiatus* they are only very slightly longer; it is testaceous, with the margins and apex blackish brown.

Brazil. In the collection of Professor Boheman.

71. Carpophilus Schiödtei.

Parvus, oblongus, parallelus, convexus, subnitidus, punctatus, leviter pubescens, ferrugineo-piceus; elytris testaceis, apice anguste piceo-nigro; subtus ferrugineus. Long. $\frac{3}{4}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Pulo Milu.

Small, oblong, parallel, convex, punctate, somewhat shining and very slightly pubescent, ferrugineo-piceous; elytra testaceous, with the apex piceous black. Below ferruginous. Head punctate, with an impression on each side at the base of the epistome (which is prominent) ferruginous, with the centre of the forehead piceo-ferruginous. Eyes large; antennæ ferruginous. Thorax transverse, sides declinate, very little rounded at the margin, anterior angles nearly right angles, very little obtuse, the point of the angle not sharp, posterior angles rounded, apex bisinuate, base straight, truncate; piceo-ferruginous, disk darker than the sides. Scutellum subpentagonal, rounded at the apex, ferrugineo-piceous, impunctate, except very slightly at the base. Elytra nearly parallel, a little widest past the middle, about a half longer than the thorax, slightly declinate at the sides and somewhat depressed towards the suture, testaceous, with the apex for about a fifth of the length black; each elytron obliquely truncate at the apex; exterior apical angles rounded, sutural angles obtuse. Exposed portion of abdomen short and abruptly attenuate, ferrugineo-piceous. Underside ferruginous. Metathorax with the epipleura rather wide and bent. Legs testaceo-ferruginous.

From Pulo Milu. In the Museum at Copenhagen: kindly lent to me for description by Professor Schiödte.

72. Carpophilus cylindricus.

Valde angustus, linearis, cylindricus, subopacus, pubescens, leviter parce punctatus, totus flavescens. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Taprobana.

Very narrow, linear, cylindrical, dull, pubescent, lightly and not thickly punctate, wholly testaceous yellow. Head impressed with a curved line in front; antennæ robust, club large. Thorax elongate, longer than broad, somewhat narrower in front, sides subparallel, all the angles rounded, impressed on each side towards the posterior angles, base slightly emarginate in the middle. Scutellum triangular, faintly and sparingly punctate and pubescent. Elytra of the same width as the thorax, nearly a half longer than the thorax, sides declinate and margined, expanded beyond the margin, apex truncate scarcely obliquely, exterior apical angles rounded, sutural a little obtuse. Abdomen pubescent, pygidium peaked. Legs robust.

Easily recognized by its long thread-like body. It clearly belongs to this section, although at first sight it looks as if its thorax was so long as almost to require another section for it. On measuring it, however, it will be found that this is an ocular deception; the thorax is actually as broad as long, or nearly so. It therefore comes literally within the section with a quadrate thorax.

From Ceylon. I owe this interesting species to the special researches of Mr. Nietner undertaken for the purpose of this Monograph.

73. Carpophilus tenuis.

C. cylindrico affinis; minor, minus convexus, minus punctatus, testaceo-brunneus, thorace haud postice impresso, elytris paulo brevioribus.

Habitat in China.

Allied to *C. cylindricus*. Smaller, not so convex, less punctate, testaceous brown; the thorax not impressed behind; the sides of the thorax more sloped away to the posterior angles, and the anterior angles more rounded, base bisinuate. Elytra a little shorter; in other respects as in that species.

From Hongkong.

(Subgenus Nitops (*Nitidula*, by elision; and ὤψ, the eye,—a Nitidula with notable eyes).)

Caput latum; oculis grandibus, fortiter et grosse granulatis. Abdominis segmentis expositis brevibus. Cætera ut in *Carpophilo*.

The distinguishing marks of this subgenus are a broad head with large and coarsely granulated eyes. The exposed dorsal part of the abdomen is short, making the elytra look long. In *C. ophthalmicus* the mandibles on the right side are pointed, and on the left bidentate.

74. CARPOPHILUS OPHTHALMICUS (La Ferté). (Plate XXXIII. fig. 8.)

Oblongus, sat cylindrico-convexus, subopacus, ferrugineo-rufus, griseo pubescens, punctatus; thorace transversim oblongo. Long. $1\frac{1}{4}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Mexico et in Trinidad.

Oblong, rather cylindrico-convex, somewhat opaque, ferruginous red, griseo-pubescent, punctate. Head bi-impressed in front. Thorax transversely oblong, twice as broad as long, sides subparallel, declinate, all the angles rounded, apex slightly rounded, base truncate. Scutellum triangular, apex somewhat rounded. Elytra a half longer than the thorax, slightly wider at the base than the thorax, shoulders rounded, with the sides parallel and declinate, deeply margined, with the apex somewhat declinate and truncate nearly straight; exterior apical angles rounded, sutural angles nearly right angles. Legs stout; tarsi short and much dilated, except the last long and slender article.

From Mexico and Trinidad. Collected by M. Sallé.

75. CARPOPHILUS SORDIDUS.

Erichs. in Wiegm. Arch. 92 (1847).

Oblongus, subconvexus, obscure castaneus vel niger, dense subtiliterque flavescente pubescens, crebre subtilissime punctatus; elytris dorso nigro-pubescentibus, callo humerali testaceo; ventre pedibusque castaneo-piceis. Long. $1\frac{2}{3}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Peruvia.

Oblong, subconvex, black or obscure chestnut, of fine and rather soft texture, thickly clothed with a fine olivaceous-flavescent pubescence, and thickly finely punctate, the pubescence and punctuation combined giving a soft silky look to the surface. Eyes smaller and less coarsely granulated than in *C. ophthalmicus*. Thorax transverse, broad, lightly convex, very finely and thickly punctate, the sides rapidly and abruptly declinate, all the angles obtuse and rounded. Scutellum rounded, subpentagonal. Elytra with the back sometimes darker in colour than the rest of the body, sometimes with the humeral callus testaceous. Abdomen, underside, and legs chestnut-piceous.

Erichson describes the elytra as having the back clothed with a black pubescence (nigro-pubescentibus). The specimens in the Berlin Museum do not bear out this; the disk of each elytron is somewhat darker than the rest of the body, so is the disk of the thorax, but the pubescence in all is of the same yellowish olivaceous hue. The humeral callus is not always lighter than the rest of the elytra.

From Bolivia, Peru, &c. In the Berlin and British Museums.

76. CARPOPHILUS PUBESCENS.

C. sordido affinis, ei simillimus statura et colore; angustior, thorace antice angustiore, lateribus citius declinatis, disco magis conico, angulis posticis minus late rotundatis, parce punctato; elytris parum brevioribus. Long. $1\frac{1}{3}$ lin., lat. $\frac{4}{7}$ lin.

Habitat in Taprobana.

Very like *C. sordidus*. The colour and general appearance of both is the same, but the form of the thorax is different. In *C. sordidus* it is transverse and broad, with the sides turning down rapidly when near the margin; in *C. pubescens* the sides slope more gradually from the culminating ridge, giving its section somewhat of a conical form. In *C. sordidus* the thorax is dull and covered with pubescence, and very finely punctate; in *C. pubescens* it is not so dull, and larger punctures are scattered over it. The pubescence also lies in a different manner: in *C. sordidus* it is directed from the sides to a point immediately before the scutellum, while in *C. pubescens* it is directed from each side towards the middle, so that the hairs meet in a ridge all along the dorsal region. The elytra also, although narrower than in *C. sordidus*, are proportionally broader when compared with the breadth of the thorax; they are also proportionally shorter. The keel of the prosternum is narrow and bent in, instead of being broad at its apex; and the segments of the abdomen are so wide, that one of the chief generic characters of *Carpophilus*, viz. that the second and third segments of the abdomen are very short, is almost absent. The eyes too are smaller and not so coarsely granulated as in *C. ophthalmicus*.

From Ceylon. I owe this species to the kindness of Mr. Nietner and Count de Motschulsky.

(Subgenus Endomerus (ἔνδον, within; and μέρος, a part,—in allusion to each of the last three segments of the abdomen retiring within the preceding segment).)

Corpus breve, convexum, subcylindricum. Abdomen segmentis ultimis tribus expositis, sed parum visis; segmentis singulis a præcedentibus intus susceptis.

The chief distinctions of this subgenus are, its having three exposed segments of the abdomen. Notwithstanding that there are three, each is so enclosed like the joints of a telescope within the preceding segment, that the whole are very short and scarcely visible. The body is short, thick, round, barreled, and cylindrical; and the elytra appear longer than usual, but this is merely an appearance due to the small portion of the abdomen which is visible.

77. Carpophilus piger. (Plate XXXIII. fig. 3.)

Curtus, subcylindricus, obesus, leviter punctatus, griseo pubescens, castaneo-fuscus; ore, antennis pedibusque testaceis. Long. 1–$1\frac{1}{4}$ lin., lat. $\frac{3}{4}$ lin.

Habitat in Guatemala.

Short, subcylindrical, obese, lightly punctate, griseo-pubescent, chestnut-brown. Head rounded, finely punctate, very faintly bi-impressed in front; mandibles, mouth, and antennæ testaceous. Thorax with the sides subparallel, all the angles rounded and declinate both in front and behind and at the sides. Scutellum rounded. Elytra declinate at the base towards the thorax and at the apex, longer than the thorax, but not a half longer, obliquely rounded at the apex, and with both the exterior apical angles and the sutural angles rounded. Abdomen finely punctate and finely pubescent, margins of the segments rufescent. Legs testaceous.

From Guatemala.

78. Carpophilus senex.

Affinis *C. pigro*; subcylindrico-convexus, subopacus, fuscus, parce et sparsim longe griseo-sericeo pubescens, haud punctatus, sed levissime subgranulatus, antennis pedibusque testaceis. Long. 1 lin., lat. $\frac{3}{5}$ lin.

Habitat in Mexico.

Allied to *C. piger*. Not so convex, somewhat opaque, dark fuscous, and sparingly clothed with a long griseous silky pubescence, not punctate, but very faintly subgranulose,—the head and thorax bearing as it were marks of scales rubbed off, and the elytra somewhat acicularly granulose. Antennæ and legs testaceous. The last segment of the abdomen so much retracted within the penultimate segment as sometimes not to be visible.

From Mexico. Collected by M. Sallé.

79. Carpophilus languidus.

Erichs. in Germ. Zeitschr. iv. 261 (1843).

C. dorsalis (Mus. Berol.).

Leviter convexus, sat brevis, fusco-testaceus, subtiliter punctatus; thorace transverso; elytris thorace sesqui longioribus, pallide testaceis, apice vittaque longitudinali fuscescentibus. Long. 1 lin., lat. $\frac{2}{5}$–$\frac{1}{2}$ lin.

Var. Testaceus, elytris pallidis.

Habitat in Columbia.

Short, moderately convex, fusco-testaceous, opaque, griseo-pubescent. Antennæ testaceous, club darker. Head faintly punctate. Thorax transverse, gently narrowed in front, strongly rounded on the sides, truncate at the apex, with all the angles obtuse and somewhat rounded, faintly punctulate. Scutellum densely punctulate. Elytra a half longer than the thorax, faintly punctate, pale livid testaceous, with an apical patch and a longitudinal fuscous stripe stretching obliquely inwards from within the shoulder to the apex; the outer margin also fuscous. Abdomen faintly punctulate, the pygidium subimpressed towards the apex. Legs pale.

It varies in colour, being in some instances testaceous, with pale elytra (probably immature). The abdomen is fuscous in both varieties, the last segment and the whole of the ventral and half of the dorsal penultimate segments being testaceous.

From Columbia.

(Subgenus Ecnomorphus.)

Motsch. Etud. Ent. vii. 42 (1858).

Corpus elongatum, depressum. Thorax basi elytris angustior. Elytra plus minusve elongata. Color obscurus, plus minusve niger vel piceus.

Body depressed and somewhat elongate. The thorax flat on the disk. Elytra wider than the base of the thorax. Colour obscure, more or less black or piceous.

The subgenus which I propose thus to characterize was first suggested by Count de Motschulsky as an asylum for his species *C. fulvipes*, which, however, does not belong to it. He formed it, as he says, "at the expense of the elongate and depressed *Carpophili* like *C. sexpustulatus*;" but *C. fulvipes* is not an elongate species, and its depression is slight, and not very different from that of other species of the typical form of *Carpophilus*. It is different, however, with *C. sexpustulatus*, whose facies is sufficiently distinct from the other species to warrant the establishment of a subgenus for its reception. The facies results from the elongate and depressed form, the long elytra, and the short thorax, rounded behind.

M. de Motschulsky attempted to find characters drawn from the antennæ of *C. fulvipes* as well as the body, but in this he has failed.

The characters given by him are, the antennæ more elongate than in the other *Carpophili*. The club only slightly massive ("peu solide"), and composed of two parts distinctly separated, of which the apical contains two articles and the basal one article, while in the other species it is formed by four transverse articles solidly joined together. He figures (*loc. cit.*) the antennæ of both, and has also had the kindness to send me specimens of his *C. fulvipes* to show the difference in nature. A careful examination of these convinces me that he has been deceived by the accidental separation of the joints of the club. In one instance I have found the antennæ correspond to his figure; but the opposite antenna of the same individual otherwise placed has shown nothing different from the usual form of the antennæ of other *Carpophili*. The parts of the mouth, which are also quite correctly figured by M. de Motschulsky, show no deviation from the usual characters of these parts in other species. It is the form of the thorax and unusual length of the elytra which give its peculiar appearance to this section of the *Carpophili*, and therefore they seem to be the characters on which the subgenus should be founded. This will exclude *C. fulvipes*, which I have already described in what I consider its proper place.

80. Carpophilus sexpustulatus.

Erichs. in Germ. Zeitschr. iv. 263 (1843). Sturm, Deutschl. Ins. xv. 41 (1844). Erichs. Naturg. d. Ins. Deutschl. iii. 137 (1848).

Nitidula 6-pustulata, Fab. Ent. Syst. i. 1. 360. 1 (1792); Syst. El. i. 352. 25 (1801). Schönh. Syn. ii. 147. 59 (1808).

Lyctus abbreviatus, Panz. Faun. Germ. 24. 21 (1794).

Ips abbreviata, Duftsch. Faun. Austr. iii. 144 (1825). Sturm, Deutschl. Ins. xiv. 102, t. 186. fig. n, N (1839). Heer, Faun. Col. Helv. i. 416 (1841).

Fig. 106.

Elongatus, parallelus, depressus, parce pubescens, piceus, elytris singulis maculis tribus rufo-testaceis, una humerali, altera ante medium prope suturam, tertia pone medium versus marginem exteriorem. Long. 1–1½ lin., lat. ½ lin.

Habitat in Europa.

Elongate, parallel, depressed, moderately shining, with hoary, very fine, almost imperceptible pubescence, piceous, with three rufo-testaceous spots on the elytra. Antennæ reddish brown, with the club blackish. The head deeply punctate, with an arched oblique line (interrupted in the middle) between the eyes; the mouth reddish brown. Thorax somewhat narrower than the elytra, rounded on the sides, rather more narrowed behind than in front, apex and base moderately straightly truncate, anterior angles rounded, posterior angles obtuse; the disk flat, depressed, not very thickly punctate, the sides more or less piceous. Scutellum rounded at the apex, with a line of punctures at the base. Elytra nearly twice as long as the thorax, flatly depressed, before and behind the middle slightly impressed, thickly punctate, an elongate spot on the shoulder, a second somewhat before the middle near the suture, and a third, smaller, behind the middle on the exterior margin, lighter or darker reddish yellow; the last spot is usually very much obliterated and scarcely perceptible, or wholly absent; sides deeply margined; apex obliquely truncate, its exterior angles rounded; the margin clear reddish brown. Abdomen very finely punctate; the margins of the segments semitransparent and ferruginous. Legs light or dark piceous.

Found throughout Europe, under the bark of trees, but not common in Britain.

Count de Motschulsky describes an East Indian species (Etudes Ent. vii. 43 (1858)) under the name of *Ecnomorphus biguttatus*, which he says is very closely allied to *C. sexpustulatus*, differing from it only in having a larger and more quadrate thorax, the sides of which are not rounded and not narrowed behind, and in the elytra having a testaceous spot in the middle. Judged of by these characters, his species can have little or no affinity with *C. sexpustulatus*, and more probably belongs to the subgenus *Myothorax*, and, as I have already suggested, may be a variety of *C. vittiger*, but the description is insufficient to allow me to deal with it. The name *biguttatus* also is preoccupied.

81. CARPOPHILUS DEPLANATUS.

Brachypeplus deplanatus, Bohem. Ins. Caffr. i. 562 (1848).

Oblongus, depressus, niger vel nigro-piceus, subopacus; nigro pubescens, thoracis elytrorumque basi cinereo pubescens; labro, mandibulis, antennis basi pedibusque rufopiceis; capite prothoraceque subtiliter crebre punctulatis; elytris longitudinaliter aciculatis. Long. 1–$1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in Africa australi apud flumina Limpopo.

Small, oblong, depressed, black or nigro-piceous, subopaque, nigro-pubescent, with the base of the thorax and elytra cinereo-pubescent. Head shorter than broad, above slightly convex, black, opaque, faintly closely punctulate, almost glabrous. Labrum, mandibles, and palpi piceous. Eyes rounded, moderately convex, black. Antennæ rather short, rufo-piceous, sparingly pubescent; club rounded, nigro-fuscous. Thorax a half shorter than broad, above almost flat, faintly and closely punctulated, clothed (except at the base) with long black pubescence which lies directed forwards; the pubescence of the base is cinereous; lightly rounded, emarginate in front, with the anterior angles slightly projecting, obtuse; the sides slenderly reflexed, narrowly edged with ferruginous, somewhat widened immediately behind the apex, thence backwards almost straight; base truncate, posterior angles obtuse. Scutellum short, broad, with the apex slightly rounded, faintly and thickly punctulate. Elytra a half longer than the thorax and not broader than its base, almost glabrous, faintly, closely, and irregularly acicularly punctate, the punctuation longitudinal, clothed (except at the base, which has cinereous pubescence) with long black pubescence lying directed backwards; truncate in front, the sides not widened, the apex truncate; shoulders not prominent, almost right-angled. Body below black, slightly shining, rather closely punctulated, slenderly cinereo-pubescent. Legs rufo-piceous, obsoletely punctulate.

This has been erroneously described as a *Brachypeplus* by Professor Boheman. He has had the kindness to send me the type, and I am enabled to say that it is undoubtedly a *Carpophilus* of the narrow section, and coming near *C. sexpustulatus*. It may be readily distinguished from any similar species by the posterior angles of the thorax, which are cut off, so that they have two posterior angles on each side as it were. The long black pubescence, directed forwards on the thorax and backwards on the elytra, is another character of ready application.

From the banks of the river Limpopo in South-east Africa.

82. Carpophilus brachypterus.

Erichs. in Germ. Zeitschr. iv. 263 (1843).

Nitidula brachyptera, Say, Journ. Acad. Nat. Sc. Philad. v. 183. 10 (1827).

Carpophilus carbonatus, Leconte, Coleopt. of Kansas and East. Mexico (Smithsonian Contrib.), 6 (1859).

Ips atrata (Dej. Cat. 134 (1837)).

Carpophilus humilis, Erichs. in Germ. Zeitschr. iv. 262 (1843).

Oblongus, subdepressus, subnitidus, parcius pubescens et punctatus, textura molli, piceo-niger, antennis basi piceis; thorace elytris angustiore, lateribus et angulis rotundatis; elytris subtiliter punctulatis, thorace duplo longioribus. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{2}$ lin.

Habitat in America boreali.

Allied to *C. sexpustulatus*; oblong, subdepressed, piceous black, sparingly punctate and pubescent, somewhat shining, texture soft. Head slightly raised on the vertex and in front. Antennæ piceous at the base. Thorax narrower than the elytra, transversely subquadrate, more than a half shorter than broad, all the angles broadly rounded, the apex scarcely emarginate, the margin of the sides narrow. Scutellum triangular, somewhat rounded at the apex, smooth, shining, and almost impunctate, there being merely two or three punctures on the disk. Elytra finely, not very closely punctate, twice as long as the thorax, sides distinctly margined and canaliculated, widest a little before the middle; apex obliquely truncate, exterior apical angles nearly right angles. Shoulders rather prominent. Legs piceous.

The colour varies from piceous or purplish black to pure black. The length of the elytra seems greater in some specimens than in others, and the thorax seems to vary slightly in its proportions. These variations, however, are merely apparent, not real. The thorax, for instance, in some specimens seems widest before the middle, in others widest behind it; but this depends upon the angle of inclination at which the thorax stands. In the same way, a careful measurement of the comparative length of the thorax and elytra shows that the proportions are the same even in those specimens in which the elytra seem longest.

An examination of Dr. Leconte's type of *C. carbonatus*, which he kindly forwarded to me, has satisfied me that it is not different from Say's *N. brachyptera*, and I can find no difference between it and Erichson's *C. humilis*. I am inclined to think that in recording in his Monograph *C. brachypterus*, Say, as a different species from *humilis*, Erichson had taken it on trust. He gives no description of *brachypterus*, merely referring to Say's paper, but describes the same species as new under the name of *C. humilis*.

From North America.

83. Carpophilus xanthopterus (Mus. Berl.).

Elongatus, angustus, oblongus, parallelus, subdepressus, subopacus, punctatus, parce pubescens, castaneus vel nigro-fuscus, capite dilutiore, elytris testaceo-castaneis. Long. $1\frac{1}{8}$ lin., lat. $\frac{1}{3}$ lin.

Patria ignota.

Narrow, elongate, oblong, parallel, subdepressed, subopaque, punctate, sparingly pubescent, chestnut or nigro-fuscous, the head paler, the elytra testaceous chestnut-coloured. Head rather lightly punctate, impressed transversely in front. Thorax transverse, somewhat rounded on the sides, especially behind, thickly punctate, the disk subdepressed, with a transverse impression behind the middle, and there more strongly punctate; the base as well as the sides margined, the posterior angles somewhat explanate and rounded, the anterior angles declinate and nearly right angles. Scutellum rounded at the apex, shining, impressed in the middle at the base. Elytra almost a half longer than the thorax, parallel, less thickly punctate, the sides declinate and margined, the disk unequally impressed, transversely impressed at the apex, which is somewhat obliquely truncate on each elytron, the exterior apical angles rounded. Abdomen above very faintly punctate. Below paler chestnut, almost testaceo-piceous. Legs of the same colour.

Country unknown. A single specimen was presented to me by Dr. Schaum, and is now placed in the British Museum. It stands in the Berlin Museum under the name which I have preserved.

(Subgenus Microxanthus (μικρὸς, small; ξανθὸς, yellow).)

Corpus parvum, depressum, lineare. Color plus minusve testaceus.

Body small, depressed, linear. Colour more or less testaceous.

84. Carpophilus tempestivus.

Erichs. in Germ. Zeitschr. iv. 260 (1843).

Parvus, elongatus, angustulus, fere linearis, subdepressus, parce subtilissimeque pubescens, testaceus, subnitidus, elytris sutura apiceque nigro marginatis. Long. 1 lin., lat. $\frac{1}{3}$ lin.

Var. A. Elytris basi etiam nigricante.

Var. B. (*C. terminatus* (Berl. Mus.).) Elytris apice solum nigro marginatis.

Habitat in Cuba et partibus vicinis Americæ.

Small, elongate, subdepressed, very shortly and thinly clothed with fine pubescence, somewhat shining, testaceous. Antennæ testaceous; club black. Head sparingly and finely punctate, obsoletely foveolate on each side in front. Thorax of the breadth of the elytra, not narrowed in front, subdepressed, finely punctate, scarcely rounded at the sides; apex truncate; base obliquely truncate on each side, both posterior and anterior angles obtuse. Scutellum triangular, with the apex rounded; finely and sparsely punctate. Elytra almost a half longer than the thorax, subdepressed, finely punctate, deeply margined on the sides, which are slightly rounded, the suture and apex edged with black; apex of each elytron slightly obliquely truncate. Abdomen very faintly punctate.

From Cuba and the neighbouring parts of America.

85. Carpophilus ochraceus.

Erichs. in Germ. Zeitschr. iv. 260 (1843).

Oblongus, parum convexus, testaceus, densius griseo pubescens; thorace transverso, elytris thorace duplo longioribus. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Brasilia.

Oblong, slightly convex, very slightly shining, griseo-pubescent, pale testaceous. Head faintly and thickly punctate, marked in front on each side with a minute fovea. Thorax of the breadth of the elytra, transverse, rounded on the sides, somewhat narrowed in front, truncate at the apex, with all the angles obtuse, slightly transversely convex, faintly punctate. Scutellum densely punctate. Elytra twice as long as the thorax, faintly punctate. Abdomen faintly punctate.

From Brazil. In the Berlin collection.

86. Carpophilus flavidus.

Fairm. Essai sur les Coléoptères de la Polynésie, Rev. et Mag. de Zool. June 1849, 26.

"Pallide flavus, oblongus, depressus, parce pubescens; thorace transverso, angulis posticis rectis; elytris thorace duplo longioribus. Long. $1\frac{1}{2}$ lin.

"Habitat in Tahiti."

Oblong, depressed, pale yellow, slightly shining, with very short and sparing golden pubescence. Head, thorax, and elytra finely and thickly punctate. Head with a small impression in front on each side. Thorax transverse, with the sides slightly rounded, posterior angles right angles. Scutellum more finely punctate than the elytra, which are twice as long as the thorax. Abdomen scarcely visibly punctate.

Allied to *C. ochraceus* of Erichson, from which it is distinguishable by its pale colour and by the posterior angles of the thorax being pointed.

From Tahiti. In M. Deyrolle's collection.

87. Carpophilus marginatus.

Erichs. in Germ. Zeitschr. iv. 262 (1843).

C. minutus, Melsh. Proc. Acad. Sc. Philad. ii. 105 (1846).

Parvus, breviusculus, subdepressus, subtiliter punctatus, saturate testaceus; thorace antrorsum angustato elytrisque fortius marginatis, his apice nigro limbatis. Long. 1 lin., lat. $\frac{1}{3}$ lin.

Habitat in Carolina et partibus meridionalibus Americæ borealis.

Small, rather short, subdepressed, scarcely shining, finely punctate and thinly griseo-pubescent, deep testaceous. Head rather large, densely and finely punctate, slightly impressed on each side in front. Thorax narrowed in front, with the sides nearly straight, emarginate at the apex, truncate at the base, with the anterior angles nearly right angles and the posterior angles acute; densely and finely punctate, with the lateral margins distinct and reflexed. Scutellum broad, subpentagonal, thickly punctate. Elytra broad, a half longer than the thorax, closely faintly punctate, with the apex edged with black or brown, the lateral margin distinct and reflexed; apex of each elytron obliquely truncate; exterior apical angles sharply rounded. Abdomen finely punctate.

This species has a good deal of the short broad form of *C. antiquus*, and was mistaken by Melsheimer for a variety of it. It is not shining like that species, but has considerable affinity to it, and should perhaps have been placed beside it rather than here.

From Carolina and other southern districts of North America.

88. Carpophilus discoideus.

Leconte, in Proc. Acad. Nat. Sc. Philad. March 1858, p. 62 (1858).

Forsan mas *C. caudalis*, Leconte, *loc. cit.*: *vide* C. caudalis, *ante*.

Oblongus, fere depressus, piceus, nitidus, subtiliter pubescens, elytris macula testacea triangulari, postice truncata, antice attenuata, utrinque ornatis; pedibus antennisque rufis, his clava paulo infuscata. Long. $\frac{9}{10}$ lin.

Habitat apud flumina Colorado in California.

Oblong, almost depressed, piceous, shining, finely pubescent; antennæ rufous, with a fuscous club. Thorax short, sides rounded, more faintly punctate. Elytra twice as long as the thorax, more strongly margined and more faintly punctulate, with a testaceous patch of a triangular form, truncate behind and attenuated in front on each side. Legs rufous.

Somewhat allied to *C. marginatus*, Er., but larger, more regularly oblong, and more flattened. Dr. Leconte suggests that it may be the male of *C. caudalis*, which in every respect corresponds with it except in having three segments of the abdomen exposed instead of two.

Found near the Colorado River in California. In Dr. Leconte's collection.

89. Carpophilus ustulatus.

Parvus, elongato-ovatus, depressus, sat nitidus, levissime punctatus, ferrugineus, elytris apice late indeterminate nigro-fusco. Long. 1 lin., lat. $\frac{2}{5}$ lin.

Habitat in Nova Guinea.

Small, elongate-ovate, depressed, somewhat shining, very finely punctate, with scarcely any pubescence, ferruginous or piceo-ferruginous, with the apex of the elytra blackish. Head broad, very finely punctate, smooth, with very slight impressions at the base of the epistome; eyes large. Thorax transverse, broader than long, slightly convex, even, very little narrower in front than behind, the sides slightly rounded, apex slightly emarginate and bisinuate, gently and slightly projecting in the middle, anterior angles rounded, posterior angles slightly obtuse, base bisinuate, all the margins paler than the disk. Scutellum rather large, subpentagonal, slightly punctate, rather darker than the neighbouring parts of the elytra. Elytra rather longer but scarcely broader than the thorax, somewhat attenuated behind, widest a little before the middle, sides gently rounded, the humeral angles projecting; finely punctate, the punctuation fainter towards the apex; the base is pale ferruginous, passing gradually into a dark chestnut, the dark portion covering more than the half of the elytra; the apex of each elytron truncate very obliquely; exterior apical angles rounded, sutural angles obtuse. Abdomen somewhat convex, more finely punctate, and with some fine rufous pubescence, darker at the apex. Legs rufous.

From Dorey and New Guinea. Collected by Mr. Wallace.

90. Carpophilus gentilis.

Elongatus, oblongus, depressus, subnitidus, leviter punctatus, subtilissime flavo pubescens, flavescens. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Victoria in Australia.

Elongate, oblong, depressed, somewhat shining, lightly punctate, very finely flavopubescent, yellowish. Head darker, subfuscous, lightly obliquely impressed on each side; antennæ with club obscure. Thorax rufo-flavescent, broader than long, with the disk broadly flat, the sides gently rounded both before and behind; anterior angles slightly obtuse, posterior somewhat obtusely rounded; apex scarcely emarginate, base straight, truncate, finely punctate and pubescent, narrower than the base of the elytra. Scutellum rounded at the apex, flat, shining at the margin, impressed at the base, and punctate in the middle. Elytra flat, testaceous, the sides as seen from above parallel, narrowly declinate, very slightly gently rounded, apex of each elytron truncate slightly obliquely; finely punctate and pubescent. Abdomen more pubescent, rather darker testaceous than the elytra.

From Victoria in Australia.

91. Carpophilus frivolus.

Minutus, elongato-oblongus, depressus, subnitidus, leviter punctatus et pubescens, testaceus, capite elytrorumque apice et regione scutellari plus minusve piceis. Long. 1 lin., lat. $\frac{1}{4}$ lin.

Habitat in Victoria in Australia.

Small, elongate-oblong, depressed, somewhat shining, faintly and not closely punctate, slightly testaceo-pubescent; testaceous. Head piceous, with the epistome very little advanced, slightly longitudinally impressed on each side. Thorax transversely oblong, apex and base truncate straight, sides subparallel, slightly rounded in front and behind, anterior angles declinate and obtuse, posterior angles rounded. Scutellum triangular, testaceo-piceous, somewhat shining, very faintly punctate and pubescent. Elytra wider and about a half longer than the thorax, humeral angles distinct, sides nearly parallel, a little wider towards the apex; more sparsely punctate than the thorax; apex somewhat obliquely truncate, and more or less piceous or testaceo-piceous; the scutellar region is also sometimes piceous. Abdomen with the penultimate segment long. Tarsi very slightly dilated.

From Melbourne in Victoria.

92. Carpophilus inconspicuus.

Minutus, oblongo-ovatus, subdepressus, levissime sparsim punctatus et pubescens, supra subnitidus, subtus nitidior, flavo-testaceus, elytris luteis, apice et basi versus scutellum saturatioribus. Long. $\frac{2}{3}$–$\frac{3}{4}$ lin., lat. $\frac{1}{4}$ lin.

Habitat in insula Batchiana.

Minute, oblong-ovate, subdepressed, very finely and sparsely punctate and very finely pubescent, somewhat shining above, more so below, flavo-testaceous, with the elytra luteous, the apex and base about the scutellum and the scutellum itself a little darker. Head with a slight depression on each side behind the epistome; antennæ rather long, testaceous, with the club dusky. Thorax transverse, depressed, disk flat, a little broader in front than behind, sides gently rounded, apex not emarginate, base truncate, anterior angles somewhat obtuse, posterior angles very obtuse and almost rounded. Scutellum large, triangular, smooth, piceo-testaceous. Elytra a little longer than the thorax, wider at the base than the base of the thorax, sides subparallel, widest behind the middle, margined and canaliculate; disk depressed, sloping a little towards the suture; sparsely and finely punctate and sparingly finely pubescent; apex of each elytron obliquely truncate, exterior apical angles rounded, sutural angles obtuse; the scutellar region and the outer margin and apex rather darker than the rest of the piceo-testaceous surface. Abdomen still more finely punctate and pubescent than the elytra. Tarsi not very testaceous.

From the island of Batchian. Collected by Mr. Wallace.

Species mihi invisa.

I have not seen this species, and the description is scarcely sufficient to indicate its proper place; I have therefore merely added it as an appendix to the whole genus.

93. Carpophilus apicalis.

Leconte, Coleopt. Kansas and E. Mexico, (Smithson. Contrib.) 6 (1859).

"Oblongus, piceo-niger, minus subtiliter punctatus et flavo pubescens; elytris rufis, circa scutellum et ad apicem extrorsum oblique infuscatis; pedibus antennisque testaceis. Long. $1\frac{1}{4}$ lin.

"Habitat in Georgia apud flumina Platte in America boreali.

"Oblong, piceous black, rather faintly punctate, and with a yellow pubescence. Thorax moderately convex, not a half shorter than its breadth, the sides rounded. Elytra a half longer than the thorax, rufous, oblique, infuscated about the scutellum and exteriorly outwards to the apex. Legs and antennæ testaceous.

"From Platte River in Georgia in North America."

I have not seen this species, and have merely reproduced Dr. Leconte's description.

Dichotomous Table.

	Three dorsal segments of abdomen exposed	1
	Two dorsal segments of abdomen exposed	11
1	Elytra not overshadowing the exposed dorsal segments of abdomen	2
	Elytra almost concealing the exposed dorsal segments of abdomen	9
2	Body elongate, somewhat depressed. Elytra partly red	3
	Body rather broad, convex. Elytra not marked with red	4
3	Elytra wholly red except the apex, which is black	*rubripennis.*
	Elytra with a red triangular patch	*caudalis.*
4	Body above shining and glabrous	5
	Body above semiopaque, shagreened	*rubiginosus.*
5	Fawn-coloured, with black or brown markings	*adumbratus.*
	Black or piceous brown	6
6	Thorax with a well-marked depression near the posterior angles	7
	Thorax without a well-marked depression near the posterior angles	8
7	Thorax with the anterior angles pale	*foveicollis.*
	Thorax with the anterior angles not pale	*humeralis.*
8	Colour black, with legs and base of antennæ yellow	*nitidus.*
	Colour piceous brown, with margins of thorax paler	*discolor.*
9	Colour brown, with the elytra more or less livid testaceous	*languidus.*
	Colour brown	10
10	Thorax with posterior angles rounded	*piger.*
	Thorax with posterior angles obtuse	*senex.*
11	Eyes moderate	12
	Eyes large and prominent. Body convex and oblong. Elytra long	88
12	Texture hard, glabrous, shining, not shagreened	13
	Texture not hard and glabrous	18
13	Thorax decidedly narrower at the apex than behind	14
	Thorax transversely quadrate, nearly as broad in front as behind	17
14	Thorax with a punctate impression near the posterior angles	15
	Thorax without a punctate impression near the posterior angles	16
15	Form fusiform. Thorax wider at the base than at the middle	*marginellus.*
	Form cuneiform. Thorax not wider at the base than at the middle	*cuneiformis.*
16	Thorax dark brown. Elytra slightly paler	*succisus.*
	Thorax reddish. Elytra darker	*rubescens.*
17	Colour dark chestnut; apical half of elytra darker	*antiquus.*
	Colour light ferruginous; apical margin only of elytra slightly darker	*ferrugineus.*
18	Body depressed. Texture various	19
	Body more or less convex. Texture shagreened	39
19	Texture leathery, or slightly shagreened. General colour black or piceous	20
	Texture fine, size small. General colour more or less testaceous	31
20	Thorax not narrower at the base than the elytra	21
	Thorax narrower at the base than the elytra	26
21	Elongate-oblong. Elytra somewhat leathery in texture	22
	Subfusiform. Texture generally faintly shagreened and somewhat shining	23
22	Thorax piceous and elytra black	*corticinus.*
	Thorax and elytra both black	*compressus.*

23	Thorax with all the angles rounded	*planatus.*
	Thorax with not all the angles rounded	24
24	Base of thorax scarcely or not at all sinuate. Elytra black	*fulvipes.*
	Base of thorax sharply sinuate near posterior angles. Elytra purplish brown	25
25	Anterior angles of thorax obtuse and not rounded	*lacertosus.*
	Anterior angles of thorax rounded	*purpureipennis.*
26	Body large and elytra not very long	*rufitarsis.*
	Body long and narrow and elytra long	27
27	Not wholly black or piceous black	28
	Wholly black or piceous black	30
28	Colour of body black or piceous, with elytra testaceous or piceo-testaceous	29
	Colour of body black or piceous, with pale markings on elytra	*sexpustulatus.*
29	Posterior angles of thorax obliquely truncate	*ligneus.*
	Posterior angles of thorax rounded	*xanthopterus.*
30	Elytra broader than the base of the thorax and somewhat variolosely punctate	*brachypterus.*
	Elytra not broader than the base of the thorax, and longitudinally acicularly punctate	*deplanatus.*
31	Elytra wholly testaceous	32
	Elytra not wholly testaceous	34
32	Scutellum densely punctate	33
	Scutellum scarcely punctate (only two or three punctures at the base)	*gentilis.*
33	Posterior angles of thorax obtuse	*ochraceus.*
	Posterior angles of thorax right angles	*flavidus.*
34	Elytra piceous, with a triangular testaceous patch	*discoideus.*
	Elytra testaceous, with portions darker	35
35	Elytra testaceous, with a distinct black or dark piceous apical margin	36
	Elytra testaceous, with the apex or other portions duller	37
36	Black or piceous apical margin of elytra narrow	*tempestivus.*
	Black or piceous apical margin of elytra broad	*ustulatus.*
37	Elytra lurid testaceous, with scutellar region and apical margin darker	*inconspicuus.*
	Elytra with the apex duller testaceo-piceous	38
38	Comparatively broad thorax with posterior angles rectangular	*marginatus**.
	Rather narrow thorax with posterior angles rounded	*frivolus.*
39	Thorax considerably narrower in front than behind, its sides rounded	40
	Thorax transversely subquadrate, not narrower, or not much narrower, in front than behind; sides subparallel, body subcylindrical	70
40	More or less elongate, subdepressed. Thorax slightly convex	41
	Not elongate—convex, broad, or fusiform	47
41	Decidedly elongate and large in size (upwards of 2 lines in length)	42
	Moderately elongate and not so large	43
42	Black, margins of thorax piceous and subserrated, legs black or dusky piceous	*niger.*
	Brownish black, margins of thorax ferruginous and only slightly or not at all rough, legs ferruginous	*Triton.*
43	Black, with shoulders of elytra rufescent	44
	Black, with shoulders of elytra not rufescent	45

* *C. marginatus*, but for its comparatively soft texture and dulness, might be sought for alongside of *C. antiquus* and *C. ferrugineus*. It has much of their form, but can be distinguished by the above characters and its smaller size.

44	Thorax not conspicuously marked with depressions	*lugubris.*
	Thorax conspicuously marked with depressions	*brevipennis.*
45	Thorax coarsely punctate. Elytra leathery-looking and more finely punctate and pubescent	*tristis.*
	Thorax and elytra equally coarsely punctate and pubescent. Elytra not leathery-looking	46
46	Anterior angles of thorax rounded	*Morio.*
	Anterior angles of thorax obtuse	*funereus.*
47	Body convex, broad, and somewhat tending to squareness	48
	Body convex, fusiform	53
48	Legs wholly testaceous	49
	Legs not testaceous	50
49	Margins of thorax slightly sinuated and anterior angles rounded	*tectus.*
	Margins of thorax not sinuated, and anterior angles obtuse	*flavipes.*
50	Punctuation variolose (when seen under the microscope)	*variolosus.*
	Punctuation simple	51
51	Large and obese. Elytra thickly punctate; suture not distinctly raised	52
	Moderate. Elytra smooth, somewhat shining, and sparsely punctate; suture raised	*puncticeps.*
52	Margins of thorax and elytra much reflexed	*obesus.*
	Margins of thorax and elytra not much reflexed	*Hoffmannseggii.*
53	Colour dark, obscure, except when there are markings on the elytra	54
	Colours bright. Thorax or elytra, or both, bright rufous	68
54	Elytra bearing pale spots or markings	55
	Elytra not bearing spots or markings	62
55	Marking on elytra consisting of a single spot or patch on each elytron	56
	Marking on elytra consisting of more than a single spot or patch on each elytron	61
56	Marking consisting of a central spot	57
	Marking consisting of a longitudinal fascia next the suture and towards the apex	*ligatus.*
57	Spot regularly round or oval	*bipustulatus.*
	Spot not regular in outline	58
58	Body narrow and comparatively depressed	*binotatus.*
	Body not narrow and not depressed	59
59	Posterior margin of spot running obliquely outwards and forwards	60
	Posterior margin of spot rounded	*biguttatus.*
60	Spot with the anterior and posterior sides nearly parallel	*bisignatus.*
	Spot with the anterior and posterior sides not parallel, inner side smallest	*bifenestratus.*
61	Each elytron with a pale patch on the shoulder and another at the sutural apical angle	*quadrisignatus.*
	Each elytron with a pale patch on the shoulder and the whole of the apex pale	*hemipterus.*
62	Body black, and elytra tinged more or less with purplish brown	63
	Black or brassy	64
63	Elytra flat and silky	*sericeus.*
	Elytra convex	*obsoletus.*
64	Slightly greenish brassy	*chalybeus.*
	Wholly black	65
65	Thorax level and flat on the middle of the disk	*Bakewellii.*
	Thorax not flat on the disk	66

66	Finely punctate and small in size	*dolens.*
	Very coarsely punctate and not below the average size	67
67	Posterior angles projecting backwards, and sides in front of them sinuate	*cribratus.*
	Posterior angles nearly rectangular, with the point rounded, posterior margins subparallel	*Fusus.*
68	Wholly bright rufous	*rufus.*
	Not wholly bright rufous	69
69	Thorax bright rufous. Elytra blue-black	*melanopterus.*
	Thorax dark or black. Elytra rufous	*pallipennis.*
70	General colour more or less testaceous	71
	General colour brown	76
71	Narrow and thread-like	72
	Subcylindrical, but not so narrow as a thread	73
72	Very pubescent and punctate	*cylindricus.*
	Shining, very little punctate or pubescent	*tenuis.*
73	Elytra slightly paler than thorax or abdomen	74
	Elytra testaceous, with the scutellar region fuscous	*australis**.
74	Very pubescent and much punctate. Thorax with a short, dorsal, raised, smooth line in front of the scutellum	*luridus.*
	Not so much punctate or pubescent, and without a dorsal line	75
75	Very finely punctate and small in size	*pallescens.*
	Moderate in size, punctuation coarser	*mutilatus.*
76	Colour fuscous, dark brown or black. Elytra very short	77
	Thorax fuscous, but not wholly fuscous. Elytra only moderately short	82
77	General colour black	78
	General colour fuscous	79
78	Wholly black	*truncatus.*
	Black, with a rufescent spot on the shoulder	*angustatus.*
79	Elytra with a pale spot in the centre	*notatus.*
	Elytra without any spot in the centre	80
80	With fine and silky pubescence. Colour lurid testaceo-fuscous	*pilosellus.*
	Coarsely pubescent, fuscous	81
81	Last segments of abdomen rather long	*dimidiatus.*
	Last segments of abdomen short	*nepos.*
82	Elytra testaceo-rufous, with the apex darker	83
	Elytra fuscous, marked with rufous	84
83	Margins of thorax ferruginous	*ochropterus.*
	Margins of thorax not ferruginous	*fumatus.*
84	Body glabrous or nearly so	85
	Body subopaque and pubescent	86
85	Of moderate size. Base of elytra rufous, enclosing a round dark spot	*oculatus.*
	Of small size. Elytra pale testaceous, with a narrow black apical margin	*Schiödtei.*
86	Base of elytra rufous	87
	Base of elytra not rufous. A rufous spot in the middle of each elytron	*mutabilis.*

* *C. australis* may perhaps claim to enter into the same group as *C. hemipterus*; in which case it would be distinguished from *C. quadrisignatus* and *C. hemipterus* by the elytra being wholly pale, except the scutellar region and a space behind the shoulder, which are fuscous.

87 A sutural rufous vitta and a spot near the outer margin on each elytron; sides of thorax and elytra each slightly convex . . . . *maculatus.*
A sutural rufous vitta usually on each elytron; sides of thorax and elytra sub-parallel. [N.B. This species is subject to much variation in colour.] . . . *vittiger.*

88 Bright rufous . . . . *ophthalmicus.*
Lurid testaceo-piceous 89

89 Pubescence on thorax radiating to a point on base immediately before the scutellum *sordidus.*
Pubescence on thorax pointing from the sides to the middle . . . . *pubescens.*

Species mihi ignotæ.

Wholly black . . . . *immaculatus.*
Piceous black. Elytra red, with a triangular fuscous space from the apex to the scutellum . . . . *apicalis.*

Genus STAUROGLOSSICUS (σταυρὸς, a cross; γλωσσικὸς, appertaining to the tongue,—in allusion to the form of the ligula).

Abdomen segmentis tribus primis æqualibus, cæteris brevioribus, sed haud brevibus. Maxillæ latissimæ, subquadratæ. Ligula alis horizontalibus, antice truncatis. Cætera ut in *Carpophilo*.

Body flat and depressed. Mandibles broadly bidentate. The lobe of the maxillæ more than usually broad, and the membranous lobes of the ligula transverse and truncate in front. They are constructed on the same principle as in the rest of the *Carpophili*: but in the latter the lobes project obliquely forward on each side; here they are as it were pushed back into a straight line, giving the lobe something of the appearance of a hammer, or of the eyes of the dipterous genus *Diopsis*. Mentum deeply emarginate. Abdomen wedge-shaped, with the first, second, and third segments nearly equal and shorter than the remaining two, which are long and nearly equal in length; fimbriæ scarcely apparent, the suture between the dorsal and ventral segments being on the sides. In other respects the same as *Carpophilus*.

Position and Affinities.—CARPOPHILUS. STAUROGLOSSICUS. EIDOCOLASTUS. TRIMENUS.

1. STAUROGLOSSICUS TERMINALIS (Mus. Berol.). (Plate XXXIII. fig. 4*.)

Elongatus, subcuneiformis, plano-depressus, punctatus, nitidus, glaber, rufo-testaceus, capite et elytrorum sutura apiceque nigricantibus. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{5}$ lin.

Habitat in Victoria in Nova Hollandia.

Elongate, subcuneiform, flat, depressed, punctate, shining, glabrous, rufo-testaceous, with the head, and the suture and apex of the elytra, black, or passing into black. Head very faintly punctate, lightly bi-impressed in front. Thorax transverse, broader than long, with the disk flat, distinctly punctate, with the sides declinate, lightly rounded, the

* By one of those unhappy accumulations of ill luck which sometimes happen even with the best artists and the best workmen, the figure of this species in the Plate quoted is neither well drawn nor rightly coloured. It is not flat enough, nor sufficiently wedge-shaped, nor wide enough in front; and instead of being brown as coloured, the insect is bright testaceous, with the apex of the elytra &c. black.

posterior angles obtusely rounded, the anterior inflexed and nearly right angles. Scutellum triangular, depressed, and with punctures in the middle. Elytra flat, longer than the thorax, scarcely broader, punctate, impressed unequally, a little narrower behind than in front, with the shoulders rather prominent, the sides shortly declinate, margined, the apex obliquely truncate, the exterior apical angles rounded. Abdomen finely punctate.

From Port Phillip in New Holland. In the Berlin and British Museums.

2. STAUROGLOSSICUS LEPIDUS.

Parum elongatus, subcuneiformis, postice attenuatus, depressus, nitidus, glaber, levissime punctatus, læte testaceus. Long. $1\frac{1}{2}$ lin., lat. $\frac{5}{8}$ lin.

Habitat in insula Batchiana.

Somewhat elongate, narrowed behind so as to be somewhat cuneiform, depressed, flat above, shining, glabrous, very finely and sparsely punctate, clear testaceous. Head smooth and flat, without impressions. Antennæ dusky towards the apex. Parts of the mouth as in *S. terminalis*, but the lobes of the ligula show more clearly the relationship to the *Carpophili*, being a very little less hammer-shaped and slightly obliquely sloped inwards behind. Thorax broader than long, broadest a little before the middle; sides gradually rounded, about equally broad at the anterior and posterior angles; apex emarginate, sides of the emargination oblique, middle straight, anterior angles declinate, nearly right angles, posterior angles obtuse, base truncate straight; disk flat from the apex to the base, the sides slightly declinate; very finely punctate. Scutellum large, triangular, faintly punctate at the base, impunctate at the apex. Elytra nearly a half longer than the thorax, flat; shoulders square, rather prominent and sharp; sides subparallel, gently rounded, margined, and slightly canaliculated; disk sloping towards the suture; apex of each elytron obliquely truncate; paler than the thorax, less shining, the chitinous structure of the surface discernible with an ordinary lens. Abdomen with the segments finely punctate. Underside finely punctate. Legs moderate; tarsi moderately dilated.

This species is interesting from its locality and from its retaining so completely the minute characters of the Australian species.

Collected by Mr. Wallace in the island of Batchian, under bark and chips of freshly cut trees, and in the island of Morty, north of Gilolo.

Genus EIDOCOLASTUS (εἶδος, likeness; and *Colastus*).

Corpus planum et depressum. Caput latum. Epistoma minus porrectum. Maxillæ apice truncatæ. Abdomen segmentis omnibus (ultimo longiore excepto) æqualibus. Cætera ut in *Carpophilo*.

Body depressed and flat, and with much of the appearance of the very flat species of *Colastus* (*C. amputatus*, &c.). Head broad, with the epistome very slightly produced. Eyes large, and occupying the whole side of the head from the antennæ back to the thorax. Maxillary lobes broad, short, and truncate at the apex; abdominal fimbriæ not visible from above, except on the penultimate segment, where they are small and curved at its anterior angles. In other respects as in *Carpophilus*.

Count de Motschulsky, who first described the two species on which I have founded this genus, referred them to *Colastus*; but they do not belong to it. That genus, which, so far as is yet known, is confined to the American continent, is one of the best-marked and most easily identified of any in this family, the peculiar lobes of the ligula and broad fimbriæ on the pygidium at once distinguishing it. The species of this genus have neither of these, but all the structural characters of *Carpophilus,* although the depressed form and broad head give them a different facies.

	CARPOPHILUS.	
Position and Affinities.—STAUROGLOSSICUS.	EIDOCOLASTUS.	HAPTONCUS.
	COLASTUS.	

1. EIDOCOLASTUS PLAGIATIPENNIS. (Plate XXXIII. fig. 6.)

Motsch. Etud. Ent. vii. 39 (1858).

Ovatus, valde depressus, subtiliter punctatus, glaber, nitidus, plus minusve nigro-fuscus; thoracis marginibus, elytrorum macula triangulari medio prope ad suturam, antennarum basi, ore, corpore subtus pedibusque testaceis; antennarum clava nigra. Long. 1 lin., lat. ½ lin.

Habitat in Taprobana.

Ovate, very much depressed, finely punctulate, glabrous, shining, more or less nigro-fuscous. Head finely punctate, with a narrow transverse impression on each side at the base of the epistome; antennæ with the club black and base testaceous. Thorax transverse, finely punctate, trisinuate at the base, with the sides gently rounded, a little narrower in front than behind; apex emarginate and bisinuate; anterior angles declinate, nearly right angles; posterior angles nearly right angles, projecting a little backwards. Scutellum broad, pentangular, the lateral angles rounded; impunctate. Elytra equal in breadth to the thorax, subquadrate, somewhat attenuate behind, sides gently rounded and margined, apex of each elytron obliquely truncate, exterior apical angles rounded, sutural angles obtuse; sparsley and finely punctate, each elytron with a triangular pale spot in the middle near the suture, the base of the triangle placed obliquely between the suture and the shoulder. Abdomen slightly pubescent.

From Ceylon. From Mr. Nietner and Count de Motschulsky.

2. EIDOCOLASTUS DILUTUS.

Motsch. Etud. Ent. vii. 39 (1858).

C. plagiatipenni simillimus; parum major, thorace fortius punctato, elytris macula testacea magis expansa et minus distincta, antennarum clava dilutiore. Long. 1 lin., lat. ½ lin.

Habitat in India orientali.

Exceedingly near to *C. plagiatipennis.* A little larger; the thorax more strongly punctate; elytra with the testaceous spots larger and less distinct; antennæ with a paler club.

From the East Indies. I am indebted for specimens of these species (which I have placed in the British Museum) to the kindness of Count de Motschulsky.

Genus HAPTONCUS (ἁπτὸς, which touches; and ὄγκος (for the sake of euphony, ὄνκος), tumidity, referring to the large last article of the labial palpi).

Oculi modici, basin capitis attingentes. Labrum bilobum. Epistoma prominens. Paraglossæ alis membranaceis plicatis. Palpi labiales articulo ultimo magno, calyciformi. Abdomen articulis duobus expositis, sed interdum sub elytris contractis; articulo primo et ultimo majoribus; cæteris æqualibus; fimbriis haud apparentibus.

Body small, slightly convex. Head rather large; epistome projecting; eyes moderate in size, occupying the whole of the sides of the head. Antennal grooves short and converging. Antennæ with the first joint large and swollen, the second short, convex, the third to the eighth inclusive very slender, the third longer than any two of the rest, which are nearly of equal length, the seventh and eighth gradually a little wider, the ninth, tenth, and eleventh forming a large oval club, very pubescent. Labrum deeply bilobed. Mandibles strongly bidentate, the second tooth not much behind the first, ciliated on the inner side. Maxillary lobes moderate, bearded at the point and on the inner side. Maxillary palpi with the first article small, the second swollen at the apex, the third short and stout, and the last article long and cylindrical. Labial palpi with the last article large, cup-shaped, the preceding article small and likewise cup-shaped, holding the last. Ligula very small, with large, projecting, ear-shaped membranaceous paraglossæ, which appear to be composed of a double fold with ciliated margins. Mentum deeply emarginate. Thorax slightly convex, transverse, margined. Scutellum moderate. Elytra not striate; apex of each elytron obliquely truncate. Abdomen scarcely visible from above, but looked at from behind, the pygidium and penultimate segment are visible; no fimbriæ are visible, the suture of the dorsal and ventral segment being on the margin; below, the first and last segments are the longest, the rest about equal, the penultimate being slightly the longest. Prosternum projecting, but not prominent, resting on the metasternum. Metathorax without axillary pieces. Posterior coxæ placed most apart. Legs robust; thighs with a groove to receive the tibiæ. Tarsi slender, not dilated.

This genus forms a transition between *Carpophilus* and *Epurea*, and it is doubtful whether it properly belongs to the *Carpophilidæ* or to the *Nitidulinæ*. The former has at least two segments of the abdomen exposed, the latter only one. In this genus the dorsal segments of the abdomen are often so curved-in that they are not visible; but when looked at from behind, the last two are seen. I have therefore placed it near the end of this group.

		STAUROGLOSSICUS.	
Position and Affinities.—	EIDOCOLASTUS.	HAPTONCUS.	EPUREA.
		CARPOPHILUS.	

1. HAPTONCUS TETRAGONUS (Dohrn). (Plate XXXIII. fig. 7.)

Parvus, oblongo-ovatus, subdepressus, levissime punctatus et pubescens, testaceus, elytris nigro maculatis; thorace latiore prope medium. Long. $\frac{3}{4}$–1 lin., lat. $\frac{1}{2}$ lin.

Habitat in Taprobana.

Small, oblong-ovate, subdepressed or only very slightly convex, very faintly punctate, finely pubescent, testaceous. Head bi-impressed in front; club of antennæ a little darker than the other joints. Thorax transverse, nearly twice as broad as long, a little narrower in front, apex emarginate and bisinuate, sides gently rounded, margins reflexed, most so towards the posterior angles; anterior angles rounded, posterior angles slightly obtuse and a little raised above the elytra. Scutellum triangular, faintly and sparingly punctate and pubescent. Elytra not wider than the thorax at the base, widest a little before the middle, and immediately behind the widest part sloping somewhat acutely obliquely towards the apex, which is considerably narrower than the base; margined; apex of each elytron obliquely rounded, apical sutural angles as well as exterior angles rounded, finely pubescent and punctate, with the apex black, and with an irregular, somewhat zigzag black fascia near the middle, reaching neither to the sides nor the suture, projecting backwards near the sides, then forwards and again backwards; there is also in some specimens a triangular patch pointing backwards within the shoulder. Abdomen pubescent and very finely punctate.

From Ceylon, where it was collected by Mr. Nietner and Count de Motschulsky. Mr. Wallace also found specimens in the island of Macassar.

2. HAPTONCUS CONCOLOR.

H. tetragono affinis; parvus, oblongo-ovatus, subdepressus, levissime punctatus, levissime pallide pubescens, totus pallide testaceus; thorace marginato et reflexo, prope angulos posticos latiore; elytris postice haud multo attenuatis, apice latis recte truncatis. Long. $\frac{3}{4}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in insula Dorey.

Allied to *H. tetragonus*. Small, oblong-ovate, subdepressed or only very slightly convex, very faintly punctate, and with a very slight pale pubescence, entirely pale testaceous. Head even. Thorax considerably narrower in front than behind, widest just before the posterior angles, rounded rapidly to them, and sloping gently to the front; the apex is deeply emarginate and bisinuate; the sides margined and reflexed, more widely in front than in the middle, and most so at the posterior angles, which are obtuse and project slightly backwards at the point; the anterior angles are rounded; base truncate straight, except when it reaches the posterior angles, where it forms a sort of projecting tooth. Scutellum transverse, triangular. Elytra somewhat convex, not much expanded at the sides, gently rounded; apex not much narrower than the base, truncate straight, with the exterior apical angles rounded and the sutural apical angles nearly right angles.

From the island of Dorey, New Guinea. Collected by Mr. Wallace. There is an example which has the elytra more expanded, as in *H. tetragonus*, and the disk more convex, with a large and deep depression on each side of the suture near the scutellum. It is doubtless merely an immature specimen. There is another individual, from Macassar, also collected by Mr. Wallace, which has the posterior angles of the thorax not so projecting as in the specimens from Dorey.

3. Haptoncus ovalis.

H. concolori affinis; parvus, late ovalis, parum convexus et subnitidus, sparsim leviter punctatus, vix pubescens, læte testaceus; antennis pallidis, articulis ultimis duobus nigris; thorace anguste marginato, angulis posticis latiore. Long. $\frac{1}{2}$ lin., lat. $\frac{1}{3}$ lin.

Habitat in Nova Guinea.

Allied to *H. concolor*. Small, broadly oval, slightly convex, somewhat shining, sparsely and faintly punctate, scarcely pubescent, clear testaceous; the antennæ pale luteous, with the last two articles of the club black or blackish. Thorax considerably narrower in front than behind, sloping in a gradual and gentle round from the posterior angles to the front; apex emarginate, very narrowly margined instead of having the margin reflexed as in *H. concolor*; anterior angles much declinate, obtuse; posterior angles slightly obtuse, almost right angles; base bisinuate. Scutellum rather large, triangular. Elytra widest before the middle, attenuated behind it, apex truncate; exterior apical angles rounded, sutural apical angles nearly right angles.

From Macassar. Collected by Mr. Wallace. A single specimen in the British Museum.

4. Haptoncus pubescens.

Epureæ luteæ similis; parallelus, levissime punctatus, testaceo pubescens, totus testaceus; thorace antice quam postice haud multo angustiore, angulis anticis obtusis; elytris haud medio expansis, apice latis. Long. $\frac{3}{4}$–1 lin., lat. $\frac{1}{2}$ lin.

Habitat in Taprobana.

Similar in appearance to *Epurea lutea*. Wholly testaceous, oblong, parallel, clothed with long soft testaceous pubescence, very finely punctate. Thorax with the sides only slightly rounded, not much narrower in front than behind; apex emarginate and bluntly bisinuate; anterior angles somewhat obtuse; sides very slightly sinuate at the posterior angles, which are somewhat obtuse; base slightly bisinuate. Elytra with the sides very little rounded, apex nearly as broad as the base, straight truncate; exterior apical angles rounded, sutural apical angles nearly right angles. Pygidium pointed.

From Ceylon, where it does not appear to be rare.

5. Haptoncus testaceus.

H. pubescenti affinis; major, minus pubescens, thorace antice quam postice parum angustiore, angulis anticis rotundatis; rufo-testaceus. Long. 1 lin., lat. $\frac{1}{2}$–$\frac{3}{5}$ lin.

Habitat in insula Macassar.

Allied to *H. pubescens*; of the same general form, but larger, less pubescent, more shining, and somewhat more rufous in colour; antennæ dark rufous; the thorax somewhat narrower in front, and the anterior angles rounded instead of obtuse. In other respects it is very similar to *H. pubescens*.

I am not sure, however, that it belongs to this genus. The parts of the mouth, with the exception of the ligula, are nearly the same, but the ligula is different. The folded double membranous lobes are absent; or, if they exist, they are concealed by the large cup-formed terminal article of the labial palpi.

From the island of Macassar. Collected by Mr. Wallace.

Genus Tetrisus (τέτρα, four; ἴσος, equal,—in allusion to the first four segments of the abdomen being equal, or nearly so).

Abdomen segmentis duobus ultimis solum expositis; penultimo fimbriis parvis sed distinctis instructo; segmentis primis quatuor longitudine æqualibus. Ligula minuta, alis membranaceis projectis vel fasciculo crinium instructis. Cætera fere ut in *Carpophilo*.

Body rather depressed, wedge-shaped. Texture fine. Labrum bilobed. Mandibles short, bidentate; inner side slightly bearded. Antennæ with the first article large and dilated; second smaller, but still dilated and unequal; third elongate and slender; fourth, fifth, and sixth very small; seventh and eighth slightly increasing in size; ninth, tenth, and eleventh forming a rounded club. Maxillæ not broad, bearded at the end and on the inner side. Maxillary palpi short; first article minute, second short and small, not much dilated, third a little larger, and fourth cylindrico-conical, nearly as long as the two preceding articles together. Labial palpi with the first article minute, the second slender, and the third broad, large, and truncate. The ligula minute, and the paraglossæ in one species seem to be little more than a few hairs*; in the other species they are rather prominent and somewhat subtriangular. The fimbriæ on the penultimate segment are distinct. Metathorax without axillary pieces. In other respects almost as in *Carpophilus*.

Position and Affinities.—Carpophilus. Tetrisus. Trimenus.

1. Tetrisus cholevoides. (Plate XXXIII. fig. 2.)

Oblongo-ovatus, postice attenuatus, subdepressus, subopacus, textura *Cholevæ*, subtilissime creberrime punctatus et cinereo pubescens; nigro-piceus, thoracis margine rufescente, ore, antennis pedibusque rufo-piceis; elytris thorace duplo longioribus. Long. $1\frac{1}{3}$ lin., lat. $\frac{2}{3}$ lin.

Habitat in Borneo.

Oblong-ovate, broadest in front, attenuated behind, subdepressed, subopaque, of the texture of the *Cholevæ* (*Catops velox* for example), very finely and thickly punctate, and closely, shortly, and finely cinereo-pubescent, nigro-piceous or black. Labrum with the lobes conical. Head very thickly and finely punctate; mouth and antennæ rufo-piceous. Thorax transverse, sides rounded and deeply margined, anterior angles rounded, posterior angles obtuse; apex emarginate, base slightly bisinuate; disk smooth, equal, and gently rounded; apex and sides slightly rufescent and translucent. Scutellum triangular, apex somewhat rounded. Elytra twice as long as the thorax, attenuated behind, slightly widened and more convex behind the middle, sides deeply margined and canaliculated; apex truncate obliquely, exterior apical angles rounded, sutural angles rectangular. Abdomen punctate and pubescent, narrow behind. Underside piceo-rufescent. Legs rufo-piceous.

From Borneo. Very rare. I have only seen two specimens, both collected by Mr. Wallace. In the British Museum.

* I do not speak with confidence of all the parts of the mouth in this species. I have had only a single specimen to examine, and, as sometimes happens, the extreme care which I took to avoid injuring it produced the opposite result, and the ligula and maxillæ were damaged in the dissection. A more successful dissection may perhaps show it to be the same as in the next species. But, throughout this monograph, I have figured everything exactly as I saw it, not venturing to alter anything to suit my own conceptions.

2. Tetrisus Hydroporoides. (Plate XXXV. fig. 10.)

Depressus, oblongo-fusiformis, opacus, levissime aciculatim punctatus, breviter griseo pubescens, testaceo-ferrugineus; thorace medio longitudinaliter, scutello, elytris lateribus apice et interdum sutura versus basin fuscis vel nigro-fuscis. Long. $1\frac{1}{2}$–$1\frac{3}{4}$ lin., lat. 1 lin.

Habitat in Borneo.

Depressed, oblong-fusiform, opaque, very finely acicularly punctate, with very short and fine griseous pubescence, testaceo-ferruginous. In appearance, form, and colouring bearing a certain resemblance to some of the *Hydropori* (as *H. 12-pustulatus* for example). Head with a large rounded fovea on each side of the epistome, which makes the middle appear raised. Labrum deeply bilobed, the lobes rounded instead of being conically shaped as in *T. Cholevoides*. Mandibles with the double tooth at the apex somewhat larger than in *T. Cholevoides*. Maxillæ and maxillary palpi as in that species. The membranous wing of the ligula sufficiently large and distinct, something of the same shape as the bunch of hairs which appears to be its substitute in *T. Cholevoides*. The labial palpi of the same shape and proportions as in it, but larger. Antennæ as in it. Thorax transverse, very smooth, equally and gently convex, narrower in front than behind, widest about one-fourth of its length before the posterior angles; apex emarginate, emargination rounded; sides gently and regularly curved and slightly margined; anterior angles obtuse, almost rounded; posterior angles obtuse and looking slightly backwards; base strongly bisinuate; disk fuscous. Scutellum rather broad, triangular, margin smooth, rest finely acicularly punctate, fuscous. Elytra depressed, rounded from the base, widest about the middle, attenuated behind, sides margined; exterior angles at the base obtuse, pointed; exterior apical angles rounded, sutural apical angles obtuse; apex of each elytron very obliquely truncate; the disk ferrugineo-testaceous, with the apex and sides dark fuscous, and the basal fuscous part twice as broad as the part between it and the apical fuscous band; the suture at the base sometimes fuscous. Abdomen usually wholly ferrugineo-testaceous, in some individuals a little darker towards the margins of the segments. Underside testaceous, palest in the middle. Legs ferrugineo-testaceous.

This species certainly belongs to the same genus as *T. Cholevoides*, although it is so much larger and differs in the membranous wings of the ligula. The general facies is similar, and its other characters nearly identical. It forms the passage between *T. Cholevoides* and the genus *Trimenus*.

From Borneo. Collected by Mr. Wallace.

Genus Trimenus (Motsch.).

Corpus latum et depressum. Oculi sat magni, basin capitis attingentes. Sulci antennarii breves, convergentes. Labrum bifidum. Epistoma porrectum. Elytra longa, lata, haud striata. Abdomen duobus segmentis supra expositis, pygidio majore; segmentis omnibus (pygidio excepto) fere æqualibus; fimbriis parvis.

Body broad, flat, and depressed. Eyes large and coarsely granulated, reaching to the base of the head. Epistome projecting. Labrum deeply bifid. Antennal grooves short, converging. Antennæ rather long and slender, except the club: first article dilated on the outer side; second stout, rather long; third not so stout, but nearly twice as long as the second, subcylindrical; fourth and fifth equal, each a little shorter than the third; sixth, seventh, and eighth submoniliform, short, slightly and gradually increasing a little in width; ninth, tenth, and eleventh forming a large, oval, flat club. Mandibles bidentate; the apical tooth chisel-shaped, inner side bearded behind the second tooth. Maxillæ short, bearded on the inner side (Pl. XXXVI. fig. 4*f*). Maxillary palpi cylindrical, with the first article small, second large, third shorter, fourth longest and cylindrical. Labial palpi with the first article very small, second a little larger, unequal, third broad and securiform. Ligula small, short, somewhat conical, with large, spherically triangular, membranous united lobes or wings projecting from the anterior angles (Pl. XXXVI. fig. 4*e*). Mentum biemarginate, with a broad projecting tooth in the middle. Thorax flat and transverse, margined. Scutellum moderate, subtriangular. Elytra broad, flat, narrowed and rounded-in towards the apex, margined. Abdomen above with only the pygidium and a portion of the penultimate segment exposed; below with all the segments about equal in length, the last segment a little the longest, and the first next longest; the fimbriæ small, but distinct; pygidium pointed. Prosternum flat, widened behind, resting on the mesosternum. Metathorax without axillary pieces. Legs stout; thighs canaliculated to receive the tibiæ; middle tibiæ bent and excised near the apex on the inner side in the males. Tarsi moderate.

	ECNOMÆUS.	
Position and Affinities.—TETRISUS.	TRIMENUS.	EPUREA.
	SOMAPHORUS.	

1. TRIMENUS ADPRESSUS. (Plate XXXVI. fig. 4.)

Subovatus, antice parum latior, sat latus, valde depressus, crebre leviter punctatus, breviter sat dense testaceo pubescens, rubro-ferrugineus. Long. 2–2¼ lin., lat. 1–1¼ lin.

Habitat in Borneo, Aru, &c.

Rather broad, subovate, somewhat narrowed behind, very much depressed; very thickly punctured so as to seem finely shagreened, clothed with a rather close, short testaceous pubescence; ferruginous red. Head with a shallow impression on each side in front behind the base of the antennæ. Thorax once and a half as broad as long, narrower in front than behind; sides very narrowly margined, posteriorly somewhat parallel, rounded-in towards the apex, which is emarginate; anterior angles obtuse, posterior angles right angles; base truncate, slightly bisinuate. Scutellum moderate in size, triangular. Elytra about twice the length of the thorax, with their base equal in breadth to the base of the thorax; sides parallel for two-thirds of their length from the base, then rather rounded-in to the apex, which is attenuated, flat, and truncate nearly straight; the sides are broadly margined and canaliculated, the margin slightly extending round the shoulder and not reaching to the apex; underside of margin broad; the exterior basal angles somewhat obtuse, the exterior apical angles rounded, the sutural apical angles slightly obtuse. The disk, both of thorax and elytra, is even and regular, without depressions. Abdomen finely punctate.

Mr. Wallace collected a considerable number of specimens of this species in the various islands of the Bornean Archipelago, &c., and those from different islands have a slight difference in their relative size, breadth, &c.; but I can find no distinctions sufficient to constitute a species, except perhaps in one (the following), which is narrower and less attenuated behind.

From Borneo, Aru, Dorey, Morty, Waigiou, Amboyna, Macassar, &c.

2. TRIMENUS ANGUSTATUS.

T. adpresso valde affinis; minor, angustior, thorace breviore, et elytris subparallelis; cæteris ut in *T. adpresso*. Long. $1\frac{3}{4}$ lin., lat. $\frac{5}{8}$ lin.

Habitat in insula Macassar et insula Morty.

Very closely allied to *T. adpressus*. Smaller, narrower, more parallel; the elytra not so much attenuated towards the apex as in that species, but parallel until they almost reach it; thorax comparatively shorter and broader, slightly narrowed towards the posterior angles.

The gradation between the broadest specimens (widest in front and most attenuated behind) and the present species or variety is so gradual, that I have great hesitation in proposing this as a distinct species. There is a slight gap, however, between it and the rest, and I have availed myself of it.

From Macassar and the island of Morty.

Genus SOMAPHORUS (σῶμα, a body; and φορὸς, bearer,—in allusion to the large size of the elytra as compared with that of the head and thorax).

Corpus latum et depressum. Oculi sat magni, basin capitis attingentes. Sulci antennarii breves, convergentes. Labrum bifidum, in fronte capitis receptum. Sine epistomate. Elytra longa, lata, haud striata. Abdomen segmentis duobus ultimis expositis, segmentis omnibus (primo excepto) fere æqualibus; sine fimbriis.

Body broad, flat, and depressed. Head broad. Eyes rather large, reaching to the base of the head. Epistome absent. Labrum with a notch excised in the middle, and received into a rounded emargination in the anterior margin of the head (Pl. XXXVI. fig. 7 *h*). Antennal grooves short and converging. Antennæ rather long; first article dilated, second stout, third longer, fourth to eighth short and gradually increasing in breadth, ninth to eleventh forming a large, flattened, truncate club. Mandibles strongly bidentate, inner side bearded behind the second tooth. Maxillæ narrow, rather long, bearded with long hairs at the end and with shorter on the inner side (Pl. XXXVI. fig. 7 *f*). Maxillary palpi rather slender and small; first article small, second the largest and dilated on the outer side, third smaller, and last conical. Labial palpi minute and of nearly equal breadth; first article small, second narrow and longer, third of about the same length as the second, but a little thicker, ovate, and truncate. Ligula rounded, with large rounded membranous lobes or wings nearly straight in front and apparently united, probably as in *Trimenus* (Pl. XXXVI. fig. 7 *e*). Mentum narrowly and straightly emarginate, without any tooth in the middle. Thorax flat, transverse, and margined. Scutellum rather large, rounded. Elytra broad, flat, parallel, margined; each elytron rounded at the apex. Abdomen above with only the pygidium and a small portion of the penultimate segment visible; below with all the segments nearly equal, except the first; pygidium short, broad, and truncate, not pointed. Legs stout; all the tibiæ straight; tarsi rather large.

Position and Affinities.—TRIMENUS. SOMAPHORUS. EPUREA.

SOMAPHORUS FERRUGINEUS. (Plate XXXVI. fig. 7.)

Latus, oblongus, planus, depressus, parallelus, crebre punctatus, dense testaceo pubescens, læte ferrugineo-testaceus, lateribus ciliatis, pygidio barbato. Long. $2\frac{1}{4}$ lin., lat. $1\frac{1}{4}$ lin.

Habitat in insulis Philippinis?

Oblong, broad, flat, depressed, parallel, thickly punctate, clothed with long testaceous pubescence, bright ferrugineo-testaceous. Labrum with a marginal line. Head finely punctate. Thorax transverse, twice as broad as long, narrower in front than behind; thickly and strongly punctate, with the disk slightly raised and the sides flat on each side, the flattened portion widest behind, the sides somewhat parallel at the base and rounded in front, widely margined, and ciliated with long hairs; apex widely and deeply emarginate; anterior angles obtusely rounded; posterior angles acute angles, not sharp at the point; base deeply bisinuate. Scutellum punctate. Elytra long, of the breadth of the base of the thorax, twice and a half the length of the thorax, parallel from the base almost to the apex, sides margined, apex of each elytron regularly and equally rounded; much punctate and with long pubescence; exterior apical angles rounded, sutural apical angles obtuse. Apex of abdomen with long tufts of hairs on each side. Tibiæ slightly serrated, and fringed with hairs.

From the Philippine Islands? Communicated to me by Professor Westwood from the Oxford Museum.

Genus ECNOMÆUS.

Erichs. in Germ. Zeitschr. iv. 264 (1843).
Lacord. Hist. des Ins. Coléopt. ii. 299 (1854).

Labrum emarginatum. Elytra apice rotundata, abdominis segmenta tria prima obtegentia. Abdomen segmentis duobus primis brevissimis, reliquis mediocribus; fimbriis sat latis. Pedes compressi; tarsis simplicibus.

Body oblong-oval, flat or concave above. Head elongate, without antennal grooves. Epistome dilated before the eyes. Antennæ inserted under the sides of the epistome, short and slender; first article cylindrical, longer and thicker than the rest; second and third of the same form, more slender, rather long, and subequal; fourth to eighth short; ninth to eleventh forming a small elongated club. Labrum large, feebly emarginate. Mandibles much arched, bordered on the outer side, terminating in a long and sharp point preceded by a strong tooth. Maxillary lobes broad, bearded at the extremity and on the inner side. Maxillary palpi filiform, with the last article subcylindric. Labial palpi of the same form, but not so slender. Ligula corneous, furnished with two very broad and projecting membranous lobes. Mentum short, broadly emarginate in front. Thorax short, somewhat emarginate in front, truncate straight behind, depressed or hollowed, margined and ciliated on the sides. Scutellum triangular. Elytra flat or concave, margined and ciliated on the sides, apex truncate. Abdomen with two segments exposed, the first two very short, the others moderate, equal; its sides ciliated. Fimbriæ distinct and rather broad. Prosternal projection broadly truncated behind. Legs robust, compressed; tibiæ straight, ciliated on the outside, their terminal spurs rather long; tarsi slender, simple, the first article a little longer than the others; claws simple.

This genus forms an exception to the characters founded on the breadth of the fimbriæ; it has them as broad as in the *Brachypepli*. Their presence here explains the conditions under which they are developed. Their occurrence appears to depend upon the flatness of the abdomen. Where the edge is sharp, the margins of the underside of the abdomen lap over and form the fimbria; where the edge is convex or rounded, they do not. It is as if a seam at the very edge would leave the suture too open. *Ecnomæus*, although belonging to the section with a less depressed body and abdomen, has the upper side as flat and depressed as any of the *Late-fimbriatæ*, and the margins of the abdomen as sharp; hence the fimbriæ overlap. The convexity, however, remains on the underside (see Pl. XXXV. fig. 9 *d*). It, as well as *Somaphorus*, intercalates badly here. The smoothest transition between *Carpophilus* and *Epurea* is, so far as regards the smaller *Epureæ*, by *Eidocolastus* and *Haptoncus*, and as regards the larger ones, by *Trimenus*, and the occurrence of *Somaphorus* and *Ecnomæus* interrupts the stream of affinity awkwardly. They compose a parallel or cross group, a proper place for which is difficult to find.

		EPUREA.	
Position and Affinities.—	SOMAPHORUS.	ECNOMÆUS.	NITIDULA.
		MYSTROPS.	

1. ECNOMÆUS PLANUS. (Plate XXXV. fig. 9.)

Erichs. in Germ. Zeitschr. iv. 264 (1843).
Ips planipennis, Dej. Cat. p. 134 (1837).

Cinnamomeus, opacus, testaceo pubescens, subtiliter punctatus. Long. $3\frac{1}{4}$ lin., lat. $1\frac{1}{2}$ lin.

Habitat in Senegallia.

Large, depressed, even somewhat concave above, oblong-ovate. Body pale, finely punctate, testaceo-pubescent, cinnamon-coloured and opaque above, rufo-testaceous and somewhat shining below. Thorax twice as broad as long, somewhat narrowed in front, a little rounded on the sides, longitudinally hollowed out; base truncate in the middle, sinuate on each side; anterior angles obtuse, posterior angles nearly right angles. Scutellum triangular. Elytra nearly flat, somewhat depressed towards the suture, and sloping posteriorly to the exterior apical angles; apex truncate, but with both the exterior and sutural angles rounded, the former broadly rounded.

From Senegal. I have only seen one specimen in the Berlin Museum, and one in Dejean's collection in the possession of the Marquis de la Ferté.

2. ECNOMÆUS CONCAVUS.

Erichs. in Germ. Zeitschr. v. 438 (1844).

Testaceus, nitidus, subtiliter pubescens, thoracis concavi elytrorumque margine elevato. Long. $3\frac{1}{2}$ lin.

Habitat in "Christmas Bay."

Testaceous, shining, finely pubescent; the thorax concave, with its margin raised; the elytra also with a raised margin.

Distinguished from *E. planus* by its lighter colour, by its shining through the pubescence, which is finer and somewhat longer on the upper side, by its breadth behind the wide concave thorax, and by the strongly raised margins of the thorax and elytra, as well as by the longer elytra. Below, the abdomen has a longer pubescence at the apex on each side.

From Christmas Bay. In the Berlin Museum.

3. ECNOMÆUS SCAPHULA.

Erichs. in Germ. Zeitschr. v. 438 (1844).

Testaceus, subnitidus, subtiliter pubescens; thorace brevissimo, coleopterisque leviter concavis, his margine laterali elevato. Long. 2 lin.

Habitat in Nubia.

Testaceous, somewhat shining, finely pubescent, with the thorax very short, the elytra slightly concave and with the lateral margin raised.

Nearly allied to *E. concavus* (perhaps merely a variety), but only half its size. The thorax is proportionally broader and shorter and the elytra less shining.

From Nubia. There is a unique specimen in the Berlin Museum.

Genus MYSTROPS.

Erichs. in Germ. Zeitschr. iv. 234 (1843).
Lacordaire, Hist. Ins. Col. ii. 294 (1837).
Othonea **(Dej. in litt.).**

Caput sine sulcis antennariis. Labrum bilobum. Abdomen segmentis subæqualibus, segmentulo anali in utrovis sexu nullo, segmentis duobus ultimis expositis. Antennæ in maribus plerumque longiores.

Head without antennal grooves. Antennæ of different proportions in different species, and in most species of different length in the sexes, longest in the males; the club is oval or rounded and compressed. Labrum rather large, bilobed. Mandibles projecting, stout, flat, rounded on the outside, simple and sharp at the tip. Lobes of the maxillæ elongate, strongly ciliated on the inner side. Maxillary palpi with the first article small, the second bent to the side and conical, the third cylindrical, about the length of the second, the fourth elongate, as long as all the rest together. Mentum slightly bisinuate in front. Labial palpi with the first article very short, the second and third equally long, the third elongate-oval. Ligula corneous, each anterior angle produced into a very slender, long coriaceous point, ciliated on the inner side. Thorax as broad as the elytra at its base, which is bisinuated, with its angles slightly produced behind. Elytra truncate, leaving the last two segments exposed. Prosternum articulated behind with the metasternum. Metathorax without axillary pieces. Abdomen short, the first and fifth segments a little larger than the rest; fimbriæ absent; the pygidium and part of the penultimate segment alone exposed. Legs moderate; thighs robust; tibiæ rather widened at the apex, their terminal spurs very small. The first three articles of the tarsi dilated, hairy beneath. Claws stout, simple.

The males are distinguished from the females by their head and their antennæ being longer and by the clypeus or epistome being impressed.

This genus is composed of small insects which have considerable resemblance to some of the *Brachypteridæ* and also to some of the species of *Epurea*. It has also relations with *Pria* through its elongated antennæ in the males and the prosternum resting on the metasternum.

As already mentioned (at the commencement of the *Carpophilidæ*), I have had great doubt where to place this genus. It has much affinity with the *Brachypteridæ*, of which the species *M. adustus* is perhaps the strongest example. It is not less closely allied to *Epurea*, as is well shown in *M. debilis* and *M. flavicans*. When I was at the commencement of the *Carpophili*, it puzzled me with its contradictory affinities; and difficulties near at hand always appearing larger than those far off, I wished it away from *Colastus*, and resolved to place it between *Carpophilus* and *Epurea*. Now that I have come to that place, I wish it away back again near the *Brachypteridæ*. I believe, were I to do it over again, I should now make a separate group (*Mystropidæ*) for its reception, between the *Brachypteridæ* and the *Carpophilidæ*.

		CARPOPHILUS.	
Position and Affinities.—	BRACHYPTERUS.	MYSTROPS.	EPUREA.
		PRIA.	

1. MYSTROPS DURUS.

Erichs. in Germ. Zeitschr. iv. 235 (1843).
Othonea longicornis (Dej. in litt.).

Convexus, niger, antennis (clava excepta) et pedibus testaceis; maribus thoracis lateribus rufescentibus, fœminis concoloribus; elytris apice singulis rotundatis. Long. $1\frac{2}{3}$ lin.

Habitat in Brasilia.

Short, convex, black, somewhat shining, closely punctate. Head, thorax, and abdomen griseo-pubescent. Scutellum and elytra blackish pubescent. Antennæ slender, in the male nearly as long as the body (Pl. XXXII. fig. 3 *a***); the first article stout and elongate; the second, third, and fourth longer, and nearly equal to each other in length; the fifth a little longer; the sixth, seventh, and eighth shorter, and decreasing by degrees; the club oblong, subcompressed, the base testaceous, the apex black: in the female reaching to the base of the thorax; the first article long; the second, third, fourth, and fifth about equal, oblong; the sixth, seventh, and eighth subglobose; club as in the male. Head with the mouth and sides rufescent. Thorax narrowed in front, the sides sometimes rufescent, sometimes concolorous. Elytra rather short, with the apex of each rounded both in male and female. Abdomen punctulate. Legs testaceous.

The males have the thorax with the sides testaceous and the disk piceous. The females are entirely black. The colour generally also is darker in the female, the dark colour in the male being piceous or piceous black, and that of the female black or nearly so. The female has the apex of the elytra rounded like the male, and not peaked as in *M. discoideus*.

From Brazil.

2. Mystrops discoideus. (Plate XXXII. fig. 5.)

♂ *M. flexuosus* (Motsch.).

♀ *M. angulipennis* (Motsch.).

Statura *M. duri*, sed minus fortiter punctatus, minus convexus, antennis aliter compositis elytrisque longioribus; testaceus, thoracis disco longitudinaliter piceo; scutello testaceo; elytris fascia basali irregulari plus minusve lata picea. Long. $1\frac{1}{2}$–$1\frac{2}{3}$ lin., lat. $\frac{3}{4}$ lin.

Fœm. Antennis brevioribus ut in *M. duro*, elytris apice acuminatis.

Habitat prope flumina Amazonum.

Very like *M. durus*, but not so convex nor so deeply punctate; the elytra longer in both sexes, and pointed in the female. The antennæ have the club composed apparently of only two articles, and the sixth, seventh, eighth, and ninth are not shorter than those preceding as in *M. durus*. The colour is usually testaceous, with the disk piceous; but it varies considerably, chiefly in the extent occupied by the piceous portion: sometimes it is nearly of the colour of the males of *M. durus*, the elytra being almost entirely piceous; but I have never seen them wholly so, the apex being always more or less testaceous. Nor have I seen the scutellum piceous: it seems to be always testaceous in this species; in *M. durus* piceous. I have a specimen entirely rufous.

From the banks of the Amazons. It appears to be not very rare about Ega, where Mr. Bates procured a good many specimens.

In the collection of the Marquis de la Ferté-Sénectère there are three individuals ticketed as having come from Caffraria, and named (with a query) *Othonea longicornis*, Dej. I can detect no difference between them and Mr. Bates's specimens from Ega; and if the locality be correct, the species must be found both in Caffraria and South America. I think it more likely, however, that an error has been made in the locality, the rather so that I observe that the specimens are marked as having been procured from a dealer who is not always correct in his localities.

3. Mystrops debilis.

Erichs. in Germ. Zeitschr. iv. 235 (1843).

Subdepressus, pallide testaceus, thoracis disco piceo, subtiliter pubescens; antennis æqualibus in utroque sexu, capitis thoracisque longitudine. Long. $1\frac{1}{2}$ lin.

Habitat in Brasilia.

About the size and appearance of *Cercus pedicularius*; oblong, pale testaceous, closely punctate, and finely griseo-pubescent. Antennæ equal in both sexes, about the length of the head and thorax; the first article not very long, rather stout; second, third, and fourth somewhat longer; fifth, sixth, seventh, and eighth rather shorter; the ninth elongate, and the club composed apparently of only two articles. Head impressed on each side in front with a small pit. Thorax transverse, slightly narrower in front; base bisinuate; anterior angles obtusely rounded; posterior angles somewhat projecting backwards; the disk longitudinally piceous. Scutellum moderate. Elytra long and subparallel, once and a half the length of the thorax, sides declinate, rounded, margined; apex truncate; exterior apical angles broadly rounded; sutural apical angles subrectangular, rounded at the point.

From Brazil. In the Berlin and the British Museums.

4. Mystrops flavicans. (Plate XXXII. fig. 3.)

Cercus flavicans (Dej. Cat. 137, 1843).

Affinis *M. debili*, sed duplo minor, textura molli et delicata: testaceus, levissime pubescens, oblongus, subdepressus; antennis longitudine fere dimidii corporis, tenuibus, articulis ut in *M. discoideo*, sed clava minore et breviore; elytris apice truncato, angulis exterioribus rotundatis, sutura utrinque sublineata. Long. $\frac{3}{4}$–1 lin., lat. $\frac{1}{3}$ lin.

Habitat in Brasilia.

Allied to *M. debilis*, but only half the size, of a soft and delicate texture. Testaceous, very slightly pubescent, oblong, subdepressed. Head with a deep transverse and oblique impression on each side in front. The antennæ about half the length of the body, slender, with the articles as in *M. discoideus*, but with a smaller and shorter club (Pl. XXXII. fig. 3 *a*). Thorax not much narrower in front than behind, impressed on each side in the middle, with the anterior angles inflexed and rounded, the posterior almost flat and right angles, truncate at the base. Scutellum triangular. Elytra subparallel, with the sides inflexed and rounded, a faint line impressed on each side of the suture, the apex truncate and its outer angles rounded.

Found in Brazil. In the British Museum.

5. Mystrops dispar (Klug).

Erichs. in Germ. Zeitschr. iv. 235 (1843).

Breviter oblongus, levissime punctatus et breviter pubescens, testaceus, thoracis disco, elytrorum regione scutellari, lateribus et apice pallide piceis; antennis maribus corpore duplo longioribus, articulo secundo brevi; thorace sat convexo, transverso, antice angustiore; scutello piceo; elytris subquadratis, lateribus marginatis, apice rotundato. Long. $1\frac{1}{4}$ lin., lat. $\frac{1}{2}$–$\frac{3}{5}$ lin.

Habitat in Madagascaria.

Rather broad, shortly oblong, very faintly punctate, and clothed with a short pubescence; testaceous, with the disk of the thorax, the scutellar region, and sides and apex of the elytra pale piceous. Mandibles broad, projecting, canaliculate, acute; the head raised at the base of the antennæ. Antennæ twice the length of the body in the males. Thorax rather convex, transverse, broader than long, narrowed in front, with the sides rounded, the base truncate and sinuate, the anterior angles obtuse, and the posterior obtusely rectangular. Scutellum moderate, piceous. Elytra subquadrate, the sides margined, the apex rounded. The pygidium alone appears exposed.

I have only seen specimens of the male.

From Madagascar. In the Berlin Museum and in the collections of the Marquis de la Ferté and of M. Deyrolle.

6. Mystrops adustus (Motsch.).

Oblongus, nitidus, glaber, leviter punctatus, nigro-piceus, elytrorum disco rufo-piceo, mandibulis testaceis, valde explanatis; antennis longitudine dimidii corporis, fuscis, basi testaceis; thorace subconvexo, transverso; elytris apice rotundatim truncato, sutura utrinque linea subimpressa; subtus et pedibus piceis.

Fœm. Antennis brevioribus, thorace vix longioribus. Long. 1 lin., lat. $\frac{1}{2}$ lin.

Habitat in Columbia.

Very like a *Brachypterus*. Smooth, glabrous, shining, oblong, faintly punctate, piceous black, with the disk of the elytra rufo-piceous. Head very much hollowed out in front in the middle and on each side at the base of the antennæ. Epistome quadrangular and impunctate, but impressed on each side. Mandibles testaceous and much flattened. Antennæ about half the length of the body, with the articles gradually slightly increasing in size from the third to the termination; the first article stout; the second, third, fourth, fifth, and sixth long and equal; the seventh and eighth shorter; the ninth, tenth, and eleventh a little thickened, forming a long and slender club; the eleventh minute; the last six articles (sixth to eleventh) fuscous, the remainder testaceous. In the female the antennæ are shorter, being scarcely longer than the thorax. Thorax transverse, subconvex, shorter than long, rather narrower in front than behind, expanded backwards near the posterior angles, embracing the shoulders of the elytra as it were; anterior angles obtuse; the sides angled behind the middle. Scutellum rather large. Elytra oblong, rufo-piceous, each with the disk surrounded by blackish piceous; the sides somewhat rounded and inflexed; a faint line impressed on each side of the suture, which is blackish piceous; the apex truncate and rounded. The pygidium and penultimate segment of the abdomen are subpubescent, the latter scarcely visible from above, the abdomen being bent in. The underside and the legs piceous.

From Columbia. In the British Museum.

EXPLANATION OF PLATE XXXII.

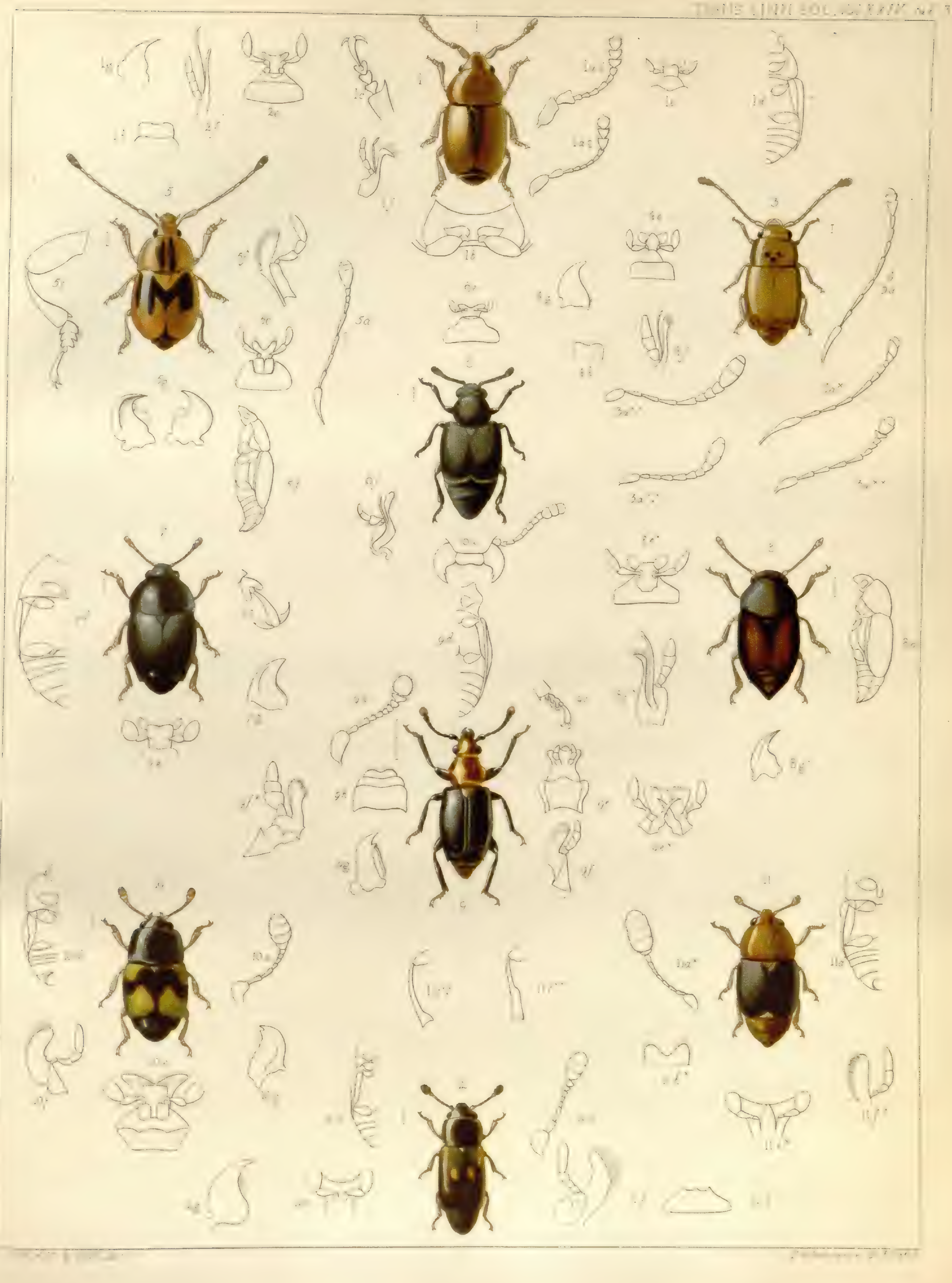
Note.—In the following Plates the initials after each figure indicate the artist by whom the figure was drawn.
J. O. W. signifies Professor Westwood. E. W. R. signifies Mr. Edward W. Robinson. A. M. signifies the Author.
The engravings have been executed by Mr. Edward W. Robinson; the colouring by Mr. Hart.

Figures of the entire Insect.

Fig. I. CERCUS PEDICULARIUS ♂. (A. M.)
III. MYSTROPS FLAVICANS. (E. W. R.)
V. MYSTROPS DISCOIDEUS. (J. O. W.)
VI. BRACHYPTERUS (BRACHYLEPTUS) QUADRATUS. (J. O. W.)
VII. BRACHYPTERUS GRAVIDUS. (A. M.)
[Pubescence not sufficiently marked.]
VIII. BRACHYPTERUS (BRACHYLEPTUS) TINCTUS. (E. W. R.)
IX. CALONECRUS WALLACEI. (J. O. W.)
[Pubescence not sufficiently marked.]
X. CARPOPHILUS HEMIPTERUS. (A. M.)
XI. CARPOPHILUS MELANOPTERUS. (A. M.)
XII. CARPOPHILUS (ECNOMORPHUS) SEXPUSTULATUS. (A. M.)

Details.

1 *a.* ♂ *Cercus pedicularius.* Antenna of male. (A. M.)
1 *a.* ♀ —— ——. Antenna of female. (A. M.)
1 *b.* —— ——. Underside of thorax. (A. M.)
1 *c.* —— ——. Tarsus. (A. M.)
1 *d.* —— ——. Underside of male. (E. W. R.)
[The separation between the metathoracic epimeron and metathoracic epipleuron has been omitted.]
1 *e.* —— ——. Ligula, membranous lobes, and labial palpi (copied from Sturm). (A. M.)
[Membranous lobes rather too small.]
1 *f.* —— ——. Maxillary lobes and palpus (copied from Sturm). (A. M.)
1 *g.* —— ——. Mandible. (A. M.)
1 *h.* —— ——. Labrum. (A. M.)
2 *e.* *Cercus Sambuci.* Ligula, membranous lobes, and labial palpi. (A. M.)
2 *f.* —— ——. Maxillary lobes and palpus. (A. M.)
3 *a.* *Mystrops flavicans.* Antenna of male. (A. M.)
3 *a**. *Mystrops durus.* Antenna of male. (A. M.)
3 *a***. —— ——. Antenna of female. (A. M.)
3 *a****. *Mystrops adustus*:—
(Upper figure) Antenna of male. (A. M.)
(Lower figure) Antenna of female. (A. M.)
4 *e.* *Amartus rufipes.* Ligula, with membranous lobes and labial palpi. (A. M.)
4 *f.* —— ——. Maxillary lobes and palpus. (A. M.)
4 *g.* —— ——. Mandible. (A. M.)
4 *h.* —— ——. Labrum. (A. M.)
5 *a.* *Mystrops discoideus.* Antenna of female. (A. M.)
5 *c.* —— ——. Leg and tarsus. (J. O. W.)
5 *d.* —— ——. Profile. (E. W. R.)
[Metathoracic epimeron omitted, and a segment too many in abdomen.]
5 *e.* —— ——. Ligula and labial palpi. (J. O. W.)
[Membranous lobes of ligula not defined.]
5 *f.* —— ——. Maxilla and palpus. (A. M.)
5 *g.* —— ——. Mandibles. (J. O. W.)
6 *a.* *Brachypterus* (*Brachyleptus*) *quadratus.* Mandibles, labrum, and antenna. (J. O. W.)
6 *e.* —— —— Ligula and labial palpi. (J. O. W.)
6 *f.* —— ——. Maxillary lobes and palpus. (J. O. W.)
[Ciliation on the margin omitted by engraver.]
7 *c.* *Brachypterus gravidus.* Claws of tarsus. (A. M.)
7 *d.* —— ——. Underside, showing the epimeron, epipleuron, and segments of abdomen of male. (A. M.)
7 *e.* —— ——. Ligula, membranous lobes, and labial palpi. (A. M.)
7 *g.* *Brachypterus gravidus.* Mandible. (A. M.)
8 *d.* *Brachypterus* (*Brachyleptus*) *tinctus.* Profile. (E. W. R.)
[Suture separating the metathoracic epimeron from the epipleuron omitted; posterior cotyloid cavities too far back.]
8 *e**. *Brachypterus* (*Brachyleptus*) *ferrugatus.* Ligula, membranous lobes, and labial palpi. (A. M.)
8 *f**. —— ——. Maxillary lobes and palpus. (A. M.)
8 *g**. —— ——. Mandible. (A. M.)
9 *a.* *Calonecrus Wallacei.* Antenna. (J. O. W.)
9 *c.* —— ——. Tarsus. (J. O. W.)
9 *d.* —— ——. Underside. (E. W. R.)
9 *e.* —— ——. Ligula, membranous lobes, and labial palpi (as seen by J. O. W.).
9 *e**. —— ——. Ligula, membranous lobes, and labial palpi (as seen by A. M.).
9 *f.* —— ——. Maxilla and palpus (as seen by J. O. W.).
9 *f**. —— ——. Maxilla and palpus (as seen by A. M.).
9 *g.* —— ——. Mandible. (J. O. W.)
9 *h.* —— ——. Epistome, clypeus, and labrum. (J. O. W.)
10 *a.* *Carpophilus hemipterus.* Antenna. (A. M.)
10 *d.* —— ——. Underside. (A. M.)
10 *e.* —— ——. Ligula, membranous lobes, and labial palpi (copied from J. Duval, and verified). (A. M.)
10 *f.* —— ——. Maxilla and palpus (ditto). (A. M.)
10 *g.* —— ——. Mandible. (A. M.)
11 *a.* *Carpophilus languidus.* Antenna. (A. M.)
[By mistake the engraver has put an article too many in the stalk of this antenna. The row of hairs near the end of the club has also been made too distinct.]
11 *c***. *Carpophilus antiquus.* Posterior tibia. (A. M.)
11 *c****. *Carpophilus ferrugineus.* Posterior tibia. (A. M.)
11 *d.* *Carpophilus melanopterus.* Underside. (A. M.)
11 *e**. *Carpophilus* (*Urophorus*) *humeralis.* Ligula, membranous lobes, and palpi. (A. M.)
11 *f**. —— ——. Maxillary lobe and palpi. (A. M.)
11 *h**. —— ——. Labrum. (A. M.)
12 *a.* *Carpophilus* (*Ecnomorphus*) *sexpustulatus.* Antenna. (A. M.)
12 *d.* —— ——. Underside. (A. M.)
[The engraver has omitted the second short segment of the abdomen and has continued the epipleura past the posterior cotyloid cavities.]
12 *e.* —— ——. Ligula, with the membranous lobe (ill defined) and labial palpi. (A. M.)
12 *f.* —— ——. Maxilla and palpus. (A. M.)
12 *g.* —— ——. Mandible. (A. M.)
12 *h.* —— ——. Mentum. (A. M.)



EXPLANATION OF PLATE XXXIII.

Figures of the entire Insect.

Fig. I. Carpophilus marginellus. (A. M.)
II. Tetrisus Cholevoides. (A. M.)
III. Carpophilus (Endomerus) piger. (A. M.)
IV. Stauroglossicus terminalis. (A. M.)
[Not sufficiently flat nor cuneiform.]
V. Carpophilus (Urophorus) adumbratus. (A. M.)
VI. Eidocolastus plagiatipennis. (A. M.)
VII. Haptoncus tetragonus. (A. M.)
VIII. Carpophilus (Nitops) ophthalmicus. (A. M.)
IX. Colastus (Cyllopodes) niger. (E. W. R.)
X. Prosopeus subæneus. (A. M.)

Details.

1 *a*. ***Carpophilus marginellus***. Antenna. (E. W. R.)
1 *b*. —— ——. Underside. (A. M.)
1 *d*. —— ——. Labrum. (A. M.)
1 *e*. —— ——. Mentum, ligula, its lobes, and the labial palpi. (A. M.)
1 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
1 *g*. —— ——. Mandible. (A. M.)
2 *a*. ***Tetrisus Cholevoides***. Antenna. (E. W. R.)
2 *b*. —— ——. Underside. (A. M.)
2 *d*. —— ——. Labrum. (A. M.)
2 *e*. —— ——. Ligula and labial palpi. (A. M.)
2 *f*. —— ——. Maxillary palpus. (A. M.)
2 *g*. —— ——. Mandible. (A. M.)
3 *a*. *Carpophilus* (*Endomerus*) *piger*. Antenna. (A. M.)
3 *b*. —— ——. Underside. (E. W. R.)
[Too many segments in the abdomen, and otherwise incorrect.]
3 *e*. —— ——. Mentum, ligula, its lobes, and the labial palpi. (A. M.)
3 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
3 *g*. —— ——. Mandible. (A. M.)
4 *a*. *Stauroglossicus terminalis*. Antenna. (E. W. R.)
4 *b*. —— ——. Underside. (A. M.)
4 *d*. —— ——. Labrum. (A. M.)
4 *e*. —— ——. Ligula and labial palpi. (A. M.)
4 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
4 *g*. —— ——. Mandible. (A. M.)
5 *b*. ***Carpophilus* (*Urophorus*) *adumbratus***. Underside. (A. M.)
6 *a*. ***Eidocolastus plagiatipennis***. Antenna. (A. M.)
6 *b*. —— ——. Underside. (E. W. R.)
[Incorrect in various respects: the second and third segments of the abdomen should be shorter than the rest, and the position of the metathoracic cotyloid cavities is wrong.]
6 *d*. ***Eidocolastus plagiatipennis***. Labrum. (E. W. R.)
[The emargination too wide, and the lobes not broad nor rounded enough.]
6 *e*. —— ——. Ligula and labial palpi. (A. M.)
6 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
6 *g*. —— ——. Mandible. (A. M.)
7 *a*. *Haptoncus tetragonus*. Antenna. (E. W. R.)
7 *b*. —— ——. Underside. (A. M.)
7 *d*. —— ——. Labrum. (A. M.)
7 *e**. —— ——. Ligula and labial palpi. (A. M.)
7 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
7 *g*. —— ——. Mandible. (A. M.)
7 *d**. ***Haptoncus pubescens***. Labrum. (A. M.)
7 *f**. —— ——. Maxilla and maxillary palpus. (A. M.)
8 *a*. *Carpophilus* (*Nitops*) *ophthalmicus*. Antenna. (E. W. R.)
[Pubescence omitted.]
8 *b*. —— ——. Underside. (A. M.)
8 *c*. —— ——. Head and eyes. (E. W. R.)
8 *d*. —— ——. Labrum. (A. M.)
8 *e*. —— ——. Ligula and labial palpi. (A. M.)
8 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
8 *g*. —— ——. Mandible. (A. M.)
9 *a*. *Colastus* (*Cyllopodes*) *niger*. Antenna. (E. W. R.)
[The club is only three-jointed. The upper segment should be a mere line of hairs.]
9 *b*. —— ——. Profile. (E. W. R.)
[The epipleuron and posterior cotyloid cavity incorrect.]
9 *c*. —— ——. Anterior tibia and tarsus. (E. W. R.)
10 *b*. *Prosopeus subæneus*. Underside. (E. W. R.)
[Incorrect. The second segment of the abdomen is only half the length of any of the rest, which are nearly all equal.]
10 *e*. —— ——. Ligula and labial palpi. (A. M.)
10 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
10 *g*. —— ——. Mandible. (A. M.)

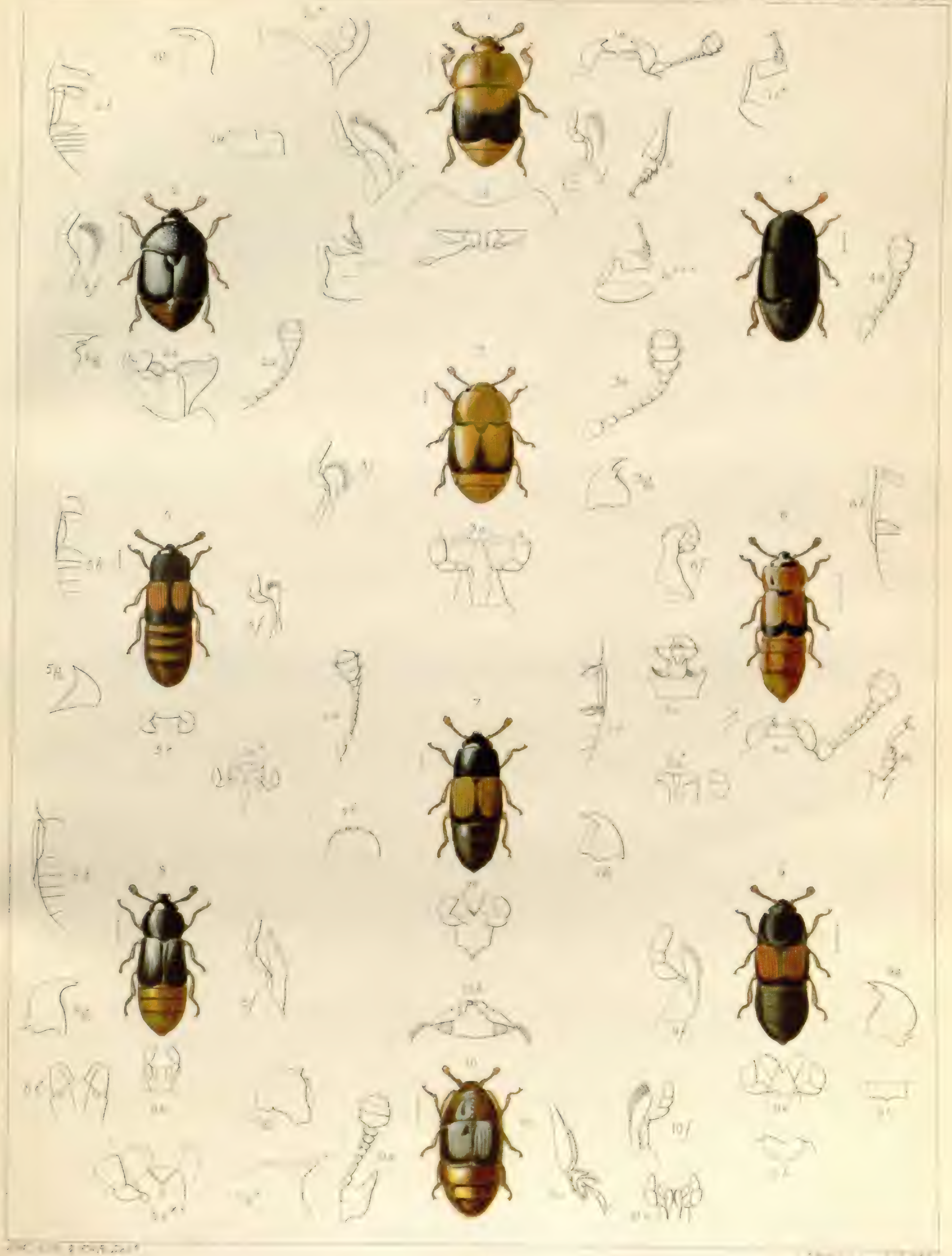
EXPLANATION OF PLATE XXXIV.

Figures of the entire Insect.

Fig. I. COLASTUS (CYLLOPODES) POSTICUS. (J. O. W.)
II. COLASTUS LATUS. (A. M.)
[Pubescence not sufficiently marked.]
III. COLASTUS AMPUTATUS. (E. W. R.)
[Not flat and shining enough.]
IV. COLASTUS OBSCURUS. (E. W. R.)
[Pubescence omitted.]
V. BRACHYPEPLUS (TASMUS) BINOTATUS. (E. W. R.)
VI. BRACHYPEPLUS (LEIOPEPLUS) RUBIDUS. (J. O. W.)
VII. BRACHYPEPLUS OMALINUS. (A. M.)
VIII. BRACHYPEPLUS (LIPAROPEPLUS) COLASTOIDES. (A. M.)
IX. BRACHYPEPLUS LOWEI. (A. M.)
X. BRACHYPEPLUS (ONICOTIS) AURITUS. (E. W. R.)

Details.

1 *a.* *Colastus* (*Cyllopodes*) *posticus.* Head, labrum, mandibles, and antenna. (J. O. W.)
1 *b.* —— ——. Prothoracic cotyloid cavities. (J. O. W.)
1 *c.* —— ——. Posterior tibia and tarsus. (J. O. W.)
1 *c**. —— ——. Anterior tibia and tarsus. (A. M.)
1 *f.* —— ——. Maxilla and maxillary palpus. (J. O. W.)
1 *c***. *Colastus* (*Cyllopodes*) *ruptus.* Anterior tibia and tarsus. (A. M.)
1 *c****. *Colastus* (*Cyllopodes*) *scutellaris.* Anterior tibia and tarsus. (A. M.)
1 *d**. —— ——. Mentum. (A. M.)
1 *e**. —— ——. Ligula, its membranous lobes, and labial palpus. (A. M.)
1 *g.* —— ——. Mandible. (A. M.)
2 *a.* *Colastus latus.* Antenna. (A. M.)
2 *b.* —— ——. Underside. (A. M.)
2 *e.* —— ——. Ligula, its lobes, and labial palpus. (A. M.)
2 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
2 *g.* —— ——. Mandible. (A. M.)
3 *a.* *Colastus amputatus.* Antenna. (A. M.)
3 *e.* —— ——. Ligula, its lobes, and the labial palpi. (A. M.)
3 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
3 *g.* —— ——. Mandible. (A. M.)
4 *a.* *Colastus obscurus.* Antenna. (E. W. R.)
5 *b.* *Brachypeplus* (*Tasmus*) *binotatus.* Underside. (A. M.)
5 *e.* —— ——. Ligula, its lobes, and labial palpi (back). (A. M.)
5 *e**. —— ——. " " " (front). (A. M.)
5 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
5 *g.* —— ——. Mandible. (A. M.)
6 *a.* *Brachypeplus* (*Leiopeplus*) *rubidus.* Head, labrum, mandibles, and antenna. (J. O. W.)
6 *b.* —— ——. Underside. (E. W. R.)
[The proportions of the first and second segments of the abdomen are incorrect.]
6 *c.* *Brachypeplus* (*Leiopeplus*) *rubidus.* Tarsus. (J. O. W.)
6 *e.* —— ——. Mentum, ligula, and labial palpi. (J. O. W.)
6 *e**. —— ——. Membranous lobes of ligula more exposed, and articles of labial palpus more magnified. (A. M.)
6 *f.* —— ——. Maxilla and maxillary palpus. (J. O. W.)
7 *a.* *Brachypeplus omalinus.* Antenna. (A. M.)
7 *b.* —— ——. Labrum. (A. M.)
7 *d.* —— ——. Underside. (E. W. R.)
7 *e.* —— ——. Ligula, its lobes, and the labial palpi. (A. M.)
7 *g.* —— ——. Mandible. (A. M.)
8 *b.* *Brachypeplus* (*Liparopeplus*) *Colastoides.* Underside. (E. W. R.)
8 *e.* —— ——. Ligula and labial palpi. (A. M.)
8 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
[The bearding on the inner side is too thin at the top.]
8 *g.* —— ——. Mandible. (A. M.)
8 *e**. *Brachypeplus anceps.* Ligula and membranous lobes. (A. M.)
8 *e***. *Brachypeplus depressus.* Ligula, membranous lobes, and labial palpus. (A. M.)
9 *e.* *Brachypeplus Lowei.* Ligula, its lobes, and labial palpi. (A. M.)
9 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
9 *g.* —— ——. Mandible. (A. M.)
9 *h.* —— ——. Labrum. (A. M.)
9 *o.* —— ——. Scutellum. (A. M.)
10 *a.* *Brachypeplus* (*Onicotis*) *auritus.* Antenna. (A. M.)
10 *b.* —— ——. Head with antennæ at rest. (E. W. R.)
10 *c.* —— ——. Posterior tibia and tarsus. (E. W. R.)
10 *e.* —— ——. Ligula, its lobes, and the labial palpi. (A. M.)
10 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
10 *g.* —— ——. Mandible. (A. M.)
10 *g**. —— —— Tooth at apex of mandible. (A. M.)



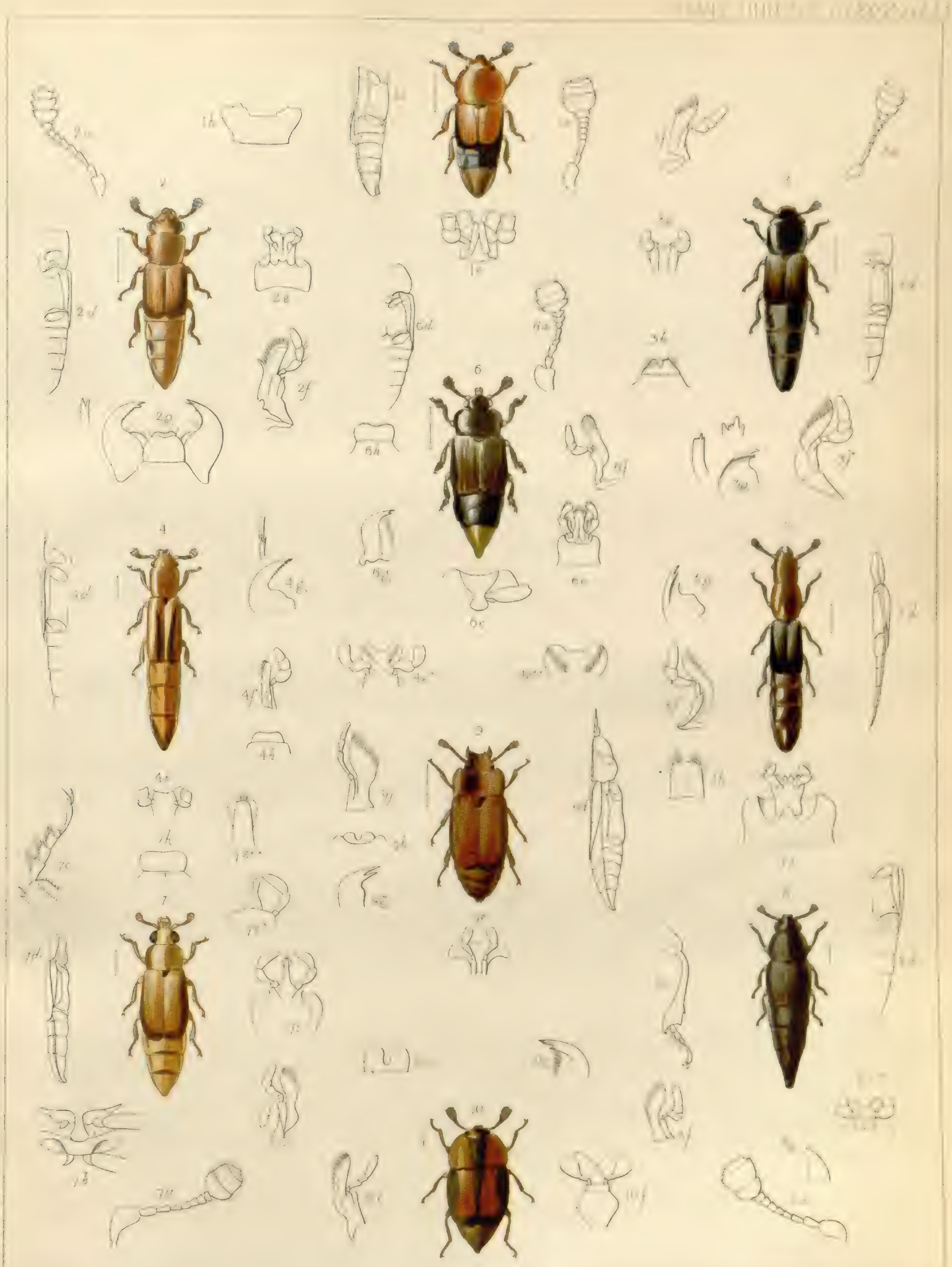
EXPLANATION OF PLATE XXXV.

Figures of the entire Insect.

Fig. I. HALEPOPEPLUS BATESII. (A. M.)
II. CILLÆUS CASTANEUS. (J. O. W.)
III. CILLÆUS OBSCURUS. (E. W. R.)
IV. CILLÆUS LINEARIS. (J. O. W.)
V. ORTHOGRAMMA FUSCIPENNIS. (J. O. W.)
VI. HYPODETUS XANTHURUS. (J. O. W.)
[Epistome too narrow.]
VII. MACROSTOLA STRAMINEA. (J. O. W.)
VIII. CONOTELUS FEMORALIS. (E. W. R.)
IX. ECNOMÆUS PLANUS. (A. M.)
X. TETRISUS HYDROPOROIDES. (E. W. R.)

Details.

1 *a.* *Halepopeplus Batesii.* Antenna. (E. W. R.)
1 *d.* —— ——. Underside. (A. M.)
1 *e.* *Halepopeplus bipustulatus.* Ligula, its lobes, and the labial palpi. (A. M.)
1 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
1 *h.* —— ——. Mentum.
2 *a.* *Cillæus castaneus.* Antenna. (J. O. W.)
2 *d.* —— ——. Underside. (E. W. R.)
2 *e.* —— ——. Ligula and labial palpi (as seen by J. O. W.).
2 *f.* —— ——. Maxilla and maxillary palpus. (J. O. W.)
2 *g.* —— ——. Epistome, labrum, and mandibles. (J. O. W.)
3 *a.* *Cillæus obscurus.* Antenna. (E. W. R.)
3 *d.* —— ——. Underside. (E. W. R.)
3 *e.* —— ——. Ligula, its lobes, and labial palpi. (A. M.)
3 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
3 *g.* —— ——. Mandible. (A. M.)
3 *h.* —— ——. Labrum. (A. M.)
4 *d.* *Cillæus linearis.* Underside. (E. W. R.)
[The first segment of the abdomen is too small.]
4 *e.* —— ——. Ligula, its lobes, and labial palpi. (A. M.)
4 *e**. *Cillæus megacephalus.* Ligula, its lobes, and labial palpi. (A. M.)
4 *e***. —— ——. Membranous lobes of ligula.
[The ciliation appears to be part of an envelope like that in some of the *Brachypepli*; for example, figs. 5 *e** & 6 *e**, Pl. XXXIV.]
4 *f.* *Cillæus linearis.* Maxilla and maxillary palpus. (A. M.)
4 *g.* —— ——. Mandible. (A. M.)
4 *h.* —— ——. Epistome and labrum. (A. M.)
5 *d.* *Orthogramma fuscipennis.* Side view. (A. M.)
5 *e.* —— ——. Mentum, ligula, and labial palpus (as seen by J. O. W.).
[The two middle projections are probably an error. I have been unable to verify them.—A. M.]
5 *f.* —— ——. Maxilla and maxillary palpus. (J. O. W.)
5 *g.* —— ——. Mandible. (A. M.)
5 *h.* —— ——. Labrum. (J. O. W.)
6 *a.* *Hypodetus xanthurus.* Antenna. (J. O. W.)
6 *c.* *Hypodetus xanthurus.* Prosternum. (J. O. W.)
6 *d.* —— ——. Underside. (E. W. R.)
6 *e.* —— ——. Mentum, ligula, and labial palpi.
[Ligula not correct. See woodcut in text, voc. *Hypodetus.*]
6 *f.* —— ——. Maxilla and maxillary palpus. (J. O. W.)
6 *g.* —— ——. Mandible. (J. O. W.)
6 *h.* —— ——. Labrum. (J. O. W.)
7 *a.* *Macrostola straminea.* Antenna. (A. M.)
7 *b.* —— ——. Prosternum and mesosternum. (J. O. W.)
7 *c.* —— ——. Anterior tarsus. (J. O. W.)
7 *d.* —— ——. Profile. (E. W. R.)
7 *e.* —— ——. Mentum, ligula, and labial palpi. (A. M.)
7 *e**. —— ——. Ligula and its lobes seen from the upper side. (A. M.)
7 *e***. —— ——. Ditto seen from the under side. (A. M.)
7 *f.* —— ——. Maxilla and maxillary palpus. (J. O. W.)
7 *h.* —— ——. Labrum. (J. O. W.)
8 *a.* *Conotelus femoralis.* Antenna. (E. W. R.)
8 *c.* *Conotelus obscurus.* Middle tibia and tarsus. (E. W. R.)
8 *d.* —— ——. Underside. (E. W. R.)
[Disproportionately broad, and two first segments disproportionately short.]
8 *e**. *Conotelus substriatus.* Ligula, its lobes, and labial palpi. (A. M.)
8 *f.* *Conotelus vicinus.* Maxilla and maxillary palpus. (A. M.)
8 *g.* —— ——. Mandible. (A. M.)
9 *d.* *Ecnomæus planus.* Side view. (A. M.)
9 *e.* —— ——. Ligula, membranous lobes, and labial palpi. (A. M.)
9 *f.* —— ——. Maxilla and maxillary palpus. (A. M.)
[Maxilla not sufficiently bearded.]
9 *g.* —— ——. Mandible. (A. M.)
9 *h.* —— ——. Labrum. (A. M.)
10 *e.* *Tetrisus Hydroporoides.* Maxilla and maxillary palpus. (A. M.)
10 *f.* —— ——. Ligula, its lobes, and labial palpi. (A. M.)
10 *g.* —— ——. Mandible. (A. M.)
10 *h.* —— ——. Labrum. (A. M.)



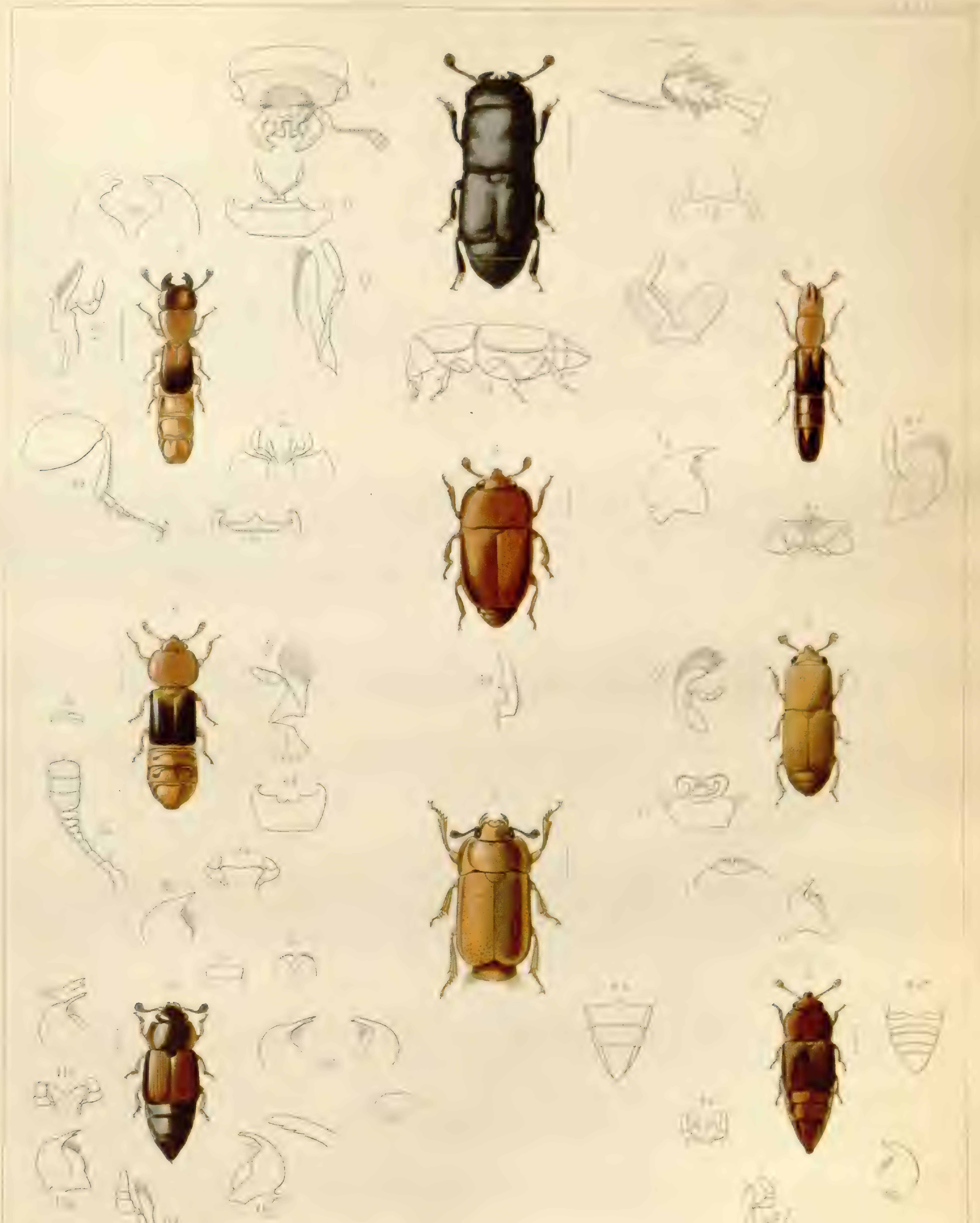
EXPLANATION OF PLATE XXXVI.

Figures of the entire Insect.

Fig. I. Ctilodes Bostrichoides. (A. M.)
II. Ithyphenes gnatho. (A. M.)
III. Orthogramma longiceps. (E. W. R.)
IV. Trimenus adpressus. (A. M.)
V. Adocimus bellus. (A. M.)
VI. Carpophilus cylindricus. (E. W. R.)
VII. Somaphorus ferrugineus. (J. O. W.)
VIII. Campsopyga pallidipennis. (E. W. R.)
XI. Brachypeplus (Selis) cuneatus. (A. M.)

Details.

1 *a*. *Ctilodes Bostrichoides*. Head, mandibles, labrum, and antenna. (A. M.)
1 *b*. —— ——. Profile. (A. M.)
[The two first segments of abdomen omitted by engraver.]
1 *c*. —— ——. Ligula, its lobes, and labial palpus. (A. M.)
[The first minute article omitted by the engraver.]
1 *d*. —— ——. Anterior tarsus. (A. M.)
1 *e*. —— ——. Mentum and labial palpi. (A. M.)
1 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
1 *g*. —— ——. Claw of anterior tarsus. (A. M.)
2 *a*. *Ithyphenes gnatho*. Posterior leg. (A. M.)
2 *c*. —— ——. Mentum. (A. M.)
2 *e*. —— ——. Ligula, its lobes, and labial palpi. (A. M.)
2 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
2 *g*. —— ——. Mandibles. (A. M.)
4 *e*. *Trimenus adpressus*. Ligula, membranous lobes, and labial palpi. (A. M.)
4 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
4 *g*. —— ——. Mandible. (A. M.)
5 *a*. *Adocimus bellus*. Antenna. (A. M.)
5 *c*. —— ——. Labrum. (A. M.)
5 *e*. —— ——. Ligula and labial palpi. (A. M.)
5 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
[Beard of maxilla rather too long.]
5 *g*. *Adocimus bellus*. Mandible. (A. M.)
5 *h*. —— ——. Mentum. (A. M.)
7 *e*. *Somaphorus ferrugineus*. Ligula and labial palpi. (J. O. W.)
7 *f*. —— ——. Maxilla and maxillary palpus. (J. O. W.)
7 *g*. —— ——. Mandible. (J. O. W.)
7 *h*. —— ——. Labrum. (J. O. W.)
8 *a*. *Campsopyga pallidipennis*. Exposed dorsal segments of abdomen. (A. M.)
8 *a**. —— ——. Underside of abdomen. (A. M.)
8 *e*. —— ——. Ligula, its lobes, and labial palpi. (A. M.)
8 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
8 *g*. —— ——. Mandible. (A. M.)
9 *g*. *Brachypeplus* (*Selis*) *apicalis*. Mandible. (A. M.)
10 *g*. *Brachypeplus* (*Selis*) *caudalis*. Mandibles. (A. M.)
10 *h*. —— ——. Labrum. (A. M.)
11 *e*. *Brachypeplus* (*Selis*) *cuneatus*. Ligula, its lobes, and labial palpi. (A. M.)
11 *f*. —— ——. Maxilla and maxillary palpus. (A. M.)
11 *g*. —— ——. Mandibles (right and left). (A. M.)
11 *h*. —— ——. Labrum. (A. M.)
11 *i*. *Campsopya pallidipennis*. Labrum. (A. M.)



XIV. *Note on the Structure and Mode of Dehiscence of the Legumes of* Pentaclethra macrophylla, *Benth.* *By* Daniel Oliver, *F.R.S., F.L.S.*

(Plate XXXVII.)

Read November 19th, 1863.

THE late Mr. Barter, while attached to the Niger Expedition under Dr. Baikie's direction as Botanical Collector, sent home from Fernando Po some remarkable legumes, which, under their native name of *Opochala*, remained undetermined in the Kew Museum until the recent return of Mr. Gustav Mann from Tropical Africa. Mr. Mann identifies these legumes as belonging to *Pentaclethra macrophylla*, Benth. He says that they are so abundant in the Island of St. Thomas that the natives collect them for fuel. The seeds also are edible, and afford a useful oil.

A note by Mr. J. R. Jackson, Curator of the Kew Museums, in Simmond's 'Technologist' (vol. iv. p. 32), referring to Mr. Mann's identification of the legumes, has reminded me of some drawings which I made, in connexion with the microscopic structure and mode of dehiscence of these fruits, shortly after they were received at Kew, nearly four years ago. My object in examining these legumes was chiefly to ascertain the nature of the tissues which, by their contraction in drying, occasioned the valves to become very strongly revolute in the direction of their length.

I have not examined a large series of fruits for the sake of comparing the mechanism of their dehiscence with that of the legumes of *Pentaclethra*; but in the few which I have examined, belonging to different groups of Leguminosæ, I have not found any essential difference in the tissues which occasion the contraction and curvature of the valves as they dry. They differ from *Pentaclethra*, as from each other, in the relation of the contracting, thick-walled, hygroscopic prosenchyma to the parenchyma and other non-contractile tissues of the valves of the fruit, and especially in the quantity, form, and position of the bundles or layers of this prosenchyma, and also in the direction of contraction and expansion, whether longitudinal or transverse with respect to its cells, and whether longitudinal, transverse, or oblique with respect to the valve. *Pentaclethra macrophylla* is remarkable chiefly because of the large size of its legumes, and the unusual extent to which its prosenchymatous bundles contract; and as it is a rare fruit in Europe, and well adapted to illustrate the mechanism of dehiscence in more familiar instances, I have thought that it might be worth while to lay before the Linnean Society the details which I have noted about it, together with the drawings which I made when the fruit was first examined, and a few others since prepared, representing corresponding tissues, and their mode of arrangement, in the legumes of three or four other genera. The legumes of *P. filamentosa* exhibit an arrangement of tissues similar to that of *P. macrophylla*, but they are much smaller.

The legumes of *Pentaclethra macrophylla* in the Kew Museum measure from 22 to

25 inches in length, and about $3\frac{1}{2}$ to $3\frac{3}{4}$ inches in breadth about the middle, tapering gradually to the base; they are but slightly narrowed towards the apex, which is more or less obtuse or rounded. Each valve is about $\frac{1}{4}$ inch thick in the middle and $\frac{1}{2}$ inch at the margin. Plate XXXVII. fig. 3 represents a cross section of a valve, showing the thickening towards both sutures. The valves are marked on the outside by numerous longitudinal anastomosing ridges, corresponding to the exterior bundles of thick-walled prosenchyma. The inner surface is nearly smooth, the direction of the woody tissue which covers it being slightly oblique. When the valves are fresh, or after they have been soaked in water, they are flat, or nearly so, and, if already separate, they may be applied face to face throughout; as they dry their extremities gradually curve outwards, as shown by fig. 1.

If a small, narrow longitudinal strip be removed from the inner face of the dry, curved valve (*e. g.* the portion marked by the dotted line *c d* in fig. 2), and soaked for an hour or so, it will become flat, without, however, increasing perceptibly in length. There may be an increase; but if there be, it is very slight. If a corresponding strip be removed from the outer side of the valve (as enclosed by the dotted line *a b*, fig. 2), and similarly treated, it will be found to increase considerably in length. One of the prosenchymatous bundles from the outer layer of a valve, measuring 2 inches in length when dry, soaked in water for an hour, gains about $\frac{3}{10}$ths of an inch. The same strip, allowed to dry gradually by exposure in a sitting-room, will nearly lose this increase in twenty-four hours—the rate of contraction depending, of course, upon the dryness of the room.

I give a few measurements of bundles of this contractile tissue taken from the outer portion of a valve. The intervals between the observations were simply those of convenience. From the general character of the observations, it appeared useless to affect accuracy by noting temperature, or by expelling the comparatively small amount of moisture which must doubtless have been present at the zero from which I reckon, and which I took as I found it in specimens which had been kept a few years in a museum-cabinet.

1. A narrow bundle, 2 inches in length when dry, after being soaked in water about

10 minutes,	measured	2·17 inches,
16 „	„	2·25 „
52 „	„	2·31 „
$4\frac{1}{2}$ hours,	„	2·33 „

It did not increase in length after soaking a day or two longer, nor after boiling.

2. A similar piece, 2 inches in length when dry, in

$5\frac{1}{2}$ minutes	measured	2·04 inches,
42 „	„	2·25 „
$4\frac{1}{2}$ hours,	„	2·3 „

The same allowed to dry by exposure on a sitting-room table, in

33 minutes,	measured	2·29 inches,
1 hour	„	2·17 „
19 hours	„	2·04 „

3. One inch long when dry, soaked about

$4\frac{1}{2}$ hours,	measured	1·17 inch.

From these memoranda, it appears that the average increase in length of the prosenchymatous bundles, when soaked in water, amounts to about 16 per cent., so that the bundles of an entire valve, 20 inches in length, may be supposed to contract or lengthen to an extent of 3 inches, or a little over. This amount of difference in length on contracting abundantly suffices to explain the insubordination manifested by the legumes when strapped down upon boards for exhibition in the Museum.

Microscopic examination of a transverse section of one of the valves shows the contracting, hygroscopic bundles of prosenchymatous tissue, imbedded in a thin-walled, often coloured parenchyma, which may be compressed or drawn out by the contraction or dilatation of the bundles which it surrounds. This parenchyma cannot interfere, to any material extent, with the action of the bundles.

The prosenchymatous cells are usually very thick-walled and pale-coloured. Fig. 5 represents some bundles of the contracting tissue in cross section, with their surrounding parenchyma; fig. 7 the same in longitudinal section; fig. 6 is a portion of the prosenchyma in cross section, highly magnified, showing the canals of the secondary, somewhat horny layers, and their concentric lamination, similar to that often found in thick-walled cells.

I accompany the drawings of the contracting tissues of *Pentaclethra* by diagrams of the corresponding tissues in the legumes of *Phanera Vahlii*, *Crotalaria incana*, the common Pea (*Pisum*), and a *Lathyrus*. In the valves of these legumes the principal layer (or layers) of contractile tissue is continuous (that is, it is not broken up into distinct bundles, as in *Pentaclethra*) and oblique to the valve; but its action appears to be controlled, in the *Phanera* and *Crotalaria*, by other layers of prosenchyma, either hygroscopic, and capable, more or less, of partial extension and contraction, or neutral. The valves of the *Phanera* are about 8 to 12 inches in length, about $2\frac{1}{2}$ inches broad, and $1\frac{1}{2}$ to 2 lines in thickness. When mature and dry they are very rigid, and spirally curved inwards. They snap obliquely in a direction transverse to their contraction, and parallel to the prosenchymatous cells of the innermost woody layer of the valve. Fig. 11 represents a transverse section of a valve cut at right angles to the direction of its contraction. The innermost layer (*a*) consists of thick-walled prosenchyma, capable of but very slight extension when moistened. A strip, 1 inch in length, cut out of this innermost layer parallel, or nearly so, to the direction of its cells (the tissue of the second layer being removed by a knife as far as could easily be done), did not gain by soaking in water more than $\frac{1}{8}$th or $\frac{1}{10}$th of a line. The second layer (*b*), at right angles to *a*, and with its cells parallel to the direction of the principal contraction of the valve, consists of a thickened prosenchyma, more collenchymatous in character than that of the innermost layer, *a*. A strip 1 inch in length, removed from this layer, after a soaking similar to that to which the strip from layer *a* was subjected, gained about $\frac{9}{10}$ths of a line, or $\frac{1}{13}$th of its length. The third, somewhat irregular layer (*c*) consists of parenchyma, the cells of which are often highly coloured. The fourth layer (*d*) is much interrupted by invasions of the parenchyma of *c*, or by coloured or otherwise altered cells. It is principally composed of a prosenchyma, the cells of which are at right angles to those of the contracting layer, *b*. A strip one inch long, cut out of this layer, gained $\frac{1}{2}$ a line, or $\frac{1}{24}$th of its length, when soaked. The fifth and outermost layer (*e*) consists of long coloured cells, disposed at right angles to those of *d*. I have not tried whether they possess any independent power of expansion when moistened, or not. The measurements given above were from single pieces cut out of each layer and thinned down, so that, if repeated, it is quite probable a slightly different result would be obtained, though not, I think, materially affecting their relative proportions. In different parts of the same valve also the several layers vary, no doubt in the proportion which they bear to the whole; the extent to which they vary I have not attempted to find out.

In some legumes, especially with follicular dehiscence, the line of contraction is almost exactly transverse to the valves. In *Platylobium*, which dehisces in this way, the principal thickness of the valve is made up of thick-walled prosenchyma, the cells of which are disposed in the direction of contraction. The cells of the inner surface are of greater diameter in the direction of the thickness of the valve than are the outer cells of the contractile layer. The contraction of the latter, however, preponderates, and the valves are consequently somewhat revolute, transversely, when dry.

Fig. 12 represents a section, oblique to the valve, of a legume of *Crotalaria incana*, cut in the direction of the striation of its inner face. This striation is due to the surface-cells of the layer *c*; *b* is a thin layer of similar cells at right angles to those of the inner layer *c*. The principal contraction of the valves appears to be in a direction nearly, or directly, transverse to the valves. I apprehend that both *c* and *b* are contractile layers, and as they are at right angles to each other, and each oblique to the valve, the contraction of the valve in a transverse direction may be regarded as the resultant of their united action. The outer layer (*a*) consists of thin-walled parenchyma. Fig. 13 represents the layers *b* and *c* cut at right angles to the section fig. 12. I have made no measurements of the tissues of these valves.

The horny hygroscopic contractile tissue of the valves of *Pentaclethra* increases in diameter as well as in length when moistened; but as this tissue is arranged in distinct bundles, the diameter of which is inconsiderable, the increase in breadth (or corresponding decrease when drying) is not practically of moment. I have but once measured a transverse section before and after moistening; the difference amounted only to about 3 or 4 per cent. Von Mohl states that the longitudinal contraction of dicotyledonous wood, in passing from the wet to a perfectly air-dried condition, amounts to about ·07 to 4 per cent., the contraction in the direction of its breadth amounting to from 4 to 9 per cent. In a large number of legumes in which the contractile tissue is disposed in a single uniform layer upon or near to the inner face of the valves, as, for example, in *Lathyrus* or *Pisum*, it would appear that the twisting of the valves when dry is due to a preponderant contraction of this layer in a transverse direction; in other words, the layer contracts most in the direction of the breadth of the cells which compose it. Fig. 10 represents a section of a valve of *Lathyrus* cut transversely to the cells of its hygroscopic layer, but in the direction of contraction of the valve. The cells have their longer transverse diameter perpendicular to the inner surface of the valve,—the innermost cells of the contractile layer being generally considerably larger than the outer ones of the same layer, and not so much thickened in proportion to their size by secondary deposits. Two narrow strips were cut out of a valve, and of its entire thickness—one parallel to the length of the cells of the contractile tissue, the other nearly at right angles and transverse to their length. The former scarcely gained an appreciable amount on soaking; the latter gained about one-third of a line, or $\frac{1}{21}$st of its length. Fig. 8 represents a section of a similar valve of the Common Pea, the prosenchymatous cells (more highly magnified in fig. 9) being cut transversely. The proportion of thin-walled cellular tissue in this valve is large. Seeing, from these instances, that in numerous legumes the principal contraction of the valves is in the direction of the *breadth* of the cells of the contracting layer, there is no reason why, in the case of the *Crotalaria* referred to above, the contraction of the opposing layers may not also be transverse. In this particular case, however, whether the contraction be in the direction of the length or of the breadth of the cells, the result must be the same.

I have no observations to record upon the behaviour of the hygroscopic tissue of these legumes with reagents. Under the microscope the secondary thickening layers of the cells do not present any peculiarity further than a horny consistence, characteristic of some so-called collenchymatous, and also of certain liber cells.

Some reference was made, orally, at the Meeting at which this Note was laid before the Linnean Society, to the observations of the late Robert Brown upon the spiral twisting of the fruits of certain Cyrtandraceæ, and to the twisting &c. of the fruits of some other Orders, but I do not consider it needful to reproduce these references here.

Mr. Darwin has kindly directed my attention to a short memorandum by Mr. Wyman, in the 'Proceedings of the American Academy' (vol. iii. p. 167), of observations upon the contractility of the valves of the fruit of Balsams, and of *Echinocystis lobata*, a Cucurbitaceous plant. Mr. Wyman concludes that, in these plants, "the motion is due to the spontaneous contraction of the cells on the contracting side, in the way that motion is produced in the hydroid polyps. In the contracted capsule the cells on the concave side are found to be shortened, while those on the opposite side are elongated. In the Balsam capsule the contraction is so sudden that the shortening of the cells cannot be watched; but in the *Echinocystis* the motion is so gradual that the change can be observed under the microscope. When gradually subjected to the action of anæsthetic agents the capsules lose their contractility; but when suddenly placed under their influence an immediate contraction is the usual result." The mechanism of contraction in the case of the plants observed by Mr. Wyman is wholly different from that which I have described above. The entire subject deserves more attention than it has as yet received.

EXPLANATION OF THE PLATE.

Plate XXXVII.

Figs. 1–7. *Pentaclethra macrophylla.*

Fig. 1. Diagram representing the extent to which the valves of the ripe legume become recurved when dry.

Fig. 2. Strip cut longitudinally from the median portion of a dry valve: *a b*, outer surface; *c d*, inner surface. The dotted lines indicate the strips referred to at page 416.

Fig. 3. Transverse section of a valve. The pale-coloured bundles, with their larger diameter perpendicular to the surface of the valve, consist of hygroscopic prosenchyma. The inner woody layer of the valve is separated from the contractile bundles by a tolerably well-defined, deeply-coloured belt of cellular tissue.

Fig. 4. Small portion of same, magnified. Small bundles of prosenchyma, apparently similar to those of the contractile outer layer (*a*), occur in the inner layer (*b*).

Fig. 5. Transverse section of portion of a valve in which the prosenchymatous bundles are comparatively small, magnified. The bundles are surrounded by a thin-walled parenchyma.

Fig. 6. Hygroscopic prosenchyma, more highly magnified.

Fig. 7. Longitudinal section, magnified, showing the anastomosing prosenchymatous bundles traversing thin-walled parenchyma.

Figs. 8 & 9. Section of a valve of a *Pisum* at right angles to its line of contraction. The inner layers of the valve, marked *a*, are represented more highly magnified in fig. 9.

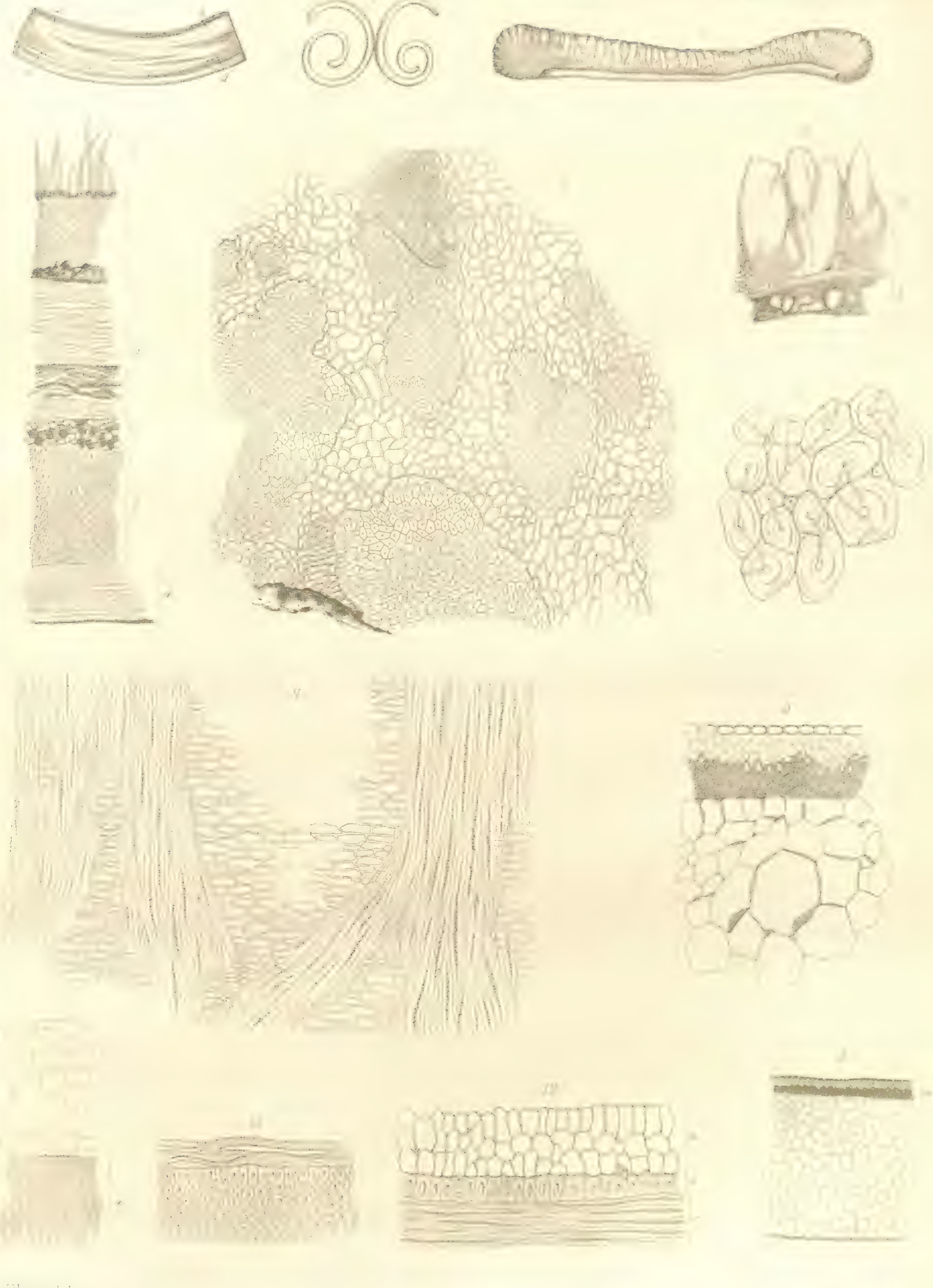
Fig. 10. Section of a valve of a *Lathyrus* made in the direction of the oblique contraction of the valve, but transverse to the contracting layer: *a*, thick-walled hygroscopic contractile layer upon the inner face of the valve.

Fig. 11. Section of a valve of *Phanera Vahlii* at right angles to its line of contraction: *a*, innermost layer; *e*, external layer (*vide* page 417).

Figs. 12 & 13. *Crotalaria incana.*

Fig. 12. Section of valve: *a*, outer layer; *b*, median layer of thick-walled prosenchyma; *c*, innermost contracting layer of prosenchyma at right angles to *b*.

Fig. 13. Section of two inner prosenchymatous layers of same, at right angles to section fig. 12.



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XV. *On the Palms of Western Tropical Africa.* *By* Gustav Mann *and* Hermann Wendland. *Communicated by* J. D. Hooker, *Esq., M.D., F.R.S., V.P.L.S., &c. &c.*

(Plates XXXVIII.–XLIII.)

Read December 3rd, 1863.

Our knowledge of the Palms of Western Tropical Africa is, in comparison with other parts of the world, very limited, as there are but five species described up to the present time, viz. *Phœnix spinosa*, Thonn., *Calamus secundiflorus*, P. de B., *Raphia vinifera*, P. de B., *Borassus Æthiopum*, Mart., and *Elæis Guineensis*, Jacq.

All these species have been re-found by one of us, and in addition twelve others, which are even of more importance than the former in a botanical point of view; and perfect specimens of all have been collected, with the exception of a few the difference between which was not recognized on the spot.

Before speaking in detail, we wish to tender our warmest thanks to Sir W. J. Hooker, of the Royal Gardens, Kew, for the materials so kindly placed at our disposal to enable us to publish the following synopsis; and more especially am I (Mann) indebted to him, for it was only through his instrumentality that I was enabled to travel in Western Africa; and for this and his continued kindness I wish publicly to express my gratitude.

The group of *Arecineæ* have, up to the present time, been quite unknown on the mainland of Africa; now, however, two species have been discovered, constituting two new genera, viz. *Podococcus* and *Sclerosperma*.

Podococcus, Mann & Wendl., is distinguished at first sight from all other genera by its pedicellate ovary and by its fruit, which, when mature, stands at almost right angles with the pedicel, and is, in comparison with its diameter, with the exception of *Areca paradoxa*, Griff. (*Kentia paradoxa*, Mart.), the longest in the whole group. The flowers are inserted in depressions of the spadix, which might lead, on a casual view, to the supposition that it belonged to the *Geonomæ* with undivided spadices; but minute examination at once proves its generic difference, which shows itself particularly in the position of the flowers in each depression; for in *Geonoma*, Willd., and the genera separated from *Geonoma*, such as *Calyptrogyne*, Herm. Wendl., and *Calyptronoma*, Grsb. & Wendl., the female flowers are hidden under two male flowers, by which this group is at once distinguished from other *Arecineæ* (except *Caryota*), in which the male flowers, if present, are situated behind the female flower. The leaflets are very similar to those of *Ceratolobus* *glaucescens*, Bl., and *Ptychosperma Rumphii*, Bl., but the difference in the fruit of these two genera is so marked that it is unnecessary here to mention them in particular. Its nearest affinity is with the genera *Dypsis*, Noronh., *Chamædorea*, Willd., *Hyospathe*, Mart., and *Synechanthus*, Herm. Wendl., from all of which, however, *Podococcus* differs in the form of its leaflets, and in the flowers being inserted in depressions.

Sclerosperma, Mann & Wendl., has for its nearest affinities the genera *Orania*, Bl., and *Manicaria*, Gærtn. To both of these *Sclerosperma* approaches in habit, although it is stemless, the præmorse leaflets resembling *Orania* in their grey-blue coating, and *Manicaria* &c. in the large lobes into which they are united: it differs from *Manicaria* in its very small spadix, but again approaches it in its spathe, which is persistent and lace-like upon the spadix; but differs again in its spathe opening at the apex, whilst *Manicaria* opens at the base or at the centre, the upper part being then pushed off. Although both *Orania* and *Manicaria* have large divided spadices, still *Sclerosperma* resembles them in the arrangement of its flowers, all three genera having female flowers with two male flowers only at the base of their spadices, whilst at the apex male flowers only are present. The outer perianth of the male flowers of *Sclerosperma* resembles that of *Nipa*, Th., and the inner that of *Arenga*, Labill. *Sclerosperma* is most remarkable for its extrorse anthers, and the position of the petals of the female flowers, which are membranous and imbricate only at the base; in *Orania* they are not at all imbricate. It differs also from the last-named genera in its unilocular ovary, on the apex of which is a large one-sided stigma. Its fruit bears a great resemblance to that of *Orania*, except that the chalaza is a little below the vertex, and not near the base. In its extraordinarily hard albumen it differs from both *Orania* and *Manicaria* and approaches *Phytelephas*, so much so that it might be taken for a small seed of that genus if the embryo were situated as near the chalaza as it is in *Phytelephas*; but this is not so, the embryo being almost opposite and a little below the vertex.

The second subfamily, *Lepidocaryineæ* or *Calameæ*, is largely represented in Western Tropical Africa, ten new species having been found, besides the two previously known; thus two-thirds of the Palms of this country belong to this subfamily, leaving only one-third for the *Arecineæ*, *Cocoineæ*, and *Borassineæ*. Whilst the ovule of *Arecineæ* and *Cocoineæ* is extrorse, in *Lepidocaryineæ* it is always introrse, which has already been pointed out by v. Martius in his 'Hist. Nat. Palm.' p. 196, "Micropyle sæpius centrum fructûs spectans?"

Most of the species of *Lepidocaryineæ* found in Western Tropical Africa will constitute separate subdivisions. With the exception of one *Calamus*, all have a trilocular ovary, as in the genus *Raphia*, P. de B., so in the four new subgenera of *Calamus* which I here propose (*Laccosperma*, *Ancistrophyllum*, *Oncocalamus*, *Eremospatha*), and in the American genera *Mauritia*, L., and *Lepidocaryum*, Mart., which fact is of great interest with regard to the geographical distribution of Palms.

Some of these new subdivisions are also remarkable for the formation of their seeds, the ovules being attached above their lower end by a short funicle to the lower part of the dissepiment; whilst, from a comparatively stronger development of the lower part of the seed, the chalaza is elongated, whence the dissepiments are lengthened out towards the apex and base of the fruit, and, the funicle being in the centre, the seed shows a peltiform attachment, which is seen in the genus *Raphia* and in the subgenera *Laccosperma* and *Eremospatha.*

Raphia became first known through Palisot de Beauvais, and is represented by four well-marked species. Our investigations have shown that the *Raphia* described and figured by Palisot de Beauvais, viz. *R. vinifera,* is most nearly related to *R. tædigera,* Mart., which it resembles most in shape of fruit and scales, and that the *Raphia* figured by Gærtner (Fruct. et Sem. i. p. 27, tab. 10. fig. 1) as "Sagus Palma Pinus" is altogether different from *R. vinifera,* and not a synonym of the latter as v. Martius (*l. c.* p. 216) supposed it to be; and this we have called *R. Gærtneri.* Although v. Martius describes a lateral spadix in *Raphia,* we have always found it terminal, whence the description given by v. Martius of *R. tædigera* appears to us erroneous. It has also up to the present time been overlooked that several species of this genus are, in the very young state, dichotomous and even sometimes trichotomous, in consequence of which the species are always seen with two or three stems together, whilst others, as for instance *R. Hookeri,* are always single-stemmed.

The following subgenera of *Calamus* (*Laccosperma*, *Ancistrophyllum*, *Eremospatha*, and *Oncocalamus*) have the following characters in common, viz. very slender stems, with pinnate fronds, the sheaths of which at their apex are more or less elongated, forming an ochrea, the petiole of which, if present, and the midrib on the edges only and never on the centre of the back (as in all Indian *Lepidocaryineæ*) are covered with reversed thorns; and besides this they have the peculiarity of being elongated beyond the part covered with leaflets, and on the elongations the leaflets through abortion have become reversed hooks thickened at their base as in several American genera, viz. *Desmoncus,* Mart., and some *Chamædoreæ.*

Although these four subgenera have several characters in common, still there are other distinctions important enough to separate them, which are easily perceived in the following Table:—

	Laccosperma.	Ancistrophyllum.	Eremospatha.	Oncocalamus.
Sheathing:	thorny	thorny	naked	scaly thorns
Ochrea:	very long thorns	very long thorns	naked and short	naked, short
Petiole:	long	short	wanting	wanting
Leaflets:	broad, ligulate	narrow, slightly ligulate	straight	ligulate
Inflorescence:	terminal	terminal	lateral	lateral
„	doubly divided	doubly divided	simply divided	simply divided
„	imperfectly sheathed	imperfectly sheathed	not sheathed	imperfectly sheathed
Flowers:	binate	binate	binate	11, 9, 7, or 5
„	hermaphrodite	hermaphrodite	hermaphrodite	monœcious
Seeds:	round	compressed	compressed	
„	with deep foveas	smooth	smooth or edges crenate	
„	attached near the centre	attached at the lower end	attached near the centre	

From the above comparison it will be seen that *Laccosperma* agrees in habit with *Ancistrophyllum*, and *Eremospatha* with *Oncocalamus*; also that *Ancistrophyllum* and *Eremospatha* have something in common in their seeds, so much so that we at first doubted if they might not be brought together in one subdivision; further investigation, however, convinced us that they were four well-marked subgenera, each of them having at least one well-defined character. Thus, *Laccosperma* is altogether distinct from *Ancistrophyllum* by the deep foveas in the seeds; and whilst *Ancistrophyllum* agrees with *Eremospatha* in the form of its seeds, these differ in their attachment to the dissepiment, for in *Ancistrophyllum* the attachment is by the lower end of the seed, whilst in *Eremospatha* it is near the centre. Besides this, the spadices are in the former terminal and covered with imperfect sheaths, whilst in the latter they are lateral and without sheaths—a character which is peculiar to this subgenus. In the former there is a tripartite inner perianth and almost entirely free stamens, and in the latter a short tridentate inner perianth, and the stamens connected in a tube. As *Eremospatha* differs in its short unsheathed spadix, so again we find in *Oncocalamus* the spadix with imperfect sheaths; also in *Eremospatha* and the two former subgenera (*Ancistrophyllum* and *Laccosperma*) always binate hermaphrodite flowers, whilst in *Oncocalamus* the flowers are glomerate 11 or 9, 7 or 5, and monœcious, the centre one only being female.

These characters are confirmed by the agreement of the two species of *Laccosperma* and of the three species of *Eremospatha*; whilst the other two plants must each be considered as the type of a new subgenus.

Throughout the tropics Palms are amongst the most useful plants to mankind; this is more especially the case among people so little advanced in civilization as the natives of West Africa, who obtain from them the source of many of their comforts.

Foremost among the useful palms of tropical Western Africa stands the *Elæis Guineensis*, Jacq. The oil of the mesocarp of the fruit of this palm constitutes in most parts the chief food of the natives, who hardly ever take a meal in which it is not used in some way or other. It is nutritious and of an agreeable flavour—so much so, indeed, that it generally becomes a favourite dish with Europeans.

Besides being used as food, the natives also use it for oiling their bodies, partly to keep away insects, and partly as a substitute for clothing, of which they are entirely destitute. The Bubis or Boobees of the Island of Fernando Po make an excellent poultice of it, which they apply when the hand of any person, found guilty of adultery, has, in accordance with the usage of these people, been cut off.

Among the more civilized natives it is used, as with us, in the manufacture of soap; and it is also employed for lighting their huts, but the oil extracted from the kernel of the nut is generally preferred for this purpose.

The exportation of the seeds of this palm is rapidly increasing, and already large quantities are shipped from Sierra Leone and its neighbourhood.

Were there less jealousy and more energy among the European traders, and could they induce or force the natives of the coast to give up their monopoly, much larger supplies could be obtained at the chief sources of the trade, as at Bonny, Brass, and Old Calabar

Rivers, and this oil would be found much superior to that now obtained from the mesocarp of the seeds.

Elæis wine, a drink much liked by the natives, is obtained by cutting off the male flower-spike; this wine is also used by the Europeans instead of yeast in making bread. The main nerves of the pinna and the exterior of the petiole are used for basket-work, for the making of brooms, and similar purposes. Dr. Welwitsch says that at St. Paul de Loando the fibre at the base of the leaves, and also that of the spathe, is used for stuffing cushions, &c.; the soft centre of the upper part of the stem, consisting of the undeveloped petioles, is much relished as a vegetable. Finger-rings, bracelets, necklaces, and other ornaments are cut from the endocarp of the seed.

Many as are the benefits derived from this palm by the natives, they are comparatively few compared with the uses made of its products by Europeans; of these we need not speak, as all must be more or less acquainted with them. It may, however, be worthy of mention that during the last three years 130,381 tons of palm oil, of the value of £5,605,913, have been imported into Great Britain.

With regard to their utility to the natives, the various species of *Raphia* rank next to the *Elæis*. The petioles furnish the materials of which their huts and beds are made, while the pinnæ are used for roofing; and the epidermis of the leaflets gives the material from which their clothing is made. In places where the *Elæis* is scarce, the oily substance between the scaly exterior of the fruit and the kernel, although bitter, is eaten with yam, cassada, &c., and the oil pressed out of it is by the women thought superior to that of *Elæis* for dressing their hair.

The pleasant taste of the wine obtained from *R. Hookeri* has even been sufficient to overcome the innate idleness of the natives of Old Calabar, and has induced them to cultivate it. The wine is procured by cutting out the terminal inflorescence as soon as it makes its appearance; the wine is then produced in large quantities. The natives of Old Calabar manufacture cloths, &c., from the epidermis of the leaflets of this palm, and in the south, at St. Paul de Loando, *R. Welwitschi* is used for the same purpose, and the petioles of *R. vinifera* are employed as poles upon which to carry the palanquins. On the river Sherboro the natives make hammocks from the former material, as well as all sorts of basket-work, mats, &c. The roofing made of the leaflets of *R. vinifera* lasts for three years, while that made from *R. Hookeri*, it is said, requires to be renewed every year.

Wine is also obtained from *Phœnix spinosa*, and the fruits of this palm are much liked by the natives. The very young leaflets, before the leaves expand, are used for the plaiting of hats and caps at Accra.

The outer part of the stems of the climbing palms of Western Tropical Africa is used for binding together the materials of which the huts are constructed. The Bafan people also make large cylindrical baskets of this in which to carry the rubber manufactured by them, and the same people take large quantities of *Calamus* (*Ancistrophyllum*) *secundiflorus* with them as food when they go into the hills of the Sierra del Crystal to procure the rubber. For this purpose they choose the extremities of the stem, cutting off the leaves to make the bundles more portable, and when required for use they simply roast the whole in the fire and then eat the soft central part, which is, however, rather bitter and tough for persons not accustomed to such primitive fare.

The fruits of *Podococcus* are also eaten. The leaves of *Sclerosperma* are used for roofing and constructing the walls of the huts, being tied between the petioles of *Raphia.*

Subfamily I. ARECINEÆ.

Genus 1. PODOCOCCUS, Mann et Wendl.

MONOICA. *Spadix* simplex, longe pedunculatus. *Spathæ* 4, inferiores tubulosæ, superior subcompleta. *Flores* in foveis sessiles, masculi geminati prope medium fœmineum rudimentarium, fœminei solitarii in diversis? spadicibus vel fortasse flores ternati in eodem spadice, laterales masculi, medius fœmineus serius florens.

MASC. *Perianthium* exterius triphyllum, interius stipitatum tripartitum. *Stamina* 6, filamentis subulatis, liberis, basi cum germinis rudimento et cum perianthii interioris tubo concretis; antheris oblongo-cordatis, dorso affixis.

FŒM. *Perianthium* exterius triphyllum, interius trifidum stipitatum. *Staminodia* 6, minima. *Germen* stigmatibus 3 triangularibus recurvatis, triloculare; ovulo pendulo. *Fructus* baccatus, abortu monospermus, raro 2- rarissime 3-spermus, supra basin genuflexus, elongato-ellipsoideus; stigmatum cicatrice subbasilari; epicarpio tenui, coriaceo, aurantiaco, lævi; mesocarpio gelatinoso-succoso; endocarpio tenuissime membranaceo. *Semen* erectum, hilo basilari, circumclusum vasorum fasciculis ex hilo radiatim ortis adscendentibus simpliciter ramosis in parte superiore anastomosantibus. *Albumen* æquabile. *Embryon* dorsale, in vel sub dimidia albuminis altitudine.

PODOCOCCUS BARTERI, Mann et Wendl. (Plates XXXVIII. A., XL. B., & XLIII. A.)

Palma 5–8′ alta, in omnibus fere partibus furfure rufo vestita. Caudex simplex, $\frac{3}{4}''$ crassus, basi se innovans, rectus, annulatus, internodiis 3–5″ inter se distantibus. Frondes 6–9, glaucescenti-virides, 5–6-pedales, pinnatisectæ; vaginis circ. pedem longis, striatis, oblique fissis, margine laceratis; petiolis 1–$1\frac{1}{2}'$ longis teretiusculis supra basin versus canaliculatis; rhachi $2\frac{1}{2}$–3′ longa, dorso convexa, supra acutangula. Segmenta utrinque 8–10, elongato-elliptica vel oblongo-elliptica, plicata, multinervia, marginibus inferioribus integris superioribus irregulariter eroso-dentatis, majora 1′ longa 4″ lata, alternantia, 3–4″ inter se distantia, inferiora decrescentia, duo terminalia confluentia. Spadices laterales, simpliciter teretiusculi, patentes deinde penduli, circ. $2\frac{1}{2}'$ longi, fusco-hirsuti, pedunculo rhachique æquilongis, illo in parte inferiore spathis 4 vestito, spathis tubulosis marcescentibus, duabus inferioribus incompletis 4–5″ longis, superioribus magis completis oblique apertis et irregulariter fissis 8–12″ longis, rhachi 3‴ crassa. Flores in foveis orthostichis 8–10 vel spiraliter dispositis sessiles, ternati, rufescentes.—MASC. Perianthium exterius triphyllum, phyllis oblongo-ellipticis apice sæpe bifidis, dorso carinatis, subfalcatis, marcescentibus, vix 1‴ longis, foliatione contorta; interius tripartitum 2‴ longum, laciniis oblongo-ellipticis, concavis, cartilagineis, dorso striatis, patentibus, foliatione valvata. Stamina 6, alternatim paulum longiora; filamentis filiformibus, basi cum perianthii interioris tubo et cum germinis rudimento subgloboso apice tridenticulato concretis; antheris oblongo-cordatis, dorso affixis.—FŒM. Perianthium exterius uti in fl. masc. sed paulum rigidius; interius trifidum, basi cum germine in stipitem brevem concretum, laciniis oblongis, acutis, concavis, dorso striatis, erecto-patentibus. Staminodia 6 minima. Germen triloculare, plerumque loculis duobus abortivis, stipitatum, oblongum, apice stigmatibus tribus brevibus recurvis; ovulo pendulo. Fructus baccatus, edulis, oblongus vel elongato-oblongus, aurantiacus, stipitatus, supra basin genuflexus, stigmatum cicatrice subbasilari, fere pollicem longus, 4–5‴ crassus. Semen erectum, elongato-ellipsoideum, paulum obliquum, 9‴ longum, 2‴ crassum.

Hab. Collected by *C. Barter*, whose name we have given to this graceful plant, and by *G. Mann* (no. 452), in swampy places at the mouth of the rivers Nun, Brass, and Gaboon, where it flowers from June to August.

PLATE XXXVIII. A. View of the plant, showing its habit.

PLATE XL. B. fig. 1. Spadix in fruit (natural size); fig. 2. Female fl.; fig. 3. Male fl. (both magnified); fig. 4. Seed (nat. size).

PLATE XLIII. A. fig. 1. Male fl.; fig. 2. do. outer perianth removed; fig. 3. do. laid open; fig. 4. Stamens; fig. 5. Female fl.; fig. 6. Outer perianth leaflet; fig. 7. Inner do. laid open; fig. 8. Vertical section of pistil; fig. 9. do. of seed: all but fig. 9 magnified.

Genus 2. SCLEROSPERMA, Mann et Wendl.

MONOICA. *Spadix* brevis, simplex. *Spathæ* 2, persistentes, interior subcompleta. *Flores* utriusque sexus in eodem spadice conferti, basi masculi ad singulorum fœmineorum latera, apicem versus solum masculi.

MASC. *Perianthium* exterius triphyllum, interius tripartitum foliatione valvata. *Stamina* plurima; filamentis brevissimis; antheris linearibus, extrorsis, basi affixis.

FŒM. *Perianthium* exterius tripartitum aut triphyllum; interius triphyllum, phyllis interioris basi convolutis, apicem versus valvatis. *Staminodia* 6–9, minima. *Germen* unicarpellare; ovulo pendulo; stigmate obliquo maximo. *Fructus* drupaceus, magnus, oblique depressus, stigmatum cicatrice laterali; epicarpio tenui; mesocarpio fibroso; endocarpio tenui lapideo. *Semen* depresso-globosum, circumclusum vasorum fasciculis ex hilo lineari ortis, radiatim divergentibus, ramosis, versus embryotegam laxe anastomosantibus. *Albumen* magnum, durissimum, æquabile, lacteum. *Embryon* dorsaliverticale, hilo suboppositum.

SCLEROSPERMA MANNII, Wendl. (Plates XXXVIII. C. & XL. A.)

Palma humilis, cæspitosa, socialis. Caudex perbrevis. Frondes 10–13 pedes longæ, furfure rufo-griseo detergibili partialiter obtectæ, rigidæ; vaginis margine reticulato-fissis 12–18″ longis; petiolis digitum crassis 7–8′ longis, teretiusculis, rigidis, fulvis; lamina oblongo-elliptica, apice bifida, 4–5′ longa, 2′ lata, utrinque 50–60-nervia, irregulariter pinnatisecta; rhachi circ. 4′ longa, supra acutangula, dorso convexa. Segmenta utrinque 9–12 opposita vel subopposita, 1–2″ inter se distantia, coriacea, supra glaucescenti-viridia, lævia, nitidula, subtus albicantia squamulis fuscis detergibilibus tecta, reduplicata, ima basi paulum contracta, 3–5- raro 7-nervia, apice oblique truncata, grosse crenato-dentata et minute acuteque dentata, 2–1½′ longa, 2–3″ lata; nervis primariis fere 9‴ inter se distantibus, subtus prominentibus, in marginis anterioris sinu in mucronem acutum procurrentibus, inter 2 nervos primarios nervo commissurali subtus prominente et in dentis apice excurrente, inter nervos primarios et commissurales circ. 30 nervis tertiariis quorum fere medio fortiore et utrinque paulum prominente, terminalia inæqualia, late confluentia, 12–17-nervia, margine exteriore abrupte truncato crenato, 4–7″ lata, margine interiore 7″ longo. Spadices simplices, breves, primum circ. 8″ longi, deinde paulum elongati, laterales inter frondium bases reconditi erecti, spathis 2 basilaribus persistentibus apice apertis fuscis vestiti; exteriore 5–6″ longa, basi coriacea compressa, apice irregulariter fisso-laciniata; interiore circ. 8″ longa, ellipsoidea vel elongato-ellipsoidea, apicem versus reticulatim disrumpente; pedunculo crassitudine digiti minoris, 4″ longo, fusco-tomentoso, rhachi circ. 4″ longa, inclusa, simplici, subcylindrica, apice attenuata. Flores spiraliter dispositi, in parte inferiore ternati, duo masculi ad latera fœminei, bractea communi latissime ovata acuta concava cum bracteis communibus collateralibus confluente suffulti, in parte superiore solum masculi confertissimi suborthostichi circ. 17 sessiles primum tomento fusco obtecti deinde glabri.—MASC. in basi spadicis seu cum fœmineis conjuncti breviter pedicellati, bractea minima sæpe obsoleta suffulti. Perianthium exterius triphyllum, phyllis oblongo-lanceolatis, concavis, dorso carinatis, membranaceis $1\frac{1}{2}$–2‴ longis; interius tripartitum, laciniis ovali-ellipticis, rigidis, crassis 3–4‴ longis. Flores masculi in apice spadicis basilaribus dimidio majores; perianthii ext. phyllis lineari-spathulatis, intus canaliculatis, dorso carinatis, apice obtusis, incurvis, inferne membranaceis superne coriaceis; interioris laciniis obovato-rotundatis, apice mucrone incurvo, concavis, crassis, subcorneis, 5‴ longis, testaceis, foliatione valvata. Stamina plurima, 25 aut plura, inclusa; filamentis brevissimis e corpusculo crasso hemisphærico enatis; antheris linearibus connectivo percurrente, extrorsis, basi affixis. Rudimentum germinis nullum.—FŒM. bractea late ovata acuta suffulti, circ. 15 in spadice. Perianthium exterius triphyllum aut tripartitum, phyllis late ovatis, incrassatis, acutis, subcarinatis, concavis, margine ciliato-lepidotis deinde glabris, foliatione convoluta 5‴ longa; interius 3-phyllum, phyllis ovatis, abrupte acuminatis, concavis, basi foliatione convoluta, marcescentibus, apicem versus valde incrassatis foliatione valvata, phyllis exterioribus æquilongis vel paulum superantibus. Staminodia 6 vel 9 lanceolata, minima, ima basi germinis. Germen uniloculare, oviforme, ellipsoideum, phyllis perianthii int. brevius; stigmate magno suberecto in latere ventrali paulum decrescente; ovulo basi affixo. Fructus drupaceus, $1\frac{1}{4}$″ in diametro, monococcus, oblique depressus, oviformi-globosus, stigmatum cicatrice laterali verticem versus; epicarpio brunneo tenui nitidulo; mesocarpio fibroso fibris tenuissimis; endocarpio tenuissimo lapideo, extus membrana medullosa brunnea tecto. Semen ei generis *Phytelephantis* affine sed minus depressum, oviformi-globosum, pollicem longum et vix $\frac{3}{4}$″ altum, hilo paulum excentrico magis ad extremitatem superiorem versus, e quo fasciculi vasorum plures ramosissimi et valde anastomosantes versus embryonis situm currentes radiatim oriuntur. Albumen magnum, durissimum, æquabile, lacteum. Embryon dorsali-verticale, hilo oppositum.

Hab. In swampy places near the river Gaboon, from Point Clara upwards (no. 1046).

This highly interesting genus is, I think, one of the finest discoveries among the numerous novelties which my friend G. Mann gathered in West Africa, for which cause I will not let the occasion escape of putting his name to the only species. Highly interesting and of much habitual beauty, I deplore sincerely the failure of the attempt to introduce it into European gardens, where it would become a great ornament in our stoves.—H. W.

PLATE XXXVIII. C. View of plant, showing its habit.

PLATE XL. A. Fig. 1. Spathe; fig. 2. Spadix in fruit; fig. 3. do. in flower; fig. 4. Fruit with portion of pericarp removed; fig. 5. Seed cut open, showing the embryo; all of nat. size: fig. 6. Ovary; fig. 7. Vertical section of do.; fig. 8. Petal of female fl.; fig. 9. Female fl.; fig. 10. Sepal of do.; fig. 11. Male fl.; all magnified.

Genus 3. PHŒNIX, L.

PHŒNIX SPINOSA, Thonning; Mart. Hist. Nat. Palm. p. 275.

Hab. On the banks of the river Nun (*Mann*, no. 528).

Subfamily II. LEPIDOCARYINEÆ.

Genus 4. CALAMUS, L.

(Subgenus 1. CALAMI VERI.)

1. CALAMUS DEERRATUS, Mann et Wendl. II. Loriferi; caudice scandente; aculeis vaginæ ancipiti-subulatis transverse seriatis petioli rhacheosque brevioribus solitariis reduncis; petiolo brevi; segmentis æquidistantibus utrinque circ. 35 elongato-lanceolatis acuminatis ad margines et ad nervos 7 paginæ inferioris et raro in nervo medio paginæ superioris nigro-setulosis, subtus squamulis minimis rufis adspersis; spadicibus elongatis 2–3-partitis apice in loram elongatis, spinis 1–3 aggregatis reduncis; spathis cylindricis appressis; fructu ovoideo, squamis flavescentibus ad marginem brunneis orthostichis 19–21. (Plate XLI. F.)

Caudex scandens, 20–25′ altus, 1′ crassus. Frondes circ. 5′ longæ, longe vaginatæ, patentes, in planta juvenili aggregato-pinnatisectæ in adultiore æquidistante pinnatisectæ, partialiter aculeatæ et fusco-tomentosæ; aculeis basi flavescentibus apice nigris nitidis, vaginæ ancipiti-subulatis basi dilatatis margine dentato-serratis 3–12‴ longis basi sæpe 3‴ latis, petioli erectis subulatis 9–12‴ longis, rhacheos conico-subulatis reduncis. Vagina cylindrica, arcta, inferne inermis, superne transverse zonatimque aculeata, oblique aperta, apice utrinque in lacinias ovatas cartilagineas marginibus aculeatissimis producta, $1\frac{1}{2}$′ longa. Petiolus semiteres, supra leviter canaliculatus, margine et medio dorsi sparse aculeatus, 3″ longus, $\frac{1}{2}$″ latus. Rhachis gradatim attenuata, supra in parte posteriore applanata et sparse aculeata, in dorso longitudinaliter unifariam remote grosseque aculeata, in lateribus partis posterioris sparse minuteque aculeata, tomento fusco detergibili obtecta. Lamina ovata. Segmenta utrinque circ. 35, alterna, utrinque decrescentia, subæquidistantia, elongato-lanceolata, basi valde contracta, acuminata, membranaceo-cartilaginea, in pagina inferiore squamulis minimis fuscis adspersa, trinervia, nervo medio supra partialiter et remote setuloso, marginibus et nervis 7 subtus sparse setulosis, setis flavescentibus apice nigris, media 14–15″ longa 12–14″ lata, 1–$1\frac{1}{4}$″ inter se distantia, terminalia 6″ longa. Spadices tenuissimi, 8′ longi, arcuato-dependentes, ramis primariis binis ternisve simpliciter ramulosis, tumque rhachi communi apice in appendicem nudam longissimam teretiusculam arcte vaginatam, ad internodia lateris alterius inermem, alterius aculeis solitariis geminatis raro ternatis quaternatisve et dimidiato-verticillatis recurvis ornatam protensa. Pedunculus basi cum vagina frondis superioris longitudinaliter connatus. Spathæ longæ, cylindricæ, apice oblique fissæ et bifidæ, sparse aculeatæ, tres inferiores ramos involventes, infima circ. 1′ longa anceps marginibus remote spinulosis, superiores unilateraliter sparse aculeatæ. Rami circ. pedem inter se remoti, arcuato-patentissimi, 9–12″ longi, simpliciter alternatim disticho-ramulosi, spathella cyathiformi oblique acuminata 6″ longa suffulti, ramulis florigeris circ. 30 bipollicaribus densissime bracteatis spathellis ramorum similibus sed multo minoribus et magis cupuliformibus. Flores flavescentes in spadice masculo solitarii, ima basi a bractea minima cupuliformi apice bidenticulata dorso fere usque ad basin fissa circumdata, in spadice fœmineo geminati, alter masculus vel neuter, alter fœmineus, ambo bractea communi uti flores masculi circumdati, fœmineus bractea partiali cupuliformi ore obliquo bidentato.—MASC. fere 3‴ longi. Perianthium exterius cupuliforme, trifidum, laciniis late ovatis; interius tripartitum, exterius duplo superans, laciniis oblongo-ovatis. Stamina 6 basi concreta, filamentis subulatis, antheris basi sagittatis lineari-oblongis. Rudimentum germinis globosum, apice stigmatibus 3 longis.—FŒM. Perianthium staminaque ut in mare, antheris effœtis, germine oblongo stigmatibus tribus triangularibus brevibus recurvis. Fructus ovoideus, apice attenuatus, 7–8‴ longus 4‴ in diametro, 19–21 seriebus squamularum loricatus, squamis convexiusculis medio sulco levi longitudinali notatis, testaceo-ochreatis, nitidis, margine inferiore membranaceo eroso-laciniato, margine linea brunnea pictis. Semen 4–5‴ longum, compressiusculum, oblongo-ellipsoideum, rugulosum, basi affixum, chalaza incrassata dorsali. Albumen corneum. Embryon basilare, erectum, juxta hilum.

Hab. Collected at two places: on the Bagroo River, under no. 895; and on the Cameroons River, under no. 2147.

It is very interesting to meet with a true *Calamus* so far westwards, going astray from its relations, in the regions explored by Mr. Mann. As far as is yet known, no connexion exists in the geographical extension of this subgenus; for we are not aware of any species which grows between the west coast of Africa and India, as *Calamus secundiflorus*, P. de B., does not belong to the subgenus *Calamus*, but is the representative of a new subgenus, as our examinations have shown. A second species seems to grow in Senegambia, where it was discovered by M. Heudelot, but his specimens in the Kew Herbarium are not sufficient to allow of their being described.

Plate XLI. F. Leaflet, portion of fruiting spadix, seed, and the same cut open vertically.

(Subgenus 2. Laccosperma, Mann et Wendl. (λάκκος, a hole; σπέρμα, seed).)

Hermaphrodita. *Spadix* terminalis, spathis incompletis vaginatus, alternatim disticheque ramosus, ramis spathellulis vestitis. *Flores* geminati, alternatim distichi.

Perianthium exterius campanulatum, trifidum, basi subcallosum; interius tripartitum, exteriore duplo longius. *Stamina* 6; filamentis ima basi perianthii int. adnatis, linguæformibus, crassis; antheris elongatis, sagittatis, dorso affixis. *Germen* triloculare, stylo longissime columnari-subulato, stigmatibus 3 brevibus, ovulo paulum supra extremitatem inferiorem et paulum supra fundum carpelli affixo, deinde peltato. *Fructus* baccatus, monospermus, subglobosus. *Semen* peltatum, subglobosum; hilo lineari, raphe lineari per canalem basilarem ad foveam dorsalem magnam adscendente, chalaza magna mamillæformi. *Albumen* lacunosum. *Embryon* ventrale, horizontale, in dimidia albuminis altitudine.

Palmæ *Calamis veris* similes; caudicibus elongatis, remote frondiferis, inermibus. Frondes pinnatisectæ, vaginis spiniferis longissime ochreatis, petiolatæ, in marginibus petioli rhacheosque retrorso-spinosæ, rhachi apice in cirrhum longum filiformem producta, segmentis abortivis in hamos seu uncos inferne alternantes superne oppositos reversos mutatis. Segmenta lato-lanceolata vel elliptico-lanceolata, falcata, reduplicata, subaggregata. Spadices terminales abbreviati, duplicato-ramosi, spathis incompletis vestiti, spathellis abbreviatis infra ramos et bracteis infra flores instructi, ramis alternatim distichis secundis. Flores geminati, alternatim distichi, flavescentes. Fructus aurantiaci.

2. Calamus (Laccosperma) lævis, Mann et Wendl. Segmentis utrinque 9–13 subuniformibus lanceolato-ellipticis margine inermibus bi- raro uninerviis nitidis. (Plate XXXVIII. B.)

Caudex scandens, tenuis, 30–40′ longus, digitum crassus, sobolifer, annulatus, internodiis $\frac{3}{4}$–1′ longis, raro dichotomo-partitus, inermis. Frondes 4–5′ longæ, tomento atrobrunneo detergibili obtectæ, glaucescentes. Vagina circ. 1′ longa, tubulosa, arcte caudicem amplectens, apicem versus spinis solitariis horizontaliter patentibus conoideo-subulatis circ. 3‴ longis obtecta, apice in ochream circ. 1′ longam unilateraliter rumpentem producta, spinis sparsis solitariis fortissimis compresso-subulatis erecto-patentibus basi flavescentibus apice nigris vestita. Petiolus 8–9″ longus, 3‴ latus, supra applanatus, dorso convexus, ad margines remote spinosus, spinis conoideis reduncis basi incrassatis et flavescentibus apice nigro 3‴ longis et 3–12‴ inter se distantibus obsitus. Rhachis in parte foliosa 18–20″

longa, gradatim attenuata, dorso convexa, supra basin versus convexa apicem versus acutangula et producta in cirrhum 1–1½′ longum filiformem segmenta 4–6 abortiva hamæformia solitaria alternantia reversa basi incrassata, infima 6–12‴ longa suprema diminuta, inferne 4″ inter se distantia superne magis approximata ferentem; margine rhacheos cirrhique spinoso, spinis iis petioli simillimis sed magis recurvis approximatis et gradatim diminutis. Segmenta subaggregata, gregibus oppositis vel suboppositis utrinque 9–13, late lanceolato-elliptica, basin versus angustata, apice acuminata, leviter falcata, marginibus inermibus utrinque lævibus nitidis, nervis duobus raro uno primariis supra prominentibus percursa, utrinque decrescentia, infima paulum retroflexa, superiora erecto-patentia, media 7–9″ longa, 1½″ lata. Spadix terminalis, ovatus, 1½–2′ altus, ramis 6–8 primariis, infimis recurvato-patentibus simpliciter ramulosis basi spatha incompleta spinosissima tubulosa oblique rumpente, apice in caudam plures pollices longam transeunte, ramulis alternatim distichis in ramo inferiore 10–12 primum erectis deinde recurvis, infimis 4–5″ longis apicem versus gradatim decrescentibus spathulis pollicem longis tubuloso-inflatis apice oblique truncatis et unilateraliter in apicem acuminatissimum productis suffultis, inermibus densissime spathellulis 2–3‴ longis obsitis. Flores alternatim distichi, patentissimi, geminati; ambo spathellula communi ventre plano vel concavo apice utrinque paulum producta dorso convexa 2‴ longa circumdati, breviter pedicellati supra pedicellum horizontaliter patentes, unusquisque ad hæc singulis spathellulis partialibus dorso inter se concretis circumdatus altera a latere rupta, altera cyathiformis florem alterum basi bractea suffultum circumcludens. Perianthium exterius campanulatum, 2‴ longum, basi calloso-incrassatum, fere semitrifidum; laciniis ovatis, acuminatis, rigidis, dorso nervoso-striatis, interiori arcte appressis: interius 4‴ longum, tripartitum, flavescens; laciniis 3½‴ longis, lineam latis, elongato-lanceolatis, acutis, marginibus præcipue superioribus incrassatis, foliatione valvata, rigidiusculis, intus concavis, tenuissime longitudinaliter nervoso-striatis. Stamina 6, perianthio int. paulum breviora; filamentis basi cum perianth. int. concretis, crassis, linguæformibus, acutis, 1½″ longis; antheris basi bifidis, medio dorso affixis, 1‴ longis, flavis. Germen globosum; stylo columnari, intus cavo 2‴ longo, apice stigmatibus 3 oblongis brevibus coronatum, squamulis minimis laciniato-fimbriatis arcte involutum, triloculare, uniovulatum. Fructus immaturus seriebus 18 verticalibus squamularum stramineарum margine castaneo laciniato-eroso.

Hab. In shady virgin forests in the neighbourhood of Gaboon (*G. Mann*, no. 1045).

Plate XXXVIII. B. View of the plant, showing its natural habit.

3. Calamus (Laccosperma) opacus, Mann et Wendl. Segmentis utrinque circ. 11 biformibus alternatim majoribus elliptico-lanceolatis vel elongato-lanceolatis falcatis marginibus ciliato-spinosis 1–4- raro 5-nerviis. (Plates XLI. D. & XLIII. D.)

Caudex 25–30′ longus, sobolifer. Frondes patentes, 6–8′ longæ, glaucescentes, tomento detergibili fusco obtectæ. Vagina circ. 1′ longa, tubulosa, arcte caudicem amplectens, apicem versus spinis solitariis ancipiti-subulatis basi flavescentibus apice nigris 6‴ longis vestita, apice in ochream 6–12″ longam tubulosam unilateraliter rumpentem spinis iis vaginæ affinibus obsitam producta. Petiolus circ. 7″ longus, 4–5‴ crassus, supra canaliculatus, dorso convexus, ad margines spinis retrorsis 3–6‴ longis dense vestitus. Rhachis in parte foliosa 2½–3′ longa, gradatim attenuata, dorso convexa, supra basin versus applanata, apicem versus acutangula, apice producta in cirrhum 2½–3′ longum filiformem et segmentis 4–6 abortivis hamæformibus flexilibus inferne solitariis alternantibus 4–6″ inter se distantibus superne oppositis reversis basi incrassatis magis approximatis et decrescentibus infimis 1¼–1½″ longis 1‴ latis vestitum. Margines rhacheos cirrhique dense spinosi, spinas valde recurvas apicem versus decrescentes ferentes. Segmenta subaggregata, gregibus oppositis, utrinque 11 biformia, angustiora et latiora alternantia, elongato-lanceolata vel elliptico-lanceolata, basin versus contracta, apicem versus acuminata, marcescentia, opaca, ad margines remote spinifera, falcata, 1–4- raro 5-nervia, nervis utrinque prominentibus, 8″ longa 1″ lata ad 12″ longa et 4″ lata, utrinque decrescentia. Spadix terminalis, ovatus, $1\frac{1}{2}$–$2\frac{1}{2}$′ altus, ramis primariis patentissimis inferioribus 1–$1\frac{1}{4}$′ longis alternatim distiche ramulosis, ramulis homomallis, pendulis, 4–8″ longis, tenuibus, cæteris uti in *C. lævi.* Flores geminati, alternatim distichi, spathellulis uti in *C. lævi* circumdati, breviter pedicellati, horizontaliter patentissimi et divergentes. Perianthium exterius campanulatum, fere 2″ longum, basi calloso-incrassatum, rigidiusculum; laciniis late ovatis acutis: interius fere 4‴ longum, tripartitum; laciniis lanceolato-ellipticis, acutis, rigidis, intus concavis, dorso nervoso-striatis, foliatione valvata. Stamina 6, perianthio int. paulum breviora; filamentis crassis, linguæformibus, basi cum perianthio int. concretis, apice acutis; antheris elongatis, basi bifidis, dorso affixis, longitudinaliter rumpentibus. Germen globosum, stylo 2‴ longo columnari coronatum, stigmatibus 3 oblongis margine fimbriatis, triloculare; loculis uniovulatis; ovulo paulum supra extremitatem inferiorem et paulum supra fundum carpelli affixo. Fructus baccatus, monospermus, miniatus, globosus, 6‴ in diametro, stylo longo coronatus, seriebus 12 verticalibus squamularum membranacearum sulco longitudinali obsolete notatarum straminearum margine castaneo. Semen subglobosum, profunde lacunosum, 5–6‴ in diametro, in latere dorsali fovea magna in cujus medio mamilla calcariformis, supra extremitatem lateris ventralis inferiorem affixum, raphe lineari adscendente et per canalem basilarem ad foveam dorsalem et chalazam calcariformem adscendente. Albumen durum, lacunosum. Embryon ventrale, horizontale, in dimidia albuminis altitudine.

Hab. In shady woods on the island of Fernando Po from the shore to 1000 feet above the level of the sea; collected by *G. Mann,* under no. 97.

Plate XLI. D. Leaflet, portion of fruiting spadix, and seed: nat. size.

Plate XLIII. D. fig. 1. Male fl.; figs. 2 & 3. Outer and inner perianth of do.; fig. 4. Vertical section of do.; fig. 5. Perianth segment and stamen; fig. 6. Stamen; fig. 7. Filament; fig. 8. Pollen; fig. 9. Vertical, and fig. 10. Transverse section of ovary; fig. 11. Top of style and stigma; fig. 12. Transverse section of seed: all but fig. 12 magnified.

(Subgenus 3. Ancistrophyllum, Mann et Wendl. (ἄγκιστρον, a grapple-hook; φύλλον, a leaf).)

Hermaphrodita. *Spadix* terminalis, distiche duplicato-ramosus, spathis pluribus incompletis, spathellis et spathellulis obtectus. *Flores* alternatim distichi, geminati. *Perianthium* exterius campanulatum, tridentatum; interius tripartitum, exteriore duplo longius. *Stamina* 6; filamentis basi perianthio inter. adnatis, linguæformibus; antheris elongatis, sagittatis, dorso affixis. *Germen* triloculare; stylo longe columnari; stigmatibus 3 brevibus; ovulis erectis. *Fructus* baccatus, monospermus, oblongus. *Semen* compresso-oblongum, læve, erectum, hilo basilari, raphe lineari fere usque ad extremitatem lateris dorsalis superiorem adscendente tum vasorum fasciculis obsolete divaricantibus, chalaza dorsali longitudinaliter paulum incrassata et albumini impressa. *Albumen* æquabile, durum. *Embryon* ventrale, horizontale, in dimidia albuminis altitudine.

4. Calamus (Ancistrophyllum) secundiflorus, Mann et Wendl. (Plates XXXVIII. D., XLI. G., & XLIII. C.)

Calamus secundiflorus, P. de Beauv. Fl. d'Oware et de Benin, i. 15, tab. 9 & 10; Mart. l. c. p. 341.

Palma cæspitosa, supra arbores longe lateque scandens. Caudex circ. $1\frac{1}{4}$″ crassus, 50–60′ longus, remote frondifer, inermis. Frondes 12–14′ longæ, longe vaginatæ, breviter petiolatæ, pinnatisectæ, 1–$1\frac{1}{2}$′ inter se distantes, rhachi apice in flagellum longum transeunte, dilute virides. Vagina 1–$1\frac{1}{2}$′ longa, cylindrica, clausa, basin versus inermis, apicem versus spinosa, spinis brevibus conoideo-subulatis 1–2‴ longis solitariis, apice in ochream longam producta. Petiolus 4″ longus, $\frac{3}{4}$″ crassus, dorso convexus et supra concavus, ad margines spinis remotiusculis subulatis basi incrassatis apice nigris recurvis obsitus.

Rhachis 5–6′ longa, gradatim attenuata, in parte foliosa dorso convexa inermis supra inferne angulato-convexa, superne acutangula ad margines inter segmenta et ad angulos ventrales spinifera, spinis $\frac{1}{4}$–$\frac{1}{2}$″ longis subulatis tenuissimis rectis vel paulum curvatis sursum decrescentibus, apice in cirrhum 5–6′ longum subinermem vel raro spiniferum producta et segmentis usque ad 18 abortivis hamæformibus basi valde incrassatis superne applanatis vel triangularibus, infimis solitariis alternantibus 4–8″ inter se distantibus 2″ longis 3‴ latis, superioribus oppositis basi confluentibus gradatim decrescentibus et approximatis ornata. Segmenta utrinque 45–55, lineari-lanceolata, basi abrupte contracta apice acuminata, ad margines ciliato-aculeata, cartilaginea, rigidiuscula, stricta, pendula, uni- vel binervia, nervis paulum prominentibus supra remote aculeatis, infima approximata 4–5″ longa $\frac{1}{2}$″ lata, media 12–13″ longa $\frac{3}{4}$–1$\frac{1}{2}$″ lata raro latiora, 1–1$\frac{1}{2}$″ inter se distantia, suprema inter se paulum remotiora. Spadix terminalis, late ovatus, 4–6′ altus. Rami 10–15 primarii circ. 3′ longi, spathulis incompletis cylindrico-tubulosis apice oblique truncatis inermibus lævibus erecto-appressis infimis vacuis circumdati. Ramuli floriferi alternatim distichi, penduli, homomalli, longissimi, pedem longi tenues, spathellulis campanulato-cylindricis brevibus 2‴ longis apice oblique truncatis alternatim distiche obsiti. Flores geminati, hermaphroditi, spathellula communi iis ramulorum simili sed minore et spathellula partiali apice bidentata circumdati, flavescentes, breviter pedicellati, divergentes et horizontaliter patentes. Perianthium exterius fere 2‴ longum, campanulatum, tridentatum, læve, basi calloso-incrassatum; laciniis transverse semioblongis, acutiusculis: interius tripartitum 4‴ longum; laciniis lineari-oblongis, breviter acutis, rigidis, crassiusculis, patentibus, foliatione valvata, 1–1$\frac{1}{4}$‴ latis, lævibus, dorso convexis, tenuissime nervoso-striatis. Stamina 6, perianthio inter. paulum breviora; filamentis crassiusculis, linguæformibus, compressiusculis; antheris linearibus, basi bifidis, 2‴ longis flavis, introrsis. Germen globosum, stylo columnari coronatum, stigmatibus tribus oblongis, triloculare, ovulo erecto, hemianatropo, squamulis retroflexis vestitum. Fructus baccatus, monospermus, vegetans aurantiacus, sicco brunneus, 6‴ longus, 4–5‴ latus, compresso-oblongus, seriebus 17 verticalibus squamularum membranacearum brunnearum marginibus scabris et castaneis circumdatus. Semen læve, compresso-oblongum, basi obtusum vel leviter bilobum, in apice mucrone brevissimo, in latere dorsali convexum, in ventrali applanatum, 4–5$\frac{1}{2}$‴ longum, 3–4‴ latum, 2$\frac{1}{2}$‴ crassum, in extremitate inferiore affixum, hilo rotundato, raphe lineari fere usque ad extremitatem lateris dorsalis superiorem adscendente et in mamillam appressam calcariformem transeunte, chalaza in dimidia seminis altitudine, testa castanea in latere dorsali albumini impressa lævi subnitida. Albumen æquabile, corneum, in latere dorsali per testam chalazamque exsculptum. Embryon ventrale, horizontale, in dimidia albuminis altitudine.

Hab. Along the coast on the margins of the forest from the equator to Sierra Leone (*G. Mann*, no. 453).

Plate XXXVIII. D. View of plant, showing its natural habit.

Plate XLI. G. Portion of fruiting spadix and seed.

Plate XLIII. C. figs. 1 & 2. Outer and inner male perianth; fig. 3. The same laid open; fig. 4. Stamen; fig. 5. Anther; fig. 6. Vertical section of ovary; fig. 7. Transverse do. of style; fig. 8. Top of do. and stigma; figs. 9–11. Seeds; fig. 12. Vertical section of do.: all but figs. 9–11 magnified.

(Subgenus 4. Eremospatha, Mann et Wendl. (ἔρημος, without; σπάθη, spathe).)

Hermaphrodita. *Spadix* lateralis, simpliciter distiche ramosus, spathis nullis. *Flores* distichi, geminati, uti rami bractea suffulti.

Perianthium exterius campanulatum, tridenticulatum; int. inflatum apice tridentatum, crassum, perianth. exter. superans. *Stamina* 6, perigyna; filamentis in tubum inter se et cum perianth. int. usque ad ejusdem partitiones connatis; antheris cordatis ad basin dorsi affixis. *Germen* triloculare, stigmatibus 3 linguæformibus fimbriatis; ovulo paulum supra extremitatem inferiorem et paulum supra fundum carpelli affixo, deinde peltato.

Fructus baccatus, 1- raro 2–3-spermus, squamis tenuibus fragilibus, endocarpio membranaceo. *Semen* peltatum, oblongo-disciforme, subrugulosum, hilo lineari, chalaza in lateris dorsalis medio hilo opposita, ibi testa longitudinaliter incrassata vel mamillæformi, raphe lineari partem seminis inferiorem amplectente, vasorum fasciculis e chalaza ortis radiatim divergentibus et in embryotegam convenientibus. *Albumen* æquabile, leviter sulcatum. Embryon ventrale, horizontale, in dimidia albuminis altitudine.

Palmæ *Calamis veris* similes; caudicibus elongatis in et ultra arbores sylvestres plerumque longe scandentes, remote frondiferis, annulatis, inermibus. Frondes pinnatisectæ, vaginatæ, vagina breviter ochreata inermi sessiles, rhachi marginibus ciliato-spinosa apice in cirrhum longum filiformem triangularem producta, segmentis abortivis in hamos oppositos reversos mutatis armata. Segmenta plicato-nervosa, reduplicata, margine ciliato-spinosa, inferiora decrescentia reflexaque, superiora erecto-patentia. Spadices inter vaginas erumpentes, patentes, breves, espathæ; ramis infra basin bractea remota suffultis. Flores straminei. Fructus aurantiaci.

5. Calamus (Eremospatha) Hookeri, Mann et Wendl. Segmentis utrinque 12–14 elongato-obovato-ellipticis, marginibus inferioribus ciliato-paucispinosis, superioribus subcrenulatis inermibus; fructu seriebus orthostichis 20. (Plate XLI. C.)

Caudex semipollicem crassus. Frondes 4–5′ longæ; vagina tubulosa nervoso-striata, glabra, apice in ochream 6–9‴ longam valde oblique truncatam producta; rhachi circ. $3\frac{1}{2}$′ longa, basi $\frac{1}{2}$″ crassa, superne gradatim attenuata, apice in cirrhum inermem elongata, dorso convexa, supra subrotundata, inter segmenta bina spinis 1–2 uncinato-recurvis, minimis, apice nigris, 1–2‴ longis obsita. Segmenta utrinque 12–14, subæquidistantia, basin versus approximata, apicem versus paulum remotiora, media $1\frac{1}{2}$–2″ inter se distantia, alternantia, 6–7″ longa, 2–$2\frac{1}{4}$″ lata, elongato-obovato-elliptica, plana, basin versus angustissima, reduplicata, papyracea, longitudinaliter nervoso-plicata, nervo medio et nervis 5 secundariis utrinque paulum prominentibus, marginibus superioribus levissime repando-crenatis, opaca, subglaucescentia, erecto-patentia, inferiora ad margines inferiores spinis paucis 2‴ longis obsita, infima retroflexa caudicem subamplectentia basi paulum incrassata 1″ longa 3‴ lata; segmenta abortiva opposita, 5-juga, infima circ. 7″ a segmentis supremis distantia 1″ longa 1‴ crassa reversa, rhachi subappressa, basi confluentia et incrassata, leviter sigmoidea, cornea, subulato-triquetra, faciebus binis concavis, superiora gradatim approximata et decrescentia. Cirrhi rhachis tenuissima, vix 1‴ crassa, parte pinnifera brevior. Spadix longe pedunculatus, inter vaginas frondium conspiciens, $1\frac{1}{2}$–2′ longus, pedunculo compresso, rhachi compressiuscula 10–12″ longa 4–5‴ crassa superne gradatim attenuata, simpliciter disticheque ramosa, elongato-ovata, ramis 14–22 patentibus, 2‴ crassis, rigidis, toto floriferis, suffultis bractea transverse oblonga acuminata a basi ramorum 3‴ remota, alternantibus, inferioribus 5–6″ longis, mediis 1″ inter se distantibus, superioribus brevioribus. Fructus ovoideo-cylindrici, 10–12‴ longi, 8–9‴ in diametro, 1- raro 2-spermi, 20 seriebus verticalibus squamarum loricati, squamis rhombeis, planiusculis, sulco medio exaratis, aurantiacis, chartaceis, margine inferiore subintegerrimo, linea fusca cinctis, 2‴ in diametro. Dissepimenta persistentia, membranacea. Semen 9‴ longum, 6‴ latum, 3‴ crassum.

Hab. At the mouth of the river Nun (*G. Mann*, no. 451).

Plate XLI. C. Leaflet, fruit, and seed: nat. size.

6. Calamus (Eremospatha) cuspidatus, Mann et Wendl. Segmentis utrinque 25–27 elongato-lanceolatis cuspidatis marginibus minute ciliato-spinosis; fructu seriebus orthostichis 18. (Plate XLI. A.)

Caudex 1″ crassus. Frondes 6–7′ longæ, vagina tubulosa lævi circ. 1′ longa apice in ochream tubulosam 1″ longam oblique truncatam producta, rhachi 5–6′ longa basi 6‴ crassa gradatim attenuata apice in cirrhum elongata, dorso convexa, supra ad partem inferiorem angulato-rotundata, ad partem superiorem triangulari, ad margines partis pinniferæ inter segmenta bina spinis 1–2 uncinato-recurvis apice atro basi incrassata fortissimis 2–3‴ longis obsita. Segmenta utrinque 25–27, subæquidistantia, basin versus approximata, apicem versus paulum remotiora; media 1–2″ inter se distantia, opposita, aut alternantia, 8–9″ longa, 10–12‴ lata, elongato-lanceolata, in apice reduplicato-contracta in cuspidem 1–2″ longam producta, chartacea, subopaca, utrinque glabra, longitudinaliter plicato-nervosa, nervo medio paulum prominente, utrinque nervis 6 secundariis, ad margines ciliato-spinosa, spinulis numerosioribus sed tenuioribus quam in specie sequente; inferiora retroflexa, caudicem subamplectentia, ima basi valde incrassata, rigidiora, grosse spinosa, 1–2″ longa, 1–3‴ lata; segmenta abortiva opposita, 8-juga, inferiora 8″ inter se distantia, 1½″ longa basi 3‴ crassa, supra basin confluentia, reversa, leviter sigmoidea, cornea, subulato-triquetra, faciebus binis concavis; superiora gradatim approximata et decrescentia. Cirrhi rhachis tenuis, 1‴ crassa, infra jugam ad 2–3‴ incrassata. Spadix longe pedunculatus, inter vaginas frondium conspiciens, 18–20″ longus, pedunculo compresso circ. 1′ longo basi vix ½″ lato intus concavo dorso convexo superne dilatato, rhachi compressiuscula 7–9″ longa basi ½″ crassa superne gradatim attenuata simpliciter disticheque ramosa ovata vel elongato-ovata, ramis 20–30 patentissimis 2‴ crassis rigidis toto floriferis, suffultis bractea transverse oblonga acuminata a basi rami 3‴ remota, inferioribus oppositis 4–5″ longis, superioribus brevioribus et alternantibus. Flores uti in specie sequente. Fructus ellipsoidei, 1″ longi, circ. 9‴ in diametro, fere æquilati, 1- raro 2-spermi, 18 seriebus verticalibus squamarum loricati, squamis rhombeis in sicco valde bullatis sulco medio exaratis miniatis chartaceis margine inferiore lacerato linea fusca cinctis 1½–2‴ in diametro. Dissepimenta persistentia. Semen 9‴ longum, 5‴ latum, 3–4‴ crassum, a ventre paulum compressum, in dorso convexum, pericarpii cavitatem replens; testa brunnea, chalaza dorsali valde incrassata et mamillæformi marginibus sublævibus, hilo lineari. Embryon hilo paulum superpositum, in dimidia albuminis altitudine, ventrale, horizontale.

Hab. Near the mouth of the river Gaboon (*G. Mann*, no. 1043).

Plate XLI. A. Leaflet, portion of male spadix, fruit, and seed: nat. size.

7. Calamus (Eremospatha) macrocarpus, Mann et Wendl. Segmentis utrinque circ. 23 elongato-lanceolatis acutis marginibus grosse ciliato-spinosis; fructu seriebus orthostichis 24. (Plates XLI. B. & XLIII. B.)

Caudex vix 1″ crassus, 30–50′ longus. Frondes circ. 9′ longæ; vagina tubulosa circ. 1′ longa, apice in ochream oblique truncatam 1″ longam, furfure atrofusco detergibili obtecta; rhachi circ. 7–8′ longa, basi 4–5‴ crassa, gradatim attenuata, apice in cirrhum elongata, dorso convexa, ventre angulata, partis pinniferæ marginibus antrorsum retrorsumque uncinato-spinosa, parte cirrhifera inermi parti pinniferæ æquilonga. Segmenta utrinque circ. 23, subæquidistantia, apicem versus paulum remotiora, elongato-lanceolata, apice acuta, subdentata, papyracea, rigida, nervoso-striata, glabra, nitida, marginibus grosse ciliato-spinosis, spinis 1–2‴ longis fuscis basilaribus ima incrassatis; inferiora decrescentia, elongato-elliptica, retroflexa, basi valde incrassata, alternantia; superiora opposita vel subopposita, 14″ longa, 12–13‴ lata, nervo medio paulum prominente, utrinque nervis 6 secundariis; segmenta abortiva opposita, 7–11-juga, reversa, cornea, basi valde incrassata et fere confluentia, subulato-triquetra, faciebus binis concavis; inferiora 6–8″ inter se distantia, 12–15‴ longa, basi 2‴ crassa; superiora minora gradatim approximata. Spadix 1½–2′ longus, glaber, simpliciter alternatim distiche ramosus, sine spathis; pedunculo 6–8″ longo, fere 6‴ crasso, intus concavo, dorso convexo, ramis 4–5″ longis 1‴ crassis sursum decrescentibus, bractea semiamplexicauli marcescente ovata acuminata 3‴ longa fere pollicem infra basin ramorum posita. Flores geminati, alternatim distichi, sessiles, 5‴ longi. Perianthium exterius monophyllum, campanulato-cyathiforme, 2‴ altum, tridentatum, papyraceum, rigidum, læve, obsolete striatum; interius exteriore fere triplo longius, monophyllum, valde inflatum, crassum, tridentatum. Stamina 6, æquilonga; filamentis in tubum inter se et cum perianth. int. usque ad ejusdem partitiones connatis, apice brevissime liberis; antheris erectis, cordatis, ima basi lateris dorsalis affixis, introrsis. Germen ovoideo-globosum, squamulis minutissimis obductum, triloculare, cum ovulo campylotropo in quovis loculamento. Stylus brevis, squamulis vestitus, stigmatibus 3 linguæformibus margine ciliolatis coronatus. Fructus $1\frac{1}{4}''$ alti, compresso-cylindrici, utrinque obtusi, apice brevissime attenuati, mono- raro dispermi, 24 seriebus squamarum verticalibus loricati; squamis rhombeis, $2'''$ in diametro, planiusculis, sulco medio exaratis, aurantiacis, chartaceis, margine inferiore membranaceis et linea fusca cinctis. Dissepimenta persistentia. Semen 9–$12'''$ longum, $9'''$ latum et 4–$5'''$ crassum, a dorso ventreque compressum, disciforme, pericarpii cavitatem exacte replens, testa brunnea, chalaza dorsali valde incrassata et mamillæformi, marginibus plus minusve crenulatis, ventre lævi. Embryon hilo approximatum et ei paulum superpositum, in dimidia albuminis altitudine, ventrale, horizontale.

Hab. Rivers Old Calabar and Bagroo (no. 2330).

PLATE XLI. B. Leaflet, portion of male spadix, fruit, and seed: nat. size.

PLATE XLIII. B. Figs. 1 & 2. Outer and inner perianth of female fl.; fig. 3. do. laid open; fig. 4. Imperfect stamens; fig. 5. Pistil; fig. 6. Vertical section of do.; fig. 7. Seed; fig. 8. Transverse section of do.: all magnified.

(Subgenus 5. ONCOCALAMUS, Mann et Wendl. (ὄγκος, a hook; κάλαμος, cane).)

MONOICA. *Spadix* lateralis, spathis incompletis vaginatus, simpliciter disticheque ramosus, ramis longissime pendulis. *Flores* spathellulati 11–5 glomerati, glomerulis alternatim distichis, medii fœminei, cæteri masculi.

MASC. *Perianthium* exterius campanulatum, tridentatum ad trifidum; interius tripartitum, fere triphyllum. *Stamina* 6 in cyathum campanulatum apice minute 6-dentatum concreta; antheris cordatis, dorso affixis. Rudimentum *germinis* oblongum, stylo cylindrico, stigmatibus minutis.

FŒM. *Perianthium* filamentaque ut in mare; antheris effœtis. *Germen* triloculare, stylo subnullo, stigmatibus 3 linguæformibus, ovulo paulum supra extremitatem inferiorem et paulum supra fundum carpelli affixo. *Fructus* ignotus.

8. CALAMUS (ONCOCALAMUS) MANNII, Wendl. (Plates XLI. E. & XLIII. E.)

Palma *Calamis veris* affinis; caudicibus circ. $60'$ longis semipollicem crassis remote frondiferis. Frondes 5–$6'$ longæ, atrovirides, in juventute cupreæ, longe vaginatæ, vaginis 1–$1\frac{1}{2}'$ longis cylindricis ochreatis, ochrea $\frac{1}{2}$–$\frac{3}{4}''$ longa oblique truncata, sessiles; rhachi foliosa $1\frac{1}{2}'$ longa, ad margines sparse minuteque spinosa, apice in cirrhum $3'$ longum inermem debilem producta, segmentis abortivis $\frac{1}{2}''$ longis $1\frac{1}{2}$–$2''$ inter se distantibus inferne alternantibus superne oppositis basi confluentibus reversis corneis mutatis; vaginis rhachique squamis atrobrunneis spiniformibus caducis vel deliquescentibus 1–$3'''$ longis vestitis. Segmenta utrinque circ. 16, continua, alternantia vel subopposita, subæquidistantia, nutantia, elongato-lanceolata, acuta, leviter falcata, nitida, uninervia, utrinque nervis secundariis 6–7 obsoletis percursa, ad margines remote spinifera, patentia, 9–$10''$ longa, 12–$15'''$ lata; inferiora paulum diminuta et paulum magis approximata non reversa. Spadices axillares, 4–$5'$ longi, atrobrunnei, penduli, simpliciter alternatim disticheque ramosi, inermes, basi nudi, superne spathis incompletis tubulosis truncatis deinde irregulariter rumpentibus $2''$ longis appressis vestiti, ramis longissimis pendulis $10''$ longis. Rami basi ad rhachim appressi, $1''$ longi, nudi, tum per totam longitudinem spathellis campanulato-infundibuliformibus deinde ventre rumpentibus se imbricantibus alternatim distichis 3–$4'''$ altis dense superpositis. Flores in ramorum parte inferiore plerumque 11, in superiore 7, 5 vel 3 aggregati, medii fœminei ebracteati, cæteri masculi totidem bracteolis variis circumpositi et æquabiliter ad utrumque floris fœminei latus dispositi.

Hab. Near the river Gaboon and on the Sierra del Crystal, at an elevation of about 1500 feet above the level of the sea (*G. Mann,* no. 1044).

Plate XLI. E. Leaflet and portion of male spadix: nat. size.

Plate XLIII. E. Transverse section of portion of spadix, showing the positions of the axis (α), male fl. (♂), and female fl. (♀): magnified.

Genus 5. Raphia, P. de Beauv.; Mart. Hist. Nat. Palm. p. 216.

Monoica in eodem spadice, monocarpa. *Spadices* (laterales, Mart.) 1–2 raro terni in apice caudicis, duplicato-ramosissimi, absque spatha communi, pluribus spathis incompletis vaginati, ramis et ramulis alternatim distichis. *Flores* in ramulis seu spicis compressis distichi, singuli e bractea cyathiformi perfoliata, bracteola campanulata cincti; fœminei basin, masculi apicem versus.

Masc. *Perianthium* exterius campanulatum, truncatum, subdenticulatum; interius tripartitum. *Stamina* 6–16; filamentis crassis clavæformibus basi plus minusve confluentibus; antheris linearibus basi affixis extrorsis. Rudimentum *germinis* nullum vel obsoletum.

Fœm. *Perianthium* exterius ut in masc.; interius campanulato-infundibuliforme, tridentatum ad semitrifidum. *Staminodia* in urceolum 6- vel multidentatum cum perianth. int. connata; antheris effœtis, cordato-sagittatis. *Germen* triloculare; ovulo paulum supra extremitatem inferiorem et paulum supra fundum carpelli affixo. *Stigmata* 3 sessilia, subulata, patentia.

Fructus baccatus, magnus, monospermus. *Semen* peltatum, elongato-ellipsoideum vel elongato-obconicum, exeso-sulcatum, hilo infra lateris ventralis medium, raphe lineari descendente usque ad chalazam in extremitate inferiore positam, tum radiatim partita in vasorum fasciculos ramosissimos anastomosantes maxima ex parte ad extremitatem superiorem adscendentes versus embryotegam revolventes. *Albumen* osseum, solidum, irregulariter ruminatum. *Embryon* ventrale, horizontale, in dimidia albuminis altitudine.

Palmæ plerumque in locis aquosis crescentes, plerumque in juventute dichotome partitæ; caudicibus mediocribus vel altis, circ. pedem crassis, dense obsoleteque annulatis. Frondes longissimæ, pinnatisectæ, segmentis divergentibus nervo medio et marginibus aculeatis. Spadices maximi, terminales, penduli, duplicato-ramosissimi, ramis ramulisque e spathis coriaceis distichis distiche prodeuntibus. Flores roseo-lutei, coriacei, in ramulis compressis. Fructus olivaceo-fusci vel cinnamomeo-castanei, nitidi.

1. Raphia vinifera, P. de Beauv. Fl. d'Oware et de Benin, i. p. 76, tab. 44. fig. 1, et tab. 45 & 46. Staminibus in fl. ♂ 10, fl. ♀ circ. 20 ad basin ramulorum inferiorum; fructu cylindrico-ellipsoideo, seriebus orthostichis 8–9, squamis latissimis basi leviter emarginatis supra basin convexiusculis infra apicem valde impressis sulco latissimo subvirescenti-olivaceis margine subfimbriato et fusco; albumine anguste ruminato. (Plate XLII. C.)

Caudices mediocres. Spadix circ. 8′ longus, elongato-ovatus, laxiuscule ramulosus, ramis primariis 55–60, inferioribus 3–$3\frac{1}{2}$′, superioribus pedem longis, ramulis inferioribus 8–10″ longis 5–6″ latis. Flores fœminei plerumque in dimidia superiore spadicis parte. Fructus breviter mucronati, 3″ longi, $1\frac{1}{2}$–$1\frac{3}{4}$″ crassi; squamis margine patulo, 9–10‴ latis, 9‴ altis. Semen cylindrico-ellipsoideum, $2\frac{1}{4}$″ longum, 1″ crassum.

Hab. Banks of the Old Calabar River (*G. Mann*).

Plate XLII. C. Fruit and transverse section of seed: nat. size.

2. Raphia Gærtneri, Mann et Wendl. *Sagus Palma Pinus,* Gærtn. Fruct. et Sem. i. p. 27, tab. 10. fig. 1. Staminibus in fl. ♂ 8, fl. ♀ circ. 8 ad basin ramulorum inferi-

orum; fructu elongato- vel ovali-ellipsoideo, seriebus orthostichis 8–10, squamis convexiusculis basi leviter emarginatis sulco latiusculo pallide castaneis margine subfimbriato et fusco; albumine anguste ruminato. (Plate XLII. D.)

Spadix laxe ramulosus; ramulis gracilibus, inferioribus 5–7″ longis et 4‴ latis. Flores masculi vix 6‴ longi, filamentis clavæformibus. Fructus oblique mucronati, $2\frac{1}{2}$–3″ longi, 15‴ crassi, squamis margine subpatulo 8‴ latis et altis. Semen elongato-ellipsoideum, utrinque acutiusculum, fere 2–$2\frac{1}{4}$″ longum, 9–11‴ crassum.

Hab. Fernando Po, from the shore up to 500 feet above the level of the sea (*G. Mann*).

Plate XLII. D. Fruit; seed; transverse section of do.; male and female fl.: nat. size.

3. Raphia longiflora, Mann et Wendl. Segmentis utrinque circ. 160 coriaceis apicem versus inermibus subconcoloribus, nervis 2 secundariis marginibus approximatis tertiariis utrinque 9–10; fl. ♂ maximis, staminibus 15; fl. ♀ 4–5 ad basin ramulorum inferiorum; fructu elongato-ovali, seriebus orthostichis 12, squamis valde convexis levissime sulcatis spadiceis basi obtusa raro leviter emarginata margine subintegerrimo; albumine anguste ruminato. (Plates XXXIX. A. & XLII. E.)

Palma 40–50′ alta. Caudices mediocres 3–4, basi uniti, 15′ alti, pedem crassi. Frondes 33′ longæ, petiolo 11–12′ longo marginibus dissolubilibus, fibrillitio rigidissimo erecto. Segmenta rigida, 5–$5\frac{1}{2}$′ longa, $2\frac{1}{4}$–$2\frac{1}{2}$″ lata, carina supra et marginibus solum basin versus spinosa, apicem versus inermia, utrinque nervo secundario margini approximato subtus prominente, nervis tertiariis utrinque 9–10. Ramuli spadicum crassi. Flores ♂ 12–13‴ longi. Fructus 3–$3\frac{1}{4}$″ longi, 16–17‴ crassi, oblique longeque mucronati, squamis 8‴ latis et altis margine subintegerrimo. Semen $2\frac{1}{4}$″ longum, 11‴ crassum, elongato-ellipsoideum.

Hab. Island of Corisco (*G. Mann*, no. 1910).

Plate XXXIX. A. View of plant, showing its natural habit.

Plate XLII. E. Portion of male spadix; fruit; seed; transverse section of do.; male and female fl.: nat. size.

4. Raphia Hookeri, Mann et Wendl. Segmentis utrinque 190–200 marcescentibus spinosis subtus glaucis, nervis secundariis obsoletis, tertiariis utrinque 7–8; fl. ♂ staminibus 16; fl. ♀ 9–12 ad basin ramulorum inferiorum; fructu ovali-ellipsoideo, seriebus orthostichis 12–15, squamis convexis levissime sulcatis castaneis vel cinnamomeis basi obtusa margine subintegerrimo; albumine anguste ruminato. (Plates XXXIX. B. & XLII. A.)

Palma circa 70′ alta, solitaria; caudice circ. 30′ alto, pedem crasso. Frondes 40′ longæ, petiolo 10–12′ longo marginibus dissolubilibus, fibrillitio pendulo cincinnato. Segmenta rigidiuscula, 4–5′ longa, $1\frac{3}{4}$–2″ lata, carina supra in medio inermi, basin et apicem versus et marginibus spinosa. Spadices bini raro solitarii, e cacumine caudicis penduli, compresso-cylindrici, coarctato-ramosissimi, subglaucescentes, ramis primariis 55–60, ramulis rigidis inferioribus 10–11″ longis 6–7″ latis. Flores masculi 9‴ longi. Fructus $3\frac{3}{4}$–4″ longi, $1\frac{3}{4}$–2″ crassi, oblique longeque mucronati, squamis fere 8‴ latis 9‴ altis margine subintegerrimo. Semen $2\frac{1}{2}$–3″ longum, 13–15‴ crassum, ovali-ellipsoideum.

Hab. In humid places along the coast, on the island of Corisco, Cameroons, and Old Calabar; at the last place it is also cultivated, and called by the natives *Ukot*! (*G. Mann*, no. 1911).

Plate XXXIX. B. View of plant, showing its natural habit.

Plate XLII. A. Portion of male spadix; fruit; seed; transverse section of do.; male and female fl.: nat. size.

We give also a diagnosis of the fruit of another new species of *Raphia* collected by Dr. Welwitsch.

5. RAPHIA WELWITSCHII, Wendl. Fructibus ovali-turbinatis, seriebus orthostichis 11–14, squamis latissimis basi convexiusculis apicem versus planiusculis plane lateque sulcatis atrocastaneis basi acuta margine magis atrocastaneo subfimbriatoque; semine ovali-turbinato plane exeso, albumine paulum ruminato. (Plate XLII. B.)

Fructus $2\frac{3}{4}''$ longi, fere $2''$ crassi; squamis 11–12$'''$ latis, 11$'''$ altis. Semen $2\frac{1}{4}''$ longum, 16$'''$ crassum.

Hab. In humid places on the rivers in the interior of Angola, in the district of Galungo (*Welwitsch*).

PLATE XLII. B. Portion of female spadix; fruit; seed; transverse section of do.: nat. size.

Subfamily III. COCOINEÆ.

Genus 6. ELÆIS, Jacq.

ELÆIS GUINEENSIS, Jacq. Amér. p. 280, tab. 172; edit. pict. p. 136, tab. 257; Mart. l. c. p. 62, tab. 54 & 56.

Hab. All along the coast (without a number).

Subfamily IV. BORASSINEÆ.

Genus 7. BORASSUS, L.

BORASSUS ÆTHIOPUM, Mart. l. c. p. 220.

Hab. Isolated on the coast (without a number).

W Fitch, del et lith.

C

Vincent Brooks, Imp

A. Podococcus Barteri B. Calamus lævis C. Sclerosperma Mannii.
D. Calamus secundiflorus.

A B

Vincent Brooks, Imp.

A. Raphia longiflora. B. Raphia Hookeri.

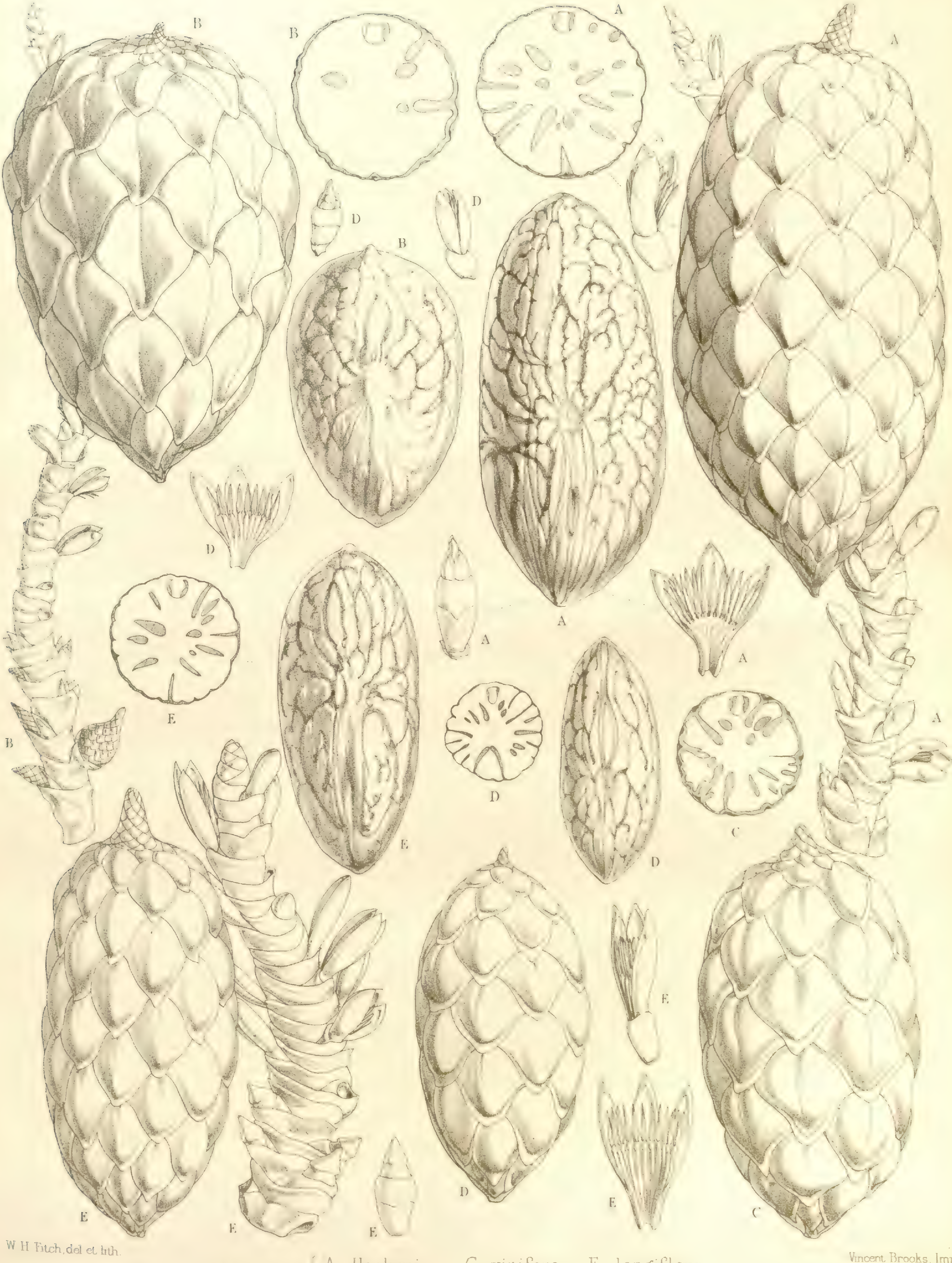
W. H. Fitch, del et lith.

Vincent Brooks, Imp.

A. Sclerosperma Mannii, Wendl. B. Podococcus Barteri. M. & W.

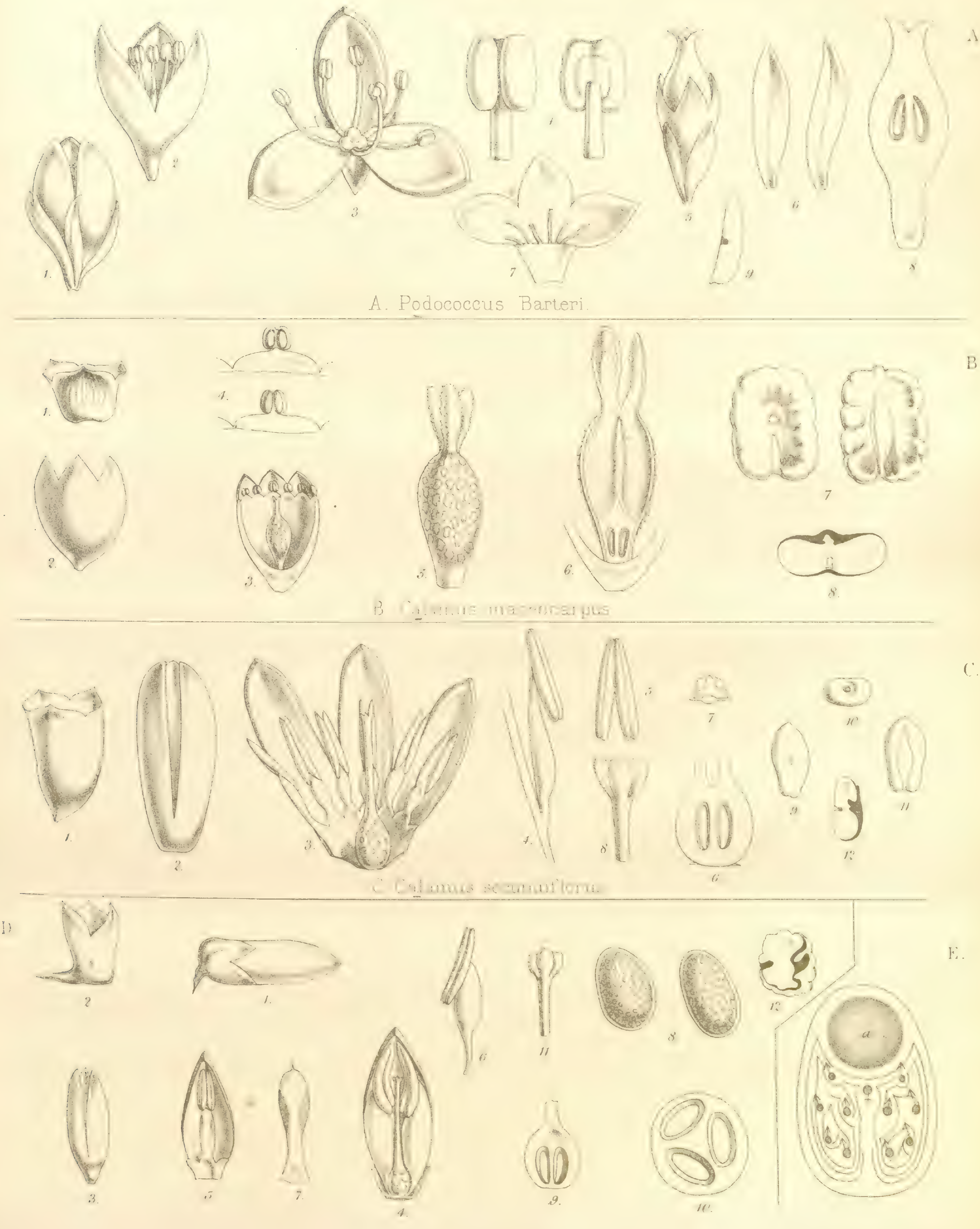
Vincent Brooks Imp.

CALAMUS { A. cuspidatus. C. Hookeri. E. Mannii. G. secundiflorus.
B. macrocarpus. D. opacus. F. deerratus.



W. H. Fitch, del et lith. | Vincent Brooks, Imp.

RAPHIA { A. Hookeri. C. vinifera. E. longiflora. B. Welwitschii. D. Gærtneri.



A. Podococcus Barteri.

B. Calamus macrocarpus

C. Calamus secundiflorus.

D. Calamus opacus.

E. Calamus Mannii

W. H. Fitch, del et lith.

Vincent Brooks Imp.

XVI. Iapyx, *a new Genus of Insects belonging to the Stirps* Thysanura, *in the Order* Neuroptera. *By* A. H. Haliday, *F.L.S.*

(Plate XLIV.)

Read January 21st, 1864.

THE genus *Campodea**, first characterized by Mr. Westwood (in the Transactions of the Entomological Society of London, vol. iii. pp. 231–234, and pl. 8. figs. 14–23), and subsequently designated by M. Gervais (Suites à Buffon, Insectes Aptères, tom. iii. p. 455) as a link between the rest of the *Thysanura* and the Neuroptera which acquire wings and have caudal filaments (the *Perlidæ* for instance), has been left in the family *Lepismidæ* in, I believe, all modern systems of entomology which take notice of the genus at all, notwithstanding that it cannot hold such a position except by virtue of a considerable modification of the characters usually employed to define that family. The abnormal character of the genus is indicated by the varying place assigned to it by the few authors who appear to have observed the insect previous to the present century,—Linnæus and, following him, Schrank having made of it a species of *Podura*, while Otho Müller has anticipated the conclusions of the moderns more accurately in referring it to the genus *Lepisma*. It may be, perhaps, no unfair inference to draw, that the insect in question is in some measure intermediate between both; and the recent discovery of an allied form induces me to propose the removal of the former, along with this, into a distinct family. The new insect referred to was first observed by me, under stones, in the neighbourhood of Lucca, when I was collecting the larvæ of *Embia* and *Termes*. Afterwards it occurred in other parts of Italy, and I communicated specimens to some of my entomological correspondents (under a name I have found cause to change here), supposing it to be entirely new, as it was so to them. Lately, however, in passing through Paris, having showed specimens to M. Lucas, he at once recognized it as an insect he had met with, years before, in Algeria. A drawing which he showed me left no doubt of the identity of the two. M. Lucas, however, had not thought fit to publish

* Campodea ambulans.

Pediculus terrestris, L. Fn. S. i. 1170.

Podura ambulans, L. Fn. S. ii. 1936 &c.; Schrank, Fn. B. iii. 184.

Lepisma minuta, Müller, Prodr. Zool. Dan.

Campodea staphylinus, Westwood, Trans. Ent. Soc. Lond. iii. 231–234; Gervais, Nicolet, &c.

? *Campodea succinea*, Nicolet, Ann. Soc. Ent. France, série ii. tom. v. p. 355.

Degeer first gave occasion to the oblivion into which the Linnean insect has fallen for so long, by misapplying the citation to his *Podura terrestris*, a *Lipura*. The description by Linnæus generally, above all "the caudal setæ half as long as the body," and the superior size of the insect negative this application, in which, however, as so often happens, Degeer has been followed implicitly by others. Schrank alone, so far as I know, has applied the synonym properly, and described the true Linnean insect. I have found it in Italy, up to the height of 7000 feet (top of Cimone), and perhaps higher still on the passes south of Monte Rosa.

it as a new genus, apprehending that it might prove to be the larval form of some undetermined insect. Although the first discovery of this interesting form—a link of some importance, perhaps, between certain families of Neuroptera—belongs to M. Lucas accordingly, that gentleman, with characteristic liberality, waived in my favour any claim he might have advanced to reserve the first publication of his discovery to himself, and furnished me with all the additional information he was in possession of as to its geographical diffusion. *Iapyx solifugus* has occurred at Paris, in the Garden of Plants; near Toulon; in Algeria; in various parts of Tuscany; in the neighbourhood of Naples, viz. at Sorrento, and within the precincts of the temples of Pæstum, the most southern point to which my search for it extended. In the Roman territory I found a couple of specimens at the base of the pile of stones which crowns the summit of Monte San Gennaro ("Lucretilis"), at an elevation considerably exceeding 5000 feet above the level of the sea. After this preliminary notice, I proceed to give the characters of the genus.

Class *Insecta*. Order *Neuroptera*. Stirps *Thysanura*.

Fam. LEPISMIDÆ (?).

Genus IAPYX*.

Antennæ in margine antico capitis approximatæ, multiarticulatæ, apice sensim attenuatæ. Maxilla integra, acuta, falcata, intus pectinata, laciniis 4 tenuibus, membranaceis, falcatis, acutis, intus subtiliter ciliatis. Palpi labiales brevissimi, biarticulati. Prothorax segmentis duobus sequentibus minor. Abdominis segmenta anteriora mutica; penultimum brevissimum, subtus incompletum; ultimum maximum, oblongo-quadratum, apice appendicibus duabus porrectis, mobilibus, corneis, subfalcatis, intus denticulatis, forcipem prehensorium fingentibus. Pedes distantes, tarso exarticulato, oblongo, unguiculis 2 paribus, falcatis, acutis.

Affinitas summa cum genere *Campodea* Westwoodii.

Discrimina utriusque in schemate sequente exhibita sunt.

Genus CAMPODEA, *Westwood*.	Genus IAPYX.
Antennæ filiformes.	Antennæ apice sensim attenuatæ.
Maxilla radiis 5.	Maxilla radiis 4.
Palpi labiales nulli.	Palpi labiales biarticulati.
Abdominis segmenta anteriora subtus utrinque appendiculata; extremum præcedentibus non majus, apice appendiculis 2 setaceis multiarticulatis flexilibus divaricatis, abdominis circiter longitudine.	Abdominis segmenta anteriora mutica; extremum maximum, apice appendiculis 2 exarticulatis, rigidis, falcatis, intus denticulatis, abdomine multo brevioribus, forcipem prehensorium fingentibus.

IAPYX SOLIFUGUS.

About 5 lines in length; ivory-white, semitransparent; the head, prothorax, and limbs paler; the terminal segments of the abdomen with the forceps chestnut; usually the dark contents of the ventricle produce the appearance of a broad longitudinal band down the back from the metathorax to the antepenultimate segment. The insect altogether

* Ἰάπυξ, poetical name for *Calabrian*; applied here in allusion to the posterior appendages; as if it were Iăpyx, derived from the obsolete pronoun ἳς for αὐτὸς, and πυγὴ, as ἰθαγενεῖς for αὐθιγενεῖς.

much resembles some pale larva of a *Forficula*, but is more slender and more lithe, nearly linear, depressed, broadest behind the middle of the abdomen. The porrected head is oblong-quadrate, with the angles rounded off, larger than the thoracic segments singly; no vestige of eyes: the antennæ inserted close to the anterior margin or epistoma, approximate; longer than the head and thorax, gradually tapering to the end; of more than thirty joints; the first two more distinct, but scarcely longer than the rest, which are thickly pubescent, and verticillate with long hairs about the middle; the joints near the middle of the antennæ usually transverse, the preceding ones turbiniform. The mouth is situated in the anterior half of the head, on the under side, only the tips of the palpi (and of the maxillæ when these are opened) projecting a very little beyond the rounded entire margin of the epistoma. The parts of the mouth are formed nearly on the same type as in *Campodea*; the labrum transversely semielliptic, entire, membranaceous; the mandibles membranaceous, except at the tip, oblong, the tip slightly incurved and obliquely truncated, the truncature armed with four teeth. Maxillæ broad at the base, much attenuated beyond the middle, falcate, acute; the inner edge armed with four very slender, acute, falcated, membranaceous rays, which are very minutely ciliated along the concave edge. The labium, at the base connate with the maxillæ, is broad, and ends in four short lobes; the exterior ones, or paraglossæ, somewhat horny along the back, with the apex attenuate obtuse, and the inner margin sinuated; the intermediate lobes are again subdivided by a slight incision, each into two rounded divisions; a very slender membranous style, crowned with two hairs, sometimes projects between them,—the analogue probably of the hypopharynx.

The palpus, inserted at the back of the exterior lobe, and scarcely extending beyond the extremity of this, is two-jointed; the joints nearly equal in length, the second somewhat conical.

The prothorax is transverse, narrower than the head or the succeeding thoracic segments, and much shorter; these two are quadrate-orbicular, larger than the anterior abdominal segments, having below a broad pentagonal sternum. The legs are distant, with coxa, trochanter, femur, tibia, and tarsus distinct; the femur about as long as the tibia, but stouter; the latter unarmed at the tip; the tarsus shorter than it, oblong, bearing at the end two equal, falcate, acute unguiculi, much shorter than the tarsus; no distinct arolium. The fore pair of legs are the shortest, and arise close to the hind angles of the head; the hind pair the longest, yet not extending back beyond the middle of the abdomen. The abdomen is composed of ten segments (if we reckon the segment succeeding the metathorax, and complete with a ventral half-ring, the propodium, as belonging to the abdomen); it is broadest behind the middle, and the segments are of nearly equal length, except the last two; the penultimate one very short (often retracted entirely in dried specimens), and widely interrupted beneath, no ventral half-ring being visible, but only the inflected margins of the dorsal portion appearing as a lateral triangle; the last segment is much the largest, oblong-quadrate, almost truncated behind, but advancing a little in the middle in a very obtuse angle, which is notched on the upper side but entire below. The forceps, nearly as long as this segment, is composed of two equal arms, broad at the base, so as nearly to occupy, with their insertion, the entire breadth of the segment, a very small interval only remaining between them. On the inner side, before the middle, they are armed with a few teeth, and thenceforth finely serrated—the attenuated and incurved tips crossing each other when the forceps is closed. The forceps, as well as the segment which bears it, is horny and rigid. The head, body, forceps, and limbs bear fine scattered hairs of different lengths, which appear simple under a lens. There is no trace apparent, on the under side of the abdomen, of such appendages as the genuine *Lepismidæ* in general possess, and which are not entirely obsolete in *Campodea*.

In younger individuals the antennæ are shorter and have fewer joints, and the forceps is proportionally smaller. Otherwise they resemble the adult insect. Even one which I found, not larger than a *Lipura fimetaria*, presented all the external characters of its kind. But it is very rare to find them less than two lines in length. The body being of much firmer consistence than that of *Campodea*, they burrow in the ground, or insinuate themselves into chinks even of solid ground, with extreme agility; and once out of sight, it is nearly hopeless to recover them by turning up the soil. They inhabit much the same localities as *Campodea*, under fallen leaves, or stones, or at the roots of trees, but are not quite so dependent on the degree of moisture. I presume their nutriment to be decaying vegetable matter or minute cryptogams; but from their aversion to light it was almost impossible to see the manner of their proceedings, although I kept a number of them alive for weeks together. I have observed the use they make of the forceps, just like *Forficulæ*, and the tactory function of the short labial palpi.

With regard to the internal structure, the softness of the parts opposes nearly the same difficulties as in the case of the *Poduridæ*, and my discoveries among them have been very little. The chief tract of the intestinal canal is occupied by a straight roomy cylindrical ventricle, without distinct proventriculus (or gizzard, as in the genuine *Lepismidæ*), or any Malpighian vessels; the œsophagus is much attenuated for some distance before its insertion into the ventricle; the small intestine is comparatively short, and is concealed by a conglomerate mass of acini, which, dividing into two arms, envelopes a number of moniliform ovithecæ of few (about five) cells, terminated by a short filament, which are implanted in the lower part of the two slender, somewhat varicose, deferent vessels, nearly as long as the ventricle, and lying at each side of it, and which end in a sort of small follicle, scarcely wider than the greatest diameter of the deferent, from which it is divided by a stricture. I have not found in any individual examined a distinction of the other sex. From this description it will be perceived that the intestinal characters agree with those of *Campodea* as closely as the structure of the oral organs and the external form in general, with the striking exception of the forceps so exactly resembling the analogous organ in the stirps *Labidura* that it is difficult not to recognize in it an indication of natural affinity, which would considerably dislocate the usual arrangement of the groups of Neuroptera with non-quiescent pupa—the Orthoptera of authors. Yet the essential characters of the *Labidura* are in many respects so remote from those of the genus *Iapyx*, that I should deliberate long before attributing to that similarity more than a secondary significance. On the other hand, with the reservation of the few differences scheduled in the comparative diagnosis of *Iapyx* and *Campodea*, these two genera, as I have said, agree so essentially in general form, and structure of oral and intestinal organs, that it seems inevitable they should be referred to one family; while *Iapyx*, at least, differs so much in nearly every one of these particulars from the typical *Lepismidæ*, that the constitution of a distinct family to receive these two genera suggests itself as a ready alternative. It remains to be inquired whether there be not some such intermediate links extant as may efface the discrepancy apparent at first sight, and forbid the division. If anywhere, such a link is to be looked for in the genus *Nicoletia* of Gervais*, as to which, unfortunately, our information remains absolutely *nil* as regards intestinal structure. The *galeate* maxillæ, well-developed palpi, and triplicate appendages of the caudal extremity vindicate for this insect a place in the family *Lepismidæ*, notwithstanding that in its general appearance—bleached and scaleless—it so much resembles *Campodea*. The pectinate inner lobe of the maxilla of *Nicoletia* and the ventral appendages of *Campodea* seem to bring them somewhat closer; and the different number of the caudal filaments may perhaps not deserve so much weight as has been commonly attributed to that character within the limits of this stirps, when we remember how the number varies between two and three among the *Ephemeridæ*, a group not very distant, perhaps, from the *Thysanura*. The differences, therefore, which incline me to propose the introduction of a new family, intermediate in position between the *Lepismidæ* and *Poduridæ*, are so much more pronounced in *Iapyx*, that I must consider it as the type, and instead of deriving the family name from the genus longest known, *Campodea*, I propose to take it from the typical one, *Iapyx*. Accordingly the family

IAPYGIDÆ,

in the stirps *Thysanura*, is distinguished from the two other families between which I have placed it by the characters exhibited, antithetically, in the columns of the Table following:—

Fam. LEPISMIDÆ.	Fam. IAPYGIDÆ.	Fam. PODURIDÆ.
Antennæ multiarticulatæ.	Antennæ multiarticulatæ.	Antennæ pauciarticulatæ; vel paucis tantum, versus basin, discretis; extremis coarctatis.
Maxilla biloba, mala exteriore subarticulata, galeiformi.	Maxilla integra, falcata, acuta, intus pectinata.	Maxilla oblonga, apice fissa et denticulata.
Palpi quatuor; maxillares maxilla longiores.	Palpi brevissimi; alteruter, aut uterque, obsoletus.	Palpi (exarticulati; vel potius) obsoleti.
Prothorax magnus.	Prothorax minimus.	Prothorax minimus.
Tarsus pluriarticulatus.	Tarsus exarticulatus, oblongus.	Tarsus brevissimus, aut cum tibia connatus.
Unguiculi bini pares.	Unguiculi bini pares.	Unguiculus unicus (vel bini impares).

* Nicoletia terrestris, L.

Lepisma terrestris, L. Fn. S. ii. 1926; S. N. xii. ii. 1012.

Nicoletia geophila, Gervais, Ann. Soc. Ent. Fr. 1re série, tome xi. p. 48, &c.

? —— *phytophila*, ibid.

Fam. Lepismidæ.	Fam. Iapygidæ.	Fam. Poduridæ.
Abdomen segmentis 10 (computato propodio).	Abdomen segmentis 10 (computato propodio).	Abdomen segmentis ad summum septem; propodii tubo infero medio exserto.
Segmenta anteriora abdominis utrinque appendiculata (nonnulla saltem).	(Segmenta abdominis anteriora appendiculata vel mutica.)	Segmenta abdominis anteriora (propodio dempto) mutica.
Segmentum extremum appendicibus porrectis pluriarticulatis, ternis (vel pluribus numero impari).	Segmentum extremum appendicibus porrectis binis tantum (diversimodo formatis).	Segmentum extremum appendice inflexa laciniis binis setaceis terminata (*furca saltatoria*); vel his brevissimis conicis retrorsum versis.
Vasa Malpighiana 4.	Vasa Malpighiana nulla.	Vasa Malpighiana nulla*.
Proventriculus triturationi aptus.	Proventriculus obsoletus.	Proventriculus obsoletus.

DESCRIPTION OF THE PLATE.

Plate XLIV.

Iapyx solifugus.

A. Natural length of a mature specimen.
B. Magnified figure of one, from above.
C. Last three segments, from beneath.
D. One arm of forceps.
E. Anterior outline of head from beneath, with the palpi (labial) in position.
F. First joint of both antennæ with their insertion.
G. Base of antennæ, first five joints.
H. An intermediate joint.
I. Terminal three joints.
K. Three intermediate joints, from a young specimen.
L. Fore leg.
M. Under side of mesothorax (sternum, *k*), with one leg complete.
N. Middle leg.
O. A claw.
1. The mouth, from beneath, with the maxillæ open.
2. Anterior portion of labium, more magnified: *p*, palpus; *q*, exterior lobe, or paraglossa; *m*, *n*, divisions of one of the intermediate lobes; *t*, hypopharynx?
3. Paraglossa, and an intermediate lobe, alone.
4. The same, with palpus in position.
5, 6, 7. Mandible, seen in different aspects.

* Six, according to Burmeister and Nicolet; but I have failed to find them. Still I should have followed their authority here without doubting, but that Mr. Lubbock's minute and careful investigations have not succeeded in bringing these organs to light (see Trans. Linn. Soc. vol. xxiii. p. 441).

8. Extremity of same, four-toothed.

9, 10. Maxillæ.

11. Intestinal canal and reproductive system of female: *a*, head; *b*, œsophagus; *c*, attenuated portion of same; *d*, ventricle; *e*, follicle and deferent; *f*, cluster of egg-sheaths enveloped in a granular mass.

12. Follicle and deferent, with the insertion of an egg-sheath in the lower part of the latter.

13. Fragments of ovithecæ.

14. Fragment of an organ connected with ovaries.

15. Two intermediate ganglia of the rachidian chain; with the internode, a double chord, longer than a ganglion.

Campodea ambulans, L.

A. Intestinal canal.

B. Follicle and deferent.

The following are rough copies of Mr. Westwood's figures:—

1. Labrum.

2. Mandible.

3, 4. Maxillæ.

5. Paraglossa (probably).

6. Terminal joints of antenna.

7. Tarsus with unguiculi.

Iapyx solifugus.

Campodea ambulans, L.

G. Jarman sc.

XVII. *Description of a new Species of* Annelide *belonging to the Family* Amphinomidæ.

By W. Baird, *M.D., F.L.S.*

(Plate XLV.)

Read January 21st, 1864.

Amphinome didymobranchiata.

Char. *A.* caruncula grossa, lobata, rubra; setis pedum numerosissimis, longissimis, albis; branchiis in fasciculis duobus, arbusculiformibus, rubris.

The genus *Amphinome*, first established by Bruguière, and afterwards more strictly defined by Blainville, contains some elegant and curious species of worms. The number now known and described is considerable, but none have as yet been discovered natives of the British seas. They are chiefly found in hot climates, and many of them are adorned with brilliant colours. The species which I have now to describe is, however, perhaps the most beautiful of all. In length it is about 5 or 6 inches, and, including the setæ on the feet, fully $1\frac{1}{2}$ inch in breadth. The dorsal surface of the body in some specimens is of a light olive-green, in others a light greenish brown; the ventral surface is of a light yellow colour, the caruncle and branchiæ of a bright carmine, and the long setæ of the feet pure white. It is somewhat narrower at the anterior, and considerably so at the posterior extremity. The number of segments into which the body is divided is about eighty-four; the first four or five are very small, and the last eight or ten equally so. The surface of the back is irregularly striated across, and marked with numerous flat granulations. The segments of the body are rather narrow and separated from each other by a fine, nearly black line. The proboscis (Pl. XLV. fig. 2 *a*, fig. 3) when protruded is very large, terminating in a circular thick fleshy pad, the surface of which is sculptured with circular waved grooved lines. The antennæ are all short, but the median is longer than the others; they are smooth, not articulated, and of a white colour. The eyes are very distinct; two pairs; the anterior larger than the posterior. The caruncle (fig. 1 *a*, fig. 4) is large and fleshy, covering nearly five of the first segments; it is composed of a number of small lobes, and is of a fine carmine hue. The branchiæ (fig. 1 *b*, fig. 5) exist on all the feet, small on the anterior segments, but becoming gradually larger as they descend, and at about the third part of the length of the body, and from that to the posterior extremity, are of a moderate size. They consist of two separate branches (fig. 5 *a*, *b*), not arising from the same stem, but at a short distance from each other—a disposition of these organs which none of the described species exhibit, and which might almost be sufficient to constitute a subgenus. They differ in size, the one nearest the base of the foot (fig. 5 *a*) being only half the size of the other; but both are arbuscular in form, and are composed of three branches, each branch consisting of several twigs, and each twig being divided into two or three branchlets.

They are all of a brilliant carmine-red colour, which, however, fades much by keeping in spirits. The setæ on the feet are in two separate tufts. The dorsal tuft (fig. 1 *c*) issues from a stout peduncle, the edge of which is tinged with the same colour as the branchiæ, to which it is attached. These setæ are extremely numerous, of very considerable length, of a pure white colour, and are straight, sharp-pointed, and slightly serrate on the outer edge (fig. 6). The ventral tuft (fig. 2 *b*) consists also of very numerous white setæ, of considerable length, but of a somewhat different structure. Each seta is stouter than those of the dorsal tuft, rather blunt and slightly curved at the extremity, and is slightly toothed or bluntly serrate near the point, and exhibiting at a short distance from the extremity a small projection or tooth (fig. 7). These setæ, especially those of the dorsal tuft, are so numerous and fine that, along with their pure white colour, they resemble tufts of fine cotton-wool. It is difficult, however, to keep them from falling off; and the specimens now preserved in spirits do not show half the beauty they had when fresh. The cirri (fig. 5 *c*) are rather slender, and slightly tinged with carmine near the free extremity; they are considerably shorter than the setæ, which completely envelope them and conceal them from view, unless pulled aside.

The specimens of this worm now in the British Museum were brought by Mr. Watson from the Island of Ascension, where they are collected by the boatmen and sold as curiosities. They pretend that they are of a venomous nature, and are able to inflict serious wounds upon those who incautiously handle them. This idea no doubt takes its origin from the numerous setæ with which their feet are clothed, but which, though (to judge from their appearance, as shown figs. 6 & 7) in reality powerful weapons for offence and defence against those animals which prey upon or are fitted for food for these, are in fact powerless for harm to human beings.

A similar-looking and brilliant-coloured species was taken by Bory St. Vincent amongst the rocks and lava off the coast of Metana in the Morea; and it is curious that this bright-hued species should be taken also on the coast of a volcanic island.

DESCRIPTION OF THE PLATE.

Plate XLV.

Fig. 1. *Amphinome didymobranchiata*, dorsal aspect, natural size (in spirits, and rather contracted): *a*, caruncle; *b*, *b*, *b*, branchiæ; *c*, dorsal tuft of setæ.

Fig. 2. Ventral aspect of animal, natural size: *a*, proboscis extruded; *b*, ventral tuft of setæ.

Fig. 3. Extremity or fleshy pad of proboscis, slightly enlarged.

Fig. 4. Caruncle, with five or six anterior segments of body ($1\frac{1}{2}$-inch power).

Fig. 5. Branchiæ, magnified: *a*, smaller branch; *b*, larger branch; *c*, cirrus.

Fig. 6. Seta of dorsal tuft ($\frac{4}{10}$ths power).

Fig. 7. Seta of ventral tuft ($\frac{4}{10}$ths power).

Amphinome didymobranchiata

XVIII. *On a new Genus of* Teredininæ. *By* E. PERCEVAL WRIGHT, *M.D., F.R.C.S.I., F.L.S., Lecturer on Zoology, Dublin University.*

(Plate XLVI.)

Read January 21st, 1864.

IN the year 1858 I had the pleasure of examining a very interesting collection of both vertebrate and invertebrate animals made by my friend A. A. Dunlop, Esq., in the Bengal Presidency. The collection chiefly consisted of insects and birds; but there were many specimens also of reptiles, and a few of Planaria and mollusks. Among the Planaria I may mention a species of *Bipalium**, a genus established by Stimpson the preceding year, in ignorance of which I described it in 1860 under the name of *Dunlopea*†. A large species of a Teredine likewise attracted my attention, and Mr. Dunlop kindly presented me with the only two specimens he possessed. After a close examination I came to the conclusion that the species was then undescribed, and belonged probably to the section of the family *Teredininæ* with compound siphonal pallets. The peculiarities, however, presented by this species are such as to preclude my referring it to the genus *Xylotrya* of Leach. I have therefore been obliged to make a new genus for it, which I rather regret, as I have been unable to examine fresh specimens of the animal, and the spirit specimens were too much injured for me to pay any very particular attention to their anatomy.

The most interesting fact, however, in connexion with this Teredine is its habitat, the following particulars of which will, I believe, abundantly prove it to be a freshwater species of Shipworm.

The district in which it was found is the indigo country below Fureedpore, which is watered by the Comer. The river Comer is a branch of the Hurreegonga, which is itself a branch of that portion of the Ganges which flows past the towns of Rampore and Pubna. For my purpose, however, the rivers Hurreegonga and Comer may be fairly considered as one stream, flowing from the Ganges and, after fertilizing a large tract of indigo country, flowing into it again, much lower down (eighty miles) than its origin, about the village of Mandarapore.

In the summer, owing to the great silting up of the banks of the Ganges at the place where the Hurreegonga takes its rise, but little water flows into the Ganges from this river.

The water from the Ganges for about thirty miles below Mandarapore (as far as Burreesaul) is considered perfectly fresh; at this distance down the river the water is at full

* *Vide* Prodromus descriptionis animalium evertebratorum quæ in Expeditione ad oceanum Pacificum Septentrionalem a Republica Fœderata missa T. Rogers duce, observavit et descripsit W. Stimpson, 1857.

† Proceedings of the Dublin University Zoological and Botanical Association, vol. ii. pt. 1. p. 47.

tide very slightly brackish; but one must go many miles further down ere meeting with the sea, the distance from which to Mandarapore is more than seventy miles. The influence of the tide, forcing back to some extent the current of the Ganges, is felt, it is true, even higher up, especially during the rainy season, when the river is swollen, but in the summer it is by no means so perceptible.

The water of the river Comer is not only considered perfectly fresh, and as such used for drinking, but it is also a soft water, and used very extensively for washing and all other household purposes. On a bend of this river Mr. Dunlop had a small boat-house, and in the proximity of this house several trees had been cut down, one or two of which falling into the river were allowed to stay there, and some time afterwards Mr. Dunlop perceived that portions of these trees which lay exposed during a very dry summer were perforated by some animals. He at once had the portion that was still under water examined, and succeeded in extracting two nearly perfect specimens of a Teredo-like mollusk. The specimens now in my possession were removed by Mr. Dunlop himself, the trees were still almost *in situ*, and the water of the river fresh; so I think there can be no reasonable doubt that these shipworms were veritable inhabitants of fresh water. It appears that they are well known to the Hindoo fishermen, who meet with them even higher up the Ganges. The plan they adopt to destroy them when they attack their boats is to suspend the boat infested across two upright poles and to light a fire beneath it, which in a short time destroys all the mollusks, and by slightly charring the timber hinders for some time a second attack.

I cannot find any previous record of a freshwater Teredine. The *Teredo Senegalensis* of Blainville is not, so far as I can see, any exception to the general rule of their being inhabitants of salt water. The species described in this paper, however, is referred to by Mr. Jeffreys in the 'Report of the British Association for 1860'*.

Genus NAUSITORA, nov. gen.

Testa globosa, regularis, e valvis duabus æqualibus, curvatissimis, bilobatis, quarum facies externæ striatæ. Sine cardine vero. Ligamentum rudimentale. Valvarum pars interior processu lato curvato et insuper lamella accessoria lata instructa.

Animal vermiforme. Pallium tubulatum. Siphones longissimi, ad finem bifurcati; quorum foramina fimbriata. Palata siphonalia longa; interior corporis facies plana, exterior convexa; stipes longus, curvatus, acutus.

Hab. Flum. Comer, prov. Bengal.

Mus. Brit. et Coll. Sanctæ et Individ. Trinitatis, juxta Dublin.

Shell globular, regular, composed of two equal, much curved, bilobed valves, their outer surfaces striated. No true hinge. Ligament rudimentary. Interior of valves furnished with a broad curved process and also with a broad accessory plate.

Animal vermiform. Mantle tubular. Siphons very long, bifurcated at their extremities; orifices fringed. Siphonal pallets long; inner surface of body flat, outer convex; stalk long, curved, and pointed.

* Report of the Oxford Meeting. Transactions of the Sections, p. 117.

NAUSITORA DUNLOPEI, nov. spec.

On examining the external portion of either of the valves, we find it to be divided into two well-marked portions: the first of these, which would correspond to the "triangular area or anterior commencement" of Forbes and Hanley in *Teredo*, is here quadrilateral; and the second, the body or "central unguiform portion" of the same authors, is rudely pentagonal. I believe that one of the characteristic marks of *Nausitora* will be found to be the absence of the third portion present in all the species which I have examined of *Teredo* or *Xylotrya—i. e.* the auricle.

The "quadrilateral" area is deeply ribbed, and these ribs are notched at minute intervals, giving to them a moniliform appearance: the lower side is somewhat oblique, and displays a slight convexity; the upper edge is irregular; the free edge is somewhat in the form of a semicircle, for the attachment of a false ligament; the fourth side is attached to the body, but distinctly marked out from it by a sharply defined suture. The body forms a rude pentagon, the base of which is continuous with the upper edge of the quadrilateral portion: one side joins on to the same area; the corresponding edge on the other side is free; and the two remaining sides are prolonged to form the unguiform portion or beak. The body is ribbed very much in the same manner as the quadrilateral area, and these ribs run at right angles to those on this latter part; they cover two-thirds of the surface of the body; on the other third they are lost, first becoming slightly curved. The texture is firm and solid, and the greater part of the surface is covered with an olivaceous epidermis.

Internally, the ventral callosity is well marked, being of a broad triangular form. The callosity of the hinge-margin is largely developed, and has a small spur-like process attached to it. The subumbonal blade is directed inwards and then slightly outwards; its outer edge is smooth, its inner irregular; it is broad and glistening. A little below its insertion there is a broad, coarsely striated, glistening lamina of shell, which extends across from the inner surface of the quadrilateral portion to within a short distance of the beak.

The dimensions of the larger specimens are—length, from extremity of beak to base of body, measured along the valve, 1 inch; breadth, in broadest part, $\frac{7}{8}$ inch.

The pallets are $\frac{7}{8}$ inch long, of which the stalk measures $\frac{5}{16}$ inch. The body is broad, slightly concave on its inner surface, which in one specimen is worn somewhat flat; the outer surface is convex and roughly imbricated. A peculiar core-like body is seen running through the expanded portion underneath the thick scale-like striæ. The stalk is cylindrical, curved, and tapers to a fine sharp point; there is a slight muscular scar around the junction of the body with the stalk.

One pair of valves of the smaller specimen (which wanted its pallets), and one pallet from the larger specimen, I have presented to Dr. J. E. Gray for the collection of the British Museum; the remaining pallet, still attached, and the larger pair of valves have been presented to the Zoological Museum of the University of Dublin.

Some short time since, I had opportunities of examining the majority of the recorded species of Teredines, of which Dr. J. E. Gray and Mr. J. G. Jeffreys have published very valuable lists in the 'Annals of Natural History'*, and with none of these, I venture to think, can the species above described be confounded. Some may think it unnecessary to constitute even a new subgenus for its reception; but, until the whole of the Teredines are more thoroughly investigated, it appears to me very difficult to know what characters to seize upon as of generic importance. In the meanwhile I trust this brief description may not be without interest.

DESCRIPTION OF THE PLATE.

Plate XLVI.

Fig. 1. *Nausitora Dunlopei*, natural size; from a specimen preserved for many years in spirits.

Fig. 2. The extremities of the siphonal tubes and the pallets, enlarged.

Fig. 3. One of the pallets, enlarged, showing the core-like body and the rough, imbricated, scale-like structure.

Fig. 4. Pallet, natural size, viewed from the outer surface.

Fig. 5. Ditto, inner surface.

Fig. 6. The valves in apposition, front view.

Fig. 7. Inner surface of right valve.

Fig. 8. Outer surface of ditto.

Fig. 9. The valves in apposition, back view.

Fig. 10. Portion of right valve, enlarged, showing the head-like markings.

Fig. 11. View of right valve (enlarged twice and a half), showing the accessory nacreous plate, the "body," and the "triangular area."

Fig. 12. Ditto, seen obliquely (enlarged twice), showing the elongated curved process from the umbonal cavity.

* Dr. J. E. Gray in Annals of Nat. Hist. 1851, vol. viii. p. 380. Mr. J. G. Jeffreys in Annals for August 1860. *Vide* also a paper by Dr. Gray in the Philosophical Magazine, vol. ii. 1827, p. 409.

W.H.Bailey del.

G.Jarman sc.

XIX. *Notes on some points in the Anatomy of* Rotatoria.

By WALTER MOXON, *Esq., M.B., F.L.S.*

(Plate XLVII.)

Read February 4th, 1864.

THE object of this paper is to point out some important particulars in the structure of certain *Rotatoria*, which I hope will serve to supply certain deficiencies in the general and special anatomy of this interesting group of animals.

In reading monographs on Rotifera, I have remarked an uncertainty in the determination of the corresponding aspects of different forms: the terms *dorsal* and *ventral* are often used in describing their anatomy, but authors not uncommonly represent structures really dorsal as placed on the side, or even, in comparing genera, make the ventral side of one genus correspond to what is truly the dorsal side of another; yet the characters of the dorsal and ventral sides of Rotatoria are constant, and may be recognized without much difficulty.

In every Rotifer there is a median plane, on either side of which the lever- and muscle-systems are symmetrically developed; the lines wherein this imaginary plane cuts the integuments above and below are respectively the *dorsal* and *ventral* median lines: we require to know which of these lines is dorsal and which ventral.

Many actively moving genera have firm tunics, one side of which differs in an obvious way from the other; on the other hand, some roving, and all stationary genera are in transverse outline more or less rounded. In those roving genera which have one side arched and the other flat, it has long been well known that the intestine runs down on that side of the ovary which is towards the arched side of the body: the mouth in these Rotifers is always in that side of the cephalic disk which is towards the flat side of the body: the eye or eyes are always on that side of the alimentary tube which is towards the arched side: in the middle line of the same side is an organ which may be generally described as a small round space bearing motionless hairs or setæ; this organ may be sessile or it may be stalked, but it is constantly in one relative position; and that is, on the same side of the œsophagus as the eye, and just on the anterior end of the body when the head is retracted: lastly, the cloaca—the common outlet of the intestine, ovary, and so-called water-vascular system—opens in the middle line on the arched side of the creature's body.

Thus in these Rotatoria there are, as distinguishing characters of the arched side, 1st, the course of the intestine towards it; 2nd, the position of the eyes on that side of the œsophagus; 3rd, the position of the median feeler (setæ-bearing spot) on that side; 4th, the opening of the cloaca upon that side; 5th, the mouth turned away from it; 6th, further, it is to be noticed that the animal, in moving over surfaces, keeps the arched side upwards.

These characters, but especially the second and fifth, serve to show that the rounded or arched side of the creature's body is dorsal, the flattened side accordingly being ventral; for in no creature are the eyes on the ventral side of the alimentary tube, nor is the mouth in any turned to the dorsal side of the body.

In those Rotifers whose dorsal side does not differ in contour from the ventral, the corresponding side is nevertheless shown by the above-enumerated characters, which will always serve to determine the dorsal side of a Rotifer.

Some Rotatoria lose part of these characters in adult life; for the eyes disappear in the stationary genera, and the mouth, in *Floscularia* and *Stephanoceros*, opens out as a great bell-shaped cavity, whose wide orifice is but slightly if at all turned to the ventral side; yet these Rotifers whilst young and in the freely moving state have the eyes, mouth, and dorsal feeler in their normal relation to each other. Under any circumstances the dorsal side may be determined by the opening of the cloaca there, or by the position of the median feeler always on the dorsal middle line.

This median feeler has up to the present time been overlooked in many genera; it has never yet been described in *Melicerta*, *Floscularia*, *Metopidia*, *Limnias*, or *Pterodina*. In these I am able to affirm its presence. Its existence has been already pointed out by others in *Rotifer*, *Salpina*, *Euchlanis*, *Hydatina*, and *Philodina*; but its constant position on the dorsal median line has, I believe, never been remarked.

But this dorsal feeler must be carefully distinguished from the lateral feelers of stationary Rotatoria, which are conspicuous in *Melicerta*, and have been known as long as that Rotifer itself. Lateral feelers are present also both in *Limnias* and *Floscularia*; and it is highly probable that they exist in all the stationary genera, though I have not as yet had an opportunity of observing other kinds than those named.

These lateral feelers are symmetrically placed on the sides of the creature's body, towards the ventral aspect, and close to the part which forms the upper end when the lobes are retracted. In *Melicerta* (Pl. XLVII. fig. 2) they are raised on stalks, and their anatomy has been well described by Professor Williamson and other observers. In *Limnias* (fig. 3) they have the same structure, but are placed on slight conical elevations, and so likewise in *Floscularia* (fig. 1); but in the last-named genus the organ is smaller in proportion to the bulk of the animal than in either of the other instances, and offers the additional peculiarity of having its setæ curved in the direction of the tail.

The setæ of the dorsal feeler are shorter and less conspicuous than those of the lateral, whilst the circular space on which they are set is larger in the dorsal. The three feelers of *Floscularia* have hitherto been entirely overlooked, as have those of *Limnias*.

In *Philodina* (fig. 4) and *Rotifer* the dorsal feeler is raised on a stalk, and much resembles a lateral feeler of *Melicerta*; but the true dorsal feeler of *Melicerta* (fig. 2), which has hitherto wholly escaped observation, is sessile on the back of the head, behind and between the eyes in the young, and on the same side of the body as the cloacal opening. It corresponds to the pedunculated dorsal feeler of *Philodina* in every particular of these relations, which fully suffice to establish a true homology between the two organs.

Hence, to properly compare these Rotifers, as done in a recent monograph, it will be necessary to place them so that their pedunculated feelers point in opposite directions; any ganglion in the oral side of the neck of *Melicerta* will be on the side opposite that wherein the ganglion of *Philodina* is seated, whilst the cloacæ will open on corresponding sides.

The structure and disposition of the alimentary canal in Rotatoria have already been the subject of much attentive observation, and little can remain for further discovery, though a comparative examination of the gizzard-teeth of all the genera would produce interesting results. The approaches to the gizzard are more elaborate in the stationary genera, and reach their highest complexity in *Floscularia* (fig. 1). In this creature the part of the alimentary canal above the gizzard is divided by a highly irritable cilium-clothed sphincter of irregular outline (fig. 1 *c*) into two portions, one of which is the great bell-shaped orifice with its five-lobed seta-bearing rim, and the other a cavity whose walls are powerfully contractile. To this second or pharyngeal cavity immediately succeeds the true gizzard, containing the crushing-machine (fig. 1 *e*). The cavity of the gizzard in *Floscularia* is much more capacious than in any other Rotifer; and this becomes especially striking through the smallness of the dental apparatus, which is composed of small two-toothed nippers at the bottom of the cavity and towards the dorsal side. The prey, instead of being drifted down the throat by a cilium-current, is swallowed by a true act of deglutition; food is brought into the oral cup by that vortex which is created by the quick cilia that cover the faucial sphincter; after a few revolutions within the mouth it is presently passed into the pharyngeal cavity, the faucial sphincter closing behind and preventing return, whilst a sudden and almost convulsive contraction of the walls of the pharyngeal cavity forces the morsel into the gizzard or crop, through the narrow fissure-like opening which leads into it. It should here be remarked that with the edges of this opening a thin-walled, flattened, cilium-lined tube (fig. 1 *d*) is continuous, and depends freely in the cavity of the gizzard; the movement of the cilia within this freely suspended tube causes it to wave about in the gizzard, in the same way as the œsophagus of *Metopidia* is kept in constant agitation by its lining cilia. When the prey reaches the crop it is still alive, and often remains so for many minutes, making meanwhile violent efforts to escape, which would be likely to prove successful if it were not for the flattened tubular valve; this, whilst allowing, and aiding with its cilia, the entrance of prey forced in by the pharynx, is admirably suited to prevent any from finding or forcing its way back again: as it is only in *Floscularia* that prey is detained in the crop, so only in *Floscularia* is the tube valve required or developed.

This tube valve has often been seen by describers, but its nature has been entirely mistaken; it has been viewed as a "slit-like opening fringed with vibratile cilia"*, as "many plates or filaments"†, as two delicate membranes‡, and as a stream of water trickling into the gizzard. To inspect it a three-parts-grown specimen should be chosen, whose anatomy will not be obscured with those refracting grains which are developed in adults. If the tube be watched by daylight with a good microscope, its true nature will

* Dobie, Ann. Nat. Hist. 1849, No. 22, vol. iv.

† Dujardin, Hist. Nat. des Zoophytes, p. 611.

‡ Huxley, Trans. of Micr. Soc., new series, vol. i., 1853.

be made out; if such a specimen be gently compressed, so as to impede the wavy movement of the tube, the observation will be more certain; but absolute demonstration must depend on the occurrence of such an act as I have witnessed in three instances, in which the creature, by a quick convulsive effort, turned its anterior third inside out, everting the whole of the approaches to the gizzard, and then expelled the contents of the gizzard through the everted tube (fig. 1^a *d*). The whole proceeding looks much like self-destruction, but the animal in all the cases slowly withdrew the everted parts and reassumed its proper shape. Whilst the tube is everted and the ciliated inner side of it has become external, the cilia can be very plainly seen vibrating on its then exterior surface (fig. 1^a *d*). I have thus fully described this structure, as I believe the employment of a long, lax, ciliated tube as an intestinal valve is not on record. A more effective contrivance, and one more admirably suited to the wants of the creature, it would be hard to devise.

The construction and disposition of that portion of the alimentary system which is below the gizzard is very constant in all Rotatoria. It has already been well described. It is lined throughout with cilia, which, however, are far from constant in their activity. It is divided into two parts by a sphincter: of these the upper and larger, called stomach, is provided with two follicles, one on each side, which open into the upper part of it; the lower and smaller part of it, called intestine, opens either into the contractile vesicle, or into the cloaca, in common with that and the ovarian duct. In *Euchlanis dilatata*, where the observation is best made whilst the creature is turned upon its side, there is in the cloaca a sphincter, just below the region where these tubes open into it (fig. 7 *v*). I have seen this sphincter do the following service:—the intestine contained much fæcal matter, and its cilia were motionless, the sphincter of the cloaca closed, and then, by the systole of the contractile vesicle (fig. 7 *h*), the contents of the latter were thrown up into the intestine (fig. 7 *g*); the liquid could be seen to spread up between the mass of contents and the intestinal wall, waking the cilia into action: this act was repeated several times, and was soon followed by the extrusion of the fæcal matter. Whether the fluid was thrown up to wash out the remains of nutriment from the refuse of the food, or whether it was a natural enema, to ease the excretion off the sides of the bowel, I cannot say; but, believing the water-system to be excretory, I think the latter the most probable reason.

The so-called water-vascular system is one of the most striking and interesting features in the anatomy of the Rotatoria; yet, at the present time, it is the subject of what I cannot help calling a remarkable error regarding its ciliated appendages.

Its presence has been uniformly denied by all describers to the genera *Limnias* and *Floscularia*.

In both these I have had no difficulty in recognizing and carefully examining this system. In *Limnias* it offers nothing worthy of especial notice (fig. 3 *k*): but in *Floscularia* the tubes and ciliated funnels of the water-vascular system are very small in diameter when compared with the bulk of the creature's body; they are strictly symmetrical, and start below from a globular vesicle (fig. 1 *h*), which I could never see contract, though I have watched it for hours; this vesicle opens by a round orifice, situate in the dorsal middle line, at a little distance from the caudal end of the body;

the lips of the aperture may be commonly seen partially closing and opening. Starting, as stated, from this vesicle, the tubes (fig. 1 *i*), as usual, seek the mid-lateral region and approach the surface, where they acquire some fat-granules in their parietes; here the first cilium-funnel is situate (fig. 1 *k*): if the side of the *Floscularia* be towards the observer this will not be visible, as I shall presently explain. The tube continues to ascend in the side, as high as the neck, where there is another funnel (fig. 1 k'), situate just behind and below the lateral feeler; it then passes, still ascending, to the back of the neck, and crossing the middle line anastomoses with its fellow just behind the faucial sphincter; above the tube, near the middle line, and below and outside the dorsal median feeler, is a third funnel, lying horizontally (fig. 1 k'''); and above and outside this is a fourth (fig. 1 k''), hanging vertically. I have been unable to find more; but as the smallest number yet known in any Rotifer is five pairs, I have little doubt that the missing one, which should be in the side of the neck, will some day be observed. I have plainly seen the cilium-funnels in activity in the egg of *Floscularia*; they may also be seen in the eggs of *Philodina* (fig. 4^a *k*).

Of the peculiar circulatory apparatus described by Mr. Gosse* as compensating for the supposed absence of the water-vessels in *Floscularia*, I could never see any trace; but, in the contractions of the body of the animal, the granules alluded to by him move freely about in the perivisceral space.

Leydig, in his account of *Pterodina*†, states that he was unable to see any ciliated appendages to the water-vascular system of that Rotifer. These appendages I found to be five in number on each side; their positions are shown in the accompanying drawing of *Pterodina* (fig. 5 *k k*).

Now with regard to what I have here called cilium-funnels, a view at present prevails, according to which these are described as blind sacs enclosing a "long flickering cilium." The grounds on which I venture to differ from this view are, I think, conclusive. The Rotifer which is best suited for the observation is *Euchlanis dilatata*. It is common, and of good size. If a large specimen be chosen, and turned on its back (fig. 7^a), four pairs of funnels can be made out: but two pairs (fig. 7^a k' k''') in the lateral ventral region are plainly visible to a low power; these are narrow in outline, and display, in a beautiful degree, the candle-flame-like appearance that is described as a flickering cilium. If the animal be now turned on its side (fig. 7), a feat which can be easily managed in a screw-compressorium, these two funnels will be so faintly marked as to be scarcely perceivable; whilst a third (fig. 7 k''), situate in the neck, which in the ventral view of the animal was barely visible, now shows itself as a flickering cilium. If now the observer search carefully, he will be able to discern each of those lateral-ventral tags which in the ventral view had the candle-flame-like appearance (fig. 7 k' k'''), but now in quite another shape —that of a broad triangle, with its lower margin well defined, and its surface clothed with short cilia in full activity—this not doubtfully or occasionally, but most evidently and constantly, so as fully to satisfy the observer's mind not only of the presence of the small cilia, but of the total absence of any large cilium. The tube (fig. 7 *i*) can be seen descending and opening into the triangle. Whether this is a triangular flattened ampulla,

* Popular Science Review, No. 2.

† Siebold and Kölliker's Zeitschrift.

or whether the tube opens, and one side of its orifice is produced and expanded into the triangle, so that the latter is a single plane, I cannot make out; but I believe the cilia must be on two opposed surfaces; and it is to be remarked that an identical appearance of flickering cilia is produced by the same conditions in the tube-valve of the crop of *Floscularia*, described before in this paper, as also by the cilium-lined tubular œsophagus of *Metopidia* and many other Rotifers, which often wear the appearance of flickering cords. Any one making this observation will be quite sure that the tags or vibratile funnels are, as in Annelida, lined with short vibratile cilia, and that the long flickering cilium, which in some positions seems so surely present, is but an optical illusion, which arises when the observer looks along the level of the ciliated surface.

The position of direct observation should exclude argument; yet it is only fair to ask, in what manner a flabellum in a blind bag could produce a current? Again, cilia do not move in the flickering way here attributed to the imaginary single cilium; they have a lashing movement, upon their root as a centre of rotation: the flabella of certain Monads which wave about in an irregular serpentine way never look in the slightest degree like the candle-flame appearance in question; whereas it is very closely resembled by the narrow œsophagus of *Metopidia*, &c., and by the tube-valve of *Floscularia*, where we certainly have short cilia within a tube.

Lastly, the close analogy between these ciliated appendages and the open vibratile funnels on the water-vessels of Naids and their allies tends powerfully to support this conclusion. (Fig. 8 *k* represents one of the funnels of *Nais*, sp.) In these animals the cilia of the funnels not only line the interior of the appendages but extend over their border, and may be seen playing in the fluid, and agitating the corpuscles, of the perivisceral cavity.

EXPLANATION OF THE PLATE.

Plate XLVII.

Fig. 1. *Floscularia*, adult.—The reproductive system and the granules in the perivisceral cavity are not represented.

Fig. 1[a]. The same, a three-parts-grown specimen, with the oral and pharyngeal cavities and the tube-valve everted: *o*, the verge of the mouth; *c*, the faucal sphincter.

Fig. 1[b]. The same, three hours after hatching.

Fig. 2. *Melicerta ringens.*

Fig. 2[a]. The same, emerging from its cell, showing its three feelers.

Fig. 3. Head of *Limnias Ceratophylli*, seen obliquely from below on its left ventral aspect.

Fig. 4. Head of *Philodina.*

Fig. 4[a]. Egg of *Philodina*: *k k*, tags of water-vascular system.

Fig. 5. *Pterodina.*

Fig. 6. Lorica of *Metopidia Lepadella*.

Fig. 7. *Euchlanis dilatata*, right side.

Fig. 7[a]. The same, ventral view.

Fig. 8. Ciliated appendage of water-vessel of *Nais*, sp.

In all the figures *a* indicates, when present, the dorsal feeler.

b b, the lateral feelers.

c, the faucal sphincter.

d, the tube valve.

e, the gizzard-teeth.

f, the stomach.

g, the intestine.

h, contractile vesicle.

i, water-vessels.

k, ciliated appendages.

m, nervous ganglion.

n, muscular fibres.

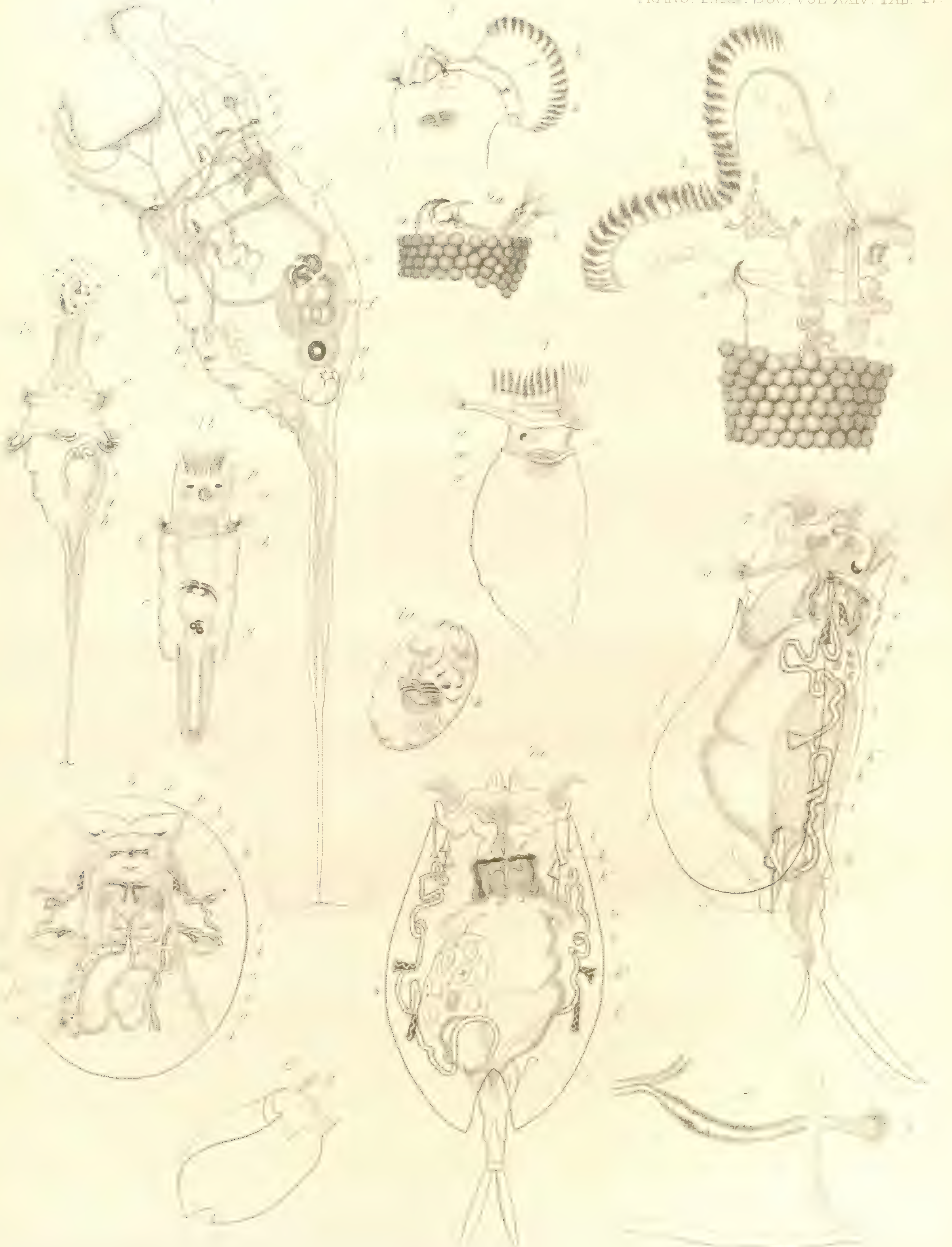
o, lips of mouth.

p, eye.

s, ovary.

v, sphincter of cloaca.

z, pancreatic sacs.



W. Moxon del.

G. Jarman sc.

XX. *Contributions to the Knowledge of the* Foraminifera.—*On the Rhizopodal Fauna of the Shetlands.* *By* HENRY B. BRADY, *F.L.S.*

(Plate XLVIII.)

Read February 18th, 1864.

BUT little addition has been made to our knowledge of the British marine Rhizopodal fauna since the publication by the Ray Society in 1858 of Professor Williamson's Monograph on the Recent Foraminifera of Great Britain. This careful and excellent work must be looked upon as the starting-point of systematic labour on the subject, rather than as an exhaustive history of the organisms of which it treats. In it there are collected together many of the fragmentary notices of Foraminifera which occur in the works of the earlier British naturalists, with collateral references to the writings of Continental authors but little known here. An effort is conspicuous throughout the volume towards a reduction of the number of species and genera, so large a proportion of which had previously been determined on trivial and unimportant characters; and the groundwork of our knowledge of their distribution in our seas is laid in the careful list of localities appended to the description of each species. The beautiful plates with which the work is illustrated were the first *series* published in this country of any value to the working naturalist, and are of great practical use as a standard of reference.

Further research, with the advantage of such a groundwork, naturally yields rapid additions to our store of facts. The examination of sands from depths not before dredged, or localities not previously visited, brings to light species new to our coast, and shows the wider distribution of those already known.

Since the publication of the 'Monograph' the nomenclature of the entire group has undergone considerable change, due to its laborious revision by Messrs. Parker and Jones; and Dr. Carpenter's 'Introduction to the Study of the Foraminifera,' written with the concurrence and assistance of the before-named naturalists, has unfolded a system of classification which, though involving many difficulties, is the only one hitherto proposed possessing a natural and at the same time an obviously scientific basis. Thus it will be seen that the facilities for the study of these organisms are now very different from those which existed a few years ago, and the altered state of our knowledge of the Protozoa generally will explain many points in which the course of the following paper differs from that pursued in Professor Williamson's work.

During the past few years I have had the opportunity, through the kindness of several naturalist friends, of examining large quantities of material from various portions of our coast, both littoral sands and those dredged from deep water, with respect to the microzoa contained in them; and I propose in the present paper to give the results of a careful investigation of a series of dredgings obtained from the Shetland Islands in the summers of 1861 and 1863 by Mr. J. Gwyn Jeffreys and Mr. E. Waller, and very kindly placed at my disposal by them.

Those who are in the habit of referring to Professor Williamson's Monograph, before alluded to, must have remarked how large a proportion of the rarer British species of Foraminifera have been collected on this ground. Of the species therein described, the occurrence of seventy-six is considered of sufficient interest to have a list of localities appended, and in fifty-seven of these cases Shetland appears, either alone or in company with other places. The researches of the late Mr. Barlee in past years and of Mr. Jeffreys are the basis upon which this record is founded; but, notwithstanding their labours, the same ground amply repays further study.

It has been remarked that, in many departments of natural history the fauna of the north and north-east shores of Great Britain is of a boreal character, and presents stronger affinities to that of the coast of Norway than of the south coast of England. The results of the recent dredging-operations off Northumberland and Durham suggested the observation; and, as might be expected, the facts now brought forward yield additional evidence of its correctness. The occurrence of *Anomalina coronata*, *Lagena distoma*, and *Glandulina lævigata*, all of them prominent forms on the Norwegian coast, is exceedingly interesting viewed in this light, and there remain but two or three of the species described in Messrs. Parker and Jones's memoir on Norwegian Foraminifera (Ann. & Mag. Nat. Hist. 2nd ser. vol. xix. p. 273, &c.) which have not been found in the Shetland Seas. The supposed occurrence of certain tropical or subtropical forms, to which I shall presently refer, has been accounted for on the supposition that chance specimens had been carried into these regions by the Gulf-stream. I have sought in vain for any evidence of the influence of the great ocean-current in the Rhizopodal fauna of our northernmost shores; indeed it seems pretty well established that on the eastern side of the Shetlands, at any rate, the distribution of animal life is not affected by it. The Foraminifera obtained fully confirm the views expressed by Mr. Jeffreys in the introduction to his 'British Conchology,' that whatever matter of foreign origin is washed upon these shores is derived from the opposite Norwegian coast.

Most of the parcels of sand placed in my hands were carefully labelled as to the depth from which they were obtained, and the appended Table will give a general view of the results of their examination. The arrangement of the Table and its classification are based upon the views advocated in Dr. Carpenter's work; and the easy way in which the various members of the group fall into their places when treated with reference to this system suggests the applicability of the term "natural" to it, in contradistinction to the "artificial" methods of d'Orbigny, Schultze, and others, founded on the mere number of chambers making up the shell, or their degree of development. The nomenclature has been adopted to a great extent from the Appendix to the same book, with a few trifling corrections, and some alteration in the use of specific and varietal terms. It would be out of place here to enter upon the much-vexed question of what constitutes a species, especially as all allow that in the Protozoa a much larger range of variation must be allowed within specific limits than it is usual to grant in more highly organized beings. Usually the species of a genus (sometimes of several so-called genera) are assignable to one central typical form; the more extensive the series of specimens examined, the more closely connected the links of the chain which binds the whole series, and very frequently it is impossible to say with certainty under what particular name specimens of the intermediate forms should stand. At the same time these subspecific and varietal distinctions are of considerable importance to the zoologist and the geologist as indicating the existence of certain climatal and bathymetrical conditions, and are in practice equally necessary whether representing true species or not. The varietal forms are sufficiently recognizable and sufficiently characteristic of habitat to deserve binomial appellation, and, so long as the connexion is understood, it is unnecessary to overload the terminology by constant repetition of the specific name as well. Whilst preserving, therefore, the specific names hitherto adopted, they have been arranged under their respective types in order to preserve the connexion indicated. Subvarietal names have only been employed in a few cases in which no author has thought the distinction sufficient to merit specific appellation. The names used in Professor Williamson's Monograph have been given in a parallel column, together with reference to his figure of each form.

Of the species figured by Professor Williamson only ten will be missed in the Table of the Shetland forms, and it seems probable that one or two, at least, of these have been introduced on the authority of chance *fossil* specimens washed out of the strata on the sea-coast. Such errors are frequent in the works of Walker and Boys, and some other conchologists, and are corrected with difficulty. The two species of *Frondicularia* figured in the Monograph (pl. 2. figs. 50 & 51), from specimens found at Sandwich, have probably been derived in this way from the chalk cliffs of Kent. Many species of the genus are common in the chalk, and amongst them the particular forms alluded to, but are almost unknown in a recent state in the seas of temperate regions. In the same way *Cristellaria subarcuatula*, var. *costata*, pl. 2. fig. 63 (*Marginulina raphanus*, d'Orb.), and *C. subarcuatula*, var. *costata*, pl. 2. figs. 64 & 67 (*Planularia strigilata*, Reuss), are probably derived, the former from the Tertiary beds near Sandwich, the latter from the Oxford or the Kimmeridge clay of Dorsetshire. With reference to another species, *Peneroplis planatus*, one or two specimens of which were supposed to have been found in Shetland sand, I have the following memorandum from Mr. Jeffreys, which renders it necessary to exclude it from the British list; and as *Vertebralina striata* was found in the same parcel, it must share the same fate. Mr. Jeffreys writes:—"I have reason to believe that the admission of *Peneroplis planatus* into the list of British Foraminifera was accidental and erroneous, so far as I was concerned. Soon after my return from a scientific excursion to the coast of Piedmont, Mr. Barlee sent me some shell-sand which he had dredged in Shetland, and I used for the separation and examination of it the same sieves that I had with me in Italy. Although these sieves had been carefully washed and cleaned before I left Genoa, a few remnants of my Mediterranean dredgings may have been left in the folds of the wire-work within the rim, and hence the mixture of Southern and Northern productions." *Peneroplis* is common in the Mediterranean, as is also *Vertebralina*; and as this is the only recorded instance of their occurrence in so high a latitude, it has probably come about accidentally as above suggested.

In completing the list of Shetland Foraminifera, I have inserted the names of four or five forms which I have not myself noticed, on the authority of Mr. Barlee's specimens noted in Professor Williamson's work, and in the few instances in which this has been done it is duly acknowledged.

I have to thank my friends Messrs. Parker and Jones for their kind assistance in many doubtful points—assistance they have been ever ready to render, and doubly valuable from their great experience and extensive knowledge of all matters connected with the Protozoa.

Notes on the rarer Species and Varieties obtained—chiefly on those not before recorded as British.

[The numbers refer to the corresponding numbers in the annexed list.]

No. 5. Biloculina sphæra, d'Orb. (Plate XLVIII. fig. 1.)

Two specimens of this rare and interesting *Biloculina* were found. In its fully developed condition it is sufficiently distinguished from its allies by its spherical shape and the large, rounded outer chamber, which almost entirely embraces the inner ones. It is described by d'Orbigny in the 'Voyage dans l'Amérique méridionale;' but his figures (pl. 8. figs. 13–16) are defective, and do not show the aperture. Mr. Parker has several specimens from the Butt of Lewis. Diameter $\frac{1}{40}$ inch.

No. 6. Biloculina contraria, d'Orb. (Plate XLVIII. fig. 2.)

A large, coarse shell, differing from the other varieties of the same type in the form and disposition of the chambers, which are here found in a directly opposite condition to that usually observed in the *Biloculinæ*. The whole shell is compressed laterally instead of from front to back, and the position of the aperture is correspondingly altered, being situated near the summit of the narrow, rounded end-view, so to speak, of the shell. It appears to be exceedingly rare, only two specimens having occurred in the examination of a large quantity of material. Diameter $\frac{1}{18}$ inch. (See d'Orb. For. Foss. Bas. Tert. Vien. p. 266, pl. 16. figs. 4–6.)

No. 12. Triloculina tricarinata, d'Orb. (Plate XLVIII. fig. 3.)

This is a tolerably well-defined modification of the Triloculine subtype, characterized by having each of the three external chambers extended to a sharp edge, thus forming three keels or ridges running from end to end of the shell. It is a common form in many seas, and occurs abundantly in a fossil condition in the Tertiaries of Grignon and other deposits. Long diameter $\frac{1}{32}$ inch. (See d'Orbigny's 'Modèle' no. 94.)

No. 17. Quinqueloculina pulchella, d'Orb. (Plate XLVIII. fig. 4.)

In reducing the numberless species of *Triloculina* and *Quinqueloculina* founded by d'Orbigny and others upon the mere surface-ornamentation of the chambers, it will be found convenient to keep this name, applied to one of Soldani's figures (adopted by d'Orbigny, Ann. des Sci. Nat. vol. vii. p. 303), for the forms characterized by coarse longitudinal ridges. In the same way, *Quinqueloculina Brongniartiana* should take precedence as the varietal term for those marked by delicate striæ. The distinction between *Triloculina* and *Quinqueloculina* is a purely artificial one; probably the only forms persistently showing three external chambers are *Triloculina trigonula* and *T. tricarinata*. The single specimen found in these dredgings assignable to *Q. pulchella* is a somewhat monstrous one, the outermost chamber having deep lateral constrictions, apparently dividing it into several segments. Long diameter $\frac{1}{15}$ inch.

No. 19. TROCHAMMINA INFLATA, Montagu, sp.

Rotalina inflata, Will.

A few young specimens, obtained by Professor Williamson from Shetland sands communicated by Mr. Barlee. (See Will. Rec. For. Gt. Brit. p. 50, pl. 4. figs. 93 & 94.)

No. 20. LITUOLA SCORPIURUS, Montfort, sp. (Plate XLVIII. fig. 5.)

This is a feeble form of *Lituola*, having the characteristic rough, arenaceous test; the chambers are arranged in a straight line instead of spirally as in the type *L. nautiloidea*. Professor Williamson figures in his first plate what may possibly be a single chamber of this shell, but many perfect specimens have occurred both to Mr. Waller and myself. Length $\frac{1}{12}$ inch. (See Ann. & Mag. Nat. Hist. 3rd ser. vol. vi. p. 346.)

No. 31. LAGENA CAUDATA, d'Orb., sp.

Entosolenia globosa, var. *lineata*, Will.

Found in this locality by Mr. Barlee. (See Will. Rec. For. Gt. Brit. p. 9, pl. 1. fig. 17.)

No. 32. LAGENA DISTOMA, P. & J., MS. (Plate XLVIII. fig. 6.)

A beautifully delicate elongate variety of *Lagena sulcata*, W. & J., having an aperture at each end of the shell. It has a long fusiform shape, two equal and symmetrical ends, and a surface-ornamentation of delicate longitudinal lines. It was described and figured by Messrs. Parker and Jones (who have since named it *L. distoma*) in their paper on the Foraminifera of the Coast of Norway (Ann. & Mag. Nat. Hist. 2nd ser. vol. xix. pl. 11. fig. 24). Only one specimen has been found in the Shetland dredgings, but several have been taken in sand dredged on the coast of Northumberland. It occurs in a subfossil condition in the clay of the Fens near Peterborough. Length $\frac{1}{60}$ inch, breadth $\frac{1}{350}$ inch*.

* Since writing the above, I have received a copy of a Memoir by Professor Seguenza ('Dei Terreni Terziarii del Distretto di Messina e dei Foraminiferi Monotalamici delle Marne Mioceniche Messinesi,' scritta da Giuseppe Seguenza: Messina, 1862) containing figures and descriptions of a considerable number of what seem to be distomatous *Lagenæ*. In this work, the forms of *Lagena* which are produced at both extremities sufficiently to assume a more or less fusiform character are included under a separate genus, *Amphorina*, d'Orb., and the author does not appear to have noticed that in many, if not in most instances, shells in this condition have two apertures, as is easily seen in recent specimens. All the varieties of *Lagena* are liable to assume the peculiarity alluded to, and do so frequently in a manner which does not admit of the assumption that it is either a generic or even a specific character on the one hand, or a mere monstrosity on the other. The form described in the text has been thought by Messrs. Parker and Jones worthy of subspecific name, there not being, so far as is known, any precise analogue to it in the single-apertured series.

No. 41. LINGULINA CARINATA, d'Orb.

No specimen has rewarded my diligent search for it. Mr. Barlee's better fortune (see Will. Rec. For. Gt. Brit. p. 14) entitles us to retain it in our list,—a point of interest, for the reasons before stated, in connexion with the Norwegian fauna.

No. 42. GLANDULINA LÆVIGATA, d'Orb. (Plate XLVIII. fig. 7.)

Mr. Waller, in his search for the shells of the Mollusca, has been fortunate enough to meet with four specimens of this beautiful species. It is common in a fossil state in many strata, but the individuals are usually smaller than those found in a recent condition. It has considerable geographical range, being noted as far north as the Norwegian coast, but does not seem to be abundant in a living state anywhere. *G. lævigata* is pretty well known by d'Orbigny's figures (Ann. des Sci. Nat. vol. vii. pl. 10. figs. 1–3, and For. Foss. Bas. Tert. Vien. pl. 1. figs. 4 & 5), and may be looked upon as a subtype of *Nodosaria*. Length $\frac{1}{30}$ inch.

No. 57. BIGENERINA DIGITATA, d'Orb. (Plate XLVIII. fig. 8.)

Though *Bigenerina* can scarcely be said to represent a true genus, it is a convenient term for a tolerably well-defined group of *Textulariæ*. Its peculiar mode of growth, commencing biserially like the typical *Textularia*, but becoming uniserial after a certain number of chambers are formed, is sufficient to distinguish the group from its allies. Like the larger *Textulariæ*, its shell is arenaceous in texture, and the arrangement of the chambers is often obscured by its rough exterior. The specimens collected are less attenuated than d'Orbigny's 'Modèle' no. 58, but the earlier chambers have not the wider growth which gives the spear-headed contour to his other species, *B. nodosaria*. It occurs sparingly in several parcels of dredgings from depths of 70 to 90 fathoms. Length $\frac{1}{20}$ inch.

No. 66. BOLIVINA PUNCTATA, d'Orb. (Plate XLVIII. fig. 9.)

Typically, *Bolivina punctata* belongs to a triserial group, *Bulimina*; but in the enfeebled form in which it is found in Northern seas it becomes biserial, and is isomorphous with *Textularia*, from which it is with difficulty distinguished. The twisted mode of growth and oblique aperture, as figured by d'Orbigny (Voyage dans l'Amér. mérid. pl. 8. figs. 10–12), are tolerably characteristic, but these are by no means invariable features in the exceedingly small and delicate specimens found in the Shetland dredgings. Length $\frac{1}{75}$ inch.

No. 70. DISCORBINA OCHRACEA, Will., sp.

Obtained from Mr. Barlee's Shetland sands. (See Will. Rec. For. Gt. Brit. p. 55, pl. 4. fig. 112, & pl. 5. fig. 113.)

No. 72. Discorbina Bertheloti, d'Orb., sp. (Plate XLVIII. fig. 10.)

Rosalina Bertheloti *, d'Orb. For. des îles Canaries, pl. 1. figs. 28–30.

A delicate flattened variety of *Discorbina turbo*, d'Orb., sp., having the central chambers depressed so as to form a sort of umbilical disk. Viewed from underneath, the chambers are seen to overlap each other successively, the smaller in front of the larger, and the aperture is hidden by the spreading growth of the large terminal chamber. Each chamber has a slightly marked border, and the whole shell is covered with minute inconspicuous perforations. Diameter $\frac{1}{100}$ inch.

No. 74. Planorbulina Haidingerii, d'Orb., sp. (Plate XLVIII. fig. 11.)

The artificial system of classification adopted by d'Orbigny with reference to the Foraminifera is never more at fault than when dealing with the numerous varieties of *Planorbulina*, *Discorbina*, &c., which he has grouped together in the genus *Rotalia*. Most of his species are quite worthless, some of them not even representing varietal distinctions of sufficient permanence to notice. In rearranging this motley assemblage of forms, Messrs. Parker and Jones propose to keep *Planorbulina farcta* (Fichtel and Moll, sp.) as the type of a genus; and if this name is confined to the bold large-pored form growing attached, *P. Haidingerii* becomes a convenient subspecific term for the round-edged form growing free, and *P. Ungeriana* is applicable to the unattached, feebler, thin-edged varieties.

A considerable number of specimens of *P. Haidingerii* have been found in these sands, of average size, though not so bold and thick in contour as they occur in warmer seas and in some tertiary deposits, but resembling more d'Orbigny's figure of *Rotalia Akneriana*, one of the subvarietal forms included under *P. Haidingerii*. Diameter $\frac{1}{30}$ inch. (See For. Foss. Bas. Tert. Vien. pl. 8. figs. 7–9, 13–15, &c.)

No. 75. Planorbulina Ungeriana, d'Orb., sp. (Plate XLVIII. fig. 12.)

A small *Planorbulina* growing unattached, more delicate than the last-named species. It has a deep central umbilicus, and the chambers are extended at their outer edge into a sharp keel, giving the appearance of a narrow border running round the shell. Diameter $\frac{1}{35}$ inch. (See For. Foss. Bas. Tert. Vien. pl. 8. figs. 16–18, &c.)

No. 77. Anomalina coronata, P. & J. (Plate XLVIII. fig. 13.)

My attention was first drawn to this shell in the Shetland dredgings by Mr. Waller, and I have since found it in considerable quantity in the material brought home by Mr. Jeffreys last year, taken from a depth of 85 and 90 fathoms. It may be described as a subsymmetrical biconcave *Planorbulina* growing unattached. It seems to be common at all depths on the Norwegian coast, and is plentiful in the Mediterranean

* This species has the name of *Rosalina Bertheloti* in the text, whilst *R. Berthelotiana* appears on the plate—a sort of oversight not uncommon in d'Orbigny's works. As it seems probable that the author would append to his description of the species the name he intended it to bear, the former has been adopted. The same course has been pursued with reference to *Nonionina stelligera*, the last-named species on my list, which is called *N. stellifera* on d'Orbigny's plate.

at a depth of 90 fathoms. A few very fine specimens have been found in the Tertiaries of Grignon, but its occurrence in a fossil condition elsewhere has not been noticed. Diameter $\frac{1}{20}$ inch. (See Ann. & Mag. Nat. Hist. 2nd ser. vol. xix. p. 294, pl. 10. figs. 15 & 16.)

No. 80. Pulvinulina concentrica, P. & J., MS. (Plate XLVIII. fig. 14.)

A variety of *P. repanda*, F. & M., sp., distinguished by the broad striking bands of clear shell-substance overgrowing the septal lines. It is not by any means abundant, and, except in two or three instances, the specimens are small. It seems to be common in the Mediterranean, where it attains great size and beauty, and it also occurs in the Bay of Biscay. Diameter $\frac{1}{20}$ inch. (See Soldani, Testac. pl. 37. fig. b.)

No. 81. Pulvinulina Karsteni, Reuss, sp. (Plate XLVIII. fig. 15.)

Three or four small starved specimens of this species have been pointed out amongst my mountings by Mr. Parker. It is almost impossible to distinguish it, in the arrested condition here presented, from small specimens of its isomorph *Discorbina rosacea*, except by a comparison of a large series of examples, although when fully developed the two forms have striking peculiarities. As I have never met with mature specimens, I can only refer to Professor Reuss's memoir on the Chalk of Mecklenburg (Zeitschr. Deutsch. Geol. Gesellsch. vol. vii. p. 273, pl. 9. fig. 6), and in this instance I have preferred copying his figures of the shell to drawing direct from immature specimens. Diameter $\frac{1}{40}$ inch.

No. 84. Rotalia orbicularis, d'Orb. (Plate XLVIII. fig. 16.)

Although this form was considered by d'Orbigny sufficiently distinct to merit a subgeneric name (*Gyroidina*), we cannot regard it as more than a deep-sea variety of *Rotalia Beccarii*. It is a thickened, Rotaline form, presenting in profile a trochoid appearance, rising to a point on the upper, and very convex on the lower surface. The septal face is narrow and shows few or no perforations. A few specimens have been found in soundings from the Irish Sea (off Laxey), but it is rare, and the individuals exceedingly small both from this and the Shetland locality. The species is common in deep water in the Red Sea and in the Mediterranean. Diameter $\frac{1}{100}$ inch. (D'Orbigny's 'Modèle' no. 13.)

No. 85. Tinoporus lævis, P. & J. (Plate XLVIII. fig. 17.)

The specimen of this shell represented in the figure is the only one which I have seen from a British locality. It is nearly globular and a good deal worn, and might easily in this condition be mistaken for a large grain of sand; a little observation, however, shows on its surface the obscure and more or less hexagonal markings caused by the prominence of the septal edges. The specimen is exceedingly small when compared with those of tropical origin, being not more than $\frac{1}{30}$ inch in diameter.

All the species of the genus *Tinoporus* are found in greater abundance in the seas of warm than in those of colder regions, though the small spherical variety now under notice has a wider geographical range than the larger forms which exist in such abundance amongst the coral-reefs of Polynesia. Mr. Parker notes the occurrence of *T. lævis* at Arran, and the single example from Shetland extends its geographical limit still further northwards.

No. 86. PATELLINA CORRUGATA, Will.

Observed by Mr. George Barlee. (See Rec. For. Gt. Brit. p. 47.)

No. 90. POLYSTOMELLA ARCTICA, P. & J., MS. (Plate XLVIII. fig. 18.)

A large, thick-walled *Polystomella* found in Northern seas. The shell is smooth and devoid of the ridges and spinous processes usually found in the typical form, *P. crispa.* The apertures are scarcely visible, owing to the excessive development of shell-substance; but where they are rendered apparent by abrasion or otherwise, they are seen to be double—a somewhat striking peculiarity. The terminal chamber is often large and projecting. Diameter $\frac{1}{25}$ inch.

Most, if not all, of my specimens (and I have found it in tolerable abundance) are dark-coloured, generally brown, but in some instances quite black; and this is the more remarkable, as the other Foraminifera in the same parcels were beautifully white. This probably arises from the deposit or infiltration of foreign matter in the shell-substance whilst the thickening process is going on. I have noticed in another species, *Nonionina turgida,* a similar peculiarity with respect to colour, viz. that most of the specimens in some dredgings had the large terminal chamber, sometimes the whole shell, much blackened, whilst the other Foraminifera in the same material presented no unusual colouring. In this case, however, the colouring was probably due to the food of the animal being of a character to produce blackening of the sarcode, which was perceptible through the delicate transparent shell. We have much still to learn respecting the colour of the sarcode in the various species of Foraminifera, which only observations on living specimens can teach.

No. 94. NONIONINA STELLIGERA, d'Orb. (Plate XLVIII. fig. 19.)

A small, delicate variety of *Nonionina asterizans*, F. & M., sp., having the stellate sutural limbation developed to its fullest extent, with some thickening of the umbilicus. D'Orbigny describes a peculiar elbow-like twist in this sutural thickening, which may be an occasional, but is certainly not an invariable character. This species was obtained by d'Orbigny in sea-sand from Teneriffe, in which he states it was very rare; in the Shetlands it is also very rare; but it has been found in considerable abundance in the Mediterranean, on the Norwegian coast, and in the Arctic seas. Diameter $\frac{1}{70}$ inch. (See d'Orb. For. Canaries, pl. 3. figs. 1 & 2.)

In the following list will be found named all the species of Foraminifera which have been observed in the examination of Shetland sands; the depth at which they occur, and their comparative scarcity, have been appended so far as practicable.

A single specimen of *Truncatulina refulgens,* Montfort, sp., was noticed; but it was in a somewhat distorted condition, and is on that ground omitted from the list.

Subkingdom PROTOZOA.

Class RHIZOPODA.

Order RETICULARIA.

(FORAMINIFERA.)

Suborder IMPERFORATA.

Family MILIOLIDA.

[As indications of the more or less frequent occurrence, in the column for "Frequency" the following symbols are used:—*v. r.*, very rare; *r.*, rare; *r. r.*, rather rare; *r. c.*, rather common; *c.*, common; *v. c.*, very common.]

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
		CORNUSPIRA, *Schultze.*				
1.	Cornuspira foliacea, *Phil.*	foliacea, *Philippi*	Spirillina foliacea	Pl. 7. figs. 199–201.	80–90	r.
	Miliola seminulum, *Linn.*	BILOCULINA, *d'Orb.*				
2.		ringens, *Lamk.*	Biloculina ringens	Pl. 6. fig. 169; Pl. 7. fig. 171.	Various.	v. c.
3.		compressa, *d'Orb.*	Biloculina ringens, var. carinata	Pl. 7. figs. 172–174.	Various.	v. c.
4.		elongata, *d'Orb.*	Biloculina ringens, var. Patagonica	Pl. 7. figs. 175 & 176.	75–90	r.
5.		sphæra, *d'Orb.*	. . . .	. . . .	75–90	v. r.
6.		contraria, *d'Orb.*	. . . .	. . . .	75–90	v. r.
		SPIROLOCULINA, *d'Orb.*				
7.		limbata, *d'Orb.*	Spiroloculina depressa	Pl. 7. fig. 177.	Various.	c.
8.		planulata, *Lamk.*	Spiroloculina depressa, var. rotundata	Pl. 7. fig. 178.	Various.	c.
9.		canaliculata, *d'Orb.*	Spiroloculina depressa, var. cymbium	Pl. 7. fig. 179.	Various.	r. c.
		TRILOCULINA, *d'Orb.*				
10.		trigonula, *Lamk.*	Miliolina trigonula	Pl. 7. figs. 180–182.	Various.	r.
11.		oblonga, *Montagu*	Miliolina seminulum, var. oblonga	Pl. 7. figs. 186 & 187.	72	r.
12.		tricarinata, *d'Orb.*	. . . .	. . . .	. . .	v. r.
		QUINQUELOCULINA, *d'Orb.*				
13.		seminulum, *Linn.*	Miliolina seminulum	Pl. 7. figs. 183–185.	Various.	v. c.
14.		bicornis, *W. & J.*	Miliolina bicornis	Pl. 7. figs. 190–194.	Various.	c.
15.		secans, *d'Orb.*	Miliolina seminulum, var. disciformis	Pl. 7. figs. 188 & 189.	Various.	c.
16.		Ferussacii, *d'Orb.*	Miliolina bicornis, var. angulata	Pl. 7. fig. 196.	Various.	r.
17.		pulchella, *d'Orb.*	. . . .	. . . .	75–90	v. r.

Family LITUOLIDA.

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
	Trochammina squamata, *P. & J.*	TROCHAMMINA, *P. & J.*				
18.		incerta, *d'Orb.*	Spirillina arenacea	Pl. 6. fig. 203.	Various.	v. r.
19.		inflata, *Montagu*	Rotalina inflata	Pl. 4. figs. 93 & 94.	. . .	v. r.
	Lituola nautiloidea, *Lamk.*	LITUOLA, *Lamk.*				
20.		scorpiurus, *Montfort*	. . . .	. . . .	75–90	r.
21.		Canariensis, *d'Orb.*	Nonionina Jeffreysii	Pl. 3. figs. 72 & 73.	Various.	r. c.
		VALVULINA, *d'Orb.*				
22.	Valvulina triangularis, *d'Orb.*	Austriaca, *d'Orb.*	Rotalina fusca	Pl. 5. figs. 114 & 115.	50–80	r.

Suborder PERFORATA.

Family LAGENIDA.

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
	Lagena sulcata, *W. & J.*	LAGENA, *Walker.*				
23.		sulcata, *W. & J.*	Lagena vulgaris, var. striata —— ——, var. interrupta Entosolenia costata	Pl. 1. figs. 10, 11, & 18.	Various.	v. c.
24.		lævis, *Montagu*	Lagena vulgaris —— ——, var. clavata —— ——, var. perlucida	Pl. 1. figs. 5, 6, & 7.	Various.	c.
25.		striata, *Montagu*	Lagena vulgaris, var. gracilis —— ——, var. substriata	Pl. 1. figs. 12, 13, & 14.	70–80	r. c.
26.		semistriata, *Will.*	Lagena vulgaris, var. semistriata	Pl. 1. figs. 8 & 9.	70–80	r.
27.		globosa, *Montagu*	Entosolenia globosa	Pl. 1. figs. 15 & 16.	. . .	r.
28.		marginata, *Montagu*	Entosolenia marginata —— ——, var. lucida —— ——, var. ornata —— ——, var. lagenoides —— ——, var. quadrata	Pl. 1. figs. 19–28.	Various.	r. c.
29.		squamosa, *Montagu*	Entosolenia squamosa —— ——, var. scalariformis —— ——, var. hexagona	Pl. 1. figs. 29, 30, & 32.	Various.	c.
30.		melo, *d'Orb.*	Entosolenia squamosa, var. catenulata	Pl. 1. fig. 31.	. . .	r.
31.		caudata, *d'Orb.*	Entosolenia globosa, var. lineata	Pl. 1. fig. 17.	. . .	r.
32.		distoma, *P. & J.*	. . . .	. . . .	82	v. r.

Family LAGENIDA (*continued*).

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
		NODOSARIA, *Lamk.*				
33.		raphanus, *Linn.*	Dentalina subarcuata, var. jugosa	Pl. 2. figs. 43 & 44.	70–90	r.
34.		longicauda, *d'Orb.*	Nodosaria radicula	Pl. 2. figs. 36–38.	70–90	r. c.
35.		pyrula, *d'Orb.*	Nodosaria pyrula	Pl. 2. fig. 39.	. . .	r.
		DENTALINA, *d'Orb.*				
36.		communis, *d'Orb.*	Dentalina subarcuata	Pl. 2. figs. 40 & 41.	. . .	v. r.
37.		acicula, *Lamk.*	Dentalina subarcuata, var. jugosa	Pl. 2. fig. 42.	. . .	r.
		VAGINULINA, *d'Orb.*				
38.	Nodosarina raphanus, *Linn.*	linearis, *Montagu*	Dentalina legumen —— ——, var. linearis	Pl. 2. figs. 45–49.	70–90	r. c.
		CRISTELLARIA, *Lamk.*				
39.		rotulata, *Lamk.*	Cristellaria calcar —— ——, var. rotifer	Pl. 2. figs. 52–54.	75–90	r. c.
40.		crepidula, *F. & M.*	Cristellaria calcar, var. oblonga —— subarcuatula	Pl. 2. figs. 55–59.	Various.	c.
		LINGULINA, *d'Orb.*				
41.		carinata, *d'Orb.*	Lingulina carinata	Pl. 2. figs. 33–35.	. . .	v. r.
		GLANDULINA, *d'Orb.*				
42.		lævigata, *d'Orb.*	. . . .	. . . .	. . .	v. r.
		POLYMORPHINA, *d'Orb.*				
43.	Polymorphina lactea, *W. & J.*	lactea, *W. & J.*	Polymorphina lactea —— ——, var. acuminata —— ——, var. oblonga —— ——, var. concava —— ——, var. communis	Pl. 6. figs. 146–149 & 151–155.	Various.	
44.		compressa, *d'Orb.*	Polymorphina lactea	Pl. 6. fig. 145.	Various.	c.
45.		tubulosa, *d'Orb.*	Polymorphina lactea, var. fistulosa	Pl. 6. fig. 150.	Various.	r. r.
46.		myristiformis, *Will.*	Polymorphina myristiformis	Pl. 6. figs. 156 & 157.	Various.	r. r.
		UVIGERINA, *d'Orb.*				
47.	Uvigerina pygmæa, *d'Orb.*	pygmæa, *d'Orb.*	Uvigerina pygmæa	Pl. 5. figs. 138 & 139.	75–90	r. r.
48.		angulosa, *Will.*	Uvigerina angulosa	Pl. 5. fig. 140.	Various.	c.

Family GLOBIGERINIDA.

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
		ORBULINA, *d'Orb.*				
49.	Orbulina universa, *d'Orb.*	universa, *d'Orb.*	Orbulina universa	Pl. 1. fig. 4.	Various.	r. c.
		SPIRILLINA, *Ehrenb.*				
50.	Spirillina vivipara, *Ehrenb.*	vivipara, *Ehrenb.*	Spirillina perforata	Pl. 7. fig. 202.	70–90	r.
		GLOBIGERINA, *d'Orb.*				
51.	Globigerina bulloides, *d'Orb.*	bulloides, *d'Orb.*	Globigerina bulloides	Pl. 5. figs. 116–118.	70–90	v. c.
		TEXTULARIA, *Defrance.*				
52.		variabilis, *Will.*	Textularia variabilis	Pl. 6. figs. 162, 163, & 168.	Various.	c.
53.		pygmæa, *d'Orb.*	Textularia variabilis, var. spathulata	Pl. 6. figs. 164 & 165.	70–90	r. c.
54.		difformis, *d'Orb.*	Textularia variabilis, var. difformis	Pl. 6. figs. 166 & 167.	70–90	r. c.
55.	Textularia agglutinans, *d'Orb.*	sagittula, *Defrance.*	Textularia cuneiformis	Pl. 6. figs. 158 & 159.	Various.	v. c.
56.		trochus, *d'Orb.*	Textularia cuneiformis, var. conica	Pl. 6. figs. 160 & 161.	Various.	c.
		BIGENERINA, *d'Orb.*				
57.		digitata, *d'Orb.*	. . . .	. . . .	70–90	r.
		VERNEUILINA, *d'Orb.*				
58.		polystropha, *Reuss*	Bulimina arenacea	Pl. 5. figs. 136 & 137.	Shallow water.	r. c.
		BULIMINA, *d'Orb.*				
59.		pupoides, *d'Orb.*	Bulimina pupoides	Pl. 5. figs. 124 & 125.	Various.	r. c.
60.		marginata, *d'Orb.*	Bulimina pupoides, var. marginata	Pl. 5. figs. 126 & 127.	Various.	c.
61.		aculeata, *d'Orb.*	Bulimina pupoides, var. spinulosa	Pl. 5. fig. 128.	Various.	r. r.
62.		ovata, *d'Orb.*	Bulimina pupoides, var. fusiformis	Pl. 5. figs. 129 & 130.	Various.	r. r.
63.	Bulimina Presli, *Reuss*	convoluta, *Will.*	Bulimina pupoides, var. convoluta	Pl. 5. figs. 132 & 133.	75	r.
64.		elegantissima, *d'Orb.*	Bulimina elegantissima	Pl. 5. figs. 134 & 135.	48	r.
		VIRGULINA, *d'Orb.*				
65.		Schreibersii, *Czjzek*	Bulimina pupoides, var. compressa	Pl. 5. fig. 131.	75	r. c.
		BOLIVINA, *d'Orb.*				
66.		punctata, *d'Orb.*	. . . .	. . . .	75	r. r.
		CASSIDULINA, *d'Orb.*				
67.	Cassidulina lævigata, *d'Orb.*	lævigata, *d'Orb.*	Cassidulina lævigata	Pl. 6. figs. 141 & 142.	Various.	r. c.
68.		crassa, *d'Orb.*	Cassidulina obtusa	Pl. 6. figs. 143 & 144.	75	r.
		DISCORBINA, *P. & J.*				
69.		rosacea, *d'Orb.*	Rotalina mamilla	Pl. 4. figs. 109–111.	80–90	r.
70.	Discorbina turbo, *d'Orb.*	ochracea, *Will.*	Rotalina ochracea	Pl. 4. fig. 112; Pl. 5. fig. 113.	. . .	v. r.
71.		globularis, *d'Orb.*	Rotalina concamerata (young)	Pl. 4. figs. 104 & 105.	Various.	c.
72.		Bertheloti, *d'Orb.*	. . . .	. . . .	75–90	v. r.
		PLANORBULINA, *d'Orb.*				
73.	Planorbulina farcta, *F. & M.*	Mediterranensis, *d'Orb.*	Planorbulina vulgaris	Pl. 5. figs. 119 & 120.	Shallow water.	c.
74.		Haidingerii, *d'Orb.*	. . . .	. . . .	75–90	r. c.
75.		Ungeriana, *d'Orb.*	. . . .	. . . .	75–90	r. c

Family GLOBIGERINIDA (*continued*).

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
		TRUNCATULINA, *d'Orb.*				
76.	Planorbulina farcta, *F. & M.*	lobatula, *Walker*	Truncatulina lobatula	Pl. 5. figs. 121–123.	Various.	v. c.
		ANOMALINA, *d'Orb.*				
77.		coronata, *P. & J.*			75–90	c.
		PULVINULINA, *P. & J.*				
78.		repanda, *F. & M.*	Rotalina concamerata	Pl. 4. figs. 101–103.	Various.	v. c.
79.	Pulvinulina repanda, *F. & M.*	auricula, *F. & M.*	Rotalina oblonga	Pl. 4. figs. 98–100.	50–70	c.
80.		concentrica, *P. & J.*			75–90	r. c.
81.		Karsteni, *Reuss*			75	v. r.
		ROTALIA, *Lamk.*				
82.		Beccarii, *Linn.*	Rotalina Beccarii	Pl. 4. figs. 90–92.	Various.	c.
83.	Rotalia Beccarii, *Linn.*	nitida, *Will.*	Rotalina nitida	Pl. 4. figs. 106–108.	Various.	r.
84.		orbicularis, *d'Orb.*			...	v. r.
		TINOPORUS, *Montfort.*				
85.	Tinoporus vesicularis, *P. & J.*	lævis, *P. & J.*			...	v. r.
		PATELLINA, *Will.*				
86.	Patellina concava, *Lamk.*	corrugata, *Will.*	Patellina corrugata	Pl. 3. figs. 86–89.	...	v. r.

Family NUMMULINIDA.

No.	Types.	Genera, Species, and Varieties.	References to Williamson's Monograph.		Depth in fathoms.	Frequency.
		OPERCULINA, *d'Orb.*				
87.	Nummulina perforata, *Montfort*	ammonoides, *Gron.*	Nonionina elegans	Pl. 3. figs. 74 & 75.	...	r.
		POLYSTOMELLA, *Lamk.*				
88.		crispa, *Linn.*	Polystomella crispa	Pl. 3. figs. 78–80.	Various.	c.
89.		striato-punctata, *F. & M.*	Polystomella umbilicatula; ——, var. incerta	Pl. 3. figs. 81, 82, & 82[a].	Various.	c.
90.		arctica, *P. & J.*			75–90	r. c.
	Polystomella crispa, *Linn.*	NONIONINA, *d'Orb.*				
91.		turgida, *Will.*	Rotalina turgida	Pl. 4. figs. 95–97.	70–90	r. c.
92.		umbilicatula, *Montagu*	Nonionina Barleeana	Pl. 4. figs. 68 & 69.	80	r.
93.		depressula, *W. & J.*	Nonionina umbilicatula (plate); Nonionina crassula (text)	Pl. 4. figs. 70 & 71.	Various.	r. c.
94.		stelligera, *d'Orb.*			80	v. r.

EXPLANATION OF THE PLATE.

PLATE XLVIII.

Fig. 1. *Biloculina sphæra*, d'Orb., magnified 40 diameters.
a, front aspect; *b*, side aspect.

Fig. 2. *Biloculina contraria*, d'Orb., magnified 25 diams.
a, front aspect; *b*, side aspect.

Fig. 3. *Triloculina tricarinata*, d'Orb., magnified 40 diams.
a, periphero-lateral aspect; *b*, end aspect.

Fig. 4. *Quinqueloculina pulchella*, d'Orb., magnified 25 diams.

Fig. 5. *Lituola scorpiurus*, Montfort, sp., magnified 25 diams.

Fig. 6. *Lagena distoma*, P. & J., magnified 75 diams.

Fig. 7. *Glandulina lævigata*, d'Orb., magnified 45 diams.
a, periphero-lateral aspect; *b*, end aspect.

Fig. 8. *Bigenerina digitata*, d'Orb., magnified 30 diams.
a, periphero-lateral aspect; *b*, diagram showing the arrangement of chambers.

Fig. 9. *Bolivina punctata*, d'Orb., magnified 85 diams.
a, periphero-lateral aspect; *b*, periphero-lateral aspect, marginal view.

Fig. 10. *Discorbina Bertheloti,* d'Orb. sp., magnified 90 diams.
a, superior lateral aspect; *b,* inferior lateral aspect.

Fig. 11. *Planorbulina Haidingerii,* d'Orb. sp., magnified 40 diams.
a, superior lateral aspect; *b,* inferior lateral aspect; *c,* periphero-lateral aspect.

Fig. 12. *Planorbulina Ungeriana,* d'Orb. sp., magnified 30 diams.
a, superior lateral aspect; *b,* inferior lateral aspect; *c,* periphero-lateral aspect.

Fig. 13. *Anomalina coronata,* P. & J., magnified 25 diams.
a, superior lateral aspect; *b,* periphero-lateral aspect.

Fig. 14. *Pulvinulina concentrica,* P. & J., magnified 25 diams.
a, superior lateral aspect; *b,* inferior lateral aspect.

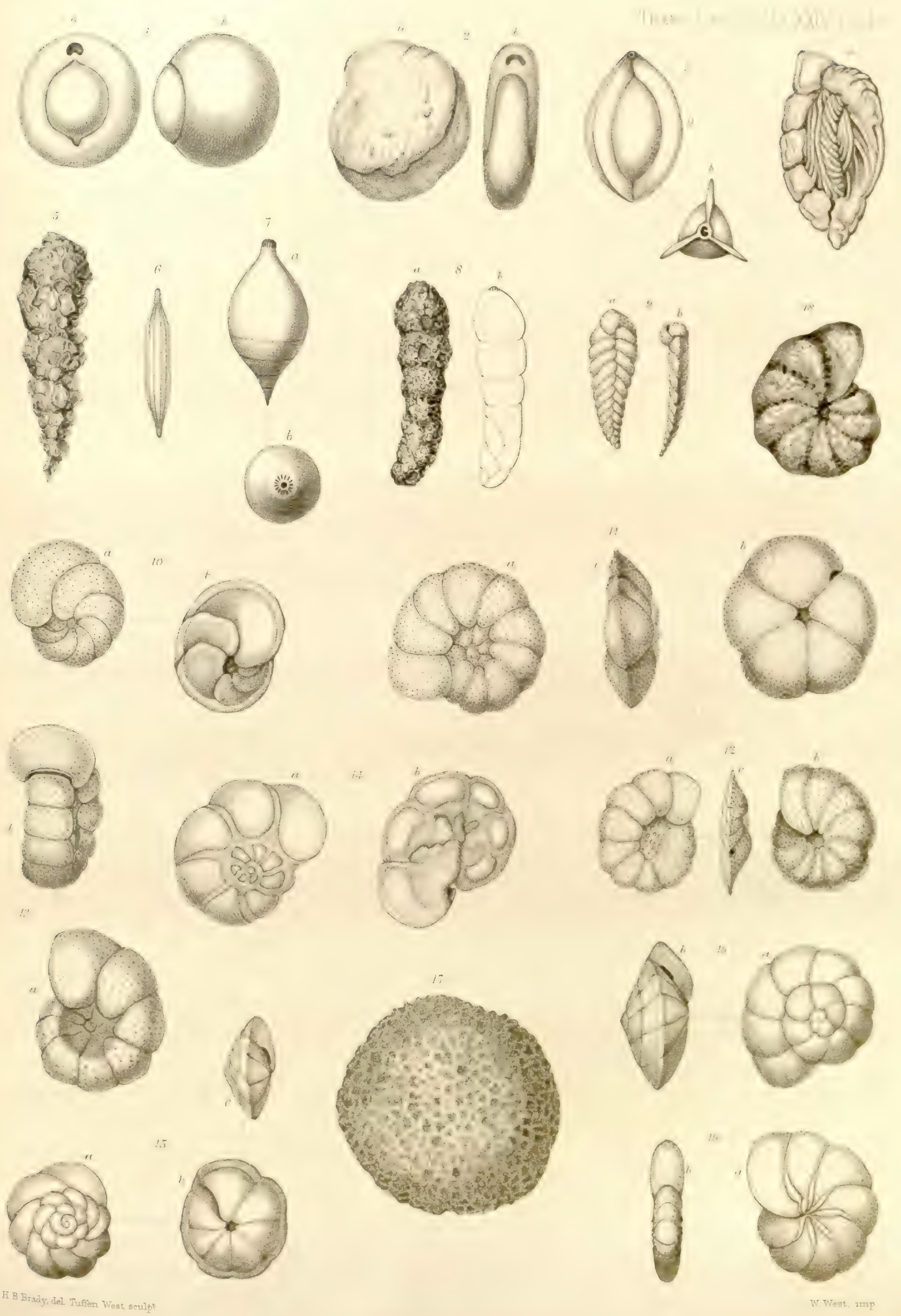
Fig. 15. *Pulvinulina Karsteni,* Reuss, sp., magnified 35 diams.
a, superior lateral aspect; *b,* inferior lateral aspect; *c,* periphero-lateral aspect.

Fig. 16. *Rotalia orbicularis,* d'Orb., magnified 100 diams.
a, superior lateral aspect; *b,* periphero-lateral aspect.

Fig. 17. *Tinoporus lævis,* P. & J., magnified 50 diams.

Fig. 18. *Polystomella arctica,* P. & J., magnified 30 diams.

Fig. 19. *Nonionina stelligera,* d'Orb., magnified 90 diams.
a, superior lateral aspect; *b,* periphero-lateral aspect.



H B Brady, del. Tuffen West sculpt W. West, imp

XXI. *On a new Species of British Annelides belonging to the Family* Chætopteridæ. *By* W. Baird, *M.D., F.L.S., &c.*

(Plate XLIX.)

Read April 21st, 1864.

AMONGST the Dorsibranchiate Annelides there is a peculiar genus, the position of which, in the arrangement of these animals, has been much misunderstood. It was first instituted by Cuvier in 1830, in the second edition of his 'Règne Animal,' for the reception of an anomalous-looking worm which lived in a kind of leathery case, and inhabited the seas of the West Indies. This genus he named *Chætopterus**, from the peculiar structure of the pedal organs, assuming as they did greater proportions than any of the others, projecting laterally and extending like a wing on each side of the body, and being supported by a series of bristles. Cuvier was exceedingly at a loss where to place the genus, and accordingly assigned it a "locus pœnitentiæ," as it were, at the end of his Dorsibranchiata. The details, with regard to its characters and the organization of the only species then known, he left to be given by MM. Audouin and Milne-Edwards. These authors accordingly furnished a more lengthened description of the genus in the Ann. des Sc. Nat. for 1833; but, though they state that it is difficult to arrange this peculiar genus amongst the Dorsibranchiate Annelides (=their order *Errantes*), and though they think that it would be "more natural" to form a distinct order for its reception, they leave it in the order in which Cuvier placed it, only forming for it a family apart from all others. This family has been adopted by all succeeding authors; but the place which was assigned to it, viz. between the peculiar family Peripatidæ and the Arenicolidæ, is evidently erroneous, as with neither of these has it much affinity. Leuckart, in a paper upon the genus *Chætopterus*, in Wiegmann's 'Archiv' for 1849, took a more correct view of its affinities. He expressed an opinion that it undoubtedly ought to belong to the large family Ariciidæ, an opinion which is evidently correct, as we will show more fully hereafter. Grube, in 1850, either not knowing this paper or dissatisfied with the author's conclusions, arranged the Chætopteridæ amongst the Limivora or mud-eating Annelides, and assigned as their place in the system a position between his family Pherusea, consisting of the single genus *Siphonostomum*, and the family Telethusa, composed of the *Arenicolæ* or "Lug-worms" of fishermen. Sars, in his 'Fauna littoralis Norvegiæ,' published in 1856, described a new species belonging to the family Chætopteridæ, found on the coast of Norway, and, adopting the view taken by Leuckart, discovers in this animal a still greater resemblance which some of the Ariciidæ bear to the Chætopteridæ. This is particularly the case with the genus *Spio*, which had always been arranged by systematists amongst the Ariciidæ, a resemblance which induced him to give to his new worm the generic name of *Spiochætopterus*.

* From χαίτη, a bristle; and πτερὸν, a wing.

The worms of which this family (the Ariciidæ) is composed are distinguished by MM. Audouin and Milne-Edwards as possessing slender elongated bodies, by their head being rudimentary, by the want of antennæ and tentacular cirri, by their branchiæ being either absent or, when present, very simple, and by their feet being dissimilar in different parts of their body. They have no eyes, no jaws, a very small and indistinct proboscis or pharynx, and in general a single cirrus to each foot.

In Grube's and Oersted's arrangements a series of genera, which were not known to MM. Audouin and Milne-Edwards as natives of the coast of France, are introduced, which possess long tentacular cirri, frequently two pairs of eyes, more distinct branchiæ, and on some parts of the body a series of hooked bristles like what we always find existing in the Capitibranchiate or Tubicolous Annelides. Oersted, in consequence of this diversity of form, divided the Ariciidæ into two groups, which he named Aricieæ veræ and Aricieæ naideæ. Grube, in his 'Familien der Anneliden,' published in 1851, follows this arrangement, retaining the large family Ariciidæ, divided into two sections; but Sars considers that these two sections must be raised to the rank of distinct families, and in this view he has been followed by Carus in the 'Handbuch der Zoologie,' a work a part of which only has been published last year (1863)*. It is to the latter section, the Aricieæ naideæ of Oersted, the Spioneæ of Sars, that the species of *Chætopterus* show the greatest resemblance. If we examine the figure of any of the species belonging to the genus *Leucodore*, and more especially to *Disoma*, the resemblance in form will be seen at once. (See the figure of *Disoma multisetosum* in Wiegmann's 'Archiv,' 1844, tab. 2. fig. 1.)

The family Chætopteridæ now consists of two genera, *Chætopterus* and *Spiochætopterus*, and only a few species have as yet been enumerated. *Spiochætopterus* contains only one, while *Chætopterus* possesses six. One of these, *Ch. pergamentaceus*, Cuvier, is a native of the seas of the West Indies; a second, *Ch. norvegicus*, is from the coast of Norway; two have lately been described by Stimpson as occurring, one at Simon's Bay, Cape of Good Hope, the other at Port Jackson, Australia; and two others have been described by Schmarda (perhaps identical with those of Stimpson), one of them being found in Simon's Bay, Cape of Good Hope, and the other in Australia. A seventh species has, more recently still, occurred to me as a native of our own shores, a species which is very interesting as showing a nearer approach to the genus *Spiochætopterus*, and consequently to the Spionidæ, than any yet noticed. This species I shall now proceed to describe.

CHÆTOPTERUS INSIGNIS, Baird. (Plate XLIX. figs. 1 & 2.)

The three parts into which the body of the animal may be distinguished are very distinct. The anterior portion (Pl. XLIX. figs. 1 & 2, *a*) is square-shaped, broad, flattened or slightly convex on the ventral surface, and somewhat concave on the dorsal, and is composed of eleven segments. The first is the buccal segment, forming the head,

* Schmarda, in his 'Neue wirbellose Thiere,' published in 1861, adopts another arrangement. He places the family Chætopteridæ in the order Abranchia, which consists, according to him, of two divisions:—1. Achæta, containing the Hirudinidæ and Peripatidæ; 2. Chætophora, containing the Lumbricidæ, Naididæ, Tomopteridæ, the Maldaniæ, and, lastly, the Chætopteridæ. This arrangement appears as faulty as Cuvier's or Grube's.

which is almost rudimentary; and the remaining ten are foot-bearing segments. The first (fig. 2 *b*), the rudimentary head, is narrow, with a smooth, thickened border or edge which projects a little beyond the rest of the segments at each side. Underneath this is the mouth, which is an oblique slit, of considerable size, covered by a flap or projecting lobe—the head-lobe of Sars. On each side of it arises a tentacle or tentacular cirrus (figs. 1 & 2 *c*), which, like that organ in *Spiochætopterus*, is of considerable length, and furrowed on the inferior surface. In some of the specimens examined these tentacular cirri were about 4 lines in length, and coiled round in one or two whirls; in others they were more than an inch in length, and laxly floating in the spirit in which the specimen was preserved. In *Chætopterus pergamentaceus*, to which in general form and size this species bears a closer resemblance than to any of the others described, these tentacles are mentioned by Audouin and Milne-Edwards as being merely a small tubercle, which they say might be considered a rudimentary antenna. In *Ch. norvegicus*, described by Sars from the seas of Norway, these cirri (or antennæ, as he calls them) are figured as being about 1 line long. In the two species described by Stimpson no mention is made of these organs at all, while in one only of the two described by Schmarda is there any tentacular cirrus depicted.

In respect of these organs, then, as I have mentioned above, our British species brings the genus *Chætopterus* nearer to the Aricieæ naideæ, or Spioneæ, than any of those previously described, and at the same time shows a nearer approach to the *Spiochætopterus* of Sars.

There is no appearance of eyes.

The nine segments succeeding the buccal are all narrow, and terminate laterally in conical pedal tubercles, which are slightly curved upwards, and vary somewhat in size and structure. Those of the first and the ninth segments are the smallest; the intermediate ones gradually increasing in length, and reaching the maximum at the seventh. Each tubercle is furnished with a transverse row of numerous rather short setæ, of a yellowish colour, and arranged along its ventral surface. These setæ are about fifty in number on one of the middle feet, and are strongly and distinctly hastate or spear-shaped (fig. 3). The pedal tubercles of the fourth segment are somewhat broader and more distinctly marked than the others, and, in addition to the hastate setæ, are furnished on the ventral surface with a row of stout black spines, which gives the animal a peculiar appearance at the first look (fig. 1, *d*). These spines are about fifteen in number, and are situated on the ventral extremity of the tubercle, occupying a portion of the usual hastate series of setæ. In form they are bluntly emarginate at the extremity, stout, of a black colour, and deeply implanted in the flesh of the foot (fig. 4), a portion, not above a tenth part of their whole length, being extruded. One or two similar spines are mentioned by Sars as occurring in *Spiochætopterus*—generally only one, but occasionally two; and, according to the same author, a series of from four to eight similar spines were observed by him in the interior part of the row of setæ of the usual hastate kind on the fourth foot of *Chætopterus norvegicus*. They are not mentioned by Audouin and Milne-Edwards as occurring in *Ch. pergamentaceus*; but Leuckart states that similar spines occur both on the fourth and fifth feet of that species. Müller, however, who has examined *Ch. pergamentaceus*, takes no notice of them. In our British species they are so observable that they strike the eye at the first sight as most remarkable. A similar bundle or fascicle of spines, however, is mentioned by Stimpson as having been observed by him in the third pair of feet of his *Ch. Capensis.* He describes them as "a fasciculus of stout, black, truncated setæ at their bases." The tenth segment has the feet strongly developed, as in *Ch. pergamentaceus*, the dorsal branch extending outwards to the length of nearly an inch (figs. 1 & 2, *e*). It is of a lanceolate shape, and encloses within its substance a fascicle of numerous long setæ, of a yellowish colour, simple, straight, and blunt-pointed (fig. 5). These are not exserted, but appear merely to support and give firmness to the pinnule. The ventral branch (fig. 1 *f*) is in the form of a broad, fleshy, flat plate, bilobed, attached to and lying across the ventral surface of the animal, and having its free edges armed all round with a row of short simple setæ, of the same form as those of the dorsal branch.

The second or middle portion of the body of the animal (figs. 1 & 2, *g*) is much narrower than the first or anterior, and much longer. It is cylindrical in form, and has a deep groove or furrow running along its ventral surface, and consists of four segments. The appendages attached to these segments are considered as feet by Milne-Edwards, but they differ very much from those of the anterior part in form and structure. They consist of two branches, the ventral one being exactly similar to that of the tenth pair of anterior feet. It is in the form of a broad, flat, fleshy lobe, bilobed like that of the tenth pair, and having a row of short straight setæ on the edges. The dorsal branch has the form of a large membranous sac or vesicle which lies across the back, and is believed by Milne-Edwards (in *Ch. pergamentaceus*) to act the part of a branchial organ. All the four pairs of feet are similar in form; but these sacs appear to bear little or no relation to branchiæ, as most of them are filled with solid matter arranged in the form of cylinders, from three to six or eight to each sac (fig. 6). This matter seems to me to be fæcal, and is composed (as seen when broken down and placed under the microscope) of a rather dark amorphous substance, interspersed with numerous globular transparent bodies, which are evidently Diatoms, and still greater numbers of what appear at first sight to be small Foraminifera, but are most probably crystallized bodies, as they do not show any distinct structure. The transparent globular bodies I at first considered might be ova; but mixed up with them are smaller bodies of a globose shape, which are evidently Diatoms. The sacs themselves communicate with the intestine, and I therefore presume them to be chiefly cæcal, and not branchial*.

The third or inferior division of the body (figs. 1 & 2, *h*) consists of twenty-seven segments in the most perfect specimen I have seen; but they seem to vary very much, as no two specimens agree, one having twenty while another has only thirteen, and yet the animals appear to be mature in growth. The body is very brittle about the middle portion, and several specimens which have been sent to me have given way at that part of the body. Each segment sends off a pair of feet, which, like those of the preceding portion of the body, are composed of two branches, ventral and dorsal. The ventral branch is like the corresponding one of the centre feet, the two or three first being simply

* The ventral branch, with its row of short setæ, may perhaps act as a branchial organ.

bilobed, while the others are divided into two separate portions, the free edges of which are beset with a row of short, straight, simple setæ. The dorsal branch consists of a conical lobe (figs. 1 *i* & 7), similar in appearance to the corresponding branches of the feet of the anterior portion of the body, but containing a fascicle of straight, simple, sharp-pointed, yellow and rather long setæ (fig. 8), which are iridescent. The segments, as well as the feet-peduncles, gradually diminish in size as they approach the extremity, the last six or eight segments being crowded together and very short.

The whole animal (as seen kept in spirits) is of a light green or greenish-yellow colour, of a uniform hue, with the exception of the series of black setæ on the fourth foot of the anterior portion, which give the appearance of a bright black spot, like an eye.

The tube in which this animal dwells is about $1\frac{1}{2}$ inch in circumference, and extends in length from 1 foot to 20 inches. It is composed of a thin parchment-like substance, covered externally with grains of sand and small pebbles, and smooth internally, but with which the animal has apparently no muscular adhesion or connexion. It is found in muddy sand at low water, lying horizontally on the mud, and frequently half buried. When of considerable length, it is bent like a siphon, with the two extremities free and projecting about an inch or so above the sand.

Chætopterus insignis does not appear to be rare, as it has been found in the Channel Islands, at Polperro in Cornwall, in the Firth of Clyde off the island of Cumbrae, and at Plymouth; and we have in the British Museum tubes without the animal, from Falmouth.

XXII. *On a Species of* Chætopterus (C. insignis, *Baird*) *from North Wales.* *By* John Williams, *Esq.* *Communicated by* W. Baird, *M.D., F.L.S., &c.*

(Plate XLIX.)

Read May 5th, 1864.

Beaumaris, April 26, 1864.

Dear Sir,

I HAVE forwarded to you a case, containing eight specimens of *Chætopterus* in spirit. I trust they will reach you in safety, and turn out to be properly preserved*. I took pains to fill every tube with spirit.

I first met with this Annelid here in December 1859, and have since found plenty of them. In one spot especially they abound. I find them in hard smooth sand and gravel, among boulders. They lie very far down, and can only be obtained on a low spring ebb.

Both ends of the tube project from half an inch to a couple of inches above the surface of the ground; but they are often hidden by tufts of seaweed growing on them. The two ends are usually about a foot apart. I make it a rule to find both ends before I begin to dig, or else I should probably cut the tube in two. When therefore many tube-ends are to be seen, great caution is necessary. Two appearing within 6 inches of each other indicate two tubes, unless they are very small.

I find great variety of size: some tubes are not above 8 inches long, and lie with their ends not 3 inches apart; others are more than 2 feet long, and broad in proportion. In both the Annelid is precisely the same in every respect, except size; and I have always found the same parasite in either tube, but smaller in a small tube.

There is a specimen of *Chætopterus pergamentaceus* in the Derby Museum at Liverpool, which, by the favour of Mr. Moore, I have examined. The tube there is much tougher and more like parchment than those I find here; but it has no adherent gravel. Here they are thickly covered with gravel and small stones. The tubes are made of the horse-shoe-form, in which they lie in the earth; and they cannot be stretched out straight without tearing the upper side. I have found one passing under a large stone, with one end appearing at each side of it. It is not unusual, when two tubes lie very near together, to find them adhering; but I never find any communication between them. So sometimes a tube is found which has a short length of similar structure fast to it. Here also I find no communication; and the extra length, having only one outlet, is always disused and full of sand.

On one occasion I spent fully half an hour watching the tubes *in situ* while there was a few inches of water still flowing over them. I saw no movement whatever: no head projected, no apparent flow of water into or out of them, and no sign of their being

[* These specimens are now in the British Museum.—W. B.]

inhabited. I have kept them alive for a week in a tank, both in and out of their tubes. Those in the tubes sometimes come up to the top and project the head and tentacles; they retire quickly when touched. Those on the gravel move very little. I have never seen them attempt to burrow, to make a new tube, or even to move away; but they are sensitive, and shrink when touched; and the three lobes of the body are constantly in wavy, slow motion, as if their skin acted as branchiæ. The feet, also, beneath the segments of the tail, frequently move, each of the two series in its proper direction. You have, no doubt, observed that the pairs of feet which are placed in the centre of each segment, and the lower half of the disks which answer the same purpose in respect to the three lobes, the stomach, and the head, are so placed as to work the Annelid *backwards*, while the outer rows of feet, which bear small cirri, and the upper halves (next the head) of the disks above mentioned work the body *forwards*. The action of these members must be materially assisted by the very remarkable comb-like bristles with which they are provided.

So far as I have been able to ascertain by dissection, the head has no exsertile proboscis, nor any jaws. It contains a cup-like mouth, opening vertically when the Annelid is at the mouth of its tubicular home, and having a lip round nearly the entire circumference, and leading into a wide throat, the inner surface of which is roughly ridged. But I find no tongue, jaws, or teeth in it. On the upper side of the head the lip is cut, and at each end of the opening springs a very lithe and active tentacle, thick, obtuse at the end, rounded on the upper side, furrowed beneath. The edges of this furrow can meet so as almost to form a tube. Just at the root of each tentacle is a dark spot, which looks like an eye. I fail, however, to convince myself that it possesses any powers of vision, or to trace any nervous system in connexion with it.

On each side of the head the golden feet, or lateral processes, are nine in number, formed of bristles, clothed with flesh. On the fourth of each series there is a group of bristles quite different in form and colour from the others. I should much like to know their probable use, as well as that of the open bag which is placed upon the back of the Annelid.

Bristles I find of four distinct kinds, and I have given a drawing of each. In the two long processes like asses' ears, and in all the segments of the tail, the bristles are golden, long, straight, plain, and tapering to a plain point. In all the processes on each side of the head they are somewhat shorter, golden, straight or very slightly curved, truncate at the inner end, and tipped at the other with an elegant "spear-head," slightly bent to the form of the process: these "spearheads" overlap each other, and must give additional strength. On the lower part of the fourth lateral head-process appears a set of different bristles, short, thick, dark-coloured, truncate at both ends, almost club-shaped. The most remarkable of the bristles are those which, placed side by side in immense numbers, form the slight brown line observable along the edges of the feet and disks beneath the body. They are "comb-like," having eight sharp teeth, and are firmly imbedded in the flesh by a long tendon. The teeth of the "combs" are turned in the direction in which the feet respectively bearing them are required to act. The number of these little saw-teeth bristles in each *Chætopterus* must be enormous; for many have forty segments in the tail portion, each segment having four feet (two to work each way). I estimate that on each foot there are not fewer than one hundred of these combs; if so, the tail alone would bear 16,000; and the disks, lobes, and other surfaces, which also bear them, would go far to increase this number by one-half at least.

In every tube, without exception, which contains a *Chætopterus* there is also a parasite —an Annelid which corresponds with the description of "*Polynoë*" given in Mr. Gosse's 'Manual.'* It has bristles of one sort only (long, pointed, toothed like a saw on one edge at least). It has antennæ and two pairs of eyes. Its segments are alternately provided with soft appendages (in this case the appendages are alternately shield plates and cirri). It has two pairs of teeth, or jaws, in an evertile proboscis. In large tubes the parasite is larger, less in the small ones. I generally find it crouching on the lower segments of the body of the *Chætopterus*; and the earliest indication of the death of that Annelid is the exit of the parasite from the tube.

In the South Carolina specimens I understand the parasite is always a small crab.

Near these *Chætopteri* I find various *Terebellæ*, *Cerianthus*, *Sabella*, *Mya*, in great numbers, and a very large *Pholas*, buried at least a foot and a half in hard soil, and having siphons, the open ends of which are nearly two inches in diameter. Should you like to have any of these, or any further specimens or information about *Chætopteri*, I shall always be glad to render any assistance in my power to collect information on a matter in which there is so much of interest.

Believe me, dear Sir, yours faithfully,

JOHN WILLIAMS.

Dr. Baird, British Museum.

EXPLANATION OF PLATE XLIX.

Figs. 1 & 2. *Chætopterus insignis,* natural size, from a specimen in spirits: 1, dorsal view; 2, ventral ditto. *a,* anterior portion of body; *b,* first segment; *c,* tentacular cirrus; *d,* spines of pedal tubercle of fourth segment; *e,* dorsal branch of feet of tenth segment; *f,* ventral branch of ditto; *g,* middle portion of body; *h,* inferior portion of body; *i,* ventral feet.

Fig. 3. Hastate setæ of one of the feet of anterior portion of body: magnified.

Fig. 4. Spine of pedal tubercle of fourth segment: magnified.

Fig. 5. Fascicle of setæ of feet of tenth segment: magnified.

Fig. 6. Cæcum, with fæcal matter: magnified.

Fig. 7. Conical lobe of one of ventral feet: magnified.

Fig. 8. Seta of ditto: magnified.

Fig. 9. *Chætopterus insignis,* natural size, from a living specimen illustrating Mr. Williams's paper.

Fig. 10. Setæ from lateral head-processes (feet of anterior portion of body): magnified.

Fig. 11. Seta from ventral feet: magnified.

Fig. 12. Black spine from foot of fourth segment: magnified.

Fig. 13. Comb-like setæ which form the faint line on feet and disks (hooked setæ of authors): magnified.

* This parasite is a variety of *Lepidonotus cirratus.*—W. B.

E. Smith & J. Williams del.

CHÆTOPTERUS INSIGNIS. (BAIRD)

G. Jarman sc.

XXIII. *On the Species of* Garcinia *which affords Gamboge in Siam.* *By* Daniel Hanbury, *Esq., F.L.S.*

(Plate L.)

Read April 7th, 1864.

More than two centuries and a half have elapsed since one of the old Dutch voyagers, returning from an expedition to India, brought to the notice of his learned countrymen a gum-like substance of an orange colour, to which various important medicinal properties were ascribed. This was the first introduction to Europe of gamboge, a production which, from that time to the present, has been an article of import. But, like many other substances having technical uses, its precise place of production long remained unknown, while its botanical origin has up to the present time not been exactly determined. The object of the present communication is to lay before the Linnean Society some information lately gathered illustrating this latter point.

The whole history of gamboge, including the various opinions that have been entertained as to its source, and the facts that have been made out during two centuries respecting it, having been admirably told by the learned French pharmacologist, Professor Guibourt, and a *résumé* of them having been given by Drs. Planchon and Triana, in their recent 'Mémoire sur la Famille des Guttifères' (p. 196), it would savour of plagiarism here to repeat it. I shall therefore content myself with referring to these writers, and simply state those points touching the origin of this drug which it is desirable to bear in mind on the present occasion.

Passing over the supposition of Clusius and Bontius, who imagined that, from its acridity, gamboge must be produced by some euphorbiaceous plant, we find that Hermann announced, in the year 1677*, that the drug was derived from two trees of Ceylon, now ascertained to belong to the order *Guttiferæ,* one of which is known to modern botanists as the *Garcinia Cambogia* of Desrousseaux, the other being in all probability the *G. Morella* of the same author. Starting from this point, it would seem, remarks M. Guibourt, that each attempt to diffuse more precise and correct information upon this subject has effected the contrary result. I may therefore excuse myself from attempting an explanation of the confusion and intricate synonymy in which the writers of the Linnean period have involved the subject, and state at once that, although it has been well ascertained that one species of *Garcinia* occurring in Ceylon† and others in continental India are capable of yielding gamboge, it is equally clear that the whole of the drug found in European commerce is produced in Siam or in regions contiguous to

* Rheede, 'Hortus Malabaricus,' pt. 1, p. 42. Hermann had resided in Ceylon.

† "This [*Garcinia Morella,* Desrouss.] is the only species growing in Ceylon from which gamboge is obtainable; and, as the tree is not uncommon, the pigment might be collected in considerable quantities."—*Thwaites, 'Enumeratio Plantarum Zeylanicæ,'* p. 49.

that country. Siam, however, is still unexplored by the botanist; but the gamboge-tree has been transported thence to Singapore, and many specimens of it, cultivated as objects of curiosity, have for some years past been flourishing on the estate of Messrs. José D'Almeida & Sons, of that island. From some of these trees specimens were obtained a few years ago, and transmitted to Professor Christison, who published an account of them in the 'Proceedings of the Royal Society of Edinburgh'*. Professor Christison has stated that the tree is nearly allied to *Garcinia elliptica*, Wallich, but that it differs from that species in having the male flowers pedicellate instead of sessile. From want of specimens, it appears that Professor Christison did not complete his investigation, at any rate so far as to publish any definition of the plant in question. In the Royal Botanical Garden of Edinburgh there has been, until recently, a living specimen of the same tree; but as it has borne no flowers, it has not been in a condition to render much service in the determination of the species.

Desirous of attempting to set at rest the question of the origin of gamboge, or at least of obtaining further materials upon which to work, I addressed myself some months ago to Messrs. D'Almeida, of Singapore, who promptly and courteously replied to my letter, and forwarded a jar containing an abundant supply of specimens of the gamboge-tree cultivated on their plantations. Messrs. D'Almeida informed me that the trees, of which they have twenty-eight (but which might have been increased to thousands had any pains been taken to do so), are from 35 to 50 feet in height, the largest with a circumference of about 3 feet; and that they grow very luxuriantly, without any attention, on the slope of a low hillock. Messrs. D'Almeida further observe, "*they are the real gamboge-tree*;" and add that at various times they have caused gamboge to be extracted from them.

The specimens received comprise numerous small leafy branches bearing male flowers, several branches with fruits, and a few with female flowers, the whole preserved in alcohol. Professor Oliver has kindly assisted me in examining them, and in comparing them with the specimens of *Garcinia* contained in the herbaria of the British Museum, Kew, and the Linnean Society, as well as with the published descriptions and figures, and especially with the recent memoir of Drs. Planchon and Triana. The Singapore gamboge-tree appeared to us exceedingly nearly allied to the *Garcinia elliptica* of Wallich, of which we examined authentic specimens, and equally close to the Ceylon species *G. Morella*, one of the two plants originally pointed out by Hermann as the source of the drug, and the plant described by Dr. Robert Graham in 1836 as *Hebradendron cambogioides*†. From both these, however, it differs in having *pedicellate* instead of *sessile* or nearly sessile male flowers—a differential specific character, the value of which in such a genus was to us questionable. We therefore transmitted specimens of the Singapore tree to Mr. Thwaites in Ceylon, requesting to have his judgment as to the probable correctness of referring them to *G. Morella*, Desrouss., a plant with which he was perfectly familiar. Mr. Thwaites, whose opinion upon other grounds we regard as deserving much consideration, replied that, although the Singapore *Garcinia* looked a little different from the

* Vol. ii. (1851) p. 263; Pharm. Journ. & Trans. vol. x. p. 235.

† Companion to the Botanical Magazine, vol. ii. (1836) tab. 27.

Ceylon *G. Morella,* there could be but little doubt that it was only a form or local variety of that species. If the correctness of this view be admitted, it will be convenient to designate the Singapore, or rather Siam, gamboge-tree, GARCINIA MORELLA, Desrouss., var. *pedicellata,* and to define it thus :—

G. Morella, Desrousseaux, in Lamarck, Encyclop. Méthod., Botan. iii. 701, pl. 405. fig. 2; Thwaites, Enum. Plant. Zeylan. i. 49.

G. elliptica, Wallich, Catal. no. 4869.

G. Gutta, Wight, Illustr. of Indian Botany, i. 126, tab. 44 (exclus. synon. Linnæi).

Hebradendron cambogioides, Graham, in Hooker's Companion to Bot. Mag. ii. (1836) 193, tab. 27.

Var. *β. pedicellata*; floribus masculis pedicellatis (pedicelli ad 3 lin. longi).

The *Garcinia elliptica* of Wallich appears to Professor Oliver and myself to offer no characters sufficient to distinguish it specifically from *G. Morella*—a conclusion substantially arrived at by Dr. Graham nearly thirty years ago; and I have therefore added it to the previously admitted synonyms of that plant.

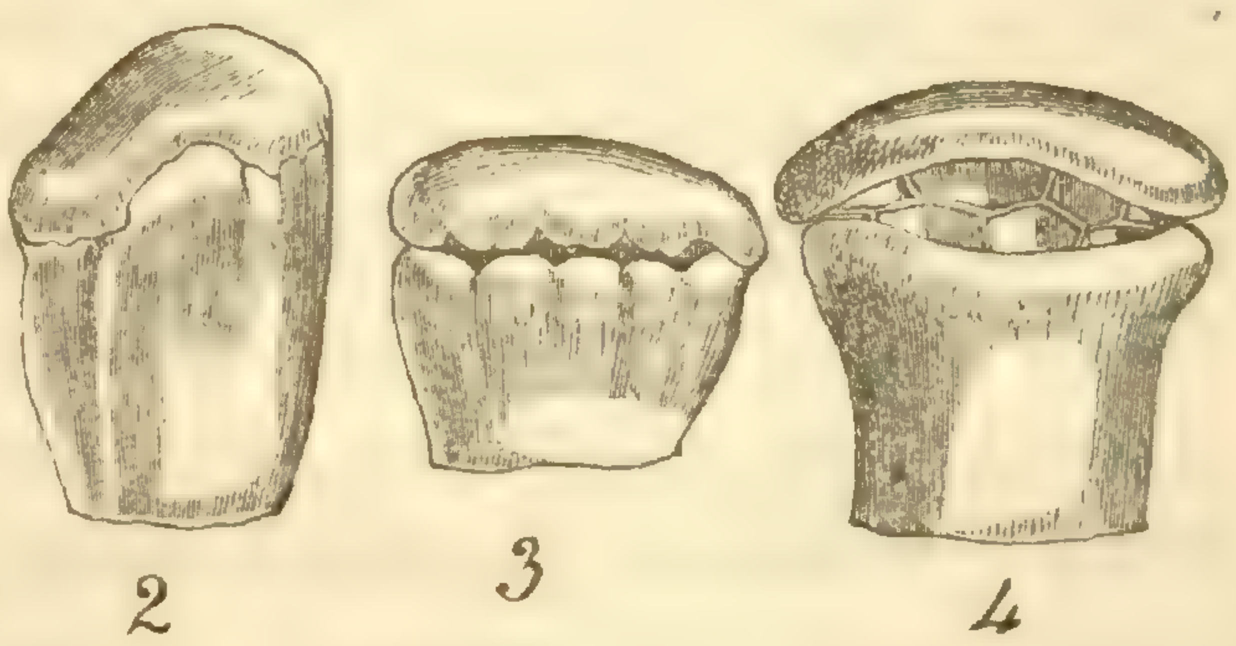
The curious structure of the anther in some *Garciniæ* induced Dr. Graham to propose for certain species a new genus, upon which he conferred the name of *Hebradendron,* which, though abandoned by subsequent botanists, is made the title of a section of the genus by Drs. Planchon and Triana. The examination of the Singapore *Garcinia* has given occasion to Professor Oliver to investigate anew the peculiarities of the circumscissile anther of Graham's *Hebradendron*: the result of this investigation will be best conveyed in the words of a memorandum with which Professor Oliver has favoured me, and which is as follows :—

"The specimens of the gamboge *Garcinia* from Messrs. D'Almeida have afforded me excellent material for the examination of the anthers of this species, which exhibit an unexpected and curious structure, which structure, however, is no doubt common to all the species of the section *Hebradendron.*

"Professor Graham, in his paper upon *Hebradendron,* in the 'Companion to the Botanical Magazine' (ii. 193), quotes an extract from a letter which he had received from the late Robert Brown, in which Mr. Brown pointed out to him 'that approaches to this structure [referring to the circumscissile anthers], and which serve to explain its analogy with the ordinary structure of the family, exist in *Garcinia.*' Messrs. Planchon and Triana, in their excellent memoir on *Guttiferæ,* in the description of their sixth section of *Garcinia* (§ *Hebradendron*), refer thus to the peculiar structure of the anthers :— 'antheræ peltatæ rima circulari dehiscentes, ideoque quasi circumscissæ.' Mr. Brown's observation as to the existence of intermediate forms, connecting the structure of the *Hebradendron*-anther with that of other *Garciniæ,* is a true one; but in the genus *Garcinia* there occur two distinct forms or types of anther, and he does not indicate of which form he regarded the *Hebradendron*-anther as a modification. In some *Garciniæ,* as in *G. paniculata,* the anthers are truly peltate, the comparatively slender apex of the filament being attached near the middle of the back of the anther (fig. 1). In these species the anther-cells are right and left on the upper surface, and the dehiscence is longitudinal,

1

as usual. In some other *Garciniæ* the filament is continued directly into the base of the anther, passing from the base to the apex, the anther being technically adnate. *A priori* the explanation of the *Hebradendron*-anther would be simply this:—that the connective of a peltate anther had become dilated transversely to such a degree that the lines of dehiscence were marginal, and the dehiscence *quasi* circumscissile, as Messrs. Planchon and Triana term it. I believe, however, that the anthers of the Gamboge *Garcinia* are not peltate, that they are truly circumscissile, and that they are a singular adaptation of the adnate type of anther. It would appear as though in this species thick, nearly sessile, and very densely packed anthers, of the adnate type, have their lateral normal polliniferous lobes wholly, or almost wholly, obliterated, and the pollen, lodged in cells of irregular form and number towards and around the apex of the anther, is set free by a special transverse line of dehiscence adapted to this peculiar condition. Evidence, in support of the view that the anther of *G. Morella* is a modification of the adnate rather than of the peltate form of anther, we find in the circumstance that the pollen is contained in numerous irregular pouches, the anther being, in fact, multilocular, as may be well seen either in a young anther (figs. 2 & 3) or in an anther after dehiscence (fig. 4). The circumscissile line of dehiscence, common to the numerous loculaments of the anther, is continuous all round the discoid apex of the connective, and is not interrupted at two points corresponding to the organic apex and base respectively, as it is in anthers of the ordinary peltate form."



2 3 4

DESCRIPTION OF THE PLATE.

Plate L.

Fig. 1. Branch bearing male flowers.
Fig. 2. Male flower.
Fig. 3. Male flower, calyx and corolla removed.
Fig. 4. Stamen showing the circumscissile anther.
Fig. 5. Female flower.
Fig. 6. Female flower, calyx and corolla removed.
Fig. 7. Pistil.
Fig. 8. Longitudinal section of same.
Fig. 9. Transverse section of ovary.
Fig. 10. Branch bearing fruits.
Fig. 11. Transverse section of fruit, four-celled.
Fig. 12. Ditto., three-celled—one-seeded by abortion.

[Figs. 1, 10, 11, & 12 of natural size; the remainder magnified.]

W. Fitch del et lith. Vincent Brooks, Imp.

Garcinia Morella, Desrouss., Var. *pedicellata*.

XXIV. *Notes on British Fungi.* By Frederick Currey, *M.A.*, *F.R.S.*, *F.L.S.*

(Plate LI.)

Read June 2nd, 1864.

Agaricus esculentus, Wulf.

This plant is not uncommon in fir-woods in many different parts of England. In some specimens sent to me this spring (1864), by the Rev. G. H. Sawyer, I noticed that the gills were studded all over with thickly set vesicles, plainly visible under a common lens. These vesicles, when highly magnified, presented the appearance shown in Pl. LI. figs. 1 & 2. Fig. 2 seems to be the more advanced state; and at this period the granular matter, which in fig. 1 is more generally diffused, becomes accumulated at the apex of the vesicle. I did not ascertain whether any septum or membrane is interposed between the granular crown and the lower, more transparent portion of the vesicle. Both in the earlier condition (fig. 1) and in the more advanced state (fig. 2), a number of clear spherical spaces are apparent in the contents of the vesicle; but whether these are cells or merely cavities in the contents, I am unable to say. A second supply of specimens sent me by Mr. Sawyer, at a later period, exhibited the same features in the gills; and I have since examined specimens from Yorkshire, and from Weybridge in Surrey, with the same results. It will be interesting to ascertain whether the phenomenon is constant. The function of the vesicles cannot at present be determined. They resemble the bodies observed in the hymenium of the *Coprini* and in some Agarics, as well as in *Merulius* and *Boletus*; but this similarity affords no assistance in determining their nature, for the functions of these bodies are as yet quite unknown. Close examination of specimens of *Ag. esculentus*, at different periods of growth, may lead to interesting results. It should be borne in mind that Dr. de Bary states that he has observed the growth of asci upon the gills of *Ag. melleus*; and if his observation is correct, it is possible that these vesicles of *Ag. esculentus* may be of a similar nature. Figures of the hymenium of several of the fungi in which the vesicular bodies occur, may be seen in the third volume of Corda's 'Icones Fungorum,' and a dissertation on their probable nature is to be found at p. 44 of the same volume. They are mostly, according to Corda's figures, considerably smaller, in proportion to the basidia, than the vesicles of *Ag. esculentus*.

M. de Seynes, in his recent work 'Essai d'une Flore mycologique de la région de Montpellier et du Gard,' has some remarks upon the nature of the so-called cystidia well deserving of consideration. I give his observations in the note below*. I may observe that the vesicles of *Ag. esculentus* are plainly visible even in dried specimens.

* "Le cystide est une cellule généralement plus grande que le baside, et qui varie beaucoup dans ses formes : naissant du parenchyme au même niveau ou un peu plus bas que les autres éléments de l'hyménium, on le voit s'élever directement et solitaire, tantôt comme une simple cellule stérile un peu plus grande, tantôt en cône plus ou moins long ou effilé, tantôt portant à son extrémité une petite sphère (*Ag. melinoides*, Bull., *Ag. sulcatus*, Dun.), tantôt se

PEZIZA LEIOCARPA, Curr. in Rabenhorst's Fungi Europæi Cent. vii. no. 620.
PEZIZA TRACHYCARPA, Curr. *l. c.* no. 622.

Before describing these two plants, I may premise that they are very probably both included by older writers under either *Peziza badia*, P., or *P. cochleata*, Huds. At the time when the two latter species were established, no sufficient attention was paid to the fructification. The differences between the sporidia of *P. leiocarpa* and *P. trachycarpa* are such as to leave no doubt of their being distinct species, although in external appearance they are sometimes so much alike that without the microscope it is difficult to distinguish them with certainty.

Peziza leiocarpa occurred at Weybridge a few years since; and it and *P. trachycarpa* were found in abundance by Mr. Broome, on Ascot Heath, in the month of November 1863. I drew up the following description from plants given to me by Mr. Broome; and it is published, with dried specimens (also supplied by him), in Rabenhorst's 'Fungi Europæi' Cent. vii. nos. 620, 622:—

divisant ou bien s'arrondissant comme une outre. Cet organe n'existe pas chez tous les Hyménomycètes et chez tous les Agarics, toutefois il a été indiqué par Corda comme étant l'organe mâle, l'anthéridie, et il leur a donné le nom de pollinaire qui a été accepté par M. Hoffmann, bien que cette auteur ne paraisse pas leur attribuer la même signification. Il nous paraît difficile d'accepter cette interprétation, des observations assez nombreuses sur ces organes, quelques-unes entreprises même avant de connaître l'hypothèse de Corda, nous amènent à une conclusion toute différente; et nous ne voyons dans les cystides que des organes revenus à des fonctions végétatives par une sorte d'hypertrophie du baside. D'après Corda, la fécondation s'opèrerait au moyen d'un liquide visqueux issu de ces organes; mais, si nous remarquons que les exemples de cette sorte de fécondation sont tirés de Champignons (*Ag. rutilus*, Schæff., *viscidus*, Fr., *mucosus*, Bull.) dont toutes les portions végétatives sont visqueuses ou ont une tendance à le devenir dans les temps humides, nous ne verrons rien d'étonnant à ce qu'une cellule leur appartenant ait la même propriété et s'agglutine ainsi des spores: il n'y a là rien de spécial; nous serions tentés d'y voir, au contraire, un argument en faveur de notre thèse, et de supposer par là que les cystides se rattachent toujours aux simples organes de végétation. Chez les Mycènes à lait (*Ag. galopus*) qui ont, du reste, les organes de reproduction très-différents de ceux des Lactaires, les cystides se montrent identiques avec ceux des Lactaires; chez les Pluteus, ils revêtent tellement la forme des basides que, si ce n'était leur dimension, on les prendrait pour de vrais basides; divisés en cornes courtes au sommet, ils semblent ainsi avoir conservé les stérigmates. D'autres fois, leur forme se rapproche de celle des cellules du parenchyme; dans un Agaric nouveau, l'*Ag. sulcatus*, Dun., j'ai observé les cystides former de petits cylindres avec une extrémité renflée sphérique, et c'est précisément la forme qu'affectent les cellules végétatives dans le chapeau et dans les lamelles; ces observations m'ont conduit à considérer ces organes, disséminés sur les lamelles, ou souvent agglomérés près de la marge, comme des basides hypertrophiés et revenus au rôle des organes de végétation, comme on voit anormalement un carpelle redevenir feuille. Nous sommes ainsi ramenés à la première conception de Micheli qui les appelait des fleurs stériles, en proposant seulement pour leur usage une interprétation diamétralement opposée à la sienne. Les cystides me paraissent remplir entre les lamelles l'office que l'anneau remplit entre le chapeau et le stipe: ces deux organes de même nature s'envoient à leur contact des prolongements qui les relient; les lamelles, organes de même nature et contigus, ont une tendance à s'envoyer des prolongements pour se relier les unes aux autres. Un certain nombre des basides, obéissant à cette loi, s'allongent et sont détournés de leur usage primitif; mais de même que l'anneau peut être très-développé ou tellement fugace et rudimentaire qu'il ne semble exister que pour mémoire ou manquer tout-à-fait, de même les cystides peuvent manquer ou prendre un développement tel, qu'ils soient visibles à l'œil nu; ils remplissent si bien dans certains cas le rôle de trabécules, qu'en séparant les lamelles d'un *Ag. atramentarius*, Bull., non entièrement épanoui, on divise les lamelles en deux portions longitudinales, au lieu de séparer les faces correspondantes de deux lamelles différentes. Ce phénomène est si apparent que Delile, qui ne connaissait pas les cystides, avait noté l'existence de prolongements fibreux reliant les lamelles de cet Agaric."—*De Seynes, l. c.* pp. 26 & 27.

Peziza trachycarpa, n. s. Prima ætate orbicularis, fere plana, et sæpissime umbilicata; demum irregularis, recurva et undulata; discus nigro-fuscus, asper et tuberculatus. Cupula $\frac{1}{4}$ ad $\frac{6}{4}$ unciæ lata, solo adpressa, extrinsecus minute granulata, substipitata, vel obconica. Paraphyses biformes; aliæ filiformes, apicem versus aliquanto clavatæ; aliæ latæ et pallide fuscæ, ascis vacuis simillimæ. Hæ fere multum corrugatæ, hymenii sectioni aspectum mirum sub microscopio præbentes. Sporidia uniseriata, penitus globosa, muricata, fusca, 0·0005 unciæ lata. Supra solum deustum, Ascot com. Surrey, Nov. 1863. Sporidia, licet sub microscopio fusca, supra chartam nigram demissa albo-grisea sunt.

Peziza leiocarpa, n. s. Cupula prima ætate connivens et subglobosa, extrinsecus, et præsertim versus marginem, aspera, fusco-vinosa, tenuis, et semipellucida, basin versus sæpe pallida, sessilis, $\frac{3}{2}$ ad $\frac{5}{2}$ unciæ lata; demum expansa et fere plana, irregularis, varie lobata et undulata. Discus olivaceo-fuscus, primum pallide, demum obscure. Sporidia penitus globosa, nunquam non lævia, uni- vel bi-seriata, coloris expertia, 0·0003 ad 0·0004 unciæ lata. Paraphyses et habitat ut in *P. trachycarpa*. Prima ætate hæc planta figuram Batschianam *P. pustulatæ*, Fr., fere repræsentat.

Plate LI. fig. 3 represents a small specimen of *Peziza trachycarpa*, of the natural size; and fig. 4 an average-sized specimen of *P. leiocarpa*, also of the natural size. Fig. 5 shows an ascus with sporidia of *P. trachycarpa*, magnified 430 diameters; and fig. 6 the asci and sporidia of *P. leiocarpa*, similarly magnified.

Rhizina undulata, Fr. Syst. Myc. ii. p. 33.

In the autumn of last year (1863) beautiful specimens of a species of *Rhizina* were sent to me by the Rev. G. H. Sawyer. From these specimens figs. 7 & 8 of Pl. LI. were drawn. I should have felt considerable doubt as to the species but for the exact identity of the fruit with the figure given by Tulasne, in his 'Fungi Hypogæi,' of the fruit of *R. undulata*. The plant shown in fig. 7 agrees, except in colour, with Fries's description of the adult form of *R. undulata*. In colour it comes nearer to *R. lævigata*, *β. prætexta*. Fries seems to doubt whether *R. undulata* and *R. lævigata* are distinct; for in speaking of the latter he says, "Quin prioris congener sit, nullus dubitet, potius de specifica differentia." The margin in fig. 8 is of a decided yellow colour, differing in this respect from both *R. undulata* and *R. lævigata*.

The genus has not hitherto been recorded as British. Plate LI. fig. 9 represents an ascus with sporidia, magnified 430 diameters. The sporidia are colourless or yellowish, measuring from 0·0012 to 0·0014 of an inch.

Rhizina nigro-olivacea, n. s.

Disk at first circular, $\frac{1}{8}$ to $\frac{1}{4}$ inch across, dark olive-green; margin of a greenish brown, strongly incurved, ribbed, and granular. Disk ultimately effused, $\frac{1}{2}$ inch or more across, dark olive-green, with a narrow brown margin, the latter very slightly, if at all, incurved. Sporidia in asci, eight in number, elliptical or slightly turbinate, of a clear bluish-green colour, uniseriate, binucleate, 0·0003 to 0·0004 inch long. *Hab.* On rotten wood, near Batheaston, October 30, 1863.

Plate LI. fig. 10 represents the plant in a young state, and fig. 11 a full-grown specimen, both of the natural size. Fig. 12 shows an ascus with sporidia, × 430 diameters.

SPHÆROBOLUS STELLATUS, Tode.

In the spring of this year (1864) Mr. Sawyer sent me some fungi growing upon wood, which at first sight appeared to come nearer to *Cyphella* than any other known genus. Each plant had the form of a white elongated hollow tube, the mouth of the tube being, however, much more contracted than is usual in *Cyphella*. I could discover no fruit; and being curious to ascertain the species of *Cyphella*, as I supposed, I took some pains to cultivate the plant. After some weeks, small spherical protuberances made their appearance all over the ends of the tubes, and this led me to make a further examination. Upon dissection I found the interior of the spherical protuberances filled with an agglomeration of spores, and after a short time the usual stellate fissure of *Sphærobolus stellatus* made its appearance, and the sporangia were ejected and adhered in numbers to the inner surface of the bell-glass with which the fungi were covered. The elongated white hollow tubes seemed to have no other function than that of forming a support (or stroma) for the spherical warts of the *Sphærobolus*, and, as far as I could judge, were in fact nothing more than an abnormally developed mycelium. The strangest part of the matter, however, was, that at the bottom of each of the white tubes there was imbedded a small whitish maggot, which Dr. Gray and Mr. Frederick Smith kindly examined for me; but, owing to the tough nature of the tissue in which the larva was embedded, the latter could not be extracted in a sufficiently perfect state for determination. I had therefore to wait until the larvæ were perfected, which took place a few days later. They were transformed into flies, belonging, as Mr. Smith informs me, to the genus *Cecidomyia*.

Plate LI. fig. 13 represents the tubes (which are attached at their base to the wood) covered with the *Sphærobolus*, slightly magnified. Fig. 14 (*a*) represents a tube without any *Sphærobolus*, (*b*) another tube with several *Sphæroboli*, (*c*) the *Sphærobolus* on the same wood in its normal state; all magnified.

PATELLARIA BICOLOR, n. s.

Disk variable in size, the largest not much more than $\frac{1}{12}$ inch wide, of a bright golden yellow, fringed with rough hairs, which are sometimes of the same colour as the disk, sometimes of a beautiful scarlet; occasionally there is a tuft of hairs in the middle of the disk, corresponding with the point of attachment of the disk to the wood. Sporidia colourless, biseriate, slightly curved, 3-septate, 0·0007 to 0·0008 inch long. On wood somewhat decayed.

This is a small but beautiful species, the contrast in the colour of the disk and the marginal hairs giving it a striking appearance under the microscope. It might at first sight be taken for a *Peziza*, but the toughness of its texture and its septate sporidia point clearly to the genus *Patellaria*.

Plate LI. fig. 15 represents specimens of the plant, magnified; and fig. 16 the sporidia, highly magnified.

Peziza Curreyana, Berk.

This plant was first described by myself in the Journal of the Linnean Society, vol. i. p. 147 *; but no figure of it has yet been published. Having met with a number of good specimens this spring at St. George's Hill, in the neighbourhood of Weybridge in Surrey, I took the opportunity of having drawings made, from which figs. 17 & 18 of Plate LI. have been engraved. The sporidia are inconspicuous; they are narrow, subcylindrical, sometimes slightly curved, and colourless, 0·0004 to 0·0005 inch long.

A minute technical description of the plant is given by Tulasne in his 'Selecta Fungorum Carpologia,' vol. i. p. 105, note.

Ascobolus miniatus, Crouan.

Ascobolus Crouani, Cooke in Seemann's Journal of Botany, May 1864.

This species was found by Mr. Broome, last autumn (1863), growing plentifully on heathy ground near the railway-station at Ascot. It was first described by the Messrs. Crouan † in the 'Annales des Sciences Naturelles,' 4th ser. vol. x. (1858) p. 197. The spores are there described as round, and having each a large sporidiolum in the centre, surrounded by a circle of smaller sporidiola. It is clear to me from an examination of Mr. Broome's specimens, which are obviously the same species, that the Messrs. Crouan have only seen the sporidia in an imperfect condition. When fully ripe, they are beautifully reticulated, as shown in fig. 19, which represents an ascus with sporidia magnified 430 diameters. The plant must not be confounded with *Peziza leucoloma*, to which externally it bears a strong resemblance, but which, according to Mr. Berkeley's account in the 'Annals of Natural History,' has very different sporidia.

Ascobolus saccharinus, Berk. & Curr. Cooke, *l. c.*

Scattered or crowded; disk almost hemispherical when young, afterwards expanded and plane, of a reddish-pink or salmon-colour; when dry, paler towards the margin; plant attached at the base by white downy threads; hymenium somewhat glistening, looking as if sprinkled with minute particles of brown sugar; sporidia elliptical, colourless, 0·0007 to 0·0008 inch long. On old leather and old rag. Chiselhurst, Kent.

Plate LI. fig. 20 represents an ascus with sporidia, magnified 430 diameters. Leather,

* On a New Species of *Peziza*, being the full development of *Sclerotium roseum*, Kneiff.

† The following is the description given by MM. Crouan :—"De 5 à 10 millimètres de diamètre, d'une couleur minium, sessile, charnu, glabre, d'abord urcéolé, puis hémisphérique; hyménium plan, entouré par une collerette membraneuse, blanche, molle, plus ou moins incisée; thèques larges, droites ou incurvées, renfermant huit spores rondes, ayant chacune une grosse sporidiole au centre, et celle-ci entourée par un cercle de plus petites; paraphyses filamenteuses, simples ou bifurquées, épaissies à leur sommet et beaucoup plus longues que les thèques; réceptacle formé par des cellules arrondies ou ovoïdes, très-petites, serrées entre elles, entremêlées à des filaments hyalins, articulés, comme soudés et anastomosés entre eux. Croit sur la terre, parmi les petites mousses. Brest; automne. Peu commun.

as Mr. Berkeley remarks in his 'Outlines of British Fungology,' has usually yielded nothing but the commonest moulds; so that the present plant is interesting from its habitat. I have received the same species, again growing on leather, from my friend the Rev. J. Gagliardi, who met with it on the Simplon, and the same gentleman has since found it in Yorkshire, on the leather and elastic of an old shoe.

Ascobolus argenteus, Curr. Cooke, *l. c.*

Gregarious, exceedingly minute, barely visible to the naked eye, subpyriform, of a silvery-white colour; sporidia elliptical, colourless, 0·0005 inch long. Found by Mr. Broome on cow-dung, at Eltham in Kent, November 1863. Fig. 21 represents asci and sporidia, magnified 430 diameters.

This species is remarkable from its excessively small size and silvery-white colour. It is perhaps the smallest of all the described *Ascoboli*.

DESCRIPTION OF THE PLATE.

Plate LI.

Figs. 1 & 2. Processes on the gills of *Ag. esculentus*, Wulf., described in the text, highly magnified.
Fig. 3. A small specimen of *Peziza trachycarpa*, Curr., nat. size.
Fig. 4. An average-sized specimen of *Peziza leiocarpa*, Curr., nat. size.
Fig. 5. Ascus and sporidia of *Peziza trachycarpa*, Curr., magnified 430 diameters.
Fig. 6. Asci and sporidia of *Peziza leiocarpa*, Curr., magnified 430 diameters.
Figs. 7 & 8. *Rhizina undulata*, Fr., nat. size.
Fig. 9. Ascus and sporidia of *Rhizina undulata*, Fr., magnified 430 diameters.
Figs. 10 & 11. *Rhizina nigro-olivacea*, Curr., in the early and full-grown condition.
Fig. 12. Ascus and sporidia of *Rhizina nigro-olivacea*, Curr., magnified 430 diameters.
Figs. 13 & 14. Abnormal states of *Sphærobolus stellatus*, Tode, described in the text.
Fig. 15. *Patellaria bicolor*, Curr., magnified.
Fig. 16. Sporidia of *Patellaria bicolor*, Curr., highly magnified.
Figs. 17 & 18. *Peziza Curreyana*, Berk., nat. size.
Fig. 19. Ascus and sporidia of *Ascobolus miniatus*, Crouan, magnified 430 diameters.
Fig. 20. Ascus and sporidia of *Ascobolus saccharinus*, Berk. & Curr., magnified 430 diameters.
Fig. 21. Ascus and sporidia of *Ascobolus argenteus*, Curr., magnified 430 diameters.

XXV. *On a New Genus of* Liliaceæ *from East Tropical Africa.*

By JOHN KIRK, *M.D., F.L.S.*

(Plate LII.)

Read May 5th, 1864.

Genus WALLERIA, Kirk, nov. gen.

Perigonium corollinum sex-partitum; laciniis æqualibus, patentibus; tubo brevissimo, libero. *Stamina* sex, æqualia; filamenta brevissima, compressa, glabra, tubo perigonii unita. *Antheræ* elongatæ, muticæ, basifixæ, biloculares, discretæ v. ad apices unitæ, basi exappendiculatæ, poro apertæ. *Ovarium* liberum v. quasi immersum, triloculare, ovulis plurimis in loculis biseriatis. *Stylus* filiformis, erectus. *Stigma* simplex.—Herbæ Africanæ, foliaceæ, foliis lineari-lanceolatis; floribus pedicellatis, axillaribus, solitariis; pedicellis unibracteatis.

WALLERIA NUTANS, Kirk, sp. nov. (Pl. LII. fig. I.)

Diag. character.—Leaves alternate, linear; flowers pendulous. Peduncles with a bract near the extremity next the flowers. Stamens united at the apex into a tube, opening by pores from partial dehiscence at the apex. Ovary quite free, on an expanded receptacle.

Herbaceous, 2 feet in height; stem rounded, with alternate linear leaves, the upper bearing solitary flowers in the axils at the end of long peduncles furnished with a small bract at the extremity. Flowers drooping. Perianth six-parted, having a short cup-shaped tube with rotate partly reflexed segments, the outer three mucronate, having seven veins, inner acuminate, with five veins. Stamens six, equal, all fertile. Filaments short, triangular, united to the cup of the perianth and with each other by a membrane, glabrous. Anthers connivent into a tube, united at the upper part, without any prolongation at the apex, and equal at base, linear-lanceolate, opening by partial dehiscence of the extremities. Ovary trilocular, included in the tube of the perianth, with several ovules in the centre of each cell, quite free from the perianth. Style filiform, projecting slightly beyond the staminal tube. Stigma simple, undivided.

Discovered in the Manganja Hills, at an altitude of 4000 feet above the sea, by Horace Waller, Esq.

WALLERIA MACKENZII, Kirk, sp. nov. (Pl. LII. fig. II.)

Diag. character.—Leaves lanceolate. Flowers erect, on axillary stalks bearing a bract at or below the middle. Stamens free; opening by a single terminal pore. Ovary slightly immersed in the receptacle.

Herbaceous, 2 feet in height. Leaves alternate, lanceolate. Flowers on axillary stalks having a bract under the middle. Perianth six-parted, rotate; tube very short, in form of a cup. Segments of perianth in double series, the outer with from seven to nine veins, inner with five. Stamens six, equal, all fertile, quite free; filaments glabrous, arising from the tube, and united with each other by a membrane at base. Anthers opening by a terminal pore. Ovary trilocular, with several ovules in the angles of each, partly immersed in the extremity of the stalk.

Native of the Manganja Mountains, at the late Bishop Mackenzie's mission-station. Discovered by Horace Waller, Esq.

Both species were discovered growing side by side in the mountains of East tropical

Africa, by Mr. H. Waller, at an elevation of 4000 feet above the sea-level, not far from the mission-station of the late Bishop Mackenzie.

Neither root nor ripe fruit have been sent: the latter, judging from young specimens, promises to be a many-seeded capsule.

In the absence of these important parts, some doubt remains as to their position in the natural system, from the complicated affinities existing in the Liliaceæ. That they form part of the Conantherous group seems, however, almost certain, from the remarkable similarity of the perianth and stamens. The ovary, however, in being quite or almost free, presents a marked point of difference.

Having been kindly permitted to examine the very complete series of allied plants in the Hookerian Herbarium, I shall mention briefly the leading peculiarities of each genus.

This group differs from other Lilies in its semiadherent ovary and anthers, which are not versatile, opening by terminal pores. The amount of adhesion, however, varies, while in one of the genera we have anthers opening by longitudinal valves. The present genus, which it is proposed to add, has the ovary in one quite free, in the other slightly immersed, while the stamens are identical with those of *Conanthera* in attachment, shape, cohesion, and dehiscence.

At first it may seem anomalous that there are in Africa members of a group otherwise peculiar to South America; but it will be found that the Cape genus *Cyanella* must also be referred here, and take a position nearer to the typical genus than some others commonly admitted.

The characters of the group are most fully represented in *Conanthera* and *Cummingia*, which differ from each other in the perianth of the one being 6-parted, of the other campanulate; in these the stamens are united near the apex in the manner of *Solanum*. *Zephyra* has two stamens abortive, represented by curved filaments, while the fertile anthers are spurred at the base. *Cyanella*, a genus of Cape plants, has not only the habit of the group, but also the structure: its ovary is semiimmersed in the stalk; the stamens open at the apices, while the amount of irregularity is less than in *Zephyra*—one of the stamens being larger than the others, but all fertile.

In *Pasithea* the ovary is semiadherent; but the stamens open by longitudinal valves, offering a transition in this respect to the ordinary structure of the Anthericeæ.

The new genus connects these two groups in like manner: retaining the staminal arrangement of the Conanthereæ, it has the ovary of the Anthericeæ, which in one of the species shows a tendency to adhesion.

It is proposed to name the genus after its discoverer, Mr. Horace Waller, one of the few survivors of the ill-fated Central-African mission, to whom we are indebted for many additions to the flora of that region.

Diagnostic Table of Genera of the Conantherous Liliaceæ.

I. *Ovary semiadherent; stamens unequal.*

1. *Zephyra*, Dav. Stamens 2 abortive; anthers opening by a terminal pore, spurred at base.
2. *Cyanella*, Linn. Stamens all fertile, one enlarged, pendulous.

II. *Ovary semiadherent; stamens equal.*

3. *Conanthera*, Ruiz & Pav. Perianth 6-parted; anthers connate, opening by pores, ending in a single arista.
4. *Cumingia*, Dav. Perianth campanulate; anthers connate, opening by pores, ending in a double arista.
5. *Pasithea*, Dav. Stamens free, opening by longitudinal valves the length of the anther.

III. *Ovary free; stamens equal.*

6. *Walleria*, Kirk. Stamens opening by pores, perianth 6-parted.

EXPLANATION OF THE PLATE.

Plate LII.

Fig. I. *Walleria nutans*, nat. size.

1. Flower, magnified.
2. Inner surface of stamens.
3. Ovary.
4. Transverse section of ovary.

Fig. II. *Walleria Mackenzii*, nat. size.

1. Flower, magnified.
2. Stamens and ovary.
3. Apex of anther.
4. Transverse section of ovary.

I. Walleria [illegible] Kirk. II. Walleria [illegible]

XXVI. *On the* Conanthereæ. *By* JOHN MIERS, *Esq., F.R.S. & L.S.*

(Plate LIII.)

Read June 2nd, 1864.

A PAPER by Dr. Leyböld was read before the Linnean Society in January 1863, and published in 'Seemann's Journal' for that month, proposing a new order of *Monocotyledoneæ* under the title of the *Tecophileaceæ*. At the request of Dr. Seemann, I communicated some remarks on this subject, which he printed in his Journal for March following (p. 92). I then stated that the typical plant upon which this order was proposed had been first mentioned by me in 1825 under the name of *Distrepta vaginata*; it was afterwards recorded, in 1828, by Kunze as *Pöppigia Chilensis*; Colla then described it, in 1836, in the Memoirs of the Turin Academy, under the name of *Tecophilea violæflora*, a name which it has since retained. Unacquainted with these circumstances, Pöppig finally published the same plant, in 1838, as *Phyganthus vernus*. Kunze and Colla placed the genus in *Narcisseæ* among *Amaryllidaceæ*; Pöppig arranged it in *Homodoraveæ*; Endlicher gave it a place at the end of *Iridaceæ* after *Crocus*. Dr. Leyböld considered his new order, although agreeing with *Iridaceæ* in the structure of the perianth and root, to be very distinct from that family in the number, introrse direction, and dehiscence of the anthers. In my note above mentioned, I described the structure of the anthers more correctly than had been done previously, and showed that the peculiarity of the genus consisted in having three of the stamens, perfectly developed, placed on one side of the perianth, while three other sterile ones are on the opposite side. Each of the fertile oblong anthers is 2-celled, the cells being united together in a spur at the base, and it opens in the apex by an oblique transverse fissure, thus forming an operculiform cap, which is thrown back, leaving two pore-like apertures for the discharge of the pollen. The three collateral staminodes are longer than the fertile stamens; they are lanceolate, of a dark blue colour, and terminated by a white lanceiform sterile anther, transversely 2-valved, like a long open 2-celled pouch. The capsule is oblong, pointed at both extremities, trigonous, with three salient carinated angles, and marked at about one-third of its length from the summit by a transverse cicatrix showing the line of circumscission of the perianth; above this ring the capsule opens loculicidally along the carinated ridges by three valves, which are septiferous in their middle.

Dr. Leyböld does not mention the circumstance; but it may be presumed that the chief feature on which the *Tecophileaceæ* would rest is the semiinferior character of the ovary and capsule, which would place it between *Liliaceæ* and *Iridaceæ*. The sterility of three of its stamens is not peculiar to *Tecophilea*, for it occurs in the Liliaceous genera *Albuca*, *Brodiea*, *Leucocoryne*, and in some degree in *Zephyra* and *Cyanella*. The partial inferiority of the ovary is also an aberrant and variable character seen in many genera, particularly in all the *Conanthereæ*; and my present object is to show that *Tecophilea* really belongs to the latter group, and has no claims on which a distinct family can be founded.

The group of the *Conanthereæ*, as proposed by D. Don in 1832, included *Zephyra*, *Pasithea*, *Conanthera*, and *Cummingia*, and was then distinguished from the *Asphodeleæ* in *Liliaceæ* by a semiinferior ovary and inarticulated pedicels. Endlicher adopted this group, considering it most allied to *Anthericeæ*, and he added *Echeandia* to it. The *Zephyra* of Don, a genus little known, singularly accords with *Tecophilea*: it has a bulbous root, the same kind of paniculated stem, with vaginant and nearly radical leaves, a similar perianth of six segments, three of them alternately furnished at the tip with the same spur-like process: it has six stamens, four of which are provided with calcarated fertile anthers having the same mode of dehiscence as in *Tecophilea*, the other two being purple, sterile, and formed as in that genus. The anthers of *Conanthera* and *Cummingia* are all fertile, and are remarkable for being shaped precisely like the sterile anthers of *Tecophilea*. The ovary, style, and stigma are nearly alike in the four genera; in all the capsule is trilocular, loculicidally 3-valved at the apex, with valves septiferous in the middle. In *Zephyra* it is nearly superior; in *Conanthera* and *Cummingia* it is from nearly half to two-thirds superior; in *Tecophilea* it is only one-third superior, the cicatrix of the fallen perianth marking these limits: in all these cases the difference is only one of degree, and therefore quite insufficient to maintain, upon that ground alone, a distinct order between *Iridaceæ* and *Liliaceæ*; for in *Zephyra* it scarcely extends beyond the usual limit of the *Anthericeæ*, and it is only in *Tecophilea* that its utmost amount of divergence is reached.

The *Conanthereæ*, reduced to these conditions, are further distinguished by having a solid semiglobular tuberose root, with nearly radical leaves and a simple stem, more or less branched, thus forming a lax panicle of pedicellated flowers, the pedicels bracteated at their origin, not being articulated with the flower: the segments of the perianth united at base into a tube, the three inner ones usually ciliated on their basal margins, and the three outer ones generally mucronated or spurred at their summit: the filaments opposite the segments are extremely short, dilated at the base, and there united in a membranous ring which is partly adnate to the base of the tube: the anthers are 2-celled or sometimes spuriously 4-celled by the inflection of corresponding grooves, the cells being sometimes combined together at the base, projecting in the form of a spur, and they are basifixed upon the filament behind the spur or in a sinus behind the lobes when the spur is wanting: they always open more or less 2-valvately in the apex or in a poriform manner. The ovary is always more or less superior.

Under these limits, *Pasithea* must be excluded from the *Conanthereæ*, on account of its fingered or branching root, its long foliiferous stem, its elongated slender filaments, and oscillatory anthers with longitudinal dehiscence, its perianth twisted in marcescence and persistent, its completely superior capsule, and its large trigonous polished seeds: in these respects it is closely allied to *Trichopetalum*, and evidently belongs to the *Anthericeæ*. For similar reasons, judging from the description given of it, *Echeandia* will also be excluded, but *Cyanella*, hitherto placed in *Anthericeæ*, from its obvious characters should rank among the *Conanthereæ*. This group, without inconsistency, might remain a distinct tribe of the *Liliaceæ*, following the *Allieæ* (*Scilleæ*), and *Anthericeæ*, nearly in the manner in which it has been well classed by Professor Lindley in his 'Veg. Kingd.' p. 205; it would thus consist of *Zephyra*, *Tecophilea*, *Conanthera*, *Cummingia*, and *Cyanella*. But if it were considered desirable, on account of its very peculiar characters, to raise the tribe to the rank of a distinct family, it would then claim on the score of priority the title of *Conanthereæ* or *Conantheraceæ*, rather than that of *Tecophileaceæ*.

I will now proceed to give an ample diagnosis of each genus, from my own careful observation.

Genus Zephyra, D. Don.

Perianthium petaloideum, tubulosum, profunde 6-partitum, segmentis tubo brevi cylindrico 3-plo longioribus, æstivatione 2-serialiter imbricatis, lineari-oblongis, 3 exterioribus extus sub apicem calcari reflexo mucronatis, 3 interioribus paulo latioribus, inermibus; his basi ad margines ciliatis, cunctis demum reflexis. *Stamina* 6, summo tubi enata, quorum 1 posticum et 3 anteriora fertilia, et 2 postica alterna sterilia: *fertilia* æqualia; *filamenta* brevissima, imo complanata et dilatata, omnia in annulum membranaceum liberum fauci tubi adnatum coalita; *antheræ* ovato-cylindricæ, 4-sulcatæ, 2-loculares, loculis collateralibus imo in calcar breve confluentibus, apice diagonaliter transversim fissæ, hinc breviter 2-valvatæ, et e poris duobus hiantes: *sterilia* fertilibus longiora; *filamenta* filiformia, elongata, singulis *anthera* minuta 2-locellata effœta apiculatis. *Ovarium* fere superum, globoso-trilobum, 3-loculare; *ovula* numerosa, ad axin centralem in quoque loculo horizontalia. *Stylus* filiformis, rectus, stamina superans. *Stigma* fere obsoletum, truncatum, cavum, margine ciliolatum. *Capsula* (immatura) fere supera, stylo apiculata, sulcato-trigastra, angulis carinatis, 3-locularis, 3-valvis, valvis medio septiferis. *Semina* matura ignota.—Herbæ *Peruvianæ, tuberoso-bulbosæ*; folia *pauca, approximata, radicalia, alternatim imo vaginantia, linearia, glabra*; caulis *erectus, breviter scapiformis, et ramoso-paniculatus*, ramis *paucis, alternis, patentibus, sub-bifloris, imo bractea membranacea spathacea pedicello longiore donatis*; flores *cernui, cærulei.*

1. Zephyra elegans, D. Don, Edin. Phil. Journ. (1862), p. 236; Kunth, Enum. iv. 634. Foliis paucissimis rudimentariis, lineari-lanceolatis, acuminatis, canaliculatis, nervosis, plerumque adpressis; panicula simplicissima; floribus crebris, azureis, pedicellis filiformibus, summo incrassatis, imo bractea subulata viridi longiore donatis.—In Peruvia inferiore, ad Tarapaca et Iquique.

The very few details recorded of this species do not identify it with the following one. Its stem is 3 inches long, denuded, but covered at its base with several membranaceous sheaths of fallen or abortive leaves; the leaves on its stem are nearly radical and rudimentary, scarcely an inch long; the branches of the panicular termination of the stem have green bracts; the perianth is of an azure blue, and 10 lines long.

2. Zephyra amœna, nob. Caule erecto, humili, basi folioso; foliis circiter 3, alternatim approximatis, imo vaginantibus, lineari-lanceolatis, canaliculatis, parallele nervosis; panicula terminali, caule fere æquilonga, ramis paucis, alternis, patentibus, bractea basali lineari-canaliculata acuminata æquilonga donatis, singulis 2-floris, pedicellis filiformibus summo crassioribus, imo bracteola lineari-acuminata membranacea breviore munitis; floribus cernuis, cæruleis.—In Peruvia inferiore, ad Iquique: v. s. in collect. Bollært.

The type of this species is now in the Herbarium of the British Museum: the underground portion of the stem, $1\frac{1}{2}$ inch long, is covered by a membranous sheath, above which the whole plant is only 3 inches high: the stem is clothed at its base by three nearly radical leaves, which are $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ line broad: the lower branch of the panicle, nearly an inch long, has a leaf-like bract at its base 9 lines long. These bracts grow gradually smaller and more subulate upwards, as the branches become shorter; the pedicels are 2 lines, the bracteoles $2\frac{1}{2}$ lines long: the flowers are much smaller than in the preceding species, the cylindrical tube being 2 lines long, $\frac{1}{2}$ line in diameter; the reflected segments of the border are 5 lines long. The immature capsule is 3 lines in diameter.

Genus Tecophilea.

As no mention is made by Colla, Pöppig, or Dr. Leyböld of the peculiar tortion of two of the interior segments of the perianth, which I found invariably occurring in the species they described, we may infer that they did not examine the flower in a living state: it was this character which suggested to me the name of *Distrepta*. In the drawing by Dr. Leyböld of his new and pretty species from the lofty Cordillera of Chile, there is no indication of this character; nor is there in Pöppig's plate, which is far from a correct representation of the typical species.

Tecophilea, *Colla* (1836). *Distrepta*, nob. (1825). *Pöppigia*, Kunze (1828), non Bert. nec Presl. *Phyganthus*, Pöpp. (1838).—*Perianthium* petaloideum, anguste tubulosum, profunde 6-partitum; segmentis tubo 2–3-plo longioribus, spathulato-oblongis, æstivatione 2-serialiter imbricatis; 3 exterioribus extus sub apicem calcari reflexo mucronatis; 3 interioribus paulo latioribus inermibus, imo ad margines ciliatis, quorum 2 anterioribus sæpe invicem resupinato-tortis; cunctis reflexis. *Stamina* 6, medio tubi inserta, segmentis opposita, quorum 3 anteriora fertilia, 3 posteriora sterilia et paulo longiora: *fertilium filamenta* brevia, sursum latiora, ex annulo fere obsoleto summo tubi orta; *antheræ* oblongo-cylindricæ, filamentis æquilongæ et his pone calcar apicifixæ, 4-sulcatæ, 2-loculares, loculis collateralibus imo in calcar longiusculum confluentibus, apice rima obliqua fissæ, et hinc 2-valvatim dehiscentes, valvula antica brevi, erecta, postica operculiformi-cucullata: *sterilium filamenta* fertilium plusquam 2-plo longiora, linearia, complanata, purpurea; *antheræ effœtæ*, albidæ, brevissimæ, acuminatæ, 2-marsupiatæ, locellis vacuis antrorsum apertæ. *Ovarium* subsuperum, pro tertia parte perianthio inclusum, 3-gonum, apice conicum, 3-loculare; *ovula* plurima in quoque loculo ad axem centralem in seriebus collateraliter affixa, horizontalia; *stylus* filiformis, stamina vix excedens; *stigma* minimum, obsolete 3-denticulatum. *Capsula* cylindrica, utrinque acuta, 3-gona, sub-trisulcata, angulis carinatis, infra apicem per carinas loculicido-trivalvis, valvis medio septiferis. *Semina* plurima, parva, ovata, funiculo brevi e strophiolo apicali horizontaliter appensa; *testa* crassiuscula, brunnea, scrobiculato-rugosa, *raphe* longitudinali notata; *tegmen* membranaceum, basi *chalaza* obscura instructum: *embryo* teres in *albumine* corneo 2-plo longiore hilum versus inclusus, *radicula* ad strophiolum spectante.—Herbæ *Chilenses, tuberoso-bulbosæ*; folia *pauca, radicalia, imo vaginantia, vaginis persistentibus, lineari-lanceolata, acuminata, canaliculata*; caulis *vel* scapus *erectus, tenuis, folio brevior*, 1–2–3-*florus, vel ramis paucis* 1–2-*floris obsolete paniculatus*; pedicelli *imo bracteolati*; flores *subcernui, crocei, pallide cærulei vel albescentes.*

1. Tecophilea violæflora, Bert. MSS.; Colla, Mem. Torin. 39. p. 19, tab. 55; Herbert, Amaryl. tab. 24. *Distrepta vaginata*, nob., Trav. ii. 529. *Pöppigia Chilensis*, Kze.

in Reich. Consp. p. 212. *Phyganthus vernus*, Pöpp., Nov. Gen. ii. 71, tab. 200.—Foliis radicalibus, solitariis, vel 2 imo laxe vaginantibus, lineari-lanceolatis, sensim acumnatis, crebre parallelim nervosis cum venis scalariformibus, canaliculatis, costa media carinatis, ad margines sæpe undulatis; scapo folio breviore, tereti, recto, sæpe 1-floro, et tunc medio alternatim 3-bracteato, aut 2–3-floro, pedicellis longiusculis, imo bracteola minuta membranacea munitis; floribus læte azureis vel cæruleis, subcernuis.—In Chile prov. centralibus: v. v. ad Concon.

Plant 4–8 inches high: root bulbous, ½ inch in diameter, covered with a thick fibrous tunic; the portion of the stem (4 inches) below the ground is covered by a lax membranaceous sheath, above which is a single radical leaf, vaginant at base, 4–7 inches long, ¼ inch broad; the scape is slender, 3–6 inches long, sometimes bearing only a solitary flower, in which case it has three small alternate bracts, showing it to be normally 3–4-flowered, and it often produces three pedicellated flowers, each 6–7 lines long. The tube of the perianth is bluish green; its segments, three times as long, are of a light azure blue, striated, the nearly apical curved mucronate spurs are greenish and ½ line long: the yellowish fertile filaments ½ line long, the bright yellow anthers ½ line; the sterile filaments, of a dark purple colour, are compressed, 1¼ line long: the capsule 8 lines long, 3 lines in diameter; its three apical valves 2 lines long, open as far as the transverse cicatrical line. The plant flowers in November and December.

2. TECOPHILEA ALBIDA, nob. Folio lanceolato sensim acuminato, apice longe mucronato, imo vaginato, striato-nervoso, margine undulato; scapo sæpius 1-floro, longiusculo, folio vix breviore; flore minore, albido, calcaribus segmentorum brevioribus.—In Chile, v. v. ad Concon.

Plant 7–8 inches high; radical leaf 6–7 inches long, 4–7 lines broad; scape 4–5 inches long; flower 4 lines long, the spurs of the external segments ½ line long; perianth always white with a faint tinge of blue.

3. TECOPHILEA CYANEO-CROCEA, Leyb. Seem. Journ. i. 10. Foliis binis, radicalibus (cum vagina tertii delapsi), lineari-lanceolatis, acuminatis, marginibus undulatis, striato-nervosis, subtus ad costam carinatis; floribus pedicellatis, 1–2, folio triente brevioribus, paulo supra basin enatis, flore magno, pedicello æquilongo; tubo cylindrico, brevi, segmentis imo subcampanulatis, ellipticis, subacutis, apice patentibus, atro-cæruleis, 2 superioribus albo pictis.—In Andibus Chilensibus (Paso de la Dehesa ad Piuquenes).

From Dr. Leyböld's drawing of this plant, kindly lent to me by Dr. Seemann, the following particulars have been obtained:—The bulbo-tuber, ¾ inch diameter, grows 3 inches below the surface; the radicular leaves are 2½ inches long, ½ inch broad; it has scarcely any scape; the slender pedicels, 10–15 lines long, spring from near the ground: the flowers are 1½ inch long; the tube, 3 lines long, is pale blue or lilac; the segments 14 lines long, 3½–4½ lines broad, are dark purple, growing paler as they wither; the three outer segments have very short mucronate points; the style, as long as the stamens, is terminated by three short fimbriated stigmata; the ovary trigonous, ¼ superior, having sixteen ascending sessile ovules collaterally fixed to the inner angle of each cell. The plant flowers in October and November.

Genus Conanthera.

This genus was established by Ruiz and Pavon in 1802. I found the typical species in 1820, and it was first raised in England in 1823 from bulbs and seeds sent by me. It differs from *Zephyra* and *Tecophilea* in its stamens being all fertile, and in the absence of the basal spur of the anther, together with a somewhat different mode of dehiscence. The ovary and capsule are half superior.

Conanthera, R. & P.—*Perianthium* petaloideum, imo breviter tubulosum, 6-partitum, segmentis tubo 8-plo longioribus, æstivatione 2-serialiter imbricatis, lineari-oblongis, 3 exterioribus apice calloso-mucronatis, 3 interioribus paulo latioribus, inermibus, imo ad margines ciliolatis, omnibus valde reflexis. *Stamina* 6, segmentis opposita, æqualia, exserta, in conum centralem conniventia; *filamenta* brevissima, imo dilatata et in annulum brevem ad tubi basin adnatum coalita; *antheræ* tenuiter elongatæ, subulatæ, basi 2-lobatæ et in sinu basifixæ, sub lente scabridulæ, 4-sulcatæ, 2-loculatæ, apice transversim et 2-valvatim profunde fissæ, valvulis membranaceis, acuminatis, apice 2-denticulatis, erectis, antica paulo breviore. *Ovarium* plusquam semisuperum, 3-gonum, parte superiore profunde 3-sulcatum, 3-loculare: *ovula* numerosa, ad axin centralem serialiter affixa, horizontalia: *stylus* tenuissime filiformis, rectus, staminibus paulo longior: *stigma* fere obsoletum, fimbriato-truncatum. *Capsula* trigono-globosa, pro tertia parte infera et hinc cicatrice transversa cincta, 3-locularis, apice loculicido-trivalvis, valvis medio septiferis. *Semina* in quoque loculo plurima, angulo centrali affixa, guttiformi-ovata, intus angulata, et hinc *raphe* longitudinali apiceque *strophiolo* crasso signata: *testa* crassiuscula, scrobiculato-rugosa, nigrescens: *tegmen* tenuiter membranaceum: *embryo* teres, in *albumine* corneo paulo longiore inclusus, *radicula* supera, strophiolo proxima.—Herbæ *Chilenses*: bulbus *tuberosus, tegete e fibris numerosissimis intricatis crassa amictus*: caulis *erectus, simplex vel pauci-ramosus*, ramis *laxe paniculatis*; folia *radicalia sæpius* 2, *lineari-ensiformia, parallelim nervosa, submembranacea, basi vaginantia*; flores *cærulei, pedicellati, cernui*; pedicelli *imo bracteati*; antheræ *luteæ*.

1. Conanthera bifolia, R. & P., Fl. Per. iii. 68, tab. 301. fig. *a*; Bot. Mag. 51, tab. 2496.; *Bermudiana bulbosa*, Feuill. iii. 8, tab. 3. Foliis radicalibus 2–3, imo vaginatis, sub-oppositis, lineari-ensiformibus, læte virentibus; floribus cernuis; segmentis valde re-curvis, violaceo-cæruleis, imo macula magna alba variegatis, 3 alternis imo ad margines ciliatis.—In Chile prov. centralibus: v. v. ad Concon.

The semiglobose tuberose bulb ½ inch in diameter, as well as the submerged portion of the stalk 1½–2½ inches long, are covered by a densely matted network 1–2 lines thick, formed of loose crossing fibres. The radical leaves are about 4 inches long, 3 lines broad; the stem, when simple, has about three alternate, equidistant, vaginant, acute, membranaceous bracts; but when compound, the branches from these bracts form a panicle rising 6 to 9 inches above the ground; the pedicels, also bracteated at their origin, are 3–4 lines long; the tube of the perianth is ¾ line long, the segments 6 lines long, 1½–2 lines broad, with five parallel nerves; the filaments ½ line long; the anthers, crowded together like an exserted cone, are 3½ lines long and of a pale yellow colour. The capsule is about 2½ lines in diameter.

Genus Cummingia.

The typical species on which this genus was founded was first described as *Conanthera campanulata*, and was first introduced into England in 1823 from bulbs and seeds sent by me from Chile: it was established as a new genus in 1832 by D. Don, who named it in honour of Lady Gordon Cumming. It is very closely allied to *Conanthera*, and differs only in having the segments of the perianth confluent for half their length into a campanulate tube, and in its stamens not converging to the centre.

Cummingia, D. Don.—*Perianthium* petaloideum, tubulosum, tubo imo angustato, dein campanulato, limbo 6-partito, segmentis tubo æquilongis, æstivatione 2-serialiter imbricatis, oblongis, obtusis, 3 exterioribus apice mucronatis, 3 interioribus apice emarginatis, imo ad margines ciliatis, omnibus sensim patentibus. *Stamina* 6, paulo supra basin tubi affixa, omnino inclusa, segmentis opposita, erecta, æqualia; *filamenta* brevissima, imo dilatata et in annulum brevem ad tubi basin adnatum coalita; *antheræ* eis *Conantheræ* similes, sed discretæ, summo tubi attingentes. *Ovarium* globosum, semisuperum, 3-loculare; *ovula* numerosa, ad axin serialiter affixa: *stylus* filiformis, longitudine staminum: *stigma* tubulosum, truncatum, fere obsoletum. *Capsula* subglobosa, subtrigona, semisupera, et hinc cicatrice transversim cincta, 3-locularis, apice loculicide 3-valvis, valvis medio septiferis. *Semina* plurima, ovata, intus angulata, apice strophiolata; *testa* scrobiculato-rugosa, fusca, crassiuscula, *raphe* longitudinali signata; *embryo* teres, in *albumine* subcarnoso 2-plo longiore hilum versus inclusus, *radicula* clavata, ad strophiolum spectante, *cotyledone* attenuata.—Herbæ *Chilenses;* bulbus *tuberosus, tegete crassa e fibris numerosissimis intricatis amictus;* caulis *erectus, simplex vel pauciramosus, ramis laxe paniculatis;* folia *radicalia* 2–3, *lineari-ensiformia, parallelim nervosa, submembranacea, basi vaginantia;* flores *pedicellati, cernui, dense purpurei, segmentis interdum violaceo maculatis, ramis pedicellisque imo bracteatis.*

1. Cummingia campanulata, D. Don, in Sw. Fl. Gard. t. 257; Kth. Enum. iv. 632. *Conanthera campanulata*, Lindl. Trans. Hort. Soc. vi. 283; Bot. Reg. t. 1193; Hook. Ex. Fl. iii. t. 214. *Conanthera bifolia*, Sims (non R. & P.) Bot. Mag. t. 2496.—Foliis radicalibus, lineari-ensiformibus, longe mucronatis, canaliculatis, imo vaginantibus; panicula laxa, ramis pedicellisque imo bracteatis; floribus cernuis, dense cæruleis; segmentis tubo campanulato æquilongis, exterioribus apice mucronatis, 3 interioribus apice subemarginatis imo ad margines ciliatis et variegato-maculatis; staminibus discretis, tubo inclusis.—In Chile centrali: v. v. ad Concon.

The semiglobose, solid bulb, $\frac{1}{2}$ inch in diameter, as well as its submerged collar, 4 inches long, are covered with a cylindrical, thick, fibrous envelope like that described in *Conanthera*: the radical leaves are 2 to 6 inches long, 2 to 3 lines broad; the stem is slightly flexuose, the branches alternate, the first being a little above the ground; they are 2 to 4 inches long, bracteated at base, as are also the secondary branchlets, which bear one or two pedicellated flowers, the whole forming a somewhat lax panicle 4 to 7 inches high; the acute membranaceous bracts are $1\frac{1}{2}$ to 3 lines long, the pedicels 2 lines, the perianth 7 lines long, and 6 lines in diameter when expanded, the segments 4 lines long, $2\frac{1}{2}$ lines broad; the stamens, 3 lines long, originate in a thick ring $\frac{3}{4}$ line above the bottom of the tube; the ovary is 1 line in diameter, the style $2\frac{1}{2}$ lines long. The capsule is globose, 3 lines in diameter, 3-grooved, with a cicatrical line about midway across, above which it opens loculicidally by three erect valves; each cell contains about eight seeds, 1 line long, collaterally and horizontally attached in pairs at the inner angle.

The *Cummingia tenella* of Don appears to me only a stunted variety of the above.

2. Cummingia trimaculata, D. Don, in Sw. Fl. Gard. 2nd ser. t. 88; Paxton, Mag. ii. t. 127; Kth. Enum. iv. 632. Foliis radicalibus, linearibus, recurvato-patentibus, canaliculatis, imo vaginantibus, apice subulato-mucronatis; panicula e basi ramosa, ramis pedicellisque bracteolatis; floribus cernuis, violaceo-cæruleis; segmentis tubo longioribus, 3 interioribus imo ad margines ciliatis et macula magna atro-violacea pictis, antheris semiexsertis. In Chile: v. s. Valparaiso (*Bridges*, n. 156).

This plant is scarcely distinguishable from the preceding, the flower of which is often spotted in the same manner; the only difference that I can perceive in Bridges's specimens is that the tube of the perianth is a little more cleft, which causes the anthers to be somewhat exserted.

Genus Cyanella.

This well-known genus was established by Linnæus 100 years ago. Its relation to the *Conanthereæ*, which is complete, does not appear to have been recognized by botanists until it was pointed out by me (Seem. Journ. i. 93). It has the same kind of solid tuberose root covered by a fibrous envelope, similar radical leaves spathaceously vaginant about its branching panicular stem, small blue pedicellated flowers divided biserially into six oblong segments, very short filaments united into an annular ring, which is fixed near the base of the short tube of the perianth, one fertile stamen, placed anteriorly, and five substerile anthers, sometimes differently coloured, as in *Tecophilea*, and the mode of dehiscence like that of *Conanthera*. This genus, peculiar to Southern Africa, adds another example to the many remarkable analogies that exist in the floras of Chile and the Cape of Good Hope. As its species have been long ago described and figured, it is only necessary to give a list of them with their references; but I add a more complete diagnosis of the genus.

Cyanella, Linn.—*Perianthium* petaloideum, 6-partitum, tubo brevissimo, segmentis patenti-reflexis, 3 exterioribus latioribus, apice mucronatis, 3-nerviis (infimo adhuc latiore et 5-nervio), 3 interioribus alternis, angustioribus et 1-nerviis. *Stamina* 6, quorum 1 fertile et valde robustius et insigniter deflexum, segmento antico opposito, reliqua minora, erecta, substerilia: *filamenta* brevia, membranaceo-dilatata, in annulum brevem summo liberum imo tubo adnatum coalita: *antheræ* lineari-oblongæ, imo truncato-calcaratæ, paulo supra basin dorso fixæ, 2-loculares, loculis collateraliter adnatis, apice rima obliqua transversali 2-valvatim dehiscentibus, valvis emarginatis. *Ovarium* semi-superum, 3-gonum, trigastro-lobatum, 3-loculare; *ovula* anatropa in quoque loculo 6–12, biseriatim sursum imbricata. *Stylus* filiformis, versus stamen fertile horizontaliter deflexus. *Stigma* obsolete 3-dentatum. *Capsula* 3-gona, subglobosa, membranacea, torulosa, 3-locularis, apice loculicide 3-valvata, valvis medio septiferis. *Semina* ovata, angulata, nigro-fusca, rugosa; *embryo* teres, leviter curvatus, in *albumine* carnoso 2-plo longiore, umbilico proximus.—Herbæ *tuberoso-bulbosæ, Capenses, tubere solido tunica reticulatim fibrosa tecto;* folia *radicalia, lanceolata vel linearia, parallelim nervosa, basi vaginantia;* caulis *erectus, scapiformis, plerumque paniculato-racemosus, ramis alternis, simplicibus, bracteatis;* flores *pedicellati, apice caulis ramorumque enati, cernui, colorati.*

1. Cyanella Capensis, Linn. Sp. 443; Bot. Mag. t. 568; And. Rep. ii. t. 141; Jacq. Hort. Vind. iii. t. 35; Red. Lil. t. 373; Kth. Enum. iv. 636; Gaertn. Fr. i. 68, t. 17. f. 7; Lam. Ill. t. 239. *Cyanella cærulea*, Eckl.—C. B. S.

2. Cyanella odoratissima, Lindl. Bot. Reg. t. 1111; R. & Sch. vii. 1696; Kth. Enum. iv. 637; Reich. Exot. t. 199.—C. B. S.

3. Cyanella orchidiformis, Jacq. Coll. iv. 211; Icon. ii. 21, t. 447; R. & Sch. *l. c.* 492; Kth. *l. c.* 637.—C. B. S.

4. Cyanella lutea, Linn. Suppl. 201; Thunb. Act. Holm. 1794, p. 195, t. 7. f. 1; Fl. Cap. 330; Bot. Mag. t. 1252.—C. B. S.

5. Cyanella alba, Linn. Suppl. 201; Thunb. Act. Holm. 1794, p. 195, t. 7; Fl. Cap. 329; Willd. Sp. ii. 132; R. & Sch. vii. 493.—C. B. S.

The *Cyanella Illcu* of Molina is unquestionably *Pasithea cærulea*, Don.

DESCRIPTION OF THE PLATE.

Plate LIII.

Fig. 1. A drawing of *Zephyra amœna*, of the natural size.

Fig. 2. The perianth cut open to show the mode of insertion and relative position of the four fertile and two sterile stamens: magnified.

Fig. 3 exhibits the manner in which the six filaments are united into an annular ring, inserted upon the tube of the perianth. One of the fertile stamens is inflected, so that the point of attachment of the filament behind the basal spur of the anther may be seen: more magnified.

Fig. 4. A sterile stamen, showing the form of the two pouch-like empty cells of the incomplete anther: still more magnified.

Fig. 5. A drawing of *Tecophilea violæflora*: natural size.

Fig. 6. The perianth cut open, showing the relative size and position of the three fertile and three sterile stamens.

Fig. 7. One of the inner segments of the perianth, the margins of which are ciliated at base.

Fig. 8. One of the outer segments of the perianth, with a curved spur inserted externally a little below its apex. All magnified.

Fig. 9. A portion of the tube of the perianth, with the six filaments conjoined at base into an annular ring, the three fertile stamens being turned into different positions, in order to show the basal spur, and the operculiform mode of dehiscence of the anthers; the three collateral sterile stamens have pouch-like empty anther-cells, like those seen in *Zephyra*: more magnified.

Fig. 10. A ripe capsule showing the cicatrical line left by the attachment of the fallen perianth.

Fig. 11. The same after its dehiscence by three short apical valves.

Fig. 12. A transverse section of the same.

Fig. 13. Some of its seeds. All of natural size.

Fig. 14. A drawing of the flowering stem of *Conanthera bifolia*.

Fig. 15. A flower with its six equal fertile and exserted anthers, connivent into an acute cone.

Fig. 16. The perianth cut open, showing the union of the filaments into an annular ring inserted upon its tube.

Fig. 17. The pistil, from which the perianth separates by a circumscissile line. All of the natural size.

Fig. 18. A portion of the staminal annular ring, with four of the filaments and two of the anthers seen in different positions, to exhibit their shape, the point of their attachment, and the manner of their apical dehiscence: magnified.

Fig. 19. A capsule showing the cicatrical line of the original attachment of the perianth.

Fig. 20. The same, with the valvate mode of its dehiscence terminating at the cicatrical line.

Fig. 21. A seed. All slightly magnified.

Fig. 22. A longitudinal section of a seed, showing the form and position of the embryo imbedded in the albumen: much magnified.

Fig. 23. A portion of the flowering stem of *Cummingia campanulata*: of the natural size.

Fig. 24. The perianth cut open, to show the position and relative size of the stamens: slightly magnified.

Fig. 25. The pistil, from which the perianth separates by a circumscissile line: equally magnified.

Fig. 26. The stigma, with a portion of the style: greatly magnified.

Fig. 27. Three of the stamens, with a corresponding portion of the annular ring attached to the tube of the perianth; the anthers are turned so as to present a front, lateral, and back view, showing their apical valves and the mode of their dehiscence: much magnified.

Fig. 28. A capsule before dehiscence.

Fig. 29. The same after dehiscence. Both of the natural size.

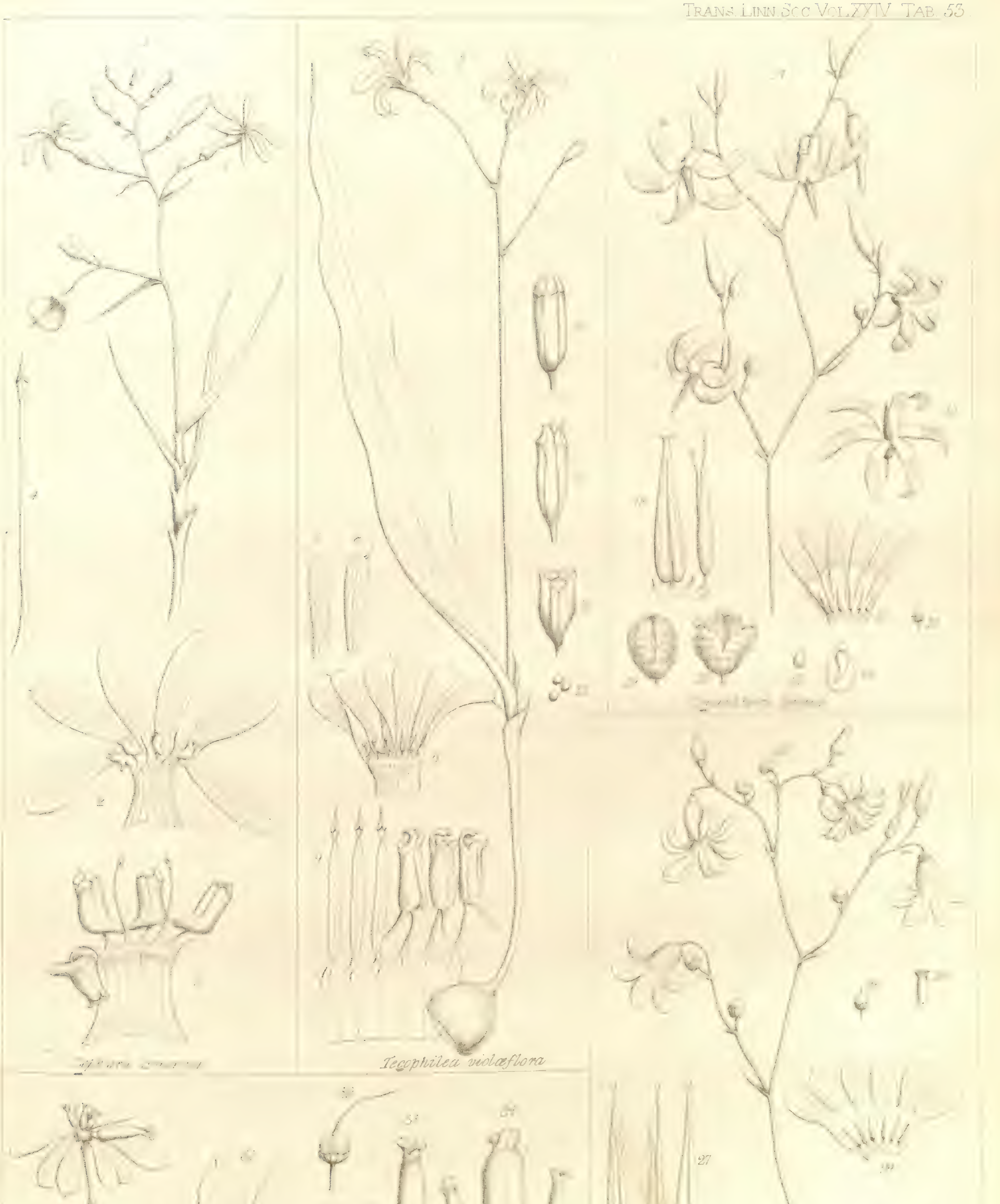
Fig. 30. A flower of *Cyanella Capensis*: of the natural size.

Fig. 31. The perianth cut open, to show the relative sizes and position of the one fertile and five sub-sterile stamens.

Fig. 32. The pistil, showing the cicatrical line from which the perianth detaches itself. Both magnified.

Fig. 33. One of the smaller stamens seen sideways, showing the mode of its dehiscence and of its attachment to the filament.

Fig. 34. The larger stamen and two of the smaller ones upon a portion of the annular ring which is inserted upon the tube of the perianth. All more magnified.


Tecophilea violæflora
Cummingia campanulata
Cyanella
27

J. Miers del.

XXVII. *On the Structure and Homologies of the Renal Organ in the Nudibranchiate Mollusca.* By ALBANY HANCOCK, *F.L.S.*

(Plates LIV.–LIX.)

Read June 2nd, 1864.

IN a paper "On the Anatomy of *Doris*," by Dr. Embleton and myself *, we described what we took to be a portal heart, a peculiar pyriform vesicle situated directly below the pericardium, and opening into it. For reasons stated at the time, we believed that this organ threw venous blood into the liver. My confidence, however, in the accuracy of this determination was much shaken on not finding any similar organ or anything equivalent to a portal system in the *Cephalopoda*, the study of the anatomy of which has for some time past engaged my attention. Had *Doris* really possessed a portal system such as we described, surely the more highly organized Cuttlefish should not be deficient in this respect. In the one case or the other it appeared to me that we must be in error. It therefore became necessary to re-examine this point in the *Dorididæ*, and in fact to institute in the Nudibranchs generally a more minute investigation than had hitherto been made of the renal organ, with which the so-called portal heart is connected.

With this view I have now completed a rather laborious examination of a large collection of Madras Nudibranchs kindly placed at my disposal by Walter Elliot, Esq., of Wolfelee, North Britain, and which form the subject of a recent communication to the Zoological Society by Mr. Alder and myself †. Some very interesting modifications of these organs have come to light during this investigation; and it is proposed on the present occasion to give a detailed account of them, and to take into consideration the bearing they have upon the question of the existence of a water-system in these animals, and also to examine their homological relation to the similar organs in some other Mollusks, particularly those in the Cephalopods.

In the first instance, however, it is desirable to describe these parts in two or three British *Dorides*, especially as we had to some extent misunderstood in them the true nature of these organs, and there will thus be afforded an opportunity of correcting one or two errors that occur in our paper before alluded to, the most important of which relates to the pyriform vesicle, which, as already stated, we described as a portal heart.

The vesicle is essentially a portion of the renal organ; it is not related to the liver in the way we supposed; and I am glad of being able on this occasion to correct a mistake which we made, not from carelessness, but after a lengthened and painstaking investigation of the subject. No doubt can exist of the fact as now determined, not only in our British species, but in large exotic specimens and various generic forms in which this organ presents numerous and instructive modifications. In the British species, indeed, this subject is fraught with much difficulty, as well on account of their diminutive size as

* Phil. Trans. for 1852 (pt. 1), p. 207.

† Trans. of the Zool. Soc. vol. v. p. 113.

also from the peculiar way in which the parts are arranged. Even now, after it has been clearly demonstrated that the pyriform vesicle is connected with the renal chamber, it is not always possible to determine the fact in the British species originally examined, namely, *Doris tuberculata*, *D. repanda*, *D. pilosa*, and *D. bilamellata*.

The examination of a single individual of the genus *Scyllæa* put the matter right at once, which the closest investigation of at least a score of the above species had failed to do. Thus it is evident how desirable it is in all difficult matters of this nature to have recourse to a diversity of examples; for the point that may be most difficult to solve in one may be exceedingly easy in another. On retracting our opinion as to the nature of the pyriform vesicle, it must also be stated that Cuvier was the first to show that this vesicle really opens externally—an assertion which we originally controverted. He, however, seems to have been unaware that it also opens into the so-called pericardium.

In *Doris tuberculata*, *D. repanda*, *D. pilosa*, and *D. bilamellata* there is a large, more or less ramified chamber or sinus stretching along the dorsal surface of the liver-mass, and having the pericardium lying above it. This, which is the renal chamber proper, is circumscribed by a delicate membrane, distinctly demonstrable above but intimately united with the liver-capsule below; and in all the species it opens externally by a small pore placed a little above and to the right of the anal nipple, and communicates with the pericardium through the instrumentality of the pyriform vesicle.

In *D. tuberculata* this chamber is much ramified (Pl. LIV. figs. 1 & 2); the trunk is rather narrow and extends along the median line from end to end of the liver-mass; it expands a little and reaches backwards to the region of the branchial circle, where its wall becomes firmly adherent to the skin. In front the trunk bifurcates, a branch passing along the right and left margin of the liver. Several ramified branches extend from the sides of the chamber and spread over the surface of this organ. Two or three of these at each side are longer than the rest, and reach for a considerable way round it. There are likewise a few small branches which seem to penetrate the substance of the liver.

The aorta runs forward, adherent to the membranous roof of the right branch of the bifurcation, which is prolonged and accompanies the gastric artery to the stomach, where it ends (as do apparently, as far as they could be examined, all the other branches) in a blind sac. Other arterial trunks from the root of the aorta run in like manner along the roof of the left branch of the bifurcation and that of the several lateral ramifications, while two pass backward in connexion with the trunk of the organ. The great branchio-hepatic vein runs backward along the median line under the floor of the chamber, bulging into it, and receiving numerous branches right and left. It reaches beyond the posterior extremity of the liver and becomes isolated within the chamber, and is surrounded by a thick, spongy-looking, glandular tissue, which extends for some distance along the trunk, and pervades the whole of the posterior portion of the renal cavity.

The renal chamber proper in *Doris repanda*, *D. pilosa*, and *D. bilamellata** is much

* Figures of the renal chamber in these three species are given in the paper before alluded to, "On the Anatomy of *Doris*," published in the 'Philosophical Transactions.' The minute structure of the glandular lining of the organ is also given.

less branched than in the preceding species, and on the left side there is an angular lobe, the margins of the whole being somewhat sinuous. In all three the chamber extends from one extremity of the liver to the other; it is rather wide, and its walls are richly supplied with an arterial network composed of twigs from numerous trunks passing from both sides of the aorta, which runs forward in the roof of the chamber. In *D. repanda* these trunks are small and very numerous, and branch off from each side of the aorta with a considerable degree of symmetry. Two trunks, larger than the rest, extend backwards parallel to each other. In *D. pilosa* and *D. bilamellata* the arterial plexus is arranged much in the same manner, but scarcely so symmetrically. In the former the network in the roof of the chamber is remarkably rich and minute.

The chamber is lined throughout with a spongy glandular tissue which is thickest over the tracks of the blood-vessels, and presents, particularly in *D. repanda*, a very peculiar honeycombed appearance, caused by slightly elevated lines of membrane enclosing five- or six-sided spaces, each holding a single large, clear, globular vesicle, containing a few smaller cells of different sizes, together with some granules.

The so-called pericardium (Pl. LIV. fig. 1, *a*) lies, as has been already stated, immediately above the renal chamber and directly below the dorsal skin in front of the branchial circle. It is, with the exception of the opening leading into the pyriform vesicle, a closed membranous sac, formed apparently by what has been designated the peritoneum, and is just sufficiently large for the accommodation of the dilated auricle and ventricle. It is lined with its own proper membrane, which is closely adherent to, and intimately confounded with, the peritoneal membrane, but can be observed reflected upon the heart at the root of the aorta. It therefore apparently encloses that viscus in a fold somewhat in the manner of a serous membrane. It has just been stated that this cavity is closed. In the paper on *Doris* before alluded to it was described as communicating with the great abdominal chamber or peritoneal cavity by numerous minute punctures in its floor. I am now satisfied, however, that this was a mistake arising from the specimens examined having been slightly decomposed. The walls of the pericardium, as we have seen, are composed of the peritoneum and the lining membrane: the former in the floor of the organ is comparatively robust, and is provided with muscular fibres mostly transverse; the latter is exceedingly delicate, and the consequence is that, when the specimen is in a soft state and the slightest strain is used, the fibres separate a little from each other, and the lining membrane gives way. Thus small openings occur which have much the appearance of being natural.

The pyriform vesicle (Pl. LIV. figs. 1, 2, 3) in some species is nearly half the size of the contracted ventricle, and, as already stated, connects the pericardial chamber with the renal chamber proper. It lies transversely between these two organs towards the right side, with the rounded extremity opening upwards through the floor of the pericardium immediately in front of the right angle of the auricle, close to the point where the latter receives the great vein from the skin. The aperture is circular, and is apparently capable of being closed as if by a sphincter. The narrow extremity of the vesicle *seems* to penetrate the roof of the renal chamber on the right side towards the posterior end, and, bulging into the organ, becomes cemented as it were to the floor of the chamber.

In *Doris tuberculata* it is prolonged into a tube (Pl. LIV. fig. 2), which, turning forwards, runs along the median line almost to the anterior extremity of the trunk-portion of the cavity, where it opens into it by a slit-like orifice. The tube overlies and partially conceals the great branchio-hepatic vein, and is liable to be confounded with its branches and with the divisions of the oviduct, which in certain conditions is also apparent through the floor of the renal chamber. It was by the complication produced by all these branches and by those before mentioned, which form a network in the walls of the chamber, that we were originally deceived into the belief that the tubular prolongation of the vesicle was itself branched, and was in this way connected with the liver.

It is above stated that the vesicle *seems* to penetrate the wall of the renal chamber. It does not in fact do so, but passes between it and the liver, and bulges so far into the cavity as to appear to have passed into it, especially as the floor of the chamber is so extremely delicate as to be scarcely, if at all, demonstrable. Hence it is that the vesicle and its tubular prolongation have the appearance of being adherent throughout to the floor of the organ.

The wall of the tubular prolongation is delicate and glandular. The vesicle itself has a firm, compact appearance, and is generally of a brownish-yellow colour. It is supplied with muscular fibres, which stretch in all directions throughout its walls; and there is also a distinct belt of similar fibres surrounding the orifice opening into the so-called pericardium, which no doubt will act as a sphincter to guard this passage of communication. The muscular belt was very distinctly observed in *Tritonia Hombergii*. The inner surface of the vesicle is strongly plicated longitudinally, the plicæ being furnished with lateral laminæ, and the whole so arranged in many cases around the orifice leading into the pericardial chamber as to act as a sort of valve to prevent fluid returning into the latter from the vesicle. The plicæ and their laminæ are covered with large vibratile cilia, which are inclined from the orifice inwards, probably for the purpose of sweeping fluid from the so-called pericardium into the vesicle. Each cilium projects from the pointed extremity of an ovate vesicle, which is filled with minutely granular matter. The broad ends of the vesicles are crowded together and assume an hexagonal form, clothing everywhere the plicæ with a sort of pavement-epithelium (Pl. LIV. fig. 6 and Pl. LV. fig. 4). The ciliated epithelium is very deciduous, and can only be observed when the specimen is in a good state of preservation. It has been detected, however, in *Doris tuberculata* and in some other species. It occurred in a very perfect condition in *Tritonia Hombergii*, in which the cilia are unusually large, measuring about $\frac{1}{200}$th of an inch in length.

There is no remarkable difference in the character and arrangement of the pericardial chamber and the pyriform vesicle in *D. bilamellata*, *D. repanda*, and *D. pilosa*, except that in the first the glandular prolongation of the vesicle is continued quite to the anterior margin of the liver, where it terminates in an opening placed a little to the right side, and that in the last the prolongation is entirely deficient (Pl. LIV. fig. 3), the narrow extremity of the vesicle opening at once by a widish orifice into the renal chamber. This orifice is placed close to the floor of the chamber, so that it is overhung by the projecting wall of the vesicle; thus a sort of valve is provided which will prevent any fluid passing from the renal into the pericardial chamber. The valvular nature of the passage is still more obvious in those species which have the apex of the vesicle prolonged into a tube, as in *D. tuberculata*. Here this tubular passage is related to the renal chamber exactly as the ureters are to the bladder in the higher animals.

Having now completed our examination of the renal organ in a few British *Dorides*, we may safely conclude that in these animals it is composed of two principal parts, namely the pericardial chamber and the renal chamber proper, which are brought into communication by the agency of a third part, the pyriform vesicle, with or without its tubular prolongation. We shall now endeavour to ascertain how far these parts are modified in the different Nudibranchiate forms, using chiefly in our examination the exotic species before alluded to.

In *Doridopsis*, a genus of a new family which we have recently established* for the reception of certain *Doris*-like mollusks with suctorial, proboscidiform mouths destitute of any armature whatever, the renal organ does not present any very striking modification.

The renal chamber proper (Pl. LV. figs. 1 & 2) in this genus occupies the usual position on the dorsal surface of the liver; it is of an irregular form, is rather wide, but does not branch over that viscus as it does in *Doris tuberculata*. A few small branches, however, apparently penetrate its substance. I have not detected the vascular network in the walls of the chamber, nor the glandular matter lining the interior: but these features can be observed only under favourable circumstances; they may therefore exist, though they have hitherto escaped detection.

The pyriform vesicle is unusually large, firm, and well developed. The narrow extremity, which lies within the renal chamber, and is adherent to its floor, ends abruptly a little in advance of the external opening, and is perforated. The perforation is large, and is placed at the junction of the lower wall of the vesicle and the floor of the chamber. The upper, overhanging wall of the vesicle will consequently act as a valve, as it does in *D. pilosa*, and prevent any fluid from passing out of the renal chamber into the vesicle and consequently into the pericardium. The laminæ in the interior of the vesicle (Pl. LV. fig. 3) are well developed, and extend the whole length of the organ; they are delicately pinnate.

The walls of the pericardial chamber are thicker than usual, and the lining membrane is raised along the anterior margin of the roof into numerous longitudinal folds, which in some of the species extend nearly half the length of the organ backward. They are of an opake yellow colour, and have a glandular appearance.

The renal organ in *Tritonia Hombergii* exhibits no important modification. The small external opening is placed on the right side of the animal, directly above the anal nipple, and leads by a short tube, scarcely longer than the thickness of the skin through which it penetrates, into a large irregularly formed renal chamber, that lies beneath the pericardium, resting upon the anterior portion of the liver. The vesicle connecting the pericardial with the renal chamber is placed towards the right side; it is very large, being scarcely less than the ventricle when in a contracted state, and is somewhat cylin-

* Trans. Zool. Soc. vol. v. p. 124.

drical in form, about as wide as long, with the ends flattened; it is strongly plicated in the interior, and has attached to it a tubular prolongation (Pl. LIV. fig. 5): but the character and extent of this appendage were not ascertained; and, indeed, several points in connexion with the renal organ in this form require a fuller examination than, on account of the deficiency of specimens, I have been able to give them.

The first form in which we observe any marked change in this complicated apparatus is *Hexabranchus gloriosus**. In this magnificent Nudibranch the renal chamber proper (Pl. LVI. fig. 1) is much reduced in size, and has assumed a tubular form of limited width, stretching almost from end to end of the liver, along the median dorsal line, parallel to and on the right side of the great branchio-hepatic vein. It tapers a little backwards to the external orifice (which is situated directly above the anal nipple), and is connected with the pyriform vesicle by a short wide tube.

On laying this tubular chamber open (Pl. LVI. fig. 2), however, it is found not to be a simple tube, but to have numerous branches of various sizes passing from either side, which for the most part follow the trunk arteries that ramify over the surface of the liver, but their exact course and extent were not determined. Small orifices in the floor of the organ indicate that branches also dip into the substance of the liver.

Immediately beneath the floor of the chamber, and bulging into it, is observed the tubular prolongation of the pyriform vesicle. It is almost as wide as the chamber itself, and, bending forward, stretches nearly as far as its anterior extremity, where the prolongation opens into it by a slit-like orifice. On laying this tube-like organ open (Pl. LVI. fig. 3), the inner surface is seen to be thickly studded all over with erect, firm, dendritic tufts (fig. 4), which are coated, as well as the surface to which they are attached, with minute granular cells.

In *Plocamophorus Ceylonicus*, one of the *Polyceridæ*, the renal organ undergoes a still more remarkable change (Pl. LV. fig. 5). In this species the narrow extremity of the pyriform vesicle gives off, as it were, two tubes of no great width. One (r'), which is the wider of the two, turns backward, and, after running for a little way in contact with the upper surface of the intestine, tapers as it terminates at the pore by the side of the anus: the walls of this tube are delicate and transparent. The other tube (j) extends down the left side of the liver, in a cleft dividing the anterior and posterior lobes. In its course it passes over the great branchio-hepatic vein, to the wall of which it is firmly adherent, and after running for a short way in contact with the intestine, which issues from the same cleft, it tapers gradually and terminates in a cæcal extremity. Throughout its whole length it is lined with a yellowish glandular matter, which in places becomes broken up into irregular nodules. These two tubes are the sole representative of the renal chamber, which we have seen so extensively developed in some of the other forms. It has now assumed the character of a cæcal gland with a tubular external outlet, which is in connexion with the pyriform vesicle.

The laminæ in the interior of the pyriform vesicle are very ample, but become abruptly curtailed as they approach the lower or pointed extremity of the organ; they are thence

* This is the *Doris gloriosa* of Kelaart, in the Journal of the Ceylon Branch of the Royal Asiatic Society.

continued, much reduced in size, for some distance down the cæcal tube. The pericardial chamber presents nothing peculiar, except that it is unusually large.

In the form now before us the renal organ is comparatively simple in its structure; but in those that are to follow, much complication will be observed; nevertheless, in them, as well as in the former, it is distinctly divisible into the two principal component parts, which we have seen to exist in all the species examined. An interesting example of this complicated condition of the organ is found in *Bornella digitata*, a very curious animal from the Indian seas, closely related to *Dendronotus*.

The pericardial chamber (Pl. LVII. figs. 1 & 6) in this species presents nothing remarkable; neither does the pyriform vesicle, though it opens into the former further backward than usual, and close to the right side, under the auricle. It is the part designated as the renal chamber proper that exhibits the interesting and extensive modifications alluded to. This portion of the renal organ (figs. 1 & 2 *j*) assumes the form of a long, wide tube, with delicate, almost transparent walls, extending along the dorsal surface of the viscera nearly from one extremity of the body to the other. In front this tube lies beneath the pericardial chamber, and at this point it bifurcates, the two branches being almost as wide as the trunk. The left branch lies above the stomach, the right above the reproductive organs. The pyriform vesicle penetrates the trunk, and opens into it close to the point where the bifurcation takes place; and immediately behind this a slender tube is given off from the right side, which passes along the dorsal surface of the rectum, and terminates at a minute orifice immediately above the anal nipple.

The whole of this tubular chamber, including the anterior bifurcation, gives off from both sides numerous slender offsets, which for the most part bend downwards and, embracing the viscera, ramify over them. These ramifications terminate in blind sacs, and have their extremities occasionally rounded and enlarged. The branches are not adherent to the organs upon which they rest, but lie free amidst the loose cellular tissue that binds the viscera to the skin; and many of the terminal extremities penetrate the intermuscular spaces of the foot, others follow the gastro-hepatic branches into the base of the branchial papillæ. The posterior trunk terminates, close to the extremity of the visceral mass, in a ramified branch similar to the lateral branches, and the members of the anterior bifurcation end in the same manner not far behind the buccal organ.

This much-ramified organ is lined throughout with a coating of opake, pale, granular matter, composed of minute cells. In the trunk this coating is very thin, but is much thicker in the branches (Pl. LVII. figs. 4 & 5), where it is thrown into longitudinal folds; consequently the latter, on account of their opacity, are more conspicuous than the former, though this is very much larger.

Now it is quite evident that we see, as it were, in this beautifully developed organ an unravelled gland, which, from its peculiar structure, throws much light on the nature of this organ in the species previously described. In *Bornella* it is no longer combined with the liver-mass (which in this form is broken up), though partially retained in the visceral chamber. Owing to this fact the gland is distinctly visible in all its parts, and it is perfectly clear that it is in no way anatomically or functionally connected with the liver. Thus we may assume that it is also distinct in those species in which it is more or less confounded with that viscus. In these latter it is difficult, if not impossible, to follow all the ramifications of the organ as they branch over and into the substance of the liver; and had it not been for the aid afforded by this and the following interesting example, doubts might have existed as to the relation of the two organs.

In the higher Nudibranchs the connexion of the renal chamber with the liver arises, apparently, from the arrangement of the vascular system, which in them is more highly developed than in the lower forms. In the former there are both hepatic arteries and veins; and these, we have seen, have a certain relation to the renal chamber. It is over the hepatico-branchial vein, which protrudes into the chamber, that in *Doris tuberculata* the glandular matter is accumulated; and the rich vascular network that pervades the walls of the organ is derived from the hepatic arteries. Hence the connexion of the two organs. In *Bornella*, which is one of the lower forms, neither the hepatic arteries nor veins exist; the renal gland is consequently detached from the liver, which in this species is found only in a rudimentary state in the visceral chamber. We have seen, however, that the gland overlies the viscera, and to a great extent embraces the rudimentary hepatic organ, following its ramifications even into the branchial papillæ, retaining, as it were, a lingering connexion with this viscus, though it must now derive its blood from that which bathes the visceral chamber.

In *Dendronotus* the kidney is apparently formed on the same plan as in *Bornella*; but the details of the organ could not be made out, though the posterior trunk of the renal chamber was observed.

Another distinct glandular form of the renal chamber is found in *Scyllæa*. In a member of this genus from Madras, and described under the name of *S. marmorata**, the development of this organ is very remarkable. The pericardial chamber (Pl. LVIII. fig. 2) presents nothing uncommon; the pyriform vesicle, however, opens into it further forward than usual, on the right side, immediately in front of the auricle, and, passing downwards, has its lower or tapering extremity united to a tube which lies on the upper surface of the rectum (Pl. LVIII. fig. 1). This tube passes to the right side, and soon terminates in the minute opening associated with the anal nipple (fig. 6). The other or inner extremity of the tube bifurcates immediately to the left of the vesicle, one branch turning forward, the other backward. The former passes under the intestine, giving off branches as it goes, to the under side of that tube, to the gizzard, and to the anterior ovarian mass; it then branches over the dorsal aspect of the stomach, and sends a branch or two to the reproductive organs. All these branches terminate in blind sacs, and lie freely in the cellular tissue in connexion with the various organs; the branch, however, that goes to the ovarian mass is more intimately attached to the surface of the organ, and forms minute and beautiful dendritic ramifications over it. The posterior branch of the tube passes backwards along the dorsal surface of the liver, towards the right side, and distributes offsets to the two posterior ovarian masses, and sends numerous dendritic ramuscules to both the upper and under surface of the liver. The hepatic ramuscules lie loosely attached to the surface of the organ, and all their twigs end in blind sacs like

* Trans. Zool. Soc. vol. v. p. 136.

those of the anterior branch. They can be easily raised by the point of a needle; so that their structure is not difficult of demonstration. The ovarian branches spread out over the surface of the masses in numerous dendritic systems, similar to those on the anterior mass. These ovarian ramuscules (Pl. LVIII. fig. 3) are much more delicate than those of the other viscera, and, unlike them, are closely adherent to the surface of the organ, but do not apparently penetrate below the surface.

The whole of this complicated system of branched tubes is glandular throughout. The walls of the branches are minutely folliculated (Pl. LVIII. fig. 4), and lined with a very finely granular matter, composed chiefly of granular cells (fig. 5). The trunk tubes are also lined with the same substance, which gives to the whole system an opake yellow colour; hence the facility with which the minutest ramifications can be traced to their terminations.

The renal organ in *Scyllæa pelagica* is provided with the same curious ramified gland; only it is less complicated in its structure. We originally mistook some of the branches of the renal gland in this species for a portion of the gastro-hepatic system*, which does not apparently exist in this genus.

On comparing this ramified gland in *Scyllæa* with that in *Bornella*, the resemblance is so obvious that no doubt can exist as to their homological relation. It is interesting, however, to observe how intimately the ramifications of the gland in the former are connected with the liver and ovary, though modified in this respect from what obtains in the *Dorides*. In *Scyllæa* the liver is broken up into two portions, and the ovary is detached from it in the form of three globular masses. But the vascular system is not degraded to the same extent as it is in *Bornella*: both the hepatic and ovarian masses are supplied with arteries; hence the ramifications of the gland maintain, to some extent, their connexion with the liver and ovary—particularly with the latter, to which, we have seen, the ramifications are closely adherent.

We have now traced the modifications of the kidney through various forms of the Nudibranchiata, and find that in all, however diversified, the organ is divisible into two principal portions, namely the pericardial chamber and the renal chamber proper; and in addition to these, there is always present the accessory organ the pyriform vesicle. The first and last of these, as far as we have examined, exhibit no material modification, save that the pyriform vesicle is occasionally prolonged into a glandular tube. The renal chamber proper, however, is considerably diversified in the several forms we have had before us. In *Doridopsis* and *Tritonia* we have seen that it is of a wide, irregular form, almost devoid of ramifications. In the *Dorides* it is still a wide sinus or chamber, but more or less branched; and in *Plocamophorus* it has assumed the character of a simple tubular gland; while in *Bornella* and *Scyllæa* it becomes extremely developed, pervading nearly all the organs of the body by its numerous ramifications—is in fact, in these two last forms, a diffused gland, varying only in the mode of branching. In *Bornella* the branches have a bilateral symmetry, the centre tube being wide; in *Scyllæa* there is no apparent order in their distribution, and they are tubular throughout, with the trunk or stem only proportionately larger than the rest.

* Monograph of the British Nudibranchiate Mollusca, Fam. 2, pl. 5.

The nature of this complicated organ in the Nudibranchs can scarcely be doubted. It is clearly an apparatus for eliminating something from the blood that has to be expelled out of the system; and from analogy this matter may fairly be assumed to be urinary. The renal chamber proper is a glandular organ, as demonstrated in the *Dorides*; and in *Bornella* and *Scyllæa* it has assumed the form of a true gland. It is therefore probable that by this portion of the apparatus, and also by the glandular portion of the pyriform vesicle, the more strictly urinary matters are abstracted, the pericardial chamber furnishing serum or perhaps little more than pure water, which may be supposed to exude from the heart, particularly from the auricle, the walls of which are exceedingly delicate.

The pericardial fluid will be drawn into the pyriform vesicle by the agency of the vibratile cilia clothing the plicæ; the sphincter muscles will then come into play, closing the communicating orifice, and the contained fluid will be forced by the pulsatile action of the organ (the walls of which we have seen to be muscular) into the trunk tube or central portion of the renal chamber, where it will mingle with the more solid urinary products of that organ, and be expelled along with them through the minute pore associated with the anal nipple. That this is the probable action of these parts is evinced by what may be observed in living Nudibranchs. I have frequently seen, in small, transparent individuals, vibratile cilia in motion, at the orifice of a vesicle having the appearance of this pyriform organ; and the vesicle itself may occasionally be observed to contract. But, however this may be, it is evident enough that the pyriform vesicle is for the passage of fluid from the one chamber to the other.

It is worthy of remark that in the higher Nudibranchs, as in *Doris* for instance, the essentially urinary matters are abstracted from the blood that circulates in the liver-mass, which is composed of the liver and ovary, there being a special arrangement of the vascular system in connexion with the renal chamber for the purpose; and this is the only blood of the entire animal that passes through the special aërating organ. In the lower forms these matters are eliminated from the blood that circulates in the visceral chamber, consequently from the general supply previous to its return to the vascular centre. Hence it may be inferred that in the former case the organ is more highly specialized than in the latter, in which it is extremely diffused. In *Scyllæa* the kidney holds a middle position in this respect; for though the ramifications of the organ are extensively distributed, a considerable number of the branches are nevertheless intimately connected with the liver and ovary, particularly with the latter; they therefore probably have some relation to the blood-system in these organs. Many of the branches, however, lie free in the interstices between the viscera.

Such being the function of this enigmatical apparatus, it can scarcely be supposed to perform the work of a water-system as generally understood. M. Milne-Edwards suggests, in his "Observations sur la Circulation," article premier, in the 'Annales des Sciences Naturelles,' 1845, "that the pore which exists by the side of the anus, in *Doris*, may be for the purpose of admitting water into the interior of the organism, there to be directly mixed with the blood." In our examination of the organs in connexion with this pore, we have seen nothing to warrant this belief; on the contrary, the anatomy of the various parts militates against it. We have seen that the renal organ forms a closed system, nowhere communicating with the vascular organs, and that any water admitted into it must remain there. Indeed no water could penetrate further than the renal chamber proper; for the passage connecting it with the pericardial chamber is, as we have seen, of a valvular nature, and would act as the ureters do in the higher animals on there being any pressure of fluid in the renal chamber. This is particularly the case where the pyriform vesicle terminates in a tubular prolongation. Now we are aware that this chamber is glandular, and that in *Bornella* and *Scyllæa* it has assumed the form of an extensively ramified tubular gland, into which it cannot be supposed that water would be admitted from the exterior, any more than it should be into the salivary or any other gland opening externally.

Having now concluded a rather lengthy examination of these complicated organs in the Nudibranchiata, the first thing that strikes us is the great resemblance they bear to the renal apparatus in the Lamellibranchs. In both, the heart is enclosed within a so-called pericardium, which communicates with a glandular organ that opens externally. In the Lamellibranch the latter is double, being composed of two lateral glands which open through the floor of the pericardium by two distinct orifices placed at the sides in front. The glandular organ (or renal chamber proper) in the Nudibranch is single, and placed symmetrically on the central line. This therefore can scarcely correspond to the former (the organs of Bojanus), but in the Lamellibranch would seem to be represented, in part at least, by the point where these two organs open into each other on the median line below the pericardium. Is there, then, anything in the Nudibranch that can be considered homologous with the organs of Bojanus? We have seen that the pyriform vesicle, with its glandular prolongation, is placed at the right side of the animal, and opens on this side through the floor of the pericardium. It is therefore a lateral organ, apparently single only on account of a deficiency of symmetrical development. Were the left-side vesicle present and placed in communication with the pericardium, at a point corresponding to the opening on the right, the arrangement of the parts would be so similar to that observed in the Lamellibranch that there could scarcely be any hesitation in pronouncing the vesicle, with its glandular prolongation, and the organ of Bojanus homologous. We might therefore at once assume that the latter is the true representative of the former, differing principally in extent of development, were we not warned by the presence of the external outlet of the renal chamber proper, which assuredly corresponds to the similar orifice of the right organ of Bojanus.

Now, taking this orifice as one fixed point, and the orifice opening into the pericardial chamber as another, it is quite possible, as Professor Rolleston has kindly suggested to me, that all the anatomical parts that lie between them, including the renal chamber proper and the pyriform vesicle with its glandular prolongation, may correspond homologically to the right organ of Bojanus—or rather that the renal chamber proper represents the right organ of Bojanus, and the pyriform vesicle the constricted passage of communication between it and the so-called pericardium.

The principal reason against this conclusion is found in the fact that the renal chamber proper is usually placed symmetrically on the median line, and is apparently therefore not a lateral organ. In our present state of knowledge, however, it is not easy to determine which view is correct. Nevertheless enough has been ascertained to satisfy us that the renal organ in the Lamellibranchiata and Nudibranchiata correspond pretty closely, so far as we have, up to this moment, compared them.

Professor Rolleston and Mr. Robertson, however, have recently described*, in addition to the parts above alluded to, what they consider a water-vascular organ—a minutely ramified system of tubes or vessels in connexion with the reproductive organs, which seems not only for the discharge of the products of these organs, but also for that of water supposed to be drawn into the economy through the orifices leading into the organs of Bojanus by the agency of the pericardial sinus. As this system of aquiferous vessels opens, in numerous instances, into the organ of Bojanus, it may be looked upon anatomically, I presume, as a development of the kidney; and if so, we cannot but be reminded of the highly ramified condition of the renal chamber in *Bornella* and *Scyllæa*. This may be a mere analogical resemblance, but it is very striking and worthy of a passing remark.

A still more important discrepancy, however, appears to exist. The above authors point out, in their valuable paper already alluded to, that the pericardial sinus is the instrument through which water from the exterior finds its way into the blood-vascular system. In the Nudibranchs we have seen that the pericardial chamber is closed, with the exception of the orifice leading into the pyriform vesicle. We should therefore scarcely expect that in the Lamellibranchiata this same chamber would communicate with the vascular system.

Moreover it is not easy to understand how water absorbed in this way could escape being contaminated with the deleterious urinary or other excretory matters it would assuredly meet with in the organ of Bojanus. And there is also, apparently, a mechanical difficulty in the way of the pericardial sinus acting as a suction-apparatus. The heart in a living state so completely fills the pericardial sinus that there is no space for any considerable influx of fluid. In *Anodon* the ventricle rolls against the wall of the cavity with such force that, on laying the latter open during life, the former bulges out through the incision. Indeed the pericardial wall follows the action of the heart during its diastole and systole, as it does likewise in the Nudibranchs. The pericardium is consequently always in a state of repletion; and the only effect the opening of the shell-valves could have would be to permit of a more unrestrained action of the heart. Nothing approaching to a vacuum can be formed by the action of an apparatus such as this.

In saying this I do not mean to deny the possibility of water entering directly into the blood-vascular system in the Lamellibranchs; only it seems unlikely that it should be received in the manner described in the memoir referred to. M. Lacaze-Duthiers described some time ago the existence, in *Dentalium* and *Pleurobranchus*, of pores by which the vascular system communicates directly with the exterior†. In *Pleurobranchus* this opening is situated at the root of the branchial vein, and leads almost directly into it, as can be proved by any one who will take the trouble to examine for himself. This is a very startling fact, and it is interesting to know that it coexists with a renal system

* Phil. Trans. vol. clii. p. 29.

† Ann. des Sci. Nat. 4e série, Zool. t. vii. p. 5, and t. xi. p. 200.

arranged after the same manner as that in the Nudibranchs. In *Pleurobranchus* there is the same closed pericardial chamber (Pl. LIV. fig. 4), communicating through its floor with a long glandular tube, the anterior extremity of which is swollen a little and corresponds to the pyriform vesicle. The tube tapers to the other extremity, which, passing backwards, opens into a large renal chamber that communicates with the exterior through a small pore situated immediately below the gill. This tubular connexion between the pericardium and the renal chamber seems to have escaped the notice of M. Lacaze-Duthiers.

The coexistence of this opening in the branchial vein along with a renal organ so constructed makes it more unlikely that water should be received into the interior through the agency of the latter organ, in either the Lamellibranchs or Nudibranchs. We should rather look for some special means for the admittance of fluid from the exterior, if, indeed, water be absorbed directly by the vascular system in either of these two Molluscan groups.

In the Nudibranchs we have seen that the renal organ is divided into two principal chambers, the pericardial and the renal chamber proper, and that these communicate with each other through the agency of the pyriform vesicle. The renal organ in the Lamellibranchs is likewise divisible in the same way into two portions. And it is interesting to remark that the Brachiopods also have the renal organ composed of two well-marked divisions—namely, the great perivisceral chamber with its extensive ramifications, and the renal organ proper or the oviducal passages.

This twofold character is also distinctly observed in the Cephalopoda. In this class of highly organized Mollusks the two renal chambers are extensively developed; and on comparing them with the corresponding parts in the Nudibranchs, many curious and instructive modifications will be observed. The renal chamber proper (Pl. LIX. fig. 2) is placed towards the underside of the body, and opens externally into the branchial chamber by two nipple-formed orifices. This is the pseudopericardium of authors. It, however, never contains the heart, but, along with other organs, always the venæ cavæ with their glandular or renal appendages. In the *Octopodidæ* it contains usually only these latter organs, and is divided longitudinally by a membranous septum into two lateral halves.

This chamber communicates with another, the genital, by two lateral passages. The genital chamber occupies the posterior extremity of the body, and is extensively developed in the *Loliginidæ*, in which it always contains the male or female secerning organ, the stomach, cæcum, and the branchial hearts. In the *Octopodidæ* it contains the above-named reproductive organs only. This chamber is the equivalent of the pericardial chamber in the Nudibranchs.

Now, the first thing that strikes us on comparing these with the corresponding parts in the Nudibranchs is the bilateral symmetry which they exhibit in the Cephalopoda. In the Nudibranchs we have seen that there is but one external orifice, and that it is placed towards the right side of the anus, the left being atrophied. In the Cephalopod, on the contrary, there are two such orifices, and they are situated symmetrically towards the sides, with the intestine between them. In the Nudibranchs, again, there is but one passage of communication between the two chambers, and it is also placed towards the right side, while in the Cuttlefish there are two similar lateral passages symmetrically placed. In the Octopod, too, as just stated, the renal chamber is divided on the median line into two lateral halves. Much of this bilateral symmetry we have seen to exist in the Lamellibranchs, in which there are two external openings and two passages of communication between the chambers. Its absence, however, in the Gasteropodous Nudibranch is what might be looked for, and in no way militates against the homology of the parts.

But the presence of this symmetry in the Lamellibranchs and Cephalopods has nevertheless a certain bearing upon the relation of these organs in the Nudibranchs. It seems, in fact, to favour the opinion previously alluded to as expressed by Professor Rolleston on this subject; for if we assume that the two lateral halves of the renal chamber in the Octopod, with their two passages of communication and two external outlets, represent the two organs of Bojanus, it would appear probable that the renal chamber of the Nudibranch is the homologue of the right organ of Bojanus, and that the pyriform vesicle is nothing more than the right passage of communication between the two renal chambers, whether of the Lamellibranch or of the Cephalopod.

In the next place, the relative situation of the renal chamber to the other viscera is very dissimilar in the Nudibranchs to that in the Cephalopods. This is very striking at first sight, but on a little consideration any doubt as to the homology of the organs on this score is readily removed. To judge fairly in this matter we must imagine what would take place on transforming the Nudibranch into the Cephalopod. To enable us to do so, we must place the former with its head downwards, and suppose the foot developed round the oral orifice (Pl. LIX. figs. 1 & 2). The intestine must then be bent forward so as to bring the anal nipple towards the head, carrying along with it the renal chamber proper and its external opening to the under or opposite side of the liver. And now, if the pericardial chamber be developed upward and backward, we shall see that the two renal chambers have assumed their Cephalopodous positions. Their contents, however, are very different; but this is apparently not of much consequence, for in the Cephalopods themselves they do not always contain the same organs.

In the *Octopodidæ* the genital chamber holds only the ovary or testis, according to the sex, while the same chamber in the *Loliginidæ* usually contains, in addition to these organs, as before pointed out, the stomach, cæcum, and branchial hearts, with their appendages; though in *Sepia* one-half of the stomach and the whole of the cæcum are excluded. Again, in the *Octopodidæ* the renal chamber or pseudopericardium has occasionally protruding into it the upper or convoluted portion of the intestine, and always the venæ cavæ with their renal appendages. In the *Loliginidæ* this chamber invariably contains, in addition to the venæ cavæ and their appendages, the hepatic ducts with their appended pancreatic glands, and in *Ommastrophes*, as well as these, the lower portion of the intestine and the greater part of the ink-bag, while in *Sepia* it likewise holds half the stomach and the whole of the spiral cæcum.

It apparently therefore depends in a great measure upon the extent and direction of the development of these chambers what organs they enclose. Consequently we ought not to be surprised at finding that the homologous chambers in the Nudibranch and Cephalopod contain dissimilar organs. This, however, is applicable more particularly to the pericardial chamber of the former, in which the heart is lodged. But we have seen that this chamber is developed upwards and backwards in the Cephalopod, and is consequently drawn away from the heart, which occupies a position between the two chambers. Now, were the ovary and stomach pushed in the same direction, it is easy to understand how they might become enveloped in the membranous wall of the chamber, and ultimately enclosed within its cavity.

The renal chamber proper in the Nudibranchs lies in contact with the intestine and the hepatico-branchial vein, which latter is the representative in these animals of the venæ cavæ of the Cephalopods. The lower portion of the intestine indeed is partially enveloped by the walls of the chamber. There is therefore no difficulty here; for by a slight modification in development both these organs might be thrust into the chamber, and, from the change of the relative position of the stomach and liver that has taken place in the Cephalopod, it is obvious that the hepatic ducts might likewise be enveloped by it; and so with the several other organs.

If, then, this reasoning be correct (and it seems scarcely possible to doubt it), the renal chamber in the Nudibranch is the homological representative of the pseudo-pericardium or renal chamber proper of the Cephalopod, or rather perhaps of the right half of it, the left half, together with its external outlet and passage of communication, having been atrophied in the Nudibranch. In both animals this chamber opens externally, and in both it communicates with another chamber,—in the Nudibranch with the so-called pericardium, and in the Cephalopod with the genital chamber—which two latter chambers are also homologous. The pyriform vesicle is apparently a mere enlargement of the tubular passage of communication between the two chambers. In the *Octopodidæ* there is a not very dissimilar enlargement of this tube, but apparently for a different functional purpose.

It thus appears that in both the Nudibranchs and the Cephalopods the renal organ is extensively diffused throughout the organism, and that it is universally divided into two portions or chambers, one of which, the renal chamber proper, is more or less glandular, and has the office, through the agency of secerning cells, to eliminate from the blood the deleterious urinary matters. This is apparently its special function, though it would seem in many instances also to have, in common with the other portion or chamber (the so-called pericardium in the Nudibranch, and the genital chamber in the Cephalopod), to act as a receptacle for the superabundant fluids, perhaps little more than water, that may be supposed to exude from the tissues of the various contained organs.

This duality of the kidney we have seen also to exist in the Brachiopod, the Lamellibranch, and in *Pleurobranchus*. It is for future research to show how far this condition of the renal organ extends throughout the Mollusca.

The renal organ in the Cephalopod differs from that of the Nudibranch chiefly by being more extensively developed. This is more particularly the case with respect to the genital chamber, which frequently contains many organs. The homologous chamber in the Nudibranch contains always, and never anything more than, the heart. In both cases, however, the function is apparently the same. The renal chamber proper, in the two groups, is characterized by its glandular nature. In the Cephalopods the renal glands are specialized in connexion with the venæ cavæ, the rest of the chamber being for the purpose of receiving the extravasated fluids from the contained organs. In the Nudibranchs this chamber is modified both in its form and function. In some it is reduced to a delicately branched gland, and is consequently a mere secreting organ; in others it is partly glandular and partly a receptacle for extravasated fluids, either from the organs with which it is connected or from vascular ramifications that are spread over its walls.

Such being the condition of the renal organs in these two groups of mollusks, it seems evident enough that they are not designed for the reception of water from the exterior; and indeed in neither the Cephalopod nor the Nudibranch could it possibly penetrate further than the first or renal chamber, as the passages connecting it with the other chamber in both these forms would be closed on the slightest pressure of the contained fluid, much in the same manner that the ureters are in the bladder of the higher animals. Fluid, however, may be easily made to pass in the contrary direction, namely, from the genital chamber in the one, or from the pericardial chamber in the other, to the renal chamber, and hence to the exterior through the external orifices. Thus an irresistible inference is raised in favour of the view that these chambers are for the purpose of throwing fluid out of the system, not for the purpose of taking it in.

Should there therefore exist any water-system as generally understood in these Mollusks, it is not in connexion with the renal organs. Some special apparatus may be provided for such a purpose; but if so, it has hitherto escaped my observation. At the same time the possibility of something of the kind must be allowed since the discovery that in at least *Pleurobranchus* the blood-vascular system opens externally: in this highly organized mollusk the external water can apparently be drawn in and mingled directly with the circulating nourishing fluid. I have searched in vain, however, for a similar opening in the Nudibranchs; and until such be found, it may be fairly assumed that the fluid which pervades the tissues of these animals, as it does the tissues of all mollusks, is admitted in the ordinary way through the agency of the alimentary tube.

EXPLANATION OF THE PLATES.

The following letters indicate the same parts in all the figures:—

a, the so-called pericardium; *a'*, dorsal wall of ditto; *a''*, floor of ditto; *b*, ventricle; *c*, auricle; *d*, pyriform vesicle; *e*, orifice of ditto leading into pericardium; *f*, laminated plicæ in the interior of the vesicle; *g*, glandular appendages lining the tubular prolongation of ditto; *h*, tubular prolongation of ditto; *i*, orifice of prolongation, leading into the renal chamber; *i'*, similar orifice at the apex of the vesicle when the prolongation is wanting; *j*, renal chamber proper; *j'*, dorsal wall of ditto; *k*, anterior bifurcation of ditto; *l*, lateral branches of ditto; *m*, artery running in the wall of the branches; *n*, aorta; *o*, hepatic artery; *p*, openings of small branches of the renal chamber that penetrate the liver; *q*, hepatico-branchial vein; *r*, external orifice of the renal chamber; *s*, anal nipple; *t*, intestine; *u*, liver.

Plate LIV.

Fig. 1. General view of the viscera of *Doris tuberculata*, the dorsal skin having been laid open so as to exhibit the pericardium: *a*, the so-called pericardium laid open; *a'*, dorsal wall of ditto; *b*, ventricle; *c*, auricle; *d*, pyriform vesicle seen through the floor of the pericardium; *e*, orifice of the vesicle leading into ditto; *j*, renal chamber seen through the floor of ditto; *k*, *k*, right and left branch of the anterior bifurcation of the renal chamber; *l*, lateral branches of ditto; *m*, arteries running in the dorsal wall of the branches; *n*, aorta; *t*, intestine; *u*, liver; *v*, stomach; *w*, buccal organ; *x*, reproductive organs; *y*, gland connected with the vascular system; *z*, cerebral ganglia.

Fig. 2. Dorsal view of the liver-mass of the same, showing the renal chamber proper laid open, the pericardium and heart having been removed: *d*, pyriform vesicle; *e*, orifice of ditto, leading into the pericardium; a shred of the floor of the pericardium is attached round the orifice; *h*, tubular prolongation of the vesicle; *i*, orifice of ditto, leading into the renal chamber; *j*, renal chamber; *j' j'*, dorsal wall of ditto, laid open; *k*, anterior bifurcation of ditto; *l l*, lateral branches of ditto; *m m*, arteries running in the dorsal wall of the branches; *n*, aorta; *p*, openings of small branches that penetrate the liver; *q*, hepatico-branchial vein, covered with glandular matter, and receiving numerous branches on each side; *r*, external orifice of the renal chamber; *s*, anal nipple; *t t*, intestine cut through; *u*, liver; *v*, stomach; *w*, reproductive organs; *x*, branchial plumes.

Fig. 3. Renal chamber of *Doris pilosa*, laid open from above: *d*, pyriform vesicle, with a fragment of the pericardial floor attached to the broad end; *e*, orifice of the vesicle leading into the pericardium; *i'*, orifice at the apex of the vesicle leading into the renal chamber; *j*, renal chamber proper, laid open; *j' j'*, dorsal wall of ditto turned back; *q*, hepatico-branchial vein; *r*, external orifice of the renal chamber; *s*, anal nipple; *t*, intestine; *u*, liver; *v*, branchial plumes.

Fig. 4. Dorsal view of the viscera of *Pleurobranchus**, with the renal chamber laid open: *a*, the so-called pericardium; *a''*, floor of ditto; *b*, ventricle turned back, the aorta having been cut through; *c*, auricle; *d*, pyriform vesicle lying below, and opening through, the floor of the pericardium; *h*, tubular prolongation of the vesicle; *i*, orifice of the prolongation, opening into the renal chamber; *j*, renal chamber; *j' j'*, dorsal wall of ditto, laid open; *n*, enlargement at the root of the aorta; *u*, liver-mass; *v*, salivary gland, with the posterior portion turned forward to expose the liver-mass; *w*, gland in connexion with the blood-system; *x*, cerebral ganglia.

Fig. 5. Pyriform vesicle of *Tritonia Hombergii*, laid open: *e*, orifice leading into pericardium; *f*, laminated plicæ; *g*, glandular appendages of the tubular prolongation.

Fig. 6. One of the laminated plicæ, removed, and much magnified: *v*, extremity attached to the margin of the orifice; *w*, vibratile cilia; *x*, a portion of the ciliated epithelium turned over to show the base of the cells from which the cilia arise.

Fig. 7. A much magnified portion of the glandular appendages from the tubular prolongation of the vesicle.

Fig. 8. A few of the granular cells from ditto, highly magnified.

* The species dissected was brought from Madras by Mr. Elliot, to whom we are indebted for so many interesting Nudibranchs. It is about an inch and a half long, of a roundish form, and of a delicate yellowish-white colour, with the upper surface reticulated with dark brown. It is probably undescribed.

Plate LV.

Fig. 1. Posterior portion of *Doridopsis tuberculosa,* laid open, the heart removed, and the interior of the renal chamber exposed to view: *a,* the so-called pericardium; *a′ a′ a′,* dorsal wall of ditto, turned back; *a″ a″ a″,* portions of the floor of ditto; *b,* ventricle turned forward; *d,* pyriform vesicle; *e,* orifice of ditto, leading into pericardium; *i′,* orifice at the apex of the vesicle, leading into the renal chamber; *j j,* renal chamber laid open; *j′ j′,* dorsal wall of ditto, opened and reflected; *o o,* hepatic arteries; *p,* orifices of small branches of the renal chamber, that penetrate the liver; *q,* hepatico-branchial vein; *r,* external orifice of the renal chamber; *s,* anal nipple; *t,* intestine; *u u,* liver; *v,* skin of the animal; *w,* branchial plumes.

Fig. 2. View of the renal chamber of *Doridopsis clavulata,* laid open: *d,* pyriform vesicle, with a little of the pericardial floor attached to the broad extremity; *e,* orifice of ditto, leading into the pericardium; *i′,* orifice at the apex of ditto, leading into the renal chamber; *j j,* renal chamber; *j′ j′,* dorsal wall of ditto, reflected; *o,* hepatic artery; *p,* orifices of small branches of the renal chamber, penetrating the liver; *q,* hepatico-branchial vein; *r,* external orifice of the renal chamber.

Fig. 3. Pyriform vesicle of *Doridopsis gemmacea,* laid open to show the laminated plicæ: *e,* orifice communicating with the pericardium; *i′,* orifice at the apex of the vesicle, opening into the renal chamber; *f,* laminated plicæ.

Fig. 4. A few of the cilia, much enlarged, from the laminated plicæ of *Tritonia Hombergii*: *v,* ovate granular vesicle at the base of the cilium; *w,* several of the cilia adhering together; *x,* surface of attachment.

Fig. 5. Lateral view of the viscera of *Plocamophorus Ceylonicus,* exhibiting the renal organ in its natural position: *a″,* floor of the pericardium, turned to one side; *b,* ventricle seen through ditto, giving off aorta and hepatic artery; *c,* auricle; *d,* pyriform vesicle attached to the floor of the pericardium, through which it opens; *j,* renal chamber reduced to a cæcal tube; *r,* external orifice of ditto; *r′,* tube leading from ditto to the renal chamber; *q,* hepatico-branchial vein laid open, showing three large orifices leading into the branchial plumes; *s,* anus; *t,* intestine; *u u,* the two lobes of the liver; *v,* first stomach; *w,* buccal organ; *x,* salivary gland; *y,* reproductive organs; *z,* cerebral ganglia.

Plate LVI.

Fig. 1. View of the posterior portion of *Hexabranchus gloriosus**, the dorsal skin removed, and the pericardium laid open: *a′ a′ a′,* dorsal wall of pericardium, turned back; *a″ a″,* floor of ditto, laid open to show the renal chamber; *b,* ventricle turned forward, with a portion of the auricle attached; *c c c,* portions of the auricle; *d,* pyriform vesicle; *e,* orifice of ditto, leading into the pericardium; *j,* renal chamber; *q,* hepatico-branchial vein; *r,* external orifice of the renal chamber; *s,* anal nipple; *u u,* liver; *v,* branchial plumes; *w,* margin of the foot; *y y,* dorsal skin.

Fig. 2. Dorsal view of the liver-mass of the same, the pericardium entirely removed, and the renal chamber laid open: *b,* ventricle, turned forward; *d,* pyriform vesicle, with a shred of the pericardial floor adhering to the broad extremity; *e,* orifice of the vesicle leading into the pericardium; *h,* tubular prolongation of ditto; *i,* orifice at the extremity of the prolongation; *j j,* renal chamber, laid open; *j′ j′,* dorsal wall of ditto, turned back; *l′, l′,* openings of lateral branches that follow the principal arteries ramifying over the liver; *n,* aorta; *o o,* hepatic arteries; *p p,* openings of small branches of the renal chamber that penetrate the liver; *q,* hepatico-

* *Doris gloriosa,* Kelaart.

branchial vein; *r*, external orifice of the renal chamber laid open; *t*, intestine; *u*, liver; *v*, portion of the stomach.

Fig. 3. Pyriform vesicle and prolongation laid open: *d*, vesicle; *e*, orifice of ditto leading into pericardium, with a shred of the pericardial floor attached; *f*, laminated plicæ; *g*, glandular dendritic appendages lining the interior of the prolongation; *h*, prolongation; *j j*, renal chamber, laid open; $j'j'$, dorsal wall of ditto, turned back.

Fig. 4. Much-enlarged view of three of the dendritic tufts or processes from the interior of the tubular prolongation.

Plate LVII.

Fig. 1. Dorsal view of the viscera of *Bornella digitata*, exhibiting the renal chamber undisturbed: *a*, the so-called pericardium, turned to one side; *b*, *c*, ventricle and auricle seen through the floor of ditto; *d*, pyriform vesicle, opening through ditto, ditto; *j j*, renal chamber; *k*, anterior bifurcation of ditto; *l l*, lateral branches of ditto; *r*, external orifice of ditto; r', tube leading from ditto to ditto; *s*, anal nipple; *t*, intestine; *u*, rudimentary liver, or central portion of the gastro-hepatic system; *v v*, lateral branches of ditto supplying the dorsal papillæ; v', branchlets of the renal organ ramifying over ditto; *w*, ovary; *x*, salivary glands; *y*, buccal organ; *z*, cerebral ganglia.

Fig. 2. Renal chamber of the same, removed, with the lateral branches spread out: *d*, pyriform vesicle, with a portion of the pericardial floor attached; *e*, orifice of ditto, leading into the pericardium; *j j*, renal chamber; *k k*, right and left branch of the anterior bifurcation of ditto; *l l*, lateral branches of ditto; *r*, external orifice of ditto; r', tube leading from ditto to ditto; *s*, anal nipple.

Fig. 3. Pyriform vesicle, more highly magnified: *d*, vesicle, with a shred of the pericardial floor adhering to the broad extremity; *e*, orifice of ditto, leading into the pericardium; i', orifice at the opposite extremity of ditto, leading into the renal chamber; *j*, renal chamber laid open; *k*, *k*, branches of the anterior bifurcation of ditto; *l*, lateral branches of ditto; *r*, tube leading to the external orifice of ditto.

Figs. 4 & 5. Much-enlarged views of two of the lateral branches of the renal chamber: *v*, root of the branch; *w w w*, enlarged cæcal extremities of ditto.

Fig. 6. The so-called pericardium, laid open: a', dorsal wall of the pericardium; a'', floor of ditto; *b*, ventricle; *c*, auricle; *d*, pyriform vesicle seen through the auricle and floor of the pericardium; *r*, external orifice of the renal chamber; *s*, anal nipple.

Plate LVIII.

Fig. 1. Dorsal view of the viscera of *Scyllæa marmorata*, the heart and pericardium having been removed: *c c c*, fragments of the auricle; *d*, pyriform vesicle; *e*, orifice of ditto leading into the pericardium; *j j*, anterior and posterior branches of the renal chamber reduced to mere tubes, giving off numerous ramuscules to the various organs; the anterior extremity of the anterior branch is seen ramifying in front of the intestine; l', gastric and hepatic ramuscules; l'', large branch to the underside of the stomach; l''', branches to the underside of the liver; l'''' l'''' l'''', ovarian ramuscules; *r*, external orifice of the renal chamber; r', tube leading to ditto; *s*, anal nipple; *t* t', intestine, with a branch of the renal organ ramifying over it; *u u*, liver-masses; *v v v*, ovarian masses; v', oviduct; *w*, anterior stomach, or crop; *y*, reproductive organs: *z*, buccal organ; z', cerebral ganglia.

Fig. 2. Pericardium of the same, laid open: a' a', dorsal wall of the pericardium turned back; a'', floor of ditto; *b*, ventricle; *c*, auricle; *d*, pyriform vesicle, opening through the floor of the pericardium.

Fig. 3. Ovarian ramuscule of the renal chamber, much enlarged: *v*, ovarian mass; *w*, branch connecting the ramuscule with the posterior trunk of the renal chamber.

Fig. 4. A portion of one of the hepatic ramuscules, greatly enlarged.

Fig. 5. Three of the granular cells from the glandular matter lining the ramuscule, greatly magnified.

Fig. 6. Anal nipple: *r*, external orifice of the renal chamber; *v*, anal orifice.

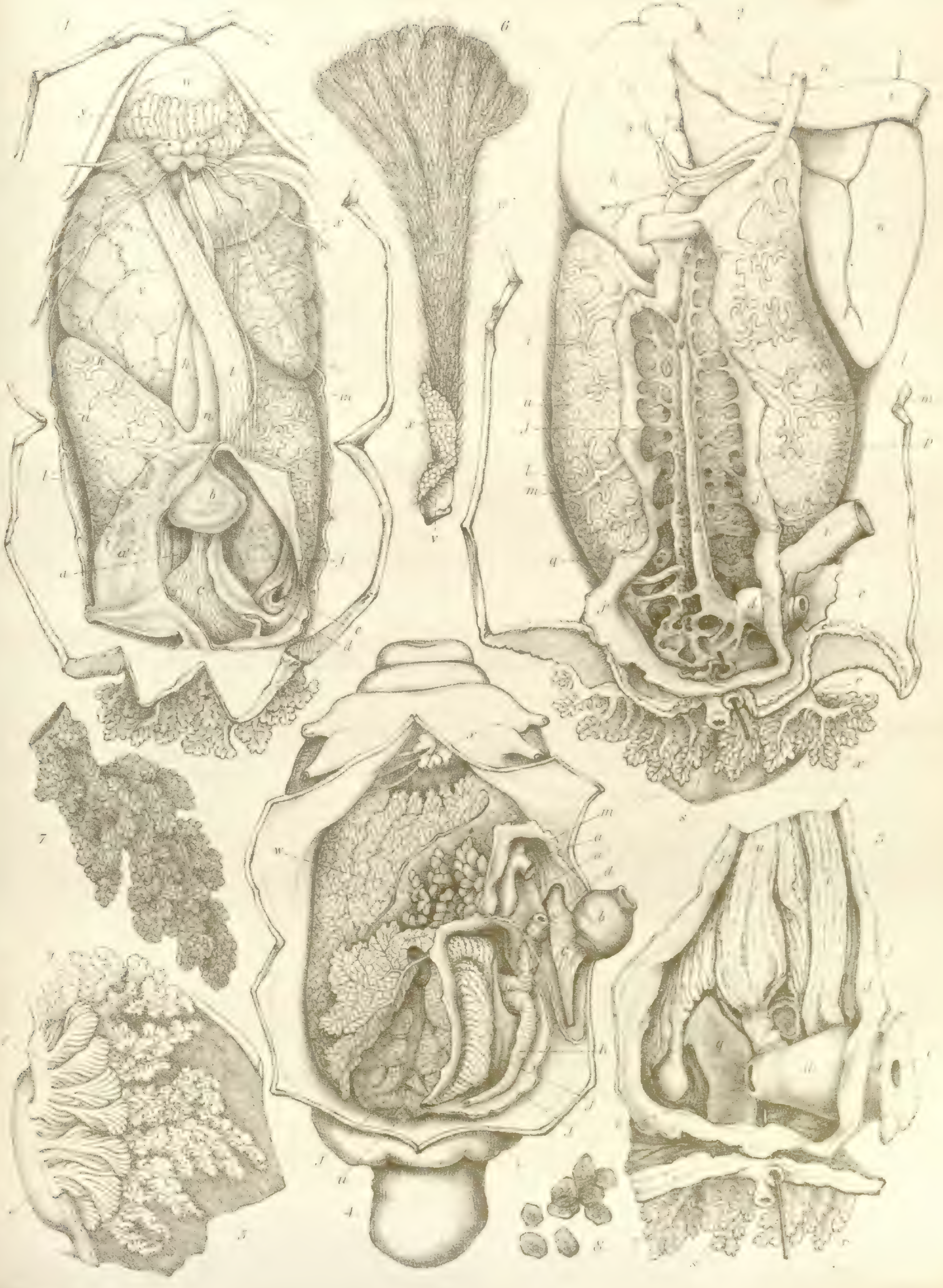
Plate LIX.

Fig. 1. Diagram of lateral view of the viscera of *Doris tuberculata*, exhibiting the relative position of the renal chambers: *a*, so-called pericardium; a', dorsal wall of ditto; a'', floor of ditto; *b*, ventricle; *c*, auricle; *d*, pyriform vesicle; *e*, orifice of ditto, opening into the pericardium; *h*, tubular prolongation of vesicle; *i*, orifice of ditto, leading into the renal chamber; *j j*, renal chamber proper; j', dorsal wall of ditto; *k k*, branches of the anterior bifurcation of ditto; *l*, lateral branches of ditto; *r*, external orifice of ditto; *s*, anal nipple; *t t*, intestine; *u*, liver; *v*, stomach; *w*, œsophagus; *x*, buccal organ; x', oral orifice; *y*, ventral surface or foot of the animal; *z*, dorsal surface.

Fig. 2. Diagram of lateral view of the viscera of *Eledone cirrosus*, to show the homological relation of the renal chambers to those of *Doris*.

(The letters in this instance in no way correspond to those of the other figures.)

a, renal chamber proper, the so-called pericardium; *b*, external orifice of ditto; *c*, genital chamber, the homologue of the so-called pericardium in *Doris*; *d*, ovary; *e*, tube connecting the genital chamber with the renal chamber proper; *f*, orifice of ditto, leading into genital chamber; *g*, orifice at the other extremity of the tube, leading into the renal chamber; *h*, systemic ventricle; *i*, oral orifice; *j*, buccal organ; *k*, œsophagus; *l*, crop, or anterior stomach; *m*, stomach or gizzard; *n*, spiral cæcum of ditto; *o*, intestine; *p*, anal nipple; *q*, biliary ducts; *r*, liver; *s*, duct of the ink-bag; *t*, branchial chamber; *u*, funnel; *v*, portion of two of the arms.



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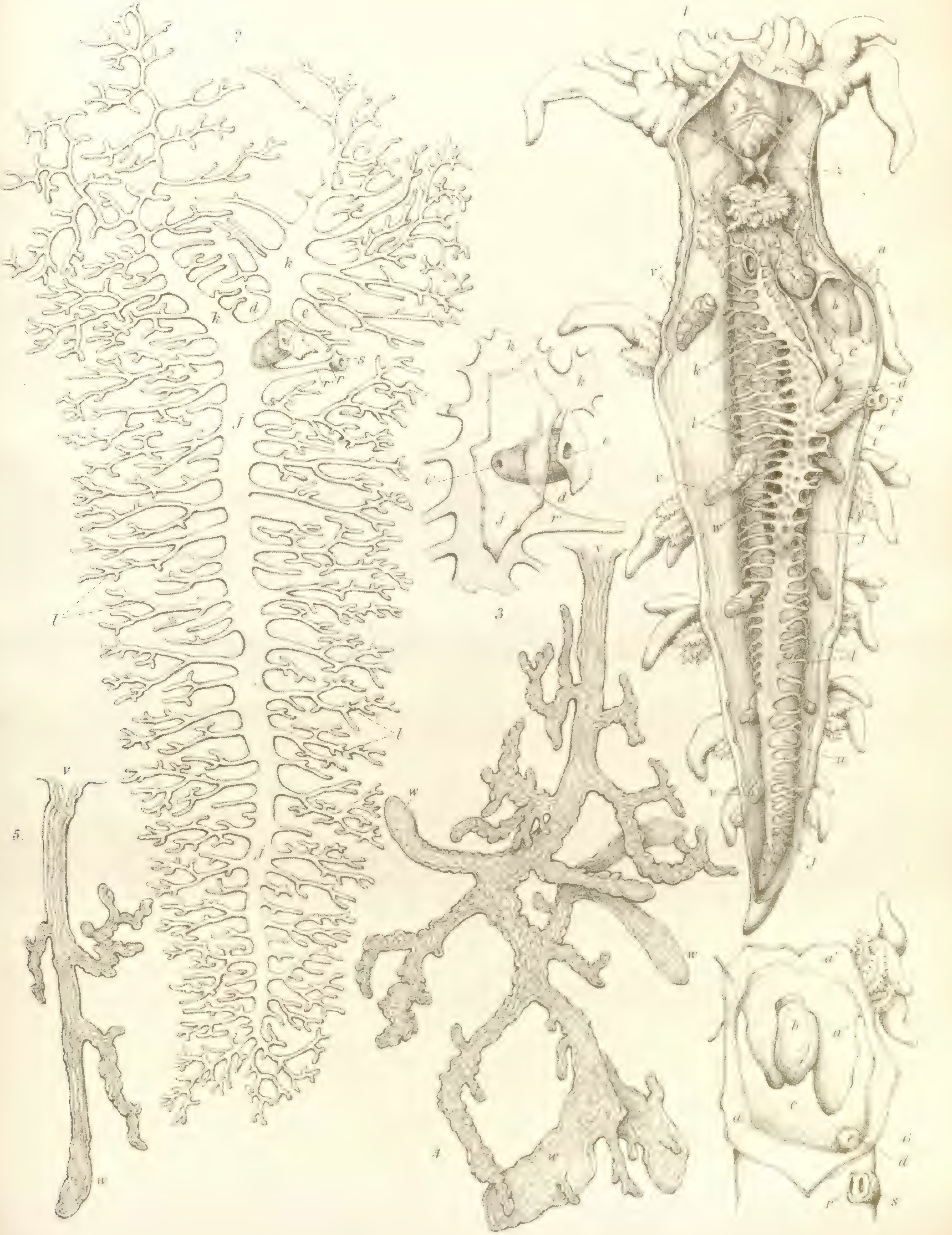

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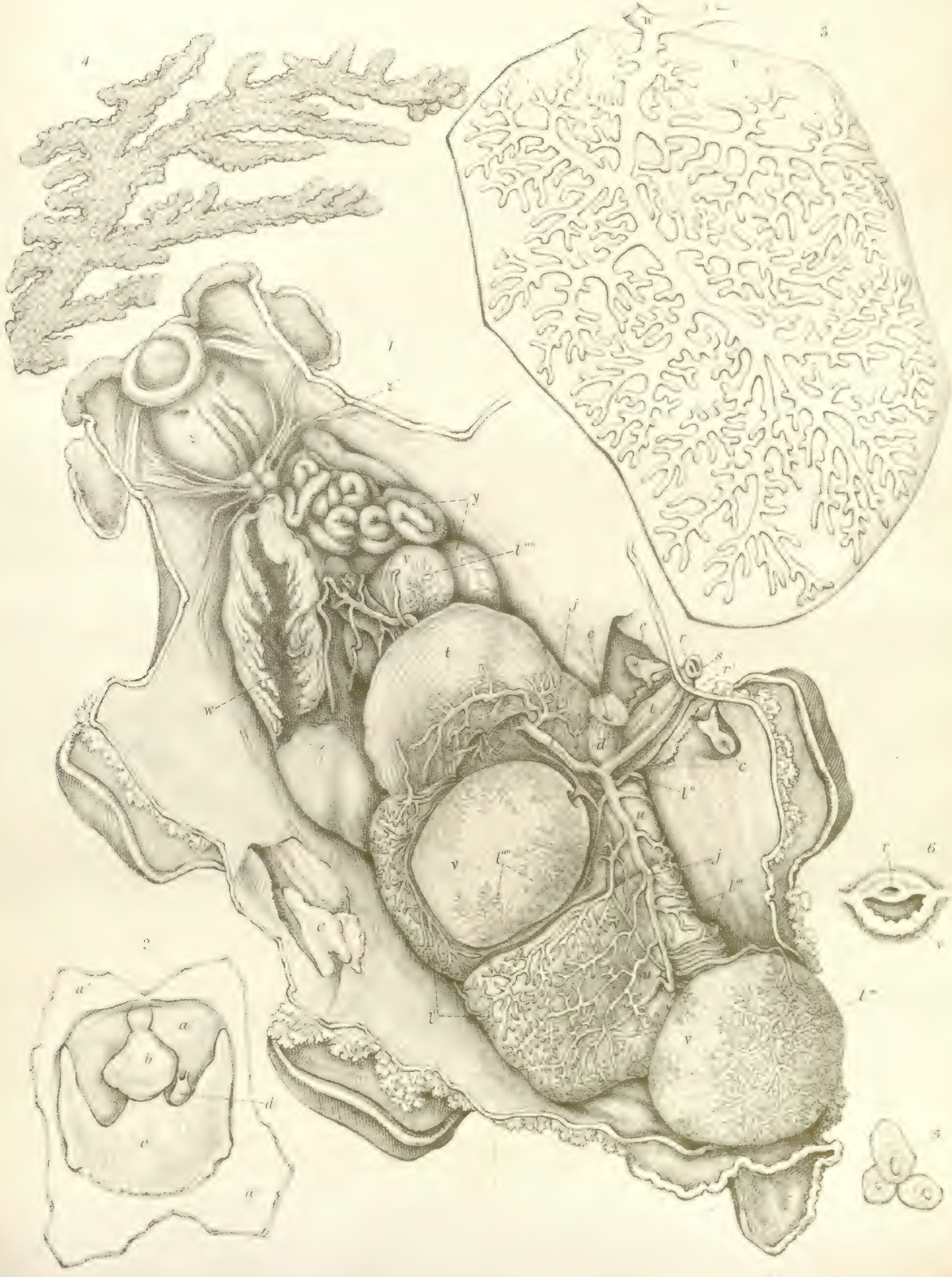

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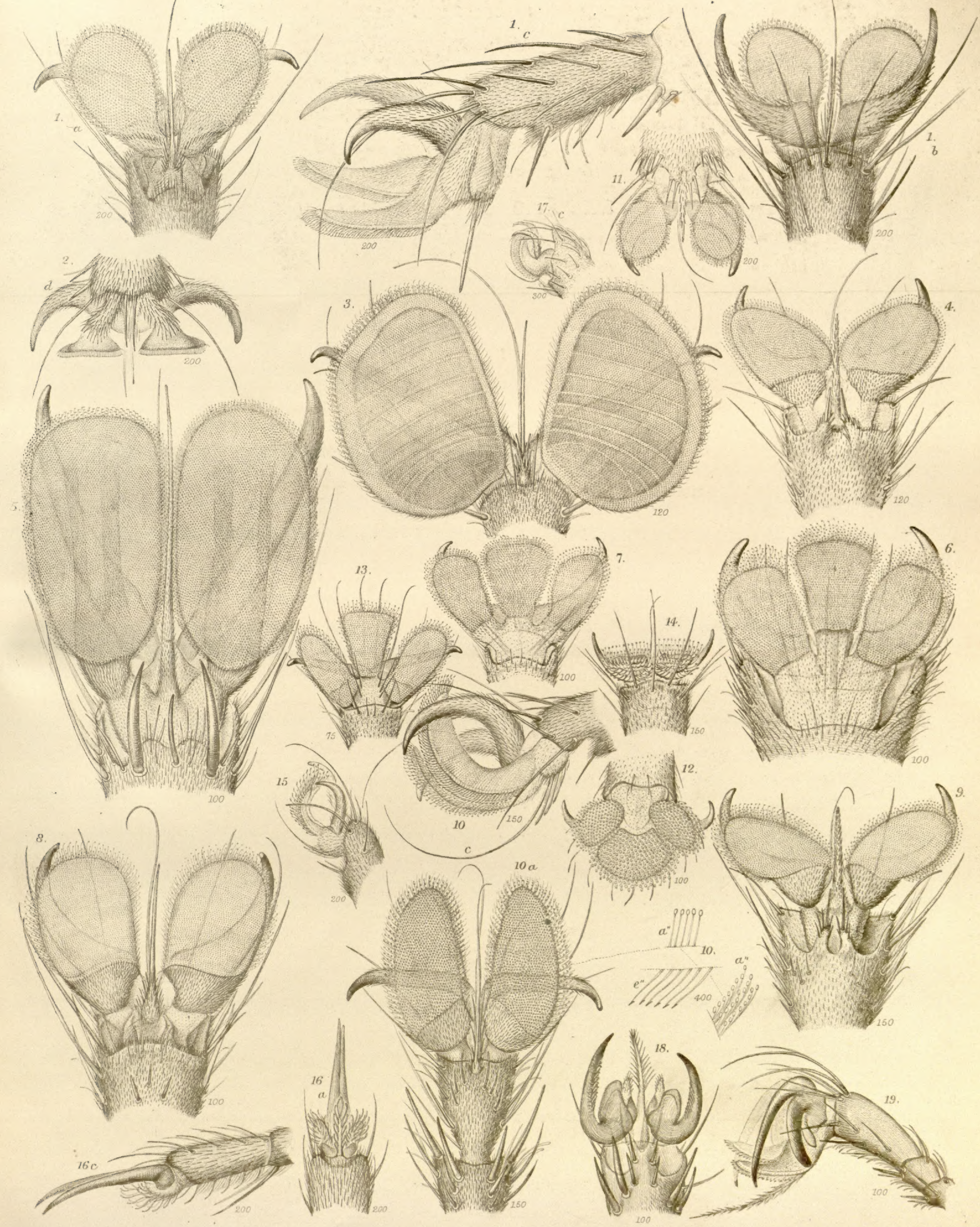

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